SIERRA CLUB
COLORADO

August 12, 2021

RE: Transportation Greenhouse Gas Rulemaking

Dear Transportation Commissioners, Governor Polis, and CDOT Executive Director Shoshana Lew,

The Colorado Sierra Club, which has more than 100,000 members and supporters in Colorado, and the 119 undersigned Coloradan supporters write to express our gratitude for your work on the Transportation Rulemaking.

As transportation is the top source of GHG emissions in Colorado, it is important to quickly implement new rules to set clear, enforceable GHG emission reduction targets.

A strong GHG pollution standard with clear targets and enforcement mechanisms can get us closer to our emissions reduction goals as outlined by HB-1261, and to meeting the state Climate Roadmap goal of a 10% reduction in vehicle miles traveled (VMT) by 2030. To meet our climate goals, the standard must consider pollution when selecting transportation projects, and all projects should model VMT impacts.

The rulemaking must prioritize reducing VMTs, GHGs, and highway expansion by prioritizing investment in multimodal transit, electrifying vehicles, expanding public transit, and investing in bicycling and pedestrian infrastructure. Across Colorado, these shifted priorities will enable communities to have more non-polluting, reliable, and affordable transportation options, and thus to enjoy better access to healthcare, education, and employment.

These goals must be met while integrating equity into planning, processes, and outcomes.

The rulemaking must apply strong scrutiny to large transportation projects that will increase traffic and pollution already experienced by disproportionately impacted communities. All Coloradans deserve transportation options that don't pollute the places where we live, work and play.

Thank you for your consideration.

Sincerely,

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Grand Junction Transportation

[redacted] Mon, Aug 23, 2021 at 12:51 PM
To: "dot_rules@state.co.us" <dot_rules@state.co.us>

Hello,

1. The bus system in Grand Junction and surrounding areas must be substantially increased before we can consider public transportation as an option.

2. Employers that already have a large population of car-pooling should be allowed credit for past behavior rather than only an “improvement” metric

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

GHG Transportation Planning Standard

1 message

[redacted] Mon, Aug 30, 2021 at 4:53 PM

To: "dot_rules@state.co.us" <dot_rules@state.co.us>

Hello,

I would like to voice my support for the GHG Transportation Planning Standard code updates under consideration (RULES GOVERNING STATEWIDE TRANSPORTATION PLANNING PROCESS AND TRANSPORTATION PLANNING REGIONS 2 CCR 601-22). Historically, we have spent the vast majority of transportation funding on building roads and highways, so it is no surprise that the vast majority of our population commutes to their jobs via personal automobile. The greenhouse gas emissions resulting from that system are obvious in Denver's high ozone and this summer's absurdly poor air quality (caused by fires exacerbated by GHG emissions). The natural disasters, like the Morgan Creek Fire and Hurricane Ida, that have become more common every summer for my entire life highlight the urgent need for a reprioritization of how we fund our transportation systems. Coloradans are relying on you to protect the clean mountain air that makes Colorado a great place to call home.

Thank you,

[redacted]

City of Centennial 2 CCR 601-22

[redacted]

Colorado Communities for Climate Action

August 31, 2021

CDOT Transportation Commission
CDOT Headquarters
2829 W. Howard Pl.
Denver, CO 80204

Dear Commissioners:

Thank you for the opportunity to provide public comments to the Transportation Commission on the proposed changes to the Rules Governing Statewide Transportation Planning Process Transportation Planning Regions, containing the Greenhouse Gas Transportation Planning Standard, proposed on August 13, 2021. We have continued to discuss this rule with Colorado Department of Transportation (CDOT) staff and appreciate the time spent explaining the proposal and discussing our suggestions. In an effort to continue that process of open collaboration, we are submitting the following comments early in the rulemaking process so we can continue those discussions while making the Transportation Commission aware of the dialogue.

Colorado Communities for Climate Action is a coalition of 39 counties and municipalities across Colorado advocating for effective state and federal climate policy. CC4CA's members span Colorado's Western Slope and Front Range; small rural towns and major suburbs; counties and municipalities; and wealthy, middle income, and low-income neighborhoods. With member populations ranging from under 1,000 to more than 500,000, CC4CA local governments represent nearly one-quarter of all Coloradans. Rural communities make up two-thirds of the membership, including more than half of the members being West Slope communities.

Because the Employee Traffic Reduction Program (ETRP) was withdrawn from consideration by the Air Quality Control Commission, this proposal is Colorado's first major transportation-related rulemaking specifically designed to respond to the climate crisis. As such, we understand that this is new territory for Colorado and all parties involved, but it's important to keep in mind the overarching target established by Colorado's Greenhouse Gas (GHG) Emissions Reduction Roadmap to reduce transportation sector emissions by 12.8 million metric tons (MMT) of carbon dioxide equivalent (CO_2e) by 2030.

This letter reflects initial comments and questions on the proposal, and we expect to have additional input after more discussion with CDOT staff and after the technical documentation is made available for a full review. The main points covered in the comments below include: ensuring that equity is a key focus of this rulemaking, the necessity for robust emission reduction targets and reductions in vehicle miles traveled (VMT), allowing public review of the modeling analysis and ground truthing the model, and key points related to potential loopholes in the proposal and enforceability of the rule.

Equity Must be a Primary Focus of this Rulemaking

This rule presents one of Colorado's best opportunities to fulfill the intent and requirements of HB19-1261 and HB21-1266 to prioritize benefits and avoid harms to disproportionately impacted communities as defined in § 24-38.5-302(3), C.R.S. We are encouraged to see some seeds planted in the proposed rule towards engaging and serving these communities, and we urge greater specificity and assurance that the most beneficial projects will be realized in those communities according to their expressed needs as well as data-driven approaches to projecting benefits.

Disproportionately impacted community input must inform all measures affecting them

Equity engagement for these rules cannot take place primarily through large listening sessions and stakeholder meetings. Before detailed measures are proposed, CDOT should work with climate outreach staff at the Colorado Air Pollution Control Division (APCD) and the Equity Unit at the Colorado Department of Public Health and Environment (CDPHE) to assess transportation priorities in disproportionately impacted communities. We appreciate the existing equitable outreach provisions (4.02.5) but would further recommend that outreach should take place at existing community meetings wherever possible. We have been glad that SB21-260 will establish a new Environmental Justice and Equity Office within CDOT in order to "work directly with disproportionately impacted communities in the project planning, environmental study and project delivery phases of transportation capacity projects." We ask that this Office be stood up in time to help existing state equity outreach staff ensure that measures being considered meet the needs of disproportionately impacted communities.

We are eagerly awaiting the public release of CDPHE's Colorado EnviroScreen tool, based on the EPA EJSCREEN model, that will enable us to delineate communities qualifying as "disproportionately impacted" under HB21-1266. CDOT and Metropolitan Planning Organizations (MPOs) must work with CDPHE as soon as possible to initiate outreach to these communities as located by the tool.

As this rule is refined, we recommend that the Transportation Commission consider the work that CDPHE's Air Pollution Division, together with its Climate Equity Advisory Committee, has already done in drafting a Climate Equity Framework, including six Climate Equity Principles that should be used in shaping state rule development. From those principles, APCD developed a checklist of "Key Questions" and "Other Important Questions to Ask" to help rulemaking staff and boards anticipate potential benefits or burdens to disproportionately impacted communities from rules being considered in order to equitably shape rule development. The Climate Equity Framework is a living document still taking input. We recommend that CDOT work with CDPHE and the Climate Equity Advisory Committee to add shape to the Framework around transportation equity so that it can be most effectively applied to these rules. We urge CDOT and the Transportation Commission to apply these Key Questions for now to develop and evaluate proposed rules, and to work with the APCD, the Climate Equity Advisory Committee, the Climate Equity Community Advisory Group, and the Environmental Justice unit at CDPHE to do so. It may be helpful to index this language to the Equity Principles and/or key questions. Furthermore, it would inspire confidence in the community if their input is indexed and/or reflected specifically in adopted rules and Applicable Planning Documents. Finally, APCD review (8.04) should answer all the "Key Questions" and "Other Important Questions to Ask," consulting with the Climate Equity Advisory Committee and Climate Equity Community Advisory Group as needed.

The rule must stipulate VMT reductions and specific local benefits in the Applicable Planning Documents as well as in Mitigation Measures

We recognize that disproportionately impacted communities benefit from any project that reduces GHG emissions or that drives down VMT on the major thoroughfares that cut through these communities. However, this rule must prioritize projects that directly improve local air quality while providing needed local clean transportation services by reducing VMT. Section 8.0.3, GHG Mitigation Measures in includes a list of good examples for the type of project that that should be prioritized. Certain measures such as these that (1) fill the transit gap in communities that are being pushed further from community centers; (2) increase affordable EV ownership and charging; and (3) evolve neighborhoods toward "complete streets" should be discussed with the community and considered as best practices that should be implemented in all disproportionately impacted communities.

It's critical that the final rule include specific requirements that will result in defined direct benefits to Disproportionately Impacted Communities. Therefore, we suggest the following specific language be added to section 8 of the proposed rule. Black text is from CDOT's proposal, red text is suggested language:

8.02 Process for Determining Compliance

8.02.3 By April 1, 2022, CDOT shall establish an ongoing administrative process, through a public process, for selecting, measuring, confirming, and verifying GHG Mitigation Measures, so that CDOT and MPOs can incorporate one or more into each of their plans in order to reach the Regional GHG Planning Reduction Levels in Table 1. Such a process shall include, but not be limited to, determining the relative impacts and benefits of GHG Mitigation Measures, measuring and prioritizing localized impacts and benefits to communities and Disproportionately Impacted Communities in particular. The mitigation credit awarded to a specific solution shall consider both aggregate and community impact and benefit. Where such impact or benefit affects a Disproportionately Impacted Community, that consideration shall take precedence over others. At least 25% of the Mitigation Measures must have a direct benefit in terms of increased multimodal options to Disproportionately Impacted Communities.

8.02.5.3 A Mitigation Action Plan that identifies GHG Mitigation Measures needed to meet the reduction levels within Table 1 shall include:

8.02.5.3.1 The anticipated start and completion date of each measure.

8.02.5.3.2 An estimate, where feasible, of the GHG emissions reductions in MMT of CO_2e achieved by any GHG Mitigation Measures.

8.02.5.3.3 Quantification of specific co-benefits including reduction of copollutants ($PM_{2.5}$, NO_x, etc.) as well as travel impacts (changes to VMT, pedestrian/bike use, transit ridership numbers, etc. as applicable).

8.02.5.3.4 Description of benefits to Disproportionately Impacted Communities and a demonstration of how at least 25% of mitigation measures will directly benefit Disproportionately Impacted Communities.

These are just two specific additions to the rule with an equity focus; we would like to discuss other options for adding equity measures to the rule. We appreciate that the plan for selecting GHG Mitigation Measures (8.02.3) and the Mitigation Action Plan (8.02.5.3) express intent to prioritize disproportionately impacted communities. However, since these only take effect "In the event that a plan fails to comply," we ask CDOT to consider commensurate equity provisions in the "Applicable Planning Document[s]" defined in the proposed rule. An emphasis on reducing VMT, discussed in our comments below, also brings a focus on equity because increasing multimodal options can have a direct impact on equity.

GHG Emissions Reduction Targets and VMT Reductions

The proposed emission reduction targets should be the absolute minimum amount of reductions considered for this rule. Colorado's existing and planned transportation measures leave a gap of 4.7 MMT of GHG reductions in 2030, and this proposed rule would reduce that gap by 1.5 MMT. CDOT staff has explained that the 1.5 MMT is the high end of the modeled range and that 0.5 MMT is the low end. That falls far short of the at least 3.3 MMT in reductions by 2030 that should be met in order to reach Colorado's climate goals. Additional strategies to further reduce transportation emissions within the 4.7 MMT category have yet to be developed, so the amount of the associated emissions reductions is uncertain. The Clean Trucking Strategy and indirect source rules are two strategies being considered in this area, but the potential reductions are unknown at this time. Because of the worsening nature of the climate crisis, early reductions have the largest impact and are absolutely necessary to reverse the current devastating course. Therefore, we strongly urge the Commission and CDOT staff to increase the GHG planning reduction levels identified in Table 1 (8.01.2).

The Roadmap's "HB 1261 Targets Scenario" assumes a VMT reduction of 10% by 2030. Because of this statewide goal, VMT reductions should be explicitly included in this rule. VMT reductions should be closely tied to the reduction goals in the budgets that are developed under the GHG planning standard. A primary emphasis of the GHG rule should be to reduce VMT through multimodal strategies such as increased transit, bike paths, and sidewalks. Strong VMT reductions in the next five years are very important because there will not be enough EVs on the road by then to reduce vehicle emissions to meet Colorado's goals. Additionally, an emphasis on VMT reduction will benefit DI communities.

The current definition of multimodal projects includes projects that increase capacity, such as adding several new traffic lanes along with bike paths. This is counterproductive: a heavy emphasis on multimodal that does not reduce VMT won't help us achieve our GHG goals. Any project that increases capacity in turn increases VMT. Yet, transportation modeling and air quality models for transportation conformity incorrectly assume that capacity projects that reduce congestion will decrease emissions.

Comments and suggested edits to Section 8, Table 1, and Table 2 of the proposed rule:

- We suggest adding language in Section 8.01.1 explaining that the reduction targets by MPO area reflect the total reductions in that area and are not the sole responsibility of the MPOs and that CDOT will assist the MPOs in meeting the targets. We understand from CDOT staff that it was too difficult to break out the share of the reductions between CDOT and the MPOs, but an explanation to this effect in the rule should be included to avoid any misunderstanding.
- The baseline projections in Table 1 are confusing despite the explanation in 8.01.1. because the projections only show slight decreases and then increase by 2050. These projections are using a business as usual scenario for modeling the emission reductions from this rule only and don't take account of the other emissions reduction strategies in Colorado. It would be best to remove these projections from the rule because it appears as if transportation emissions will barely decrease in almost 30 years, while in reality, emissions should greatly diminish.
- If the baseline projections remain in the rule, an explanation should be added as to why the projections vary from the Roadmap projections. The 2025 baseline projections in the proposed rule are 27.4 MMT while Colorado's GHG Roadmap figure for 2025 is 23 MMT.
- Table 2 is confusing as well; presumably these figures project total transportation sector emissions with all the strategies implemented, including this proposed rule. But the 2030 projections are 20 MMT while the Roadmap's 2030 projections are 18 MMT (see Colorado's GHG Roadmap Table 7, page 97). Is this meant to indicate that the proposed rule, plus the projected uptake of EVs, will leave us 2.0 MMT short of the Roadmap target?
- Suggested new language for the Table 2 description is provided below. If the figures in this table don't reflect the new explanation, we suggest that they be updated if possible.
- Based on our comments above, please include a table showing VMT reductions for all projection years as well.

Suggested edits follow. Black text is from CDOT's proposal, red text and red strikeouts are suggested edits.

8.00 GHG Emission Requirements

8.01 Establishment of Regional GHG Transportation Planning Reduction Levels

8.01.1 The GHG emission reduction levels within Table 1 apply to MPO~~s~~ areas and the Non-MPO area within the state of Colorado as of the effective date of these Rules. The reduction levels listed by MPO are not meant as the sole responsibility of that MPO, but rather the total reduction for that area. CDOT is responsible for a share of the reductions in the MPO area. ~~Baseline values are specific to each MPO and CDOT area and represent estimates of GHG emissions resulting from the existing transportation network and implementation of the most recently adopted RTP for all MPOs and the 10 Year Plan in non MPO areas as of the effective date of these Rules.~~ Table 2 projects total transportation sector emissions ~~reflects the difference in Baseline levels from year to year~~ assuming ~~a rapid growth in~~ Colorado's electric vehicle~~s~~ goals are met ~~across the State~~ (940,000 light duty electric vehicles in 2030, 3.38 million in 2040 and a total of 97% of all light duty vehicles in 2050) in addition to the emission reductions from this rule.

Values in both tables include estimates of population growth as provided by the state demographer.

8.01.2 Regional GHG Transportation Planning Reduction Levels

Table 1: GHG Transportation Planning Reduction Levels in MMT of CO2e

Regional Areas	2025 Reduction Level (MMT)	2030 Reduction Level (MMT)	2040 Reduction Level (MMT)	2050 Reduction Level (MMT)
DRCOG	0.27	0.82	0.63	0.37
NFRMPO	0.04	0.12	0.11	0.07
PPACG	N/A	0.15	0.12	0.07
GVMPO	N/A	0.02	0.02	0.01
PACOG	N/A	0.03	0.02	0.01
CDOT/Non-MPO	0.12	0.37	0.30	0.18
TOTAL	0.5	1.5	1.2	0.7

Table 2: ~~Baseline Emissions Due to Projected Number of Light Duty Electric Vehicles~~ Transportation Sector Emissions Projections from All Implemented Strategies

	2025 Projections (MMT)	2030 Projections (MMT)	2040 Projections (MMT)	2050 Projections (MMT)
TOTAL	27.0	20.0	14.0	8.9

Modeling Analysis Review and Modeling Requirements Under the Rule

The technical documentation and the modeling analysis and inputs should be available for the public to review now that the rulemaking process has begun. Without these technical materials, it's difficult to review this rule as a whole. CDOT has said that they are working on finalizing a modeling report and a Q&A document; it would be best if this information is made available well in advance of the scheduled regional hearings. Because we haven't been able to review any technical document associated with this proposal, we aren't able to provide comments on the modeling at this time. But one key question about the modeling at this point is whether EVs and charging infrastructure investments are included in the modeling. We need to ensure those reductions are not double counted in this proposal because most of those reductions are already covered in other emissions reduction estimates.

Regarding the modeling requirements in the proposed rule itself, we have the following questions and comments:

- Are MPOs going to be required to ground truth their modeled GHG emissions/VMT with real-world data collection (such as traffic counts)? If so, how often will this be required?
- Will a third-party review process be used to review the modeling analyses?
- Will the modeling results and documentation be available for public review?

Measurable Reductions Are Critical

Under the proposal CDOT and MPOs need to provide a GHG Transportation Report that meets several specific requirements, including a GHG emissions analysis demonstrating compliance with the applicable GHG reductions level and a mitigation action plan that identifies the needed mitigation measures and estimates reductions, where feasible (see Section 8.02.5.3.2). We would like more explanation of when GHG estimates would be infeasible and suggest edits to the rule language so that the rule does not imply that estimates would often be infeasible.

> 8.02.5.3 A Mitigation Action Plan that identifies GHG Mitigation Measures needed to meet the reduction levels within Table 1 shall include:
>
> 8.02.5.3.1 The anticipated start and completion date of each measure.
>
> 8.02.5.3.2 An estimate~~, where feasible,~~ of the GHG emissions reductions in MMT of CO2e achieved by any GHG Mitigation Measures. It's expected there will be rare situations where GHG estimates are not feasible.

Enforcement is Key to the Success of this Rule

Under the proposed rule, if compliance is not demonstrated after committing to GHG mitigation measures, the Commission will restrict the use of certain funds, requiring that money be focused on projects that reduce GHGs. The proposal includes the option to apply for a waiver if the rule requirements have not been met. We would like to learn more about this potential waiver process and how Colorado's GHG goals will still be met. The proposal states that "a substantial increase in GHG emissions" won't be allowed, but what is considered a substantial increase and how can we meet reduction goals while allowing any increases in emissions? As explained above, the proposed 1.5 MMT reductions by 2030 are not enough to meet the sector's goal of 12.8 MMT reductions. Waivers could also circumvent the requirement to protect and prioritize disproportionately impacted communities that might otherwise see air quality and transportation infrastructure improvements. Any increase in GHG emissions would be counter to the goal of this rule.

We appreciate the opportunity to comment on this proposed rule and the continued communications with CDOT staff to ensure that this is a strong rule that will help Colorado achieve its reduction goals for the transportation sector. Much progress has been made and we look forward to discussing our input with the Transportation Commission and CDOT.

Sincerely,

[redacted]

[redacted]

c: Shoshana Lew, Herman Stockinger, Rebecca White, Theresa Takushi

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Greenhouse Gas Pollution Reduction for Transportation Planning Proposed Standards

[redacted] Thu, Sep 2, 2021 at 1:07 PM
To: "dot_rules@state.co.us" <dot_rules@state.co.us>
Cc: "natalie.lutz@state.co.us" <natalie.lutz@state.co.us>

Thank you for the opportunity to comment on the Greenhouse Gas Pollution Reduction for Transportation Planning Proposed Standards.

These common-sense proposed standards are an excellent start to the implementation of Colorado's GHG reduction goals for the transportation sector. Section 4.06.1.8 is a good addition, requiring analysis of how the Statewide Transportation Plan is aligned with Colorado's climate goals and helps reduce, prevent, and mitigate GHG pollution throughout the State. In section 8, GHG reduction requirements, the Regional GHG Transportation Planning Reduction Levels contained in table 1 are very reasonable. Since the majority of emissions reductions are assumed to be achieved by an optimistic projection of private (and in some cases public) purchases of electric vehicles, the additional greenhouse gas emission reduction levels that CDOT and the MPOs need to achieve are tiny—in some cases, as little as 40,000 metric tonnes of CO_2-eq. These targets are incredibly reasonable, some might even say they are too small.

These targets can be achieved, and communities may already be further along developing actions to help achieve these goals than the Commission may realize. To illustrate, in my area, the Northwest TPR, our local electricity cooperative is already assisting in achieving these goals by helping businesses and homeowners finance EV chargers, and by funding electric school bus purchases. In the fast-growing east Grand county region, our expanding public bus systems is helping reduce vehicle miles traveled, and new bike lanes, pedestrian walkways and approved e-bike routes are helping provide additional multimodal transportation options. CDOT should consider working closely with Colorado's rural electric cooperatives in addition to local governments—co-ops can be helpful partners in the State's plan to achieve these targets.

Thank you again, and good luck implementing your new rules.

[redacted], Institute for Governance & Sustainable Development

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Strengthen the transportation rule

1 message

[redacted] Mon, Sep 6, 2021 at 8:09 AM

To: dot_rules@state.co.us

Dear Transportation Commission,

In order to ensure the health of Coloradans, I am urging you to strengthen the proposed transportation rule to ensure environmental justice is centered in decision making, and strong pollution reduction methods are enforceable. While the draft rule suggests good policies to mitigate transportation pollution, we need to set solid goals for pollution reduction that will enable us to meet our existing targets. Colorado is in a public health crisis, with over 60 days and counting of unhealthy air quality due to ozone, transportation pollution, and wildfire smoke from climate change.

This rule making should center people and environmental justice, and right now, the draft rule fails us. Black, Indigenous, Latinx, and other people of color are hurt worst by transportation pollution. CDOT should develop a Transportation Equity Framework, and representatives of disproportionately impacted and marginalized communities need to be included in developing, monitoring and implementing the rule.

Furthermore, we've over prioritized investment in single occupancy vehicle infrastructure, like highway expansions, for decades: to the detriment of other, less polluting, modes of transportation. The state's climate roadmap calls for a 10% reduction in driving by 2030. We need to get cars off the road in a permanent, sustainable way that increases options for walking, biking, and public transit for urban and rural Coloradans.

Climate change, and the associated pollution from the transportation sector, is a dire health crisis.
Coloradans are struggling to breathe and developing chronic conditions from the resulting impacts. We urge CDOT to strengthen the proposed rule by including strengthened provisions regarding environmental justice and more enforcement mechanisms that ensure pollution reduction and reduced vehicle miles traveled.

Sincerely,

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Strengthen the transportation rule

1 message

[redacted] Mon, Sep 6, 2021 at 10:44 AM

To: dot_rules@state.co.us

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Sincerely,

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Strengthen the transportation rule

1 message

[redacted] Mon, Sep 6, 2021 at 11:20 AM

To: dot_rules@state.co.us

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[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Strengthen the transportation rule

1 message

[redacted] Mon, Sep 6, 2021 at 11:53 AM

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Sincerely,

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Strengthen the transportation rule

1 message

[redacted] Mon, Sep 6, 2021 at 12:16 PM
To: dot_rules@state.co.us

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Sincerely,
[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Strengthen the transportation rule

1 message

[redacted] Mon, Sep 6, 2021 at 2:04 PM

To: dot_rules@state.co.us

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In order to ensure the health of Coloradans, I am urging you to strengthen the proposed transportation rule to ensure environmental justice is centered in decision making, and strong pollution reduction methods are enforceable. While the draft rule suggests good policies to mitigate transportation pollution, we need to set solid goals for pollution reduction that will enable us to meet our existing targets. Colorado is in a public health crisis, with over 60 days and counting of unhealthy air quality due to ozone, transportation pollution, and wildfire smoke from climate change.

This rule making should center people and environmental justice, and right now, the draft rule fails us. Black, Indigenous, Latinx, and other people of color are hurt worst by transportation pollution. CDOT should develop a Transportation Equity Framework, and representatives of disproportionately impacted and marginalized communities need to be included in developing, monitoring and implementing the rule.

Furthermore, we've over prioritized investment in single occupancy vehicle infrastructure, like highway expansions, for decades: to the detriment of other, less polluting, modes of transportation. The state's climate roadmap calls for a 10% reduction in driving by 2030. We need to get cars off the road in a permanent, sustainable way that increases options for walking, biking, and public transit for urban and rural Coloradans.

Climate change, and the associated pollution from the transportation sector, is a dire health crisis.
Coloradans are struggling to breathe and developing chronic conditions from the resulting impacts. We urge CDOT to strengthen the proposed rule by including strengthened provisions regarding environmental justice and more enforcement mechanisms that ensure pollution reduction and reduced vehicle miles traveled.

Sincerely,

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Strengthen the transportation rule

1 message

[redacted] Mon, Sep 6, 2021 at 4:22 PM

To: dot_rules@state.co.us

Dear Transportation Commission,

In order to ensure the health of Coloradans, I am urging you to strengthen the proposed transportation rule to ensure environmental justice is centered in decision making, and strong pollution reduction methods are enforceable. While the draft rule suggests good policies to mitigate transportation pollution, we need to set solid goals for pollution reduction that will enable us to meet our existing targets. Colorado is in a public health crisis, with over 60 days and counting of unhealthy air quality due to ozone, transportation pollution, and wildfire smoke from climate change.

This rule making should center people and environmental justice, and right now, the draft rule fails us. Black, Indigenous, Latinx, and other people of color are hurt worst by transportation pollution. CDOT should develop a Transportation Equity Framework, and representatives of disproportionately impacted and marginalized communities need to be included in developing, monitoring and implementing the rule.

Furthermore, we've over prioritized investment in single occupancy vehicle infrastructure, like highway expansions, for decades: to the detriment of other, less polluting, modes of transportation. The state's climate roadmap calls for a 10% reduction in driving by 2030. We need to get cars off the road in a permanent, sustainable way that increases options for walking, biking, and public transit for urban and rural Coloradans.

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Coloradans are struggling to breathe and developing chronic conditions from the resulting impacts. We urge CDOT to strengthen the proposed rule by including strengthened provisions regarding environmental justice and more enforcement mechanisms that ensure pollution reduction and reduced vehicle miles traveled.

Sincerely,

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Please strengthen the “Greenhouse Gas Pollution Standard”

1 message

[redacted] Tue, Sep 7, 2021 at 11:41 AM

To: Colorado Transportation Commission <dot_rules@state.co.us>

Dear The Colorado Transportation Commission,

The climate crisis has never been worse. This summer’s ongoing wildfires and drought remind us that dirty air pollution and climate change are already hurting our health—especially in communities of color.

Colorado is not on track to meet our targets to reduce climate pollution—especially from our state’s largest source of climate pollution: transportation.

I am writing today to ask that your draft “Greenhouse Gas Pollution Standard” include stronger greenhouse gas reduction targets in order to meet the goals for reductions from the transportation sector in the state’s climate roadmap. Unfortunately, the draft rule leaves a gap of two million metric tons of carbon dioxide - reductions that will not come from vehicle electrification and must be achieved through a reduction in statewide vehicle miles traveled.

The draft rule also is insufficient for Black, Indigenous, Latinx, and other people of color who are hurt worst by transportation pollution. We ask you to develop a Transportation Equity Framework, and include representatives of disproportionately impacted and marginalized communities in developing, monitoring and implementing the rule.

Thank you for your work and leadership. Please ensure that your transportation rule is equitable, enforceable, and verifiable.

Sincerely,
[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Strengthen the transportation rule

1 message

[redacted] Tue, Sep 7, 2021 at 4:37 PM

To: dot_rules@state.co.us

Dear Transportation Commission,

In order to ensure the health of Coloradans, I am urging you to strengthen the proposed transportation rule to ensure environmental justice is centered in decision making, and strong pollution reduction methods are enforceable. While the draft rule suggests good policies to mitigate transportation pollution, we need to set solid goals for pollution reduction that will enable us to meet our existing targets. Colorado is in a public health crisis, with over 60 days and counting of unhealthy air quality due to ozone, transportation pollution, and wildfire smoke from climate change.

This rule making should center people and environmental justice, and right now, the draft rule fails us. Black, Indigenous, Latinx, and other people of color are hurt worst by transportation pollution. CDOT should develop a Transportation Equity Framework, and representatives of disproportionately impacted and marginalized communities need to be included in developing, monitoring and implementing the rule.

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Coloradans are struggling to breathe and developing chronic conditions from the resulting impacts. We urge CDOT to strengthen the proposed rule by including strengthened provisions regarding environmental justice and more enforcement mechanisms that ensure pollution reduction and reduced vehicle miles traveled.

Sincerely,

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

GHG Rule Redline Suggestions

1 message

[redacted] Wed, Sep 8, 2021 at 11:24 AM
To: "dot_rules@state.co.us" <dot_rules@state.co.us>
[redacted]

CDOT staff,

The attached document has redline edits for CDOT's consideration for the GHG rule update for tomorrow, 9/9. These edits are technical in nature and the NFRMPO will submit more substantive comments at a later date. Please let me know if you have any questions.

Thank you,

[redacted]

Transportation and Air Quality Planner III

Pronouns: she/her

North Front Range Metropolitan Planning Organization

Website: https://nfrmpo.org

[redacted]

[redacted]

2 CCR 601-22_Redline_8.13.21_NFR FINAL.doc
228K

Style Definition: Title1

DEPARTMENT OF TRANSPORTATION

Transportation Commission

RULES GOVERNING STATEWIDE TRANSPORTATION PLANNING PROCESS AND TRANSPORTATION PLANNING REGIONS

2 CCR 601-22

[Editor s Notes follow the text of the rules at the end of this CCR Document.]

August 13, 2021, Version

Please note the following formatting key:

Font Effect	Meaning
Underline	New Language
~~Strikethrough~~	Deletions
[Blue Font Text]	Annotation

STATEMENT OF BASIS AND PURPOSE, ~~AND~~ STATUTORY AUTHORITY AND PREAMBLE

The purpose of the Rules Governing the Statewide Transportation Planning Process and Transportation Planning Regions (Rules) is to prescribe the statewide transportation planning process through which a long-range ~~multimodal~~Multimodal, comprehensive ~~statewide~~ Statewide ~~transportation~~ Transportation ~~plan~~ Plan will be developed, integrated, updated, and amended by the Colorado Department of Transportation (Department or CDOT), in cooperation with local governments, Metropolitan Planning Organizations (MPOs) , Regional Planning Commissions, Indian tribal governments, relevant state and federal agencies, the private sector, transit and freight operators, ~~special interest groups,~~ and the general public. This cooperative process is designed to coordinate regional transportation planning, guided by the statewide transportation policy set by the Department and the ~~transportation~~ Transportation ~~commission~~ Commission of Colorado ("Commission"), as a basis for developing the ~~statewide~~ Statewide ~~transportation~~ Transportation ~~plan~~Plan. The result of the statewide transportation planning process shall be a long-range, financially feasible, environmentally sound, ~~multimodal~~ Multimodal transportation system plan for Colorado that will reduce traffic and smog.

Further, the purpose of the Rules is to define the state's Transportation Planning Regions for which long-range Regional Transportation Plans are developed, prescribe the process for conducting and initiating transportation planning in the non-MPO Transportation Planning Regions and coordinating with the ~~Metropolitan Planning Organizations~~MPOs for planning in the metropolitan areas. Memoranda of Agreement (MOA) that serve as the Metropolitan Planning Agreements (MPAs) ~~per~~ pursuant to 23 C.F.R. § 450 between the Department, each MPO, and applicable transit provider(s) further prescr be the transportation planning process in the MPO ~~transportation~~ Transportation ~~planning~~ Planning ~~regions~~Regions. In addition, the purpose of the Rules is to describe the organization and function of the

Statewide Transportation Advisory Committee (STAC) as established by § 43-1-1104, Colorado Revised Statutes (C.R.S.).

The Rules are promulgated to meet the intent of both the U.S. Congress and the Colorado General Assembly for conducting a continuing, cooperative, and comprehensive statewide performance-based ~~multimodal~~ Multimodal transportation planning process for producing a Statewide Transportation Plan and Regional Transportation Plans that address the transportation needs of the ~~state~~State. This planning process, through comprehensive input, results in systematic project prioritization and resource allocation.

The Rules, governing the statewide planning process, emphasize Colorado's continually greater integration of Multimodal, cost-effective, and environmentally sound means of transportation which leads to cleaner air and reduced traffic. The Rules reflect the Commission's and the Department's focus on Multimodal transportation projects including highways, transit, rail, bicycles and pedestrians. Section 8 of these Rules establishes an ongoing administrative process for identifying, measuring, confirming, and verifying those best practices and their impacts, so that CDOT and MPOs can easily apply them to their plans in order to achieve the pollution reduction levels required by these Rules.

The Rules are promulgated by the Commission pursuant to the specific statutory authority in § 43-1-1103 (5), C.R.S., and § 43-1-106 (8)(k), C.R.S.

Preamble for 2018 Rulemaking

In 2018, rulemaking was initiated to update the rules to conform to recently passed federal legislation, update expired rules, clarify the membership and duties of the ~~Statewide Transportation Advisory Committee~~STAC pursuant to HB 16-1169 and HB 16-1018, and to make other minor corrections. ~~The Rules are intended to be consistent with and not be a replacement for the federal transportation planning requirements contained in 23 United States Code (U.S.C.) §§ 134, 135 and 150, Pub. L. No. 114-94 (Fixing America's Surface Transportation Act or the "FAST Act") signed into law on December 4, 2015, and its implementing regulations, where applicable, contained in 23 Code of Federal Regulations (C.F.R.) Part 450, including Subparts A, B and C and 25 C.F.R. § 170.421 in effect as of August 1, 2017, which are hereby incorporated into the Rules by this reference, and do not include any later amendments. All referenced laws and regulations shall be available for copying or public inspection during regular business hours from the Office of Policy and Government Relations, Colorado Department of Transportation, 2829 W. Howard Pl., Denver, Colorado 80204.~~

~~Copies of the referenced United States Code may be obtained from the following address:~~

~~Office of the Law Revision Counsel~~
~~U.S. House of Representatives~~
~~H2-308 Ford House Office Building~~
~~Washington, DC 20515~~
~~(202) 226-2411~~

~~Copies of the referenced Code of Federal Regulations may be obtained from the following address:~~

~~U.S. Government Publishing Office~~
~~732 North Capitol Street, N.W.~~
~~Washington, DC 20401~~
~~(202) 512-1800~~

~~The Statewide Planning Rules, governing the statewide planning process, emphasize Colorado's continually greater integration of multimodal, cost-effective and environmentally sound means of transportation. The Rules reflect the Department's focus on multimodal transportation projects including highways, aviation, transit, rail, bicycles and pedestrians.~~

~~The Rules are promulgated by the Commission pursuant to the specific statutory authority in § 43-1-1103 (5), C.R.S., and § 43-1-106 (8)(k), C.R.S. The Commission may, at their discretion, entertain petitions for declaratory orders pursuant to § 24-4-105(11), C.R.S.~~

Preamble for 2021 Rulemaking

Overview

Section 8 of these Rules establishes Greenhouse Gas (GHG) pollution reduction planning levels for transportation that will improve air quality, reduce smog, and provide more sustainable options for travelers across Colorado. The purpose of these requirements is to limit the GHG pollution which would result from the transportation system if the plan was implemented, consistent with the state greenhouse gas pollution reduction roadmap. This is accomplished by requiring CDOT and MPOs to establish plans that meet targets through a mix of projects that limit and mitigate air pollution and improve quality of life and Multimodal options. CDOT and MPOs will be required to demonstrate through travel demand modeling and approved air quality modeling that statewide and regional aggregate emissions resulting from its state or regional plans do not exceed a specified emissions level in total. In the event that a plan fails to comply, CDOT and MPOs have the option to commit to implementing GHG Mitigation Measures that provide travelers with cleaner and more equitable transportation options such as safer pedestrian crossings and sidewalks, better transit and transit-access, or infrastructure that supports access to housing, jobs, and retail.

Examples of these types of mitigations, which also benefit quality of place and the economic resilience of communities, will include but not be limited to: adding bus rapid transit facilities and services, enhancing first-and-last mile connections to transit, adding b ke-sharing services including electric bikes, improving pedestrian facilities like sidewa ks and safe access ble crosswa ks, investments that support v brant downtown density and local zoning decisions that favor sustainable building codes and inclusive multi-use facilities downtown, and more. The process of identifying and approving mitigations will be established by a policy process that allows for ongoing innovations from local governments and other partners to be considered on an iterative basis.

If compliance still cannot be demonstrated, even after committing to GHG Mitigation Measures, the Commission shall restrict the use of certain funds, requiring that dollars be focused on projects that help reduce transportation emissions ~~and~~or are recognized as approved mitigations. These requirements address the Colorado General Assembly's directive to reduce statewide GHG pollution in § 25-7-102(2)(g), C.R.S., as well as the directive for transportation planning to consider environmental stewardship and reducing GHG emissions, § 43-1-1103(5), C.R.S.

Commented [redacted]: The rule says or, not and.

Context of Section 8 of these Rules Within Statewide Objectives

The passage of House Bill (HB)19-1261 set Colorado on a course to dramatically reduce GHG emissions across all sectors of the economy. In HB 19-1261, now codified in part at §§ 25-7-102(2) and 105(1)(e), C.R.S., the General Assembly declared that "climate change adversely affects Colorado's economy, air quality and public health, ecosystems, natural resources, and quality of life[,]" acknowledged that "Colorado is already experiencing harmful climate impacts[,]" and that "many of these impacts disproportionately affect" certain Disproportionately Impacted Communities. *see* § 25-7-102(2), C.R.S. The General Assembly also recognized that "[b]y reducing [GHG] pollution, Colorado will also reduce other harmful air pollutants, which will, in turn, improve public health, reduce health care costs, improve air quality, and help sustain the environment." *see* § 25-7-102(2)(d), C.R.S.

Since 2019, the State has been rigorously developing a plan to achieve the ambitious GHG pollution reduction goals in § 25-7-102(2)(g), C.R.S. In January 2021, the State published its Greenhouse Gas Pollution Reduction Roadmap (Roadmap). The Roadmap identified the transportation sector as the single largest source of statewide GHG pollution as of 2020, with passenger vehicles the largest contr butor within the transportation sector. Additionally, the Roadmap determined that emissions from transportation are a "significant contributor to local air pollution that disproportionately impacts lower-income communities and communities of color." *see* Roadmap, p. XII.

A key finding in the Roadmap recognized that "[m]aking changes to transportation planning and infrastructure to reduce growth in driving is an important tool" to meet the statewide GHG pollution reduction goals. *see* Roadmap, p. 32. Section 8 of these Rules also advances the State's goals to reduce emissions of other harmful air pollutants, including ozone.

Why the Commission is Taking This Action

Senate Bill 21-260, signed into law by the Governor on June 17, 2021, and effective upon signature, includes a new § 43-1-128, C.R.S., which directs CDOT and MPOs to engage in an enhanced level of planning, modeling and other analysis to minimize the adverse environmental and health impacts of planned transportation capacity projects. Section 43-1-128, C.R.S. also directs CDOT and the Commission to take steps to account for the impacts of transportation capacity projects on GHG pollution and Vehicle Miles Traveled and to help achieve statewide GHG pollution targets established in § 25-7-102(2)(g), C.R.S.

Under Colorado law governing transportation planning, CDOT is charged with and identified as the proper body for "developing and maintaining the state transportation planning process and the state transportation plan" in cooperation with Regional Planning Commissions and local government officials. *see* § 43-1-1101, C.R.S.

The Commission is responsible for formulating policy with respect to transportation systems in the State and promulgating and adopting all CDOT financial budgets for construction based on the Statewide Transportation Improvement Programs. *see* § 43-1-106(8), C.R.S. The Commission is statutorily charged "to assure that the preservation and enhancement of Colorado's environment, safety, mobility and economics be considered in the planning, selection, construction and operation of all transportation projects in Colorado." *see* § 43-1-106(8)(b), C.R.S. In addition, the Commission is generally authorized "to make all necessary and reasonable orders, rules and regulations in order to carry out the provisions of this part . . ." *see* § 43-1-106(8)(k), C.R.S.

As such, CDOT and the Commission are primarily respons ble for ensuring compliance with GHG reductions in transportation planning.

What Relevant Regulations Currently Apply to Transportation Planning

Transportation planning is subject to both state and federal requirements. Under federal law governing transportation planning and federal-aid highways, it is declared to be in the national interest to promote transportation systems that accomplish a number of mobility objectives "while minimizing transportation-related fuel consumption and air pollution through metropolitan and statewide transportation planning processes…" *see* 23 U.S.C. § 134; *see also* 23 U.S.C. § 135(a)(1). In the metropolitan planning process, consideration must be given to projects and strategies that will "protect and enhance the environment, promote energy conservation, improve the quality of life…" *see* 23 U.S.C. § 134(h)(1)(E); *see also* 23 C.F.R. Part 450, Subpart B (federal regulations governing statewide transportation planning and programming). The same planning objective applies to statewide transportation planning. *see* 23 U.S.C. § 135(d)(1)(E); *see also* 23 C.F.R. Part 450, Subpart C (governing metropolitan transportation planning and programming). Further, the Statewide Transportation Plan shall be developed, as appropriate, in consultation with State...local agencies responsible for...environmental protection…" *see* 23 U.S.C. § 135(f)(2)(D)(i).

Under conforming Colorado law, the Statewide Transportation Plan is developed by integrating and consolidating Regional Transportation Plans developed by MPOs and regional transportation planning organizations into a "comprehensive statewide transportation plan" pursuant to rules and regulations promulgated by the Commission. *see* § 43-1-1103(5), C.R.S. The Statewide Transportation Plan must address a number of factors including, but not limited to, "environmental stewardship" and "reduction of greenhouse gas emissions." *see* § 43-1-1103(5)(h) and (j), C.R.S.

Regional Transportation Plans must account for the "expected environmental, social, and economic impacts of the recommendations in the plan, including a full range of reasonable transportation alternatives...in order to provide for the transportation and environmental needs of the area in a safe and efficient manner." *see* § 43-1-1103(1)(d), C.R.S. Further, in developing Regional Transportation Plans, MPOs "[s]hall assist other agencies in developing transportation control measures for utilization in accordance with state...regulations...and shall identify and evaluate measures that show promise of supporting clean air objectives." *see* § 43-1-1103(1)(e), C.R.S.

Putting Section 8 of these Rules into Perspective

Section 8 establishes GHG regulatory requirements that are among the first of their kind in the U.S. However, from an air pollutant standpoint, connecting transportation planning to emissions is not a new policy area. In fact, transportation conformity provisions within the Clean Air Act approach ozone much the same way. Transportation conformity ensures that federally funded or approved highway and transit activities within a Nonattainment Area are consistent with or "conform to" a state's plan to reduce emissions. Colorado's front range has been in ozone nonattainment for many years, which has required the North Front Range and the Denver Regional Council of Governments' MPOs to demonstrate conformity with each plan adoption and amendment.

However, because the transportation sector encompasses the millions of individual choices people make every day that have an impact on climate, a variety of strategies are necessary to achieve the State's climate goals. Section 8 of these Rules is one of many steps needed to achieve the totality of reduction goals for the transportation sector.

Purpose of GHG Mitigation Measures

The transportation modeling conducted for this rulemaking may demonstrate that certain projects increase GHG pollution for a variety of reasons. These reasons may include factors such as induced demand as a result of additional lane mileage attracting additional vehicular traffic, or additional traffic facilitated by access to new commercial or residential development in the absence of public transit options or bicycle/pedestrian access that provides consumers with other non-driving options. Transportation infrastructure itself can also increase or decrease GHG and other air pollutants by virtue of factors like certain construction materials, removal or addition of tree cover that captures carbon pollution, or integration with vertical construction templates of various efficiencies that result in higher or lower levels of per capita energy use. The pollution impacts of various infrastructure projects will vary significantly depending on their specifics and must be modeled in a manner that is context-sensitive to a range of issues such as location, footprint of existing infrastructure, design, and how it fits together with transportation alternatives.

Furthermore, other aspects of transportation infrastructure can facilitate reductions in emissions and thus serve as mitigations rather than contr butors to pollution. For example, the addition of transit resources in a manner that can displace Vehicle Miles Traveled can reduce emissions. Moreover, improving downtown pedestrian and bike access, particularly in areas that allow individuals to shift multiple daily trips for everything from work to dining to retail, can improve both emissions and quality of life.

There is an increasing array of proven best practices for reducing pollution and smog and improving economies and neighborhoods that can help streamline decision-making for state and local agencies developing plans and programs of projects.

[Note: The Commission proposes to repeal Section 1 of these Rules in its entirety and re-enact Section 1 of these Rules below to re-format the numbering of the administrative rules into alphabetical order.]

~~1.00 Definitions.~~

~~1.01 Accessible - ensure that reasonable efforts are made that all meetings are reachable by persons from households without vehicles and that the meetings will be accessible to persons with disabilities in accordance with the Americans with Disabilities Act (ADA) , and also accessible to persons with limited English proficiency. Accessible opportunities to on planning related matters include those provided on the internet and through such methods as telephone town halls. comment~~

~~1.02 Attainment Area – any geographic region of the United States that meets the national primary or secondary National Ambient Air Quality Standards (NAAQS) for the pollutants as defined in the Clean Air Act (CAA) (Amendments of 1990).~~

~~1.03 Commission - the transportation commission of Colorado created by § 43-1-106, C.R.S.~~

~~1.04 Corridor - a transportation system that includes all modes and facilities within a described geographic area.~~

~~1.05 Corridor Vision - a comprehensive examination of a specific transportation corridor, which includes a determination of needs and an expression of desired state of the transportation system that includes transportation modes and facilities over a planning period.~~

~~1.06 Department - the Colorado Department of Transportation created by § 43-1-103, C.R.S.~~

~~1.07 Division – the Division of Transportation Development within the Colorado Department of Transportation.~~

~~1.08 Division Director - the Director of the Division of Transportation Development.~~

~~1.09 Fiscally Constrained - the financial limitation on transportation plans and programs based on the projection of revenues as developed cooperatively with the MPOs and the rural TPRs and adopted by the Commission that are reasonably expected to be available over the long-range transportation planning period and the Transportation Improvement Program (TIP) and Statewide Transportation Improvement Program (STIP) programming periods.~~

~~1.10 Intergovernmental Agreement - an arrangement made between two or more political subdivisions that form associations for the purpose of promoting the interest and welfare of said subdivisions.~~

~~1.11 Intermodal Facility- A site where goods or people are conveyed from one mode of transportation to another, such as goods from rail to truck or people from passenger vehicle to bus.~~

~~1.12 Land Use – the type, size, arrangement, and use of parcels of land.~~

~~1.13 Limited English Proficiency (LEP) – individuals who do not speak English as their primary language and who have a limited ability to read, speak, write, or understand English.~~

~~1.14 Long-range Planning - a reference to a planning period with a minimum 20-year planning horizon.~~

~~1.15 Maintenance Area – any geographic region of the United States previously designated by the U.S. Environmental Protection Agency (EPA) as a nonattainment area pursuant to the Clean Air Act (CAA) Amendments of 1990 and subsequently redesignated to attainment subject to the requirement to develop a maintenance plan under section 175A of the CAA, as amended in 1990.~~

~~1.16 Memorandum of Agreement (MOA) – a written agreement between two or more parties on an intended plan of action.~~

~~1.17 Metropolitan Planning Agreement (MPA) – a written agreement between the MPO, the State, and the providers of public transportation serving the metropolitan planning area that descr bes how they will work cooperatively to meet their mutual responsibilities in carrying out the metropolitan planning process.~~

~~1.18 Metropolitan Planning Area - a geographic area determined by agreement between the Metropolitan Planning Organization for the area and the Governor, in which the metropolitan transportation planning process is carried out pursuant to 23 U.S.C. § 134.~~

~~1.19 Metropolitan Planning Organization (MPO) - an organization designated by agreement among the units of general purpose local governments and the Governor, charged to develop the regional transportation plans and programs in a metropolitan planning area pursuant to 23 U.S.C. § 134.~~

~~1.20 Mobility - the ability to move people, goods, services, and information among various origins and destinations.~~

~~1.21 Multimodal - an integrated approach to transportation that takes into account all modes of travel, such as bicycles and walking, personal mobility devices, buses, transit, rail, aircraft, and motor vehicles.~~

~~1.22 National Ambient Air Quality Standards (NAAQS) – are those established by the U.S. Environmental Protection Agency for air pollutants considered harmful to public health and environment. These criteria pollutants are: carbon monoxide, lead, nitrogen dioxide, ozone, small particles, and sulfur dioxide.~~

~~1.23 Nonattainment Area - any geographic region of the United States which has been designated by the EPA under section 107 of the CAA for any pollutants for which an NAAQS exists.~~

~~1.24 Non-metropolitan Area – a rural geographic area outside a designated metropolitan planning area.~~

~~1.25 Plan Integration – Plan integration is a comprehensive evaluation of the statewide transportation system that includes all modes, an identification of needs and priorities, and key information from other related CDOT plans.~~

~~1.26 Planning Partners – local and tribal governments, the rural Transportation Planning Regions and MPOs.~~

~~1.27 Project Priority Programming Process ("4P") – the process by which CDOT adheres to 23 U.S.C. § 135 and 23 C.F.R. Part 450 when developing and amending the statewide transportation improvement program (STIP).~~

~~1.28 Regional Planning Commission (RPC) - a planning body formed under the provisions of § 30-28-105, C.R.S., and designated under these Rules for the purpose of transportation planning within a rural Transportation Planning Region.~~

~~1.29 Regional Transportation Plan (RTP) - a long-range plan designed to address the future transportation needs for a Transportation Planning Region including, but not limited to, anticipated funding, priorities, and implementation plans, pursuant to, but not limited to, § 43-1-1103, C.R.S. and 23 C.F.R. Part 450. All rural and urban Transportation Planning Regions in the state produce RTPs.~~

~~1.30 State Transportation System - refers to all state-owned, operated, and maintained transportation facilities in Colorado, including, but not limited to, interstate highways, other highways, and aviation, bicycle and pedestrian, transit, and rail facilities.~~

~~1.31 Statewide Transportation Advisory Committee (STAC) - the committee created by § 43-1-1104, C.R.S., comprising one representative from each Transportation Planning Region and one representative from each tribal government to review and comment on Regional Transportation Plans, amendments, and updates, and to advise both the Department and the Commission on the needs of the transportation system in Colorado.~~

~~1.32 Statewide Transportation Improvement Program (STIP) - a staged, fiscally constrained, multi-year, statewide, multimodal program of transportation projects which is consistent with the statewide transportation plan and planning processes, with metropolitan planning area plans, Transportation Improvement Programs and processes, and which is developed pursuant to 23 U.S.C. § 135.~~

~~1.33 Statewide Transportation Plan - the long-range, comprehensive, multimodal statewide transportation plan covering a period of no less than 20 years from time of adoption, developed through the statewide transportation planning process descr bed in these Rules and 23 U.S.C. § 135, and adopted by the Commission pursuant to § 43-1-1103, C.R.S.~~

~~1.34 System Continuity - includes, but is not limited to, appropriate intermodal connections, integration with state modal plans, and coordination with neighboring Regional Transportation Plans, and, to the extent practicable, other neighboring states' transportation plans.~~

~~1.35 Traditionally Underserved - refers to groups such as seniors, persons with disabilities, low-income households, minorities, and student populations, which may face difficulties accessing transportation systems, employment, services, and other amenities.~~

~~1.36 Transit and Rail Advisory Committee (TRAC) – an advisory committee created specifically to advise the Executive Director, the Commission, and the Division of Transit and Rail on transit and rail-related activities.~~

~~1.37 Transportation Commonality - the basis on which Transportation Planning Regions are established including, but not limited to: Transportation Commission Districts, the Department's Engineering Regions, travelsheds, watersheds, geographic unity, existing intergovernmental agreements, and socioeconomic unity.~~

~~1.38 Transportation Improvement Program (TIP) - a staged, fiscally constrained, multi-year, multimodal program of transportation projects developed and adopted by MPOs, and approved by the Governor, which is consistent with an MPO's RTP and which is developed pursuant to 23 U.S.C. § 134.~~

~~1.39 Transportation Mode - a particular form of travel including, but not limited to, bus, motor vehicle, rail, transit, aircraft, bicycle, pedestrian travel, or personal mobility devices.~~

~~1.40 Transportation Planning and Programming Process - all collaborative planning-related activities including the development of regional and statewide transportation plans, the Department's Project Priority Programming Process, and development of the Transportation Improvement Programs (TIPs) and Statewide Transportation Improvement Program (STIP).~~

~~1.41 Transportation Planning Region (TPR) - a geographically designated area of the state, defined by section 2.00 of these Rules in consideration of the criteria for transportation commonality, and for which a regional transportation plan is developed pursuant to the provisions of § 43-1-1102 and 1103, C.R.S. and 23 U.S.C. § 134. The term TPR is inclusive of these types: non-MPO Transportation Planning Regions, MPO Transportation Planning Regions, and Transportation Planning Regions with both MPO and non-MPO areas.~~

~~1.42 Transportation Systems Planning – provides the basis for identifying current and future deficiencies on the state highway system and outlines strategies to address those deficiencies and make improvements to meet Department goals.~~

~~1.43 Travelshed - the region or area generally served by a major transportation facility, system, or corridor.~~

~~1.44 Tribal Transportation Improvement Program (TTIP) – a multi-year fiscally constrained list of proposed transportation projects developed by a tribe from the tribal priority list or tribal long-range transportation plan, and which is developed pursuant to 25 C.F.R. Part 170. The TTIP is incorporated into the STIP without modification.~~

~~1.45 Urbanized Area - an area with a population of 50,000 or more designated by the Bureau of the Census.~~

~~1.46 Watershed - a land area that drains to a common waterway, such as a stream, lake, estuary, wetland, or ultimately the ocean.~~

[Note: The Commission proposes to add nineteen (19) new definitions. New proposed defined terms include: Applicable Planning Document, Approved Air Quality Model, Baseline, Carbon Dioxide Equivalent, Congestion Mitigation and Air Quality, Disproportionately Impacted Communities, Four-Year Prioritized Plan, Greenhouse Gas, Greenhouse Mitigation Measures, Greenhouse Gas Reduction Levels, Mitigation Action Plan, MPO Model, Multimodal Transportation and Mitigation Options Fund, Regionally Significant Project, State Interagency Consultation Team, Statewide Travel Model, Surface Transportation Block Grant, Vehicle Miles Traveled, and 10-Year Plan. Only minor non-substantive changes, such as correcting grammar errors or capitalizing defined terms, were made to the existing forty-six (46) defined terms.]

1.00 Definitions.

1.01 Accessible - ensure that reasonable efforts are made that all meetings are reachable by persons from households without vehicles and that the meetings will be accessible to persons with disabilities in accordance with the Americans with Disabilities Act (ADA), and also accessible to persons with Limited English Proficiency. Accessible opportunities to comment on planning related matters include those provided on the internet and through such methods as telephone town halls.

1.02 Applicable Planning Document - refers to MPO Fiscally Constrained RTPs,TIPs for MPOs in NAAs, CDOT's 10-Year Plan and Four-Year Prioritized Plan in non-MPO areas, CDOT's STIP in in non-MPO areas within an NAA, and amendments to the MPO RTPs and CDOT's 10-Year Plan and Four-Year Prioritized Plan in non-MPO areas that include the addition of Regionally Significant Projects.

1.03 Approved Air Quality Model - the ~~most recent~~ version of the Environmental Protection Agency issued model that quantifies GHG emissions from transportation and is required for transportation conformity analyses per federal regulations.

1.04 Attainment Area - any geographic region of the United States that meets the national primary or secondary National Ambient Air Quality Standards (NAAQS) for the pollutants as defined in the Clean Air Act (CAA) (Amendments of 1990).

1.05 Baseline - estimates of GHG emissions for each of the MPOs, and for the non-MPO areas, prepared using the MPO Models or the Statewide Travel Model. Estimates must include GHG emissions resulting from the existing transportation network and implementation of the most recently adopted RTP for all MPOs and the 10-Year Plan in non-MPO areas as of the effective date of these Rules.

1.06 Carbon Dioxide Equivalent (CO2e) - a ~~metric measure used to~~standard unit for comparinge the emissions from various GHG based upon the 100-year global warming potential (GWP). CO2e is calculated by multiplying the mass amount of emissions (metric tons per year), for each GHG constituent by that gas's GWP, and summing the resultant values to determine CO2e (metric tons per year). This calculation allows comparison of different greenhouse gases and their relative impact on the environment over ~~different~~a standard time periods.

1.07 Commission - the Transportation Commission of Colorado created by § 43-1-106, C.R.S.

1.08 Congestion Mitigation and Air Quality (CMAQ) - a ~~federally mandated~~federal funding program established in 23 U.S.C § 149 to improve air quality in Nonattainment and Maintenance Areas for ozone, carbon monoxide, and particulate matter. References related to this program include any successor programs as established by the federal government.

1.09 Corridor - a transportation system that includes all modes and facilities within a described geographic area.

1.10 Corridor Vision - a comprehensive examination of a specific transportation Corridor, which includes a determination of needs and an expression of desired state of the transportation system that includes Transportation Modes and facilities over a planning period.

1.11 Department or CDOT - the Colorado Department of Transportation created by § 43-1-103, C.R.S.

1.12 Disproportionately Impacted Communities - defined in § 24-38.5-302(3), C.R.S. as a community that is in a census block group, as determined in accordance with the most recent United States Decennial Census where the proportion of households that are low income is greater than forty percent (40%), the proportion of households that identify as minority is greater than forty percent (40%), or the proportion of households that are housing cost-burdened is greater than forty percent (40%).

1.13 Division - the Division of Transportation Development within CDOT.

1.14 Division Director - the Director of the Division of Transportation Development.

1.15 Fiscally Constrained - the financial limitation on transportation plans and programs based on the projection of revenues as developed cooperatively with the MPOs and the rural TPRs and adopted by the Commission that are reasonably expected to be available over the long-range transportation planning period and the TIP and STIP programming periods.

1.16 Four-Year Prioritized Plan - a four-year subset of the 10-Year Plan consisting of projects prioritized for near-term delivery and partial or full funding.

1.17 Greenhouse Gas (GHG) - for purposes of these Rules, GHG is defined as the primary transportation greenhouse gases: carbon dioxide, methane, and nitrous oxide.

1.18 Greenhouse Gas (GHG) Reduction Level - the amount of the GHG expressed as CO2e reduced from the projected Baseline that CDOT and MPOs must attain through transportation planning.

1.19 Greenhouse Gas (GHG) Mitigation Measures - non-Regionally Significant Project strategies ~~implemented by CDOT and MPOs~~ that reduce transportation GHG pollution and help meet the GHG Reduction Levels.

Commented [redacted]: MMT is a metric measure, but CO2e is not inherently metric

Commented [redacted]: Any agency's GHG measures should be able to count, same as how any regionally significant project (even if locally funded) counts. In addition, better to not use the past tense because almost all the measures are planned measures for future implementation.

1.20 Intergovernmental Agreement - an arrangement made between two or more political subdivisions that form associations for the purpose of promoting the interest and welfare of said subdivisions.

1.21 Intermodal Facility - a site where goods or people are conveyed from one mode of transportation to another, such as goods from rail to truck or people from passenger vehicle to bus.

1.22 Land Use - the type, size, arrangement, and use of parcels of land.

1.23 Limited English Proficiency - individuals who do not speak English as their primary language and who have a limited ability to read, speak, write, or understand English.

1.24 Long-Range Planning - a reference to a planning period with a minimum 20-year planning horizon.

1.25 Maintenance Area - any geographic region of the United States previously designated by the U.S. Environmental Protection Agency (EPA) as a Nonattainment Area pursuant to the Clean Air Act (CAA) Amendments of 1990 and subsequently redesignated to attainment subject to the requirement to develop a maintenance plan under § 175A of the CAA, as amended in 1990.

1.26 Memorandum of Agreement (MOA) - a written agreement between two or more parties on an intended plan of action.

1.27 Metropolitan Planning Agreement (MPA) - a written agreement between the MPO, the State, and the providers of public transportation serving the Metropolitan Planning Area that describes how they will work cooperatively to meet their mutual responsibilities in carrying out the metropolitan planning process.

1.28 Metropolitan Planning Area - a geographic area determined by agreement between the MPO for the area and the Governor, in which the metropolitan transportation planning process is carried out pursuant to 23 U.S.C. § 134.

1.29 Metropolitan Planning Organization (MPO) - an organization designated by agreement among the units of general purpose local governments and the Governor, charged to develop the RTPs and programs in a Metropolitan Planning Area pursuant to 23 U.S.C. § 134.

1.30 Mitigation Action Plan - an element of the GHG Transportation Report that specifies which GHG Mitigation Measures shall be implemented that help achieve the GHG Reduction Levels.

1.31 Mobility - the ability to move people, goods, services, and information among various origins and destinations.

1.32 MPO Models - one (1) or more of the computer-based models maintained and operated by the MPOs which depict the MPO areas' transportation systems (e.g., roads, transit, etc.) and development patterns (i.e., number and location of households and jobs) for a defined year (i.e., past, present, or forecast) and produce estimates of roadway VMT, delays, operating speeds, transit ridership, and other characteristics of transportation system use.

1.33 Multimodal - an integrated approach to transportation that takes into account all modes of travel, such as bicycles and walking, personal mobility devices, buses, transit, rail, aircraft, and motor vehicles.

1.34 Multimodal Transportation and Mitigation Options Fund (MMOF) - a program created in the State Treasury pursuant to § 43-4-1003, C.R.S. which funds bicycle, pedestrian, transit and other Multimodal projects as defined in § 43-4-1002(5), C.R.S. and GHG Mitigation projects as defined in § 43-4-1002(4.5), C.R.S.

1.35 National Ambient Air Quality Standards (NAAQS) - are those established by the U.S. Environmental Protection Agency for air pollutants considered harmful to public health and environment. These criteria pollutants are: carbon monoxide, lead, nitrogen dioxide, ozone, small particles, and sulfur dioxide.

1.36 Nonattainment Area - any geographic region of the United States which has been designated as nonattainment by the EPA under section 107 of the CAA for any pollutants for which a NAAQS exists.

Commented [redacted]: EPA also designates areas as attainment, maintenance, or unclassifiable.

1.37 Non-Metropolitan Area - a rural geographic area outside a designated Metropolitan Planning Area.

1.38 Plan Integration - a comprehensive evaluation of the statewide transportation system that includes all modes, an identification of needs and priorities, and key information from other related CDOT plans.

1.39 Planning Partners - local and tribal governments, the rural TPRs and MPOs.

1.40 Project Priority Programming Process - the process by which CDOT adheres to 23 U.S.C. § 135 and 23 C.F.R. Part 450 when developing and amending the STIP.

1.41 Regional Planning Commission (RPC) - a planning body formed under the provisions of § 30-28-105, C.R.S., and designated under these Rules for the purpose of transportation planning within a rural TPR.

1.42 Regionally Significant Project - a transportation project that is on a facility which serves regional transportation needs (such as access to and from the area outside of the region, major activity centers in the region, major planned developments such as new retail malls, sports complexes, etc., or transportation terminals as well as most terminals themselves) and would normally be included in the modeling of a metropolitan area's transportation network or state transportation network, including at a minimum all principal arterial highways and all fixed guideway transit facilities that offer an alternative to regional highway travel. If the MPOs have received approval from the EPA to use a different definition of regionally significant project as defined in 40 C.F.R. § 93.101, the State Interagency Consultation Team will accept the modified definition. Necessary specificity for MPO Models or the Statewide Travel Model will be approved by the State Interagency Consultation Team.

Commented [redacted]: Recommend clarifying if this applies to all areas or just those without an EPA-approved definition.

1.43 Regional Transportation Plan (RTP) - a long-range plan designed to address the future transportation needs for a TPR including, but not limited to, Fiscally Constrained or anticipated funding, priorities, and implementation plans, pursuant to, but not limited to, § 43-1-1103, C.R.S. and 23 C.F.R. Part 450. All rural and urban TPRs in the state produce RTPs.

1.44 State Interagency Consultation Team - consists of the Division Director or the Division Director's designee, the Colorado Department of Public Health and Environment (CDPHE) Director of Air Pollution Control Division or the Director's designee, and the Director of each MPO or their designee.

1.45 State Transportation System - refers to all state-owned, operated, and maintained transportation facilities in Colorado, including, but not limited to, interstate highways, other highways, and aviation, bicycle and pedestrian, transit, and rail facilities.

1.46 Statewide Transportation Advisory Committee (STAC) - the committee created by § 43-1-1104, C.R.S., comprising one representative from each TPR and one representative from each tribal government to review and comment on RTPs, amendments, and updates, and to advise both the Department and the Commission on the needs of the transportation system in Colorado.

1.47 Statewide Transportation Improvement Program (STIP) - a Fiscally Constrained, multi-year, statewide, Multimodal program of transportation projects which is consistent with the Statewide Transportation Plan and planning processes, with Metropolitan Planning Area plans, Transportation Improvement Programs and processes, and which is developed pursuant to 23 U.S.C. § 135.

1.48 Statewide Travel Model - the computer-based model maintained and operated by CDOT which depicts the state's transportation system (roads, transit, etc.) and development scale and pattern (number and location of households, number and location of firms/jobs) for a selected year (past, present, or forecast) and produces estimates of roadway VMT and speed, transit, ridership, and other characteristics of transportation system use.

1.49 Statewide Transportation Plan - the long-range, comprehensive, Multimodal statewide transportation plan covering a period of no less than 20 years from time of adoption, developed through the statewide transportation planning process descr bed in these Rules and 23 U.S.C. § 135, and adopted by the Commission pursuant to § 43-1-1103, C.R.S.

1.50 Surface Transportation Block Grant (STBG) - a flex ble federal funding source established under 23 U.S.C. § 133 for state and local transportation needs. Funds are expended in the areas of the State based on population. References related to this program include any successor programs established by the federal government.

1.51 System Continuity - includes, but is not limited to, appropriate intermodal connections, integration with state modal plans, and coordination with neighboring RTPs, and, to the extent practicable, other neighboring states' transportation plans.

1.52 Traditionally Underserved - refers to groups such as seniors, persons with disabilities, low-income households, minorities, and student populations, which may face difficulties accessing transportation systems, employment, services, and other amenities.

1.53 Transit and Rail Advisory Committee (TRAC) - an advisory committee created specifically to advise the Executive Director, the Commission, and the Division of Transit and Rail on transit and rail-related activities.

1.54 Transportation Commonality - the basis on which TPRs are established including, but not limited to: Transportation Commission Districts, the Department's Engineering Regions, Travelsheds, Watersheds, geographic unity, existing Intergovernmental Agreements, and socioeconomic unity.

1.55 Transportation Improvement Program (TIP) - a staged, Fiscally Constrained, multi-year, Multimodal program of transportation projects developed and adopted by MPOs, and approved by the Governor, which is consistent with an MPO's RTP and which is developed pursuant to 23 U.S.C. § 134.

1.56 Transportation Mode - a particular form of travel including, but not limited to, bus, motor vehicle, rail, transit, aircraft, bicycle, pedestrian travel, or personal mobility devices.

1.57 Transportation Planning and Programming Process - all collaborative planning-related activities including the development of regional and Statewide Transportation Plans, the Department's Project Priority Programming Process, and development of the TIPs and STIP.

1.58 Transportation Planning Region (TPR) - a geographically designated area of the state, defined by section 2.00 of these Rules in consideration of the criteria for Transportation Commonality, and for which a regional transportation plan is developed pursuant to the provisions of § 43-1-1102 and 1103, C.R.S. and 23 U.S.C. § 134. The term TPR is inclusive of these types: non-MPO TPRs, MPO TPRs, and TPRs with both MPO and non-MPO areas.

1.59 Transportation Systems Planning - provides the basis for identifying current and future deficiencies on the state highway system and outlines strategies to address those deficiencies and make improvements to meet Department goals.

1.60 Travelshed - the region or area generally served by a major transportation facility, system, or Corridor.

1.61 Tribal Transportation Improvement Program (TTIP) - a multi-year Fiscally Constrained list of proposed transportation projects developed by a tribe from the tribal priority list or tribal long-range transportation plan, and which is developed pursuant to 25 C.F.R. Part 170. The TTIP is incorporated into the STIP without modification.

1.62 Urbanized Area - an area with a population of 50,000 or more designated by the Bureau of the Census.

1.63 Vehicle Miles Traveled (VMT) - the traffic volume of a roadway segment or system of roadway segments multiplied by the length of the roadway segment or system.

1.64 Watershed - a land area that drains to a common waterway, such as a stream, lake, estuary, wetland, or ultimately the ocean.

1.65 10-Year Plan - a vision for Colorado's transportation system that includes a specific list of projects categorized across priority areas as identified in the Statewide Transportation Plan.

2.00 Transportation Planning Regions (TPR).

2.01 Transportation Planning Region Boundaries. ~~Transportation Planning Region~~TPRs are geographically designated areas of the state with similar transportation needs that are determined by considering transportation commonalities. Boundaries are hereby established as follows:

2.01.1 The P kes Peak Area ~~Transportation Planning Region~~TPR comprises the Pikes Peak Area Council of Governments' metropolitan area within El Paso and Teller counties.

2.01.2 The Greater Denver ~~Transportation Planning Region~~TPR, which includes the Denver Regional Council of Governments’ planning area, comprises the counties of Adams, Arapahoe, Boulder, Broomfield, Clear Creek, Denver, Douglas, Gilpin, Jefferson, and parts of Weld.

2.01.3 The North Front Range ~~Transportation Planning Region~~TPR comprises the North Front Range Transportation and Air Quality Planning Council's metropolitan area within Larimer and Weld counties.

2.01.4 The Pueblo Area ~~Transportation Planning Region~~TPR comprises Pueblo County, including the Pueblo Area Council of Governments' metropolitan area.

2.01.5 The Grand Valley ~~Transportation Planning Region~~TPR comprises Mesa County, including the Grand Valley Metropolitan Planning Organization's metropolitan area.

2.01.6 The Eastern ~~Transportation Planning Region~~TPR comprises Cheyenne, E bert, Kit Carson, Lincoln, Logan, Phillips, Sedgwick, Washington, and Yuma counties.

2.01.7 The Southeast ~~Transportation Planning Region~~TPR comprises Baca, Bent, Crowley, Kiowa, Otero, and Prowers counties.

2.01.8 The San Luis Valley ~~Transportation Planning Region~~TPR comprises Alamosa, Chaffee, Conejos, Costilla, Mineral, Rio Grande, and Saguache counties.

2.01.9 The Gunnison Valley ~~Transportation Planning Region~~TPR comprises Delta, Gunnison, Hinsdale, Montrose, Ouray, and San Miguel counties.

2.01.10 The Southwest ~~Transportation Planning Region~~TPR comprises Archuleta, Dolores, La Plata, Montezuma, and San Juan counties, including the Ute Mountain Ute and Southern Ute Indian Reservations.

2.01.11 The Intermountain ~~Transportation Planning Region~~TPR comprises Eagle, Garfield, Lake, Pitkin, and Summit counties.

2.01.12 The Northwest ~~Transportation Planning Region~~TPR comprises Grand, Jackson, Moffat, Rio Blanco, and Routt counties.

2.01.13 The Upper Front Range ~~Transportation Planning Region~~TPR comprises Morgan County, and the parts of Larimer and Weld counties, that are outside both the North Front Range and the Greater Denver (metropolitan) TPRs.

2.01.14 The Central Front Range ~~Transportation Planning Region~~TPR comprises Custer, El Paso, Fremont, Park, and Teller counties, excluding the Pikes Peak Area Council of Governments' metropolitan area.

2.01.15 The South Central ~~Transportation Planning Region~~TPR comprises Huerfano, and Las Animas Counties.

2.02 Boundary Revision Process.

2.02.1 TPR boundaries, excluding any MPO-related boundaries, will be reviewed by the Commission at the beginning of each regional and statewide transportation planning process. The Department will notify counties, municipalities, MPOs, Indian tribal governments, and RPCs for the TPRs of the boundary review revision requests. MPO boundary review shall be conducted pursuant to 23 U.S.C. § 134 and 23 C.F.R. Part 450 Subpart B and any changes shall be provided to the Department to update the Rules. All boundary revision requests shall be sent to the Division Director, and shall include:

2.02.1.1 A geographical description of the proposed boundary change.

2.02.1.2 A statement of justification for the change considering transportation commonalities.

2.02.1.3 A copy of the resolution stating the concurrence of the affected ~~Regional Planning Commission~~RPC.

2.02.1.4 The name, title, mailing address, telephone number, fax number and electronic mail address (if available) of the contact person for the requesting party or parties.

2.02.2 The Department will assess and STAC shall review and comment (as set forth in these Rules) on all ~~non~~Non-~~metropolitan~~ Metropolitan ~~area~~ Area TPR boundary revision requests based on transportation commonalities and make a recommendation to the Commission concerning such requests. The Department will notify the Commission of MPO boundary changes. The Commission may initiate a rule-making proceeding under the ~~State~~ Colorado Administrative Procedure Act, § 24-4-103, C.R.S. to consider a boundary revision request. Requests received for a MPO or non-metropolitan TPR boundary revision outside of the regularly scheduled boundary review cycle must include the requirements identified above.

2.02.3 In the event that the Commission approves a change to the boundary of a TPR that has a ~~Regional Planning Commission~~RPC, the RPC in each affected TPR shall notify the Department of any changes to the ~~intergovernmental~~ Intergovernmental ~~agreement~~ Agreement governing the RPC as specified in these Rules.

2.03 Transportation Planning Coordination with MPOs.

2.03.1 The Department and the MPOs shall coordinate activities related to the development of ~~Regional Transportation Plan~~RTPs, the Statewide Transportation Plan, TIPs, and the STIP in conformance with 23 U.S.C. § 134 and 135 and § 43-1-1101 and § 43-1-1103, C.R.S. The Department shall work with the MPOs to resolve issues arising during the planning process.

2.04 Transportation Planning Coordination with Non-MPO RPCs.

2.04.1 The Department and RPCs shall work together in developing ~~Regional Transportation Plan~~RTPs and in planning future transportation activities. The Department shall consult with all RPCs on development of the Statewide Transportation Plan; incorporation of RTPs into the Statewide Transportation Plan; and the inclusion of projects into the STIP that are consistent with the RTPs. In addition, the Department shall work with the RPCs to resolve issues arising during the planning process.

2.05 Transportation Planning Coordination among RPCs.

2.05.1 If transportation improvements cross TPR boundaries or significantly impact another TPR, the RPC shall consult with all the affected RPCs involved when developing the ~~regional transportation plan~~RTP. In general, RPC planning officials shall work with all ~~planning~~ Planning ~~partners~~ Partners affected by transportation activities when planning future transportation activities.

2.06 Transportation Planning Coordination with the Southern Ute and the Ute Mountain Ute Tribal Governments.

2.06.1 Regional transportation planning within the Southwest TPR shall be coordinated with the transportation planning activities of the Southern Ute and the Ute Mountain Ute tribal governments. The long-range transportation plans for the tribal areas shall be integrated in the Statewide Transportation Plan and the ~~Regional Transportation Plan~~RTP for this TPR. The TTIP is incorporated into the STIP without modification.

3.00 Statewide Transportation Advisory Committee (STAC).

3.01 Duties of the ~~Statewide Transportation Advisory Committee (~~STAC~~)~~. Pursuant to § 43-1-1104 C.R.S. the duties of the STAC shall be to meet as necessary and provide advice to both the Department and the Commission on the needs of the transportation system in Colorado including, but not limited to: budgets, ~~transportation improvement programs~~TIPs of the ~~metropolitan planning organizations~~MPOs, the ~~Statewide Transportation Improvement Program~~STIP, transportation plans, and state transportation policies.

The STAC shall review and provide to both the Department and the Commission comments on:

3.01.1 All ~~Regional Transportation Plan~~RTPs, amendments, and updates as described in these Rules.

3.01.2 Transportation related communication and/or conflicts which arise between RPCs or between the Department and a RPC.

3.01.3 The integration and consolidation of RTPs into the Statewide Transportation Plan.

3.01.4 Colorado's ~~mobility~~ Mobility requirements to move people, goods, services, and information by furnishing regional perspectives on transportation problems requiring interregional and/or statewide solutions.

3.01.5 Improvements to modal choice, linkages between and among modes, and transportation system balance and ~~system~~ System ~~continuity~~Continuity.

3.01.6 Proposed TPR boundary revisions.

3.02 Notification of Membership

3.02.1 Each RPC and tribal government shall select its representative to the STAC pursuant to § 43-1-1104(1), C.R.S. The Ute Mountain Ute Tr bal Council and the Southern Ute Indian Tr bal Council each appoint one representative to the STAC. Each TPR and tribal government is also entitled to name an alternative representative who would serve as a proxy in the event their designated representative is unable to attend a STAC meeting and would be included by the Department in distributions of all STAC correspondence and notifications. The Division Director shall be notified in writing of the name, title, mailing address, telephone number, fax number and electronic mail address (if available) of the STAC representative and alternative representative from each TPR and tribal government within thirty (30) days of selection.

3.03 Administration of ~~Statewide Transportation Advisory Committee~~STAC

3.03.1 STAC recommendations on Regional and Statewide Transportation Plans, amendments, and updates shall be documented in the STAC meeting minutes, and will be considered by the Department and Commission throughout the statewide transportation planning process.

3.03.2 The STAC shall establish procedures to govern its affairs in the performance of its advisory capacity, including, but not limited to, the appointment of a chairperson and the length of the chairperson's term, meeting times, and locations.

3.03.3 The Division Director will provide support to the STAC, including, but not limited to:

3.03.3.1 Notification of STAC members and alternates of meeting dates.

3.03.3.2 Preparation and distr bution of STAC meeting agendas, supporting materials, and minutes.

3.03.3.3 Allocation of Department staff support for STAC-related activities.

4.00 Development of Regional and Statewide Transportation Plans.

4.01 ~~Regional Planning Commission~~RPCs, MPOs, and the Department shall comply with all applicable provisions of 23 U.S.C. § 134 and § 135, 23 C.F.R. Part 450, and § 43-1-1103, C.R.S. and all applicable provisions of Commission policies and guidance documents in development of regional and statewide transportation plans, respectively.

4.02 Public Participation

4.02.1 The Department, in coordination with the RPCs of the rural TPRs, shall provide early and continuous opportunity for public participation in the transportation planning process. The process shall be proactive and provide timely information, adequate public notice, reasonable public access, and opportunities for public review and comment at key decision points in the process. The objectives of public participation in the transportation planning process include: providing a mechanism for public perspectives, needs, and ideas to be considered in the planning process; developing the public's understanding of the problems and opportunities facing the transportation system; demonstrating explicit consideration and response to public input through a variety of tools and techniques; and developing consensus on plans. The Department shall develop a documented public participation process pursuant to 23 C.F.R. Part 450.

4.02.2 Statewide Plans and Programs. Pursuant to 23 C.F.R. Part 450 Subpart B, the Department is respons ble, in cooperation with the RPCs and MPOs, for carrying out public participation for developing, amending, and updating the ~~statewide~~ Statewide ~~transportation~~ Transportation ~~plan~~Plan, the ~~Statewide Transportation Improvement Program (~~STIP~~)~~, and other statewide transportation planning activities.

4.02.3 MPO Plans and Programs. Pursuant to 23 C.F.R. Part 450 Subpart C, the MPOs are responsible for carrying out public participation for the development of ~~regional transportation plan~~RTPs, ~~transportation improvement programs~~TIPs and other related regional transportation planning activities for their respective ~~metropolitan~~ Metropolitan ~~planning~~ Planning ~~areas~~Areas. Public participation activities carried out in a metropolitan area in response to metropolitan planning requirements shall by agreement of the Department and the MPO, satisfy the requirements of this subsection.

4.02.4 Non-MPO TPR Plans and Programs. ~~Regional Planning Commission~~RPCs for non-MPO TPRs are respons ble for public participation related to regional planning activities in that TPR, in cooperation with the Department. Specific areas of cooperation shall be determined by agreement between the ~~Regional Planning Commission~~RPC and the Department.

4.02.5 Public Participation Activities. Public participation activities at both the rural TPR and statewide level shall include, at a minimum:

4.02.5.1 Establishing and maintaining for the geographic area of responsibility a list of all known parties interested in transportation planning including, but not limited to: elected officials; municipal and county planning staffs; affected public agencies; local, state, and federal agencies elig ble for federal and state transportation funds; local representatives of public transportation agency employees and users; freight shippers and providers of freight transportation services; public and private transportation providers; representatives of users of transit, bicycling and pedestrian, aviation, and train facilities; private industry; environmental and other interest groups; Indian tribal governments and the U.S. Secretary of the Interior when tribal lands are involved; and representatives of persons or groups that may be underserved by existing transportation systems, such as minority, low-income, seniors, persons with disabilities, and those with ~~limited~~ Limited English ~~proficiency~~Proficiency; and members of the general public expressing such interest in the transportation planning process.

4.02.5.2 Providing reasonable notice and opportunity to comment through mailing lists and other various communication methods on upcoming transportation planning-related activities and meetings.

4.02.5.3 Utilizing reasonably available internet or traditional media opportunities, including minority and diverse media, to provide timely notices of planning-related activities and meetings to members of the public, including ~~LEP~~ Limited English Proficiency individuals, and others who may require reasonable accommodations. Methods that will be used to the maximum extent practicable for public participation could include, but not be limited to, use of the internet; social media, news media, such as newspapers, radio, or television, mailings and notices, including electronic mail and online newsletters.

4.02.5.4 Seeking out those persons or groups ~~traditionally~~ Traditionally ~~underserved~~ Underserved by existing transportation systems including, but not limited to, seniors, persons with disabilities, minority groups, low-income, and those with ~~limited~~ Limited English ~~proficiency~~Proficiency, for the purposes of exchanging information, increasing their involvement, and considering their transportation needs in the transportation planning process. Pursuant to § 43-1-601, C.R.S., the Department shall prepare a statewide survey identifying the transportation needs of seniors and of persons with disabilities.

4.02.5.5 Consulting, as appropriate, with ~~Regional Planning Commission~~RPCs, and federal, state, local, and tribal agencies respons ble for land use management, natural resources, environmental protection, conservation and historic preservation concerning the development of long-range transportation plans.

4.02.5.6 Providing reasonable public access to, and appropriate opportunities for public review and comment on criteria, standards, and other planning-related information. Reasonable public access includes, but is not limited to, ~~LEP~~ Limited English Proficiency services and access to ADA-compliant facilities, as well as to the internet.

4.02.5.7 Where feasible, scheduling the development of regional and statewide plans so that the release of the draft plans may be coordinated to provide for the opportunity for joint public outreach.

4.02.5.8 Documentation of Responses to Significant Issues. ~~Regional Planning Commissions~~RPCs and the Department shall respond in writing to all significant issues raised during the review and comment period on transportation plans, and make these responses available to the public.

4.02.5.9 Review of the Public Involvement Process. All interested parties and the Department shall periodically review the effectiveness of the Department's public involvement process to ensure that the process provides full and open access to all members of the public. When necessary, the process will be revised and allow time for public review and comment per 23 C.F.R. Part 450.

4.03 Transportation Systems Planning. ~~Regional Planning Commission~~RPCs, and the Department, shall use an integrated ~~multimodal~~ Multimodal ~~transportation~~ Transportation ~~systems~~ Systems ~~planning~~ Planning approach in developing and updating the long-range ~~Regional Transportation Plans~~RTPs and the long-range Statewide Transportation Plan for a minimum 20-year forecasting period. ~~Regional Planning Commission~~RPCs shall have flexibility in the methods selected for ~~transportation~~ Transportation ~~systems~~ Systems ~~planning~~ Planning based on the complexity of transportation problems and available resources within the TPR. The Department will provide guidance and assistance to the ~~Regional Planning Commission~~RPCs regarding the selection of appropriate methods.

4.03.1 Transportation ~~systems~~ Systems ~~planning~~ Planning by ~~Regional Planning Commission~~RPCs and the Department shall consider the results of any related studies that have been completed. ~~Regional Planning Commission~~RPCs and the Department may also identify any ~~corridor~~Corridor(s) or sub-area(s) where an environmental study or assessment may need to be performed in the future.

4.03.2 Transportation ~~systems~~ Systems ~~planning~~ Planning by ~~Regional Planning Commission~~RPCs shall consider ~~corridor vision~~ needs and desired state of the transportation system including existing and future land use and infrastructure, major activity centers such as industrial, commercial and recreation areas, economic development, environmental protection, and modal choices.

4.03.3 Transportation ~~systems~~ Systems ~~planning~~ Planning by ~~Regional Planning Commission~~RPCs shall include operational and management strategies to improve the performance of existing transportation facilities to relieve vehicular congestion and maximize the safety and ~~mobility~~ Mobility of people goods, and services.

4.03.4 Transportation ~~systems~~ Systems ~~planning~~ Planning by the Department should include capital, operations, maintenance and management strategies, investments, procedures, and other measures to ensure the preservation and most efficient and effective use of the ~~state~~ State ~~transportation~~ Transportation ~~system~~System.

4.03.5 Transportation ~~systems~~ Systems P~~p~~lanning by the Department shall consider and integrate all modes into the Statewide Transportation Plan and include coordination with Department modal plans and modal committees, such as the ~~Transit and Rail Advisory Committee (~~TRAC~~)~~.

4.03.6 Transportation Systems Planning by the Department shall provide for the establishment and use of a performance-based approach to transportation decision-making to support the national goals descr bed in 23 U.S.C. § 150 (FAST Act, P.L. 114-94). Performance targets that the Department establishes to address the performance measures described in 23 U.S.C. § 150, where applicable, are to be used to track progress towards attainment of critical outcomes for the state. The state shall consider the performance measures and targets when developing policies, programs, and investment priorities reflected in the Statewide Transportation Plan and STIP.

4.04 Regional Transportation Plans (RTP). Long-range ~~regional transportation plans~~RTPs shall be developed, in accordance with federal (23 U.S.C. § 134 and § 135) and state (§ 43-1-1103 and § 43-1-1104, C.R.S.) law and implementing regulations. Department selection of performance targets that address the performance measures shall be coordinated with the relevant MPOs to ensure consistency, to the maximum extent practicable.

4.04.1 Content of ~~Regional Transportation Plan~~RTPs. Each RTP shall include, at a minimum, the following elements:

4.04.1.1 Transportation system facility and service requirements within the MPO TPR over a minimum 20-year planning period necessary to meet expected demand, and the anticipated capital, maintenance and operating cost for these facilities and services.

4.04.1.2 State and federal transportation system planning factors to be considered by ~~Regional Planning Commission~~RPCs and the Department during their respective ~~transportation~~ Transportation ~~systems~~ Systems ~~planning~~ Planning shall include, at a minimum, the factors descr bed in § 43-1-1103 (5), C.R.S., and in 23 U.S.C. § 134 and § 135.

4.04.1.3 Identification and discussion of potential environmental mitigation measures, ~~corridor~~ Corridor studies, or ~~corridor~~ Corridor ~~visions~~Visions, including a discussion of impacts to minority and low-income communities.

4.04.1.4 A discussion of potential environmental mitigation activities and potential areas to carry out these activities, including activities that may have the greatest potential to restore and maintain the environmental functions affected by the plan.

4.04.1.5 For rural RTPs, the integrated performance-based ~~multimodal~~ Multimodal transportation plan based on revenues reasonably expected to be available over the minimum 20-year planning period. For metropolitan RTPs, a ~~fiscally~~ Fiscally ~~constrained~~ Constrained financial plan.

4.04.1.6 Identification of reasonably expected financial resources developed cooperatively among the Department, MPOs, and rural TPRs for ~~long~~Long-~~range~~ Range ~~planning~~ Planning purposes, and results expected to be achieved based on regional priorities.

4.04.1.7 Documentation of the public notification and public participation process pursuant to these Rules.

4.04.1.8 A resolution of adoption by the responsible ~~Metropolitan Planning Organization~~MPO or the ~~Regional Planning Commission~~RPC.

4.04.2 Products and reviews

4.04.2.1 Draft Plan. ~~Transportation Planning Region~~TPRs shall provide a draft of the RTP to the Department through the Division ~~of Transportation Development~~.

4.04.2.2 Draft Plan Review. Upon receipt of the draft RTPs, the Department will initiate its review and schedule the STAC review (pursuant to these Rules). The Department will provide its comments and STAC comments to the ~~Transportation Planning Region~~TPR within a minimum of 30 days of receiving the draft RTP. ~~Regional transportation plan~~RTPs in metropolitan areas completed pursuant to the schedule identified in 23 C.F.R. § 450.322 shall be subject to the provisions of this section prior to being submitted to the Department for consideration as an amendment to the ~~statewide~~ Statewide ~~transportation~~ Transportation ~~plan~~Plan.

4.04.2.3 Final Plan. ~~Transportation Planning Region~~TPRs shall provide the final RTP to the Department through the Division ~~of Transportation Development~~.

4.04.2.4 Final Plan Review. Upon receipt of the final RTP, the Department will initiate its review and schedule the STAC review (pursuant to these

Rules) of the final RTPs to determine if the plans incorporate the elements required by the Rules. If the Department determines that a final RTP is not complete, including if the final RTP does not incorporate the elements required by these Rules, then the Department will not integrate that RTP into the statewide plan until the ~~Transportation Planning Region~~TPR has sufficiently revised that RTP, as determined by the Department with advice from the STAC. The Department will provide its comments and STAC comments to the ~~Transportation Planning Region~~TPR within a minimum of 30 days of receiving the final RTP. ~~Transportation Planning Region~~TPRs shall submit any RTP revisions based on comments from the Department and STAC review within 30 days of the Department's provision of such comments. ~~Regional transportation plans~~RTPs in metropolitan areas completed pursuant to the schedule identified in 23 C.F.R. § 450.322 shall be subject to the provisions of this section prior to being submitted to the Department for consideration as an amendment to the ~~statewide~~ Statewide ~~transportation~~ Transportation ~~plan~~Plan.

4.05 Maintenance and Nonattainment Areas. Each RTP, or RTP amendment, shall include a section that:

4.05.1 Identifies any area within the TPR that is designated as a ~~maintenance~~ Maintenance or ~~nonattainment~~ Nonattainment ~~area~~Area.

4.05.2 Addresses, in either a qualitative or quantitative manner, whether transportation related emissions associated with the pollutant of concern in the TPR are expected to increase over the ~~long~~Long-~~range~~ Range ~~planning~~ Planning period and, if so, what effect that increase might have in causing a ~~maintenance~~ Maintenance ~~area~~ Area for a~~n~~ NAAQS pollutant to become a ~~nonattainment~~ Nonattainment ~~area~~Area, or a ~~non-attainment~~Nonattatinment ~~area~~ Area to exceed its emission budget in the approved State Implementation Plan.

4.05.3 If transportation related emissions associated with the pollutant are expected to increase over the ~~long~~Long-~~range~~ Range ~~planning~~ Planning period, identifies which programs or measures are included in the RTP to decrease the l kelihood of that area becoming a ~~nonattainment~~ Nonattainment ~~area~~ Area for the pollutant of concern.

4.06 Statewide Transportation Plan. The ~~Regional Transportation Plans~~RTPs submitted by the ~~Regional Planning Commissions~~RPCs shall, along with direction provided through Commission policies and guidance, form the basis for developing and amending the Statewide Transportation Plan. The Statewide Transportation Plan shall cover a minimum 20-year planning period at the time of adoption and shall guide the development and implementation of a performance-based ~~multimodal~~ Multimodal transportation system for the State.

4.06.1 The Statewide Transportation Plan shall:

4.06.1.1 Integrate and consolidate the RTPs and the Department's systems planning, pursuant to these Rules, into a long-range 20-year ~~multimodal~~ Multimodal transportation plan that presents a clear, concise path for future transportation in Colorado.

4.06.1.2 Include the long-term transportation concerns of the Southern Ute Indian Tribe and the Ute Mountain Ute Tribe in the development of the Statewide Transportation Plan.

4.06.1.3 Coordinate with other state and federal agencies respons ble for land use management, natural resources, environmental protection, conservation, and historic preservation.

4.06.1.4 Include a discussion of potential environmental mitigation activities and potential areas to carry out these activities that may have the greatest potential to restore and maintain the environmental functions affected by the plan developed in consultation with federal, state, and tribal wildlife, land management and regulatory agencies.

4.06.1.5 Include a comparison of transportation plans to state and tribal conservation plans or maps and to inventories of natural or historical resources.

4.06.1.6 Provide for overall ~~multimodal~~ Multimodal transportation system management on a statewide basis.

4.06.1.7 The Statewide Transportation Plan shall be coordinated with metropolitan transportation plans pursuant to 23 C.F.R. Part 450, § 43-1-1103 and § 43-1-1105, C.R.S. Department selection of performance targets shall be coordinated with the MPOs to ensure consistency, to the maximum extent practicable.

4.06.1.8 Include an analysis of how the Statewide Transportation Plan is aligned with Colorado's climate goals and helps reduce, prevent, and mitigate GHG pollution throughout the State.

4.06.1.9 Includes the 10-Year Plan as an appendix.

4.06.2 Content of the Statewide Transportation Plan. At a minimum, the Statewide Transportation Plan shall include priorities as identified in the RTPs, as identified in these Rules and pursuant to federal planning laws and regulations. The Statewide Transportation Plan shall be submitted to the ~~Colorado Transportation~~ Commission for its consideration and approval.

4.06.3 Review and Adoption of the Statewide Transportation Plan.

4.06.3.1 The Department will submit a draft Statewide Transportation Plan to the Commission, the STAC, and all interested parties for review and comment. The review and comment period will be conducted for a minimum of 30 days. The Statewide Transportation Plan and appendices~~The publication~~ will be available in physical form upon request~~at public facilities, such as at the Department headquarters and region offices, state depository libraries, county offices, TPR offices, Colorado Division offices of the Federal Highway Administration and Federal Transit Administration~~, and made available on the internet.

4.06.3.2 The Department will submit the final Statewide Transportation Plan to the ~~Colorado Transportation~~ Commission for adoption.

5.00 Updates to Regional and Statewide Transportation Plans.

5.01 Plan Update Process. The updates of ~~Regional Transportation Plan~~RTPs and the Statewide Transportation Plan shall be completed on a periodic basis through the same process governing development of these plans pursuant to these Rules. The update cycle shall comply with federal and state law and be determined in consultation with the ~~Transportation~~ Commission, the Department, the STAC and the MPOs so that the respective update cycles will coincide.

5.02 Notice by Department of Plan Update Cycle. The Department will notify ~~Regional Planning Commission~~RPCs and the MPOs of the initiation of each plan update cycle, and the schedule for completion.

6.00 Amendments to the Regional and Statewide Transportation Plans.

6.01 Amendment Process

6.01.1 The process to consider amendments to ~~Regional Transportation Plan~~RTPs shall be carried out by rural RPCs and the MPOs. The amendment review process for ~~Regional Transportation Plan~~RTPs shall include an evaluation, review, and approval by the respective RPC or MPO.

6.01.2 The process to consider amendments to the Statewide Transportation Plan shall be carried out by the Department, either in considering a proposed amendment to the Statewide Transportation Plan from a requesting RPC or MPO or on its own initiative.

6.01.3 The process to consider amendments to the 10-Year Plan shall be carried out by CDOT in coordination with the rural RPCs and the MPOs.

7.00 Transportation Improvement Programs (TIPs) and Statewide Transportation Improvement Program (STIP).

7.01 TIP development shall occur in accordance with 23 C.F.R. Part 450, Subpart C. The Department will develop the STIP in accordance with 23 C.F.R. Part 450, Subpart B.

7.02 The Department will work with its ~~planning~~ Planning ~~partners~~ Partners to coordinate a schedule for development and adoption of TIPs and the STIP.

7.03 A TIP for an MPO that is in a ~~non-attainment~~Nonattainment or Maintenance Area must first receive a conformity determination by FHWA and FTA before inclusion in the STIP pursuant to 23 C.F.R. Part 450.

7.04 MPO TIPs and Colorado's STIP must be ~~fiscally~~ Fiscally ~~constrained~~Constrained. Under 23 C.F.R. Part 450, each project or project phase included in an MPO TIP shall be consistent with an approved metropolitan RTP, and each project or project phase included in the STIP shall be consistent with the long-range ~~statewide~~ Statewide ~~transportation~~ Transportation ~~plan~~Plan. MPO TIPs shall be included in the STIP either by reference or without change upon approval by the MPOs and the Governor.

8.00 GHG Emission Requirements

8.01 Establishment of Regional GHG Transportation Planning Reduction Levels

8.01.1 The GHG emission reduction levels within Table 1 apply to MPOs and the Non-MPO area within the state of Colorado as of the effective date of these Rules. Baseline values are specific to each MPO and CDOT area and represent estimates of GHG emissions resulting from the existing transportation network and implementation of the most recently adopted RTP for all MPOs and the 10-Year Plan in non-MPO areas as of the effective date of these Rules. Table 2 reflects the difference in Baseline levels from year to year assuming a rapid growth in electric vehicles across the State (940,000 light duty electric vehicles in 2030, 3.38 million in 2040 and a total of 97% of all light duty vehicles in 2050).

Values in both tables include estimates of population and employment growth as provided by the state demographer.

8.01.2 Regional GHG Transportation Planning Reduction Levels

Table 1: GHG Transportation Planning Reduction Levels in MMT of CO2e

Regional Areas	2025 Baseline Projections (MMT)	2025 Reduction Level (MMT)	2030 Baseline Projections (MMT)	2030 Reduction Level (MMT)	2040 Baseline Projections (MMT)	2040 Reduction Level (MMT)	2050 Baseline Projections (MMT)	2050 Reduc Leve (MMT
DRCOG	14.9	0.27	11.8	0.82	10.9	0.63	12.8	0.37
NFRMPO	2.3	0.04	1.8	0.12	1.9	0.11	2.2	0.07
PPACG	2.7	N/A	2.2	0.15	2.0	0.12	2.3	0.07
GVMPO	0.38	N/A	0.30	0.02	0.30	0.02	0.36	0.01
PACOG	0.50	N/A	0.40	0.03	0.30	0.02	0.4	0.01
CDOT/Non-MPO	6.7	0.12	5.3	0.37	5.2	0.30	6.1	0.18
TOTAL	27.4	0.5	21.8	1.5	20.6	1.2	24.2	0.7

Commented [redacted]: For some of the compliance years, the TOTAL line at the bottom does not match the sum of the regional areas. The same number of significant digits should be used for all baselines and reduction levels.

8.01.3 Baseline Emissions Due to Projected Number of Light Duty Electric Vehicles

Table 2: Baseline Emissions Due to Projected Number of Light Duty Electric Vehicles

	2025 Projections (MMT)	2030 Projections (MMT)	2040 Projections (MMT)	2050 Projections (MMT)
TOTAL	27.0	20.0	14.0	8.9

Commented [redacted]: There is no regulatory purpose for this table. If a regulatory purpose is not provided, it should be removed from the rule. Potential regulatory purpose: Adding in the EV assump ion for each year and stating if the EV assumption changes, then the reduction levels in the rule should be revisited to determine if they are still feasible.

8.02 Process for Determining Compliance

8.02.1 Analysis Requirements When Adopting or Amending an Applicable Planning Document - Each MPO and CDOT shall conduct a GHG emissions analysis using MPO Models or the Statewide Travel Model, and the Approved Air Quality Model, to estimate total CO2e emissions. Such analysis shall include the existing transportation network and implementation of Regionally Significant Projects. The emissions analysis must estimate total CO2e emissions in million metric tons (MMT) for each compliance year in Table 1, as long as the compliance year is not in the past ~~and compare these emissions to the Baseline specified in Table 1~~. This provision shall not apply to MPO TIP amendments.

Commented [redacted]: The comparison to Table 1 should occur using the GHG Emissions Analysis AND the GHG mitigation measures, not just the GHG Emissions analysis.

8.02.2 Agreements on Modeling Assumptions and Execution of Modeling Requirements. Prior to the adoption of the next RTP for any MPO, CDOT, CDPHE, and each MPO shall enter into an Intergovernmental Agreement which outlines CDOT, CDPHE, and MPO

Commented [redacted]: CDOT should also have an IGA required prior to the next 10-year plan responsibilities for development and execution of MPO Models or the Statewide Travel Model, and Approved Air Quality Model.

8.02.3 The State Interagency Consultation Team shall meet as needed to address any questions on the classification of projects as Regionally Significant, modeling assumptions, and projects that reduce GHG emissions.

8.02.3 By April 1, 2022, CDOT shall establish an ongoing administrative process, through a public process, for selecting, measuring, confirming, and verifying GHG Mitigation Measures, so that CDOT and MPOs can incorporate one or more into each of their plans ~~in order to reach~~to assist in meeting the Regional GHG Planning Reduction Levels in Table 1. Such a process shall include, but not be limited to, determining the relative impacts of GHG Mitigation Measures, measuring and prioritizing localized impacts to communities and Disproportionately Impacted Communities in particular. The mitigation credit awarded to a specific solution shall consider both aggregate and community impact.

8.02.4 Timing for Determining Compliance

8.02.4.1 By October 1, 2022, CDOT shall update their 10-Year Plan and DRCOG and NFRMPO shall update their RTPs pursuant to § 43-4-1103, C.R.S. and meet the reduction levels in Table 1 or the requirements pursuant to § 43-4-1103, C.R.S and restrictions on funds.

8.02.4.2 After October 1, 2022

8.02.4.2.1 ~~CDOT must f~~For each Applicable Planning Document adopted or amended after October 1, 2022, CDOT must meet either the reduction levels within Table 1 for Non-MPO areas or the requirements as set forth in Rule ~~8.05~~8.02.5.1.1.

8.02.4.2.2 ~~MPOs must meet either the corresponding reduction levels within Table 1 f~~For each Applicable Planning Document adopted or amended after October 1, 2022, MPOs must either meet the corresponding reduction levels within Table 1~~,~~ or the relevant MPO and CDOT each must meet the requirements as set forth in Rule ~~8.05~~8.02.5.1.1 or Rule 8.02.5.1.2, as applicable. This provision shall not apply to MPO TIP Amendments.

8.02.5 Demonstrating Compliance. At least thirty (30) days prior to adoption or amendment of any Applicable Planning Document except amendments to MPO TIPs, CDOT for Non-MPO areas and the MPOs for their areas shall provide to the Commission a GHG Transportation Report containing the following information:

8.02.5.1 GHG emissions analysis and, if applicable, a GHG Mitigation Plan demonstrating that the Applicable Planning Document is in compliance with the GHG Reduction Levels in MMT of CO2e for each compliance year in Table 1 or that the requirements in Rules 8.02.5.1.1 or 8.02.5.1.2., as applicable, have been met.

8.02.5.1.1 In non-MPO areas or for MPOs that are not in receipt of -federal suballocations pursuant to the CMAQ and~~/or~~ STBG programs, the Department utilizes 10-Year Plan funds anticipated to be expended on Regionally Significant Projects in those areas on projects that reduce GHG emissions.

Commented [redacted]: Unclear what these terms mean. The rule already provides a process for reporting he status of the measures – would this process impact the format/approval process of the mitigation report and/or status report?

Commented [redacted]: Agencies may choose to report these measures even hough they don't enable reaching the reduction levels (i.e. hey still fall short). Not sure if the suggested language goes far enough to explain that concept.

Commented [redacted]: As proposed, the rule implies the applicable plans must comply immediately after October 1, 2022.

Commented [redacted]: Only having this language in §8 02.1 means we'd still have to comply and submit a report for TIP Amendments, it just wouldn't have the emissions analysis. Is that the intent?

Commented [redacted]: The rule needs to clearly identify that compliance is not based solely on the GHG emissions analysis (or the GHG emissions analysis needs to clearly identify that the mi iga ion measures are included in the analysis)

Commented [redacted]: If "or" is retained here, it is unclear which provision applies to MPOs that receive only one of the federal suballocations

8.02.5.1.2 In MPO areas that are in receipt of federal suballocations pursuant to the CMAQ and/or STBG programs, the MPO ~~utilizes~~ shall award those funds anticipated to be expended on Regionally Significant Projects ~~on~~to projects or approved GHG Mitigation Measures that reduce GHG emissions, and CDOT ~~utilizes~~shall award 10-Year Plan funds anticipated to be expended on Regionally Significant Projects in that MPO area, on projects that reduce GHG emissions.

8.02.5.2 Identification and documentation of the MPO Model or the Statewide Travel Model and the Approved Air Quality Model used to determine GHG emissions in MMT of CO2e.

8.02.5.3 At the discretion of the MPO or CDOT, submission of ~~A~~a Mitigation Action Plan that identifies GHG Mitigation Measures, if any, ~~needed to meet~~that will count toward the reduction levels within Table 1. The Mitigation Action Plan shall include:

8.02.5.3.1 The anticipated start and completion date of each measure.

8.02.5.3.2 An estimate, where feasible, of the annual GHG emissions reductions in MMT of CO2e achieved per year by any GHG Mitigation Measures.

8.02.5.3.3 Quantification of specific co-benefits, where feasible, including reduction of co-pollutants (PM2.5, NOx, etc.) as well as travel impacts (changes to VMT, pedestrian/bike use, transit ridership numbers, etc. as applicable).

8.02.5.3.4 Description of benefits to Disproportionately Impacted Communities.

8.02.6 Reporting on Compliance- Following the submission of a GHG Transportation Report containing a Mitigation Action Plan, ~~Annually by April 1,~~ CDOT and MPOs must provide a status report to the Commission annually by April 1 on an approved form with the following items for each GHG Mitigation Measure identified in their most recent GHG Transportation Report:

8.02.6.1 The implementation timeline;

8.02.6.2 The current status;

8.02.6.3 For measures that are in progress or completed, quantification of the benefit or impact of such measures; and

8.02.6.4 For measures that are delayed, cancelled, or substituted, an explanation of why that decision was made.

8.03 GHG Mitigation Measures. When assessing compliance with the GHG Reduction Levels, CDOT and MPOs shall have the opportunity to utilize approved GHG Mitigation Measures as set forth in Rules 8.02.3 and 8.02.5.3 to offset emissions and demonstrate progress toward compliance. Illustrative examples of GHG Mitigation Measures include, but are not limited to:

Commented [redacted]: Unclear when this takes effect. Projects currently in progress should not have their funding removed, as that would be highly disruptive. The least disruptive approach is to apply he requirement to future awards.

Commented [redacted]: Rule should allow an agency to not submit a Mitigation Ac ion Plan. If the GHG analysis demonstrates compliance, no mitigation measures would be needed.

Commented [redacted]: Again, measures would likely be identified even if they don't allow he agency to meet the reduction levels.

8.0.3.1 The addition of transit resources in a manner that can displace VMT.

8.03.2 Improving pedestrian and bike access, particularly in areas that allow individuals to reduce multiple daily trips.

8.03.3 Encouraging local adoption of more effective forms of vertical development and zoning plans that integrate mixed use in a way that links and rewards transportation project investments with the city making these changes.

Commented [redacted]: This language is unclear.

8.03.4 Improving first-and-final mile access to transit stops and stations that make transit resources safer and more usable by consumers.

8.03.5 Improving the safety and efficiency of crosswa ks for pedestrians, bicyclists, and other non-motorized vehicles, including to advance compliance with the ADA.

8.03.6 Adopting or encouraging the adoption of locally driven changes to parking policies and physical configuration that encourage more walking and transit trips.

8.03.7 Incorporating medium/heavy duty vehicle electric charging and hydrogen refueling infrastructure -- as well as upgrading commensurate grid improvements -- into the design of key freight routes to accelerate truck electrification.

8.03.8 Establishing policies for clean construction that result in scalable improvements as a result of factors like lower emission materials, recycling of materials, and lower truck emissions during construction.

Commented [redacted]: This language is unclear.

8.03.9 ~~Adoption of~~Implementing or encouraging the adoption of transportation demand management practices that reduce VMT.

8.03.10 Implementing or encouraging the implementation of operations improvements such as ramp metering, signal timing, intersection improvements, access control plans, anti-idling programs, and incident management that result in GHG reductions.

8.04 Air Pollution Control Division (APCD) Confirmation and Verification

8.04.1 At least sixty (60)~~forty-five (45)~~ days prior to adoption of any Applicable Planning Document, CDOT for Non-MPO areas and the MPOs for their areas shall provide to APCD for review and verification of the technical data contained in the draft GHG Transportation Report required per Rule 8.02.5. If APCD has not provided written verification within thirty (30) days, the document shall be considered acceptable. The APCD shall submit any written verification to the agency adopting the Applicable Planning Document and to the Commission.

8.04.2 At least forty-five (45)~~thirty (30)~~ days prior to adoption or amendment of policies per Rule 8.02.3, CDOT shall provide APCD the opportunity to review and comment. If APCD has not provided written comment within thirty (30)~~forty-five (45)~~ days, the document shall be considered acceptable.

8.05 Enforcement. The Commission shall review all GHG Transportation Reports to determine whether the applicable reduction targets in Table 1 have been met and the sufficiency of any GHG Mitigation Measures needed for compliance.

8.05.1 If the Commission determines the requirements of Rule 8.02.5 have been met, the Commission shall, by resolution, accept the GHG Transportation Report.

8.05.2 If the Commission determines, by resolution, the requirements of Rule 8.02.5 have not been met, the Commission shall restrict the use of funds pursuant to Rules 8.02.5.1.1 or 8.02.5.1.2, as applicable, to projects and approved GHG Mitigation Measures that reduce GHG. Prior to the enforcement of such restriction, an MPO, CDOT or a TPR in a non-MPO area, may~~, within thirty (30) days of Commission action,~~ issue one or both of the following opportunities to seek a waiver or to ask for reconsideration accompanied by an opportunity to submit additional information:

8.05.2.1 Request a waiver from the Commission imposing restrictions on specific projects not expected to reduce GHG emissions. A waiver may be requested at any time, including concurrently with the submission of a GHG Transportation Report. The Commission may waive the restrictions on specific projects on the following basis:

8.05.2.1.1 The GHG Transportation Report reflected significant effort and priority placed, in total, on projects and GHG Mitigation Measures that reduce GHG emissions; and

8.05.2.1.2 In no case shall a waiver be granted if such waiver results in a substantial increase in GHG emissions when compared to the required reduction levels in this Rule.

8.05.2.2 Request reconsideration of a non-compliance determination by the Commission and provide written explanation of how the requirements of Rule 8.02.5 have been met. A request for reconsideration must be submitted within thirty (30) days of Commission action.

8.05.2.3 The Commission shall act, by resolution, on a waiver or reconsideration request within thirty (30) days of receipt of the waiver or reconsideration request or at the next regularly scheduled Commission Meeting, whichever is later. If no action is taken within this time period, the waiver or reconsideration request shall be deemed to be ~~denied~~approved.

8.05.3 Notwithstanding any other provision of this Rule, CDOT, DRCOG and NFRMPO must meet the requirements of § 43-4-1103, C.R.S.

8.06 Reporting. Beginning July 1, 2025, and every 5 years thereafter, the Executive Director on behalf of CDOT shall prepare and make public a comprehensive report on the statewide GHG reduction accomplishments.

9.00 Materials Incorporated by Reference

9.01 The Rules are intended to be consistent with and not be a replacement for the federal transportation planning requirements in Rule 9.01.1 and federal funding programs in Rules 9.01.2 and 9.01.3, which are incorporated into the Rules by this reference, and do not include any later amendments.

9.01.1 Fixing America’s Surface Transportation Act or the “FAST Act”), 23 U.S.C. §§ 134, 135 and 150, Pub. L. No. 114-94, signed into law on December 4, 2015, and its accompanying regulations, where applicable, contained in 23 C.F.R.Part 450, including Subparts A, B and C in effect as of November 29, 2017, and 25 C.F.R. § 170 in effect as of November 7, 2016.

9.01.2 Congestion Mitigation and Air Quality Improvement (CMAQ) Program, 23 U.S.C. § 149, in effect as of March 23, 2018.

9.01.3 Surface Transportation Block Grant (STBG) Program, 23 U.S.C. § 133, in effect as of December 4, 2015.

9.02 Also incorporated by reference are the following federal laws and regulations and do not include any later amendments:

9.02.1 Americans with Disabilities Act (ADA), 42 U.S.C. § 12101, *et. seq*., in effect as of January 1, 2009.

9.02.2 Clean Air Act (CCA), 42 U.S.C. §§ 7407-7410, and 7505a, in effect as of November 15, 1990.

9.02.2 Transportation Conformity Regulations, 40 C.F.R. § 93.101, in effect as November 24,1993.

9.03 Also incorporated by reference are the following documents, standards, and models and do not include any later amendments:

9.03.1 Greenhouse Gas Pollution Reduction Roadmap by the Colorado Energy Office and released on January 14, 2021.

9.03.2 MOVES3 Motor Vehicle Emissions Model for SIPs and Transportation Conformity released by the U.S. Environmental Protection Agency, in effect as of January 7, 2021.

9.04 All referenced laws and regulations are available for copying or public inspection during regular business hours from the Office of Policy and Government Relations, Colorado Department of Transportation, 2829 W. Howard Pl., Denver, Colorado 80204.

9.05 Copies of the referenced federal laws and regulations, planning documents, and models.

9.05.1 Copies of the referenced United States Code (U.S.C.) may be obtained from the following address:

Office of the Law Revision Counsel
U.S. House of Representatives
H2-308 Ford House Office Building
Washington, DC 20515
(202) 226-2411
https://uscode.house.gov/browse.xhtml

9.05.2 Copies of the referenced Code of Federal Regulations (C.F.R.) may be obtained from the following address:

U.S. Government Publishing Office
732 North Capitol State, N.W.
Washington, DC 20401
(866) 512-1800
https://www.govinfo.gov/

9.0.5.3 Copies of the Greenhouse Gas Pollution Reduction Roadmap (Roadmap) may be obtained from the following address:

Colorado Energy Office
1600 Broadway, Suite 1960
Denver, CO 80202
(303) 866-2100
energyoffice.colorado.gov

9.0.5.4 To download MOVES3 released by the U.S. Environmental Protection Agency may be obtained from the following address:

U.S. Environmental Protection Agency
The Office of Transportation and Air Quality
1200 Pennsylvania Ave, N.W.
Washington, DC 20460
(734) 214–4574 or (202) 566-0495
mobile@epa.gov
https://www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves

10.00 Declaratory Orders

10.01 The Commission may, at their discretion, entertain petitions for declaratory orders pursuant to § 24-4-105(11), C.R.S.

Editor's Notes

History

Entire rule eff. 12/15/2012.

Section SB&P eff. 05/30/2013.

Entire rule eff. 09/14/2018.

Annotations

Rules 1.22, 1.25, 1.42, 2.03.1 – 2.03.1.4, 4.01, 4.02.1 – 4.02.3, 4.02.5.9, 4.04.2.2, 4.04.2.4, 4.06.1.7, 6.01.2, 7.01, 7.03 – 7.04 (adopted 10/18/2012) were not extended by Senate Bill 13-079 and therefore expired 05/15/2013.

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Proposed revisions

1 me age

[redacted] Thu, Sep 9, 2021 at 3:10 PM
To: dot_rules@state.co.us

Ye !! Plea e do everything po ible to improve public tran portation, bike path and idewalk ! Our air quality i atrociou and climate change is upon us. It is in everyone's best interest to make changes towards sustainable transportation-NOT more roads and highways.

Thank you,
[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

GHG Rule Public Comment Extension Request

1 message

[redacted] Mon, Sep 13, 2021 at 4:42 PM

To: "governorpolis@state.co.us" <governorpolis@state.co.us>, "shoshana.lew@state.co.us" <shoshana.lew@state.co.us>, "Andrew.Hogle@state.co.us" <Andrew.Hogle@state.co.us>, [redacted] "dot_transp_comm@state.co.us" <dot_transp_comm@state.co.us>, [redacted] "Stockinger, Herman (herman.stockinger@state.co.us)" <herman.stockinger@state.co.us>, Rebecca White - CDOT <rebecca.white@state.co.us>, Theresa Takushi - CDOT <theresa.takushi@state.co.us>, "Lutz - CDOT, Natalie" <natalie.lutz@state.co.us>, "Uebelher - CDOT, Jennifer" <jennifer.uebelher@state.co.us>

Governor Polis, Director Lew, Hearing Officer Hogle, and Transportation Commissioners,

Please see the attached comment letter from the North Front Range Metropolitan Planning Organization (NFRMPO) requesting an extension of the public comment period for the TC's proposed Greenhouse Gas (GHG) rule for transportation plans.

Thank you,

[redacted]

Transportation and Air Quality Planner III

[redacted]

North Front Range Metropolitan Planning Organization

[redacted]

GHG Rule Time Request 9.13.2021 - signed.pdf
190K

September 13, 2021

To: Governor Jared Polis, Director Shoshana Lew, Hearing Officer Andrew Hogle, and Transportation Commissioners

Re: Public Comment Period Extension Request for the Proposed GHG Rule

Thank you for the opportunity to provide comment on the Transportation Commission's (TC's) proposed greenhouse gas (GHG) rule for transportation plans. The North Front Range Transportation & Air Quality Planning Council, also known as the NFRMPO, is comprised of 15 elected officials representing portions of Larimer and Weld counties. As a Metropolitan Planning Organization (MPO), the NFRMPO will be responsible for demonstrating compliance with the proposed rule and NFRMPO staff have engaged extensively in the stakeholder process conducted by the Colorado Department of Transportation (CDOT) that began in January 2021.

The public comment period for this rulemaking began on August 16, 2021, and is scheduled to close on October 15, 2021. This comment letter addresses the need for additional time to make informed public comment on the proposed rule. The NFRMPO anticipates providing substantive comments on the proposed rule in a separate letter prior to the close of the public comment period.

The NFRMPO recognizes CDOT has conducted considerable public outreach and stakeholder engagement on this rule, particularly at the conceptual level. However, there are certain pieces of technical information that must be released during the public comment period to allow for fully informed decision making and meaningful stakeholder involvement. There are four items the NFRMPO has requested from CDOT staff and/or Colorado Department of Public Health and the Environment (CDPHE) staff which have not been provided, although these requests have been acknowledged and NFRMPO staff have been told they are underway.

The specific request is for the **public comment period to extend at least 30 days past the delivery of the following information** to allow for the submission of data-driven comments and development of a data-driven rule:

1. The **technical report** from CDOT describing the modeling process for demonstrating compliance and documentation for the Energy and Emissions Reduction Policy Analysis Tool (EERPAT) model.
   - **Status:** This information was requested in mid-July and has not yet been provided. Documentation for the EERPAT model is not available online.
   - **Reason:** The technical report and EERPAT documentation will enable the staff at agencies subject to the rule to understand how the GHG Baselines and GHG Reduction Levels were set and how modeling for future compliance demonstrations will be conducted. Such understanding may uncover

[redacted]

comments or suggestions for how to improve the rule's timing requirements, clarity (e.g. will the compliance demonstrations be compared against the GHG Baselines and/or the GHG Reduction Levels), and feasibility of the GHG Reduction Levels.

2. **GHG Baselines** from CDPHE for each compliance year based on MPO models instead of the statewide model for any MPO that prefers the GHG Baselines in the rule to be set based on their in-house model.
   - **Status:** The NFRMPO submitted this request to CDPHE on July 29, 2021, for the NFRMPO region. In a best-case scenario, these results will not be available until October 1, 2021. CDPHE staff are experienced and trained in using the EPA's Motor Vehicle Emissions Simulator (MOVES) model, which is the model needed to turn outputs from the travel demand model into GHG emission estimates. MPO and CDOT staff do not have the experience or training to run MOVES.
   - **Reason:** CDOT and each MPO maintain their own travel demand model. These models have different update schedules, base years, and sensitivities. The GHG baselines in the rule were set using the statewide model; however, the NFRMPO will demonstrate compliance using the travel demand model maintained by the NFRMPO, as allowed by the rule. Using one model to set a baseline and a different model to assess compliance is a concern because they could show different outputs with the same set of inputs. Using the MPO model to demonstrate compliance instead of the statewide model is preferable because it will be more resource efficient allowing for model updates and iterations that would not be feasible if the information needs to pass through to CDOT and incorporated into the statewide model each time a GHG analysis is needed.

3. **Corrections to the GHG Reduction Levels** from CDOT for Table 1 to address the likely error that occurred when transferring data between models.
   - **Status:** This issue was originally raised on July 6, 2021, and has been raised several other times since then. On August 31, 2021, CDOT staff agreed it was likely an issue and are currently investigating it.
   - **Reason:** It appears light-duty VMT reductions were mistakenly applied to all vehicle types, resulting in unreasonably high GHG Reduction Levels in the later compliance years. This can most clearly be seen in the 2050 compliance year, which shows a reduction of 0.7 MMT GHG using strategies that reduce light duty VMT while also assuming only 3 percent of light duty vehicles will be powered by internal combustion engines in 2050. It is not possible for the VMT reductions of 3 percent of the light duty fleet to create 0.7 MMT in GHG reductions.

4. **Per capita GHG emissions** from CDOT in each compliance year to enable the rule's GHG estimates to be more tangible.
    - **Status:** Commissioner Bracke requested this information at the TC Workshop on August 18, 2021. CDOT staff agreed to provide this information, and again at a meeting with NFRMPO staff on August 27, 2021, CDOT staff agreed this information would be made available.
    - **Reason:** The State of Colorado, but particularly the Front Range, is projected to have tremendous population and employment growth. GHG per capita would provide a clearer picture into how the reduction levels are trending while the population increases.

Providing time in the rulemaking for review of these four items will enhance, not jeopardize, the ability of the NFRMPO, DRCOG, and CDOT to meet the October 1, 2022, deadline for updating their plans in compliance with the GHG rule per the requirements of SB21-260.

The NFRMPO appreciates the time and effort CDOT staff has committed to developing a GHG Rule to reduce GHG emissions from transportation planning. We respectfully request the Hearing Officer, TC Ad Hoc Committee, and the TC ensure there is adequate time for public comment, and we look forward to continuing the collaboration of the NFRMPO with CDOT staff in this effort. If you have any questions, please contact [redacted]

Sincerely,

[redacted]

[redacted]

GHG Rule Time Request 9.13.2021

Final Audit Report 2021-09-13

Created:	2021-09-13
By:	[redacted]
Status:	Signed
Transaction ID:	[redacted]

"GHG Rule Time Request 9.13.2021" History

- Document created by NFR MPO [redacted]
  2021-09-13 - 5:43:22 PM [redacted]

- Document emailed to [redacted] for signature
  2021-09-13 - 5:43:42 PM GMT

- Email viewed by [redacted]
  2021-09-13 - 10:10:09 PM GMT- [redacted]

- Document e-signed by [redacted]
  Signature Date: 2021-09-13 - 10:10:44 PM GMT - Time Source: [redacted]

- Agreement completed.
  2021-09-13 - 10:10:44 PM GMT

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

GHG pollution reduction standard comments

1 message

[redacted] Wed, Sep 15, 2021 at 1:35 PM

To: dot_rules@state.co.us

I am writing today on behalf of myself and my family. Thank you for the opportunity to provide written testimony.

Reducing greenhouse gas pollution is of utmost importance to our community, Colorado, the nation, and the world. If successful, this rulemaking will be among the first of its kind in the country. I appreciate CDOT for undertaking this project.

- While the draft rule suggests good policies to mitigate transportation pollution, we need to set solid goals for pollution reduction that will enable us to meet our existing targets. It's impossible to miss the effects that climate change is having in Western Colorado. From the beetle-killed trees, to the record-breaking heat waves after record-breaking heat-waves, to the intense drought that has gripped our region for nearly 20 years. Wildfire smoke the last two years has been intense, unhealthy, and pervasive. This is not the Colorado that we have come to know and love!
- This rulemaking should center people and environmental justice, and right now, the draft rule fails us. Black, Indigenous, Latinx, and other people of color are hurt worst by transportation pollution. CDOT should develop a Transportation Equity Framework, and representatives of disproportionately impacted and marginalized communities need to be included in developing, monitoring and implementing the rule.
- A transportation system built to serve cars limits how we can move. The state's climate roadmap calls for a 10% reduction in driving by 2030. We need to get cars off the road in a permanent, sustainable way that increases freedom of choice for urban and rural Coloradans.
- As an EV driver and advocate, I applaud the implementation of Colorado's "DC Fast Charging Corridors". However, we need more DC fast chargers in visible and usable places such as roadside rest areas. Level 2 chargers should be more present in State Parks, apartment and condo complexes, and major workplaces.

Thank you,

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Please strengthen the Greenhouse Gas Pollution Standard

1 message

[redacted] Wed, Sep 15, 2021 at 9:31 PM

To: dot_rules@state.co.us

Dear CDOT Rulemaking Comments,

Our car-centric transportation system has divided communities, polluted our air, and left Coloradans with few options for safely and conveniently moving around our state. I'm excited to see this rulemaking moving forward and have a few recommendations for improving the draft.

I urge you to strengthen the rule to center communities most harmed by the impacts of our existing transportation system. A Transportation Equity Framework should be developed as a part of this process and representatives of disproportionately impacted and marginalized communities should be included in developing, monitoring, and implementing this rule.

Colorado is in an air quality crisis and transportation is a top contributor. We must take aggressive action to reduce emissions or we will all continue to pay the price by way of air pollution and the ongoing impacts of the climate crisis. Please outline specific goals for pollution reduction that will enable us to meet existing air quality targets.

I urge you to consider these changes and continue to strengthen this rule through the revision process.

Sincerely,

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Comments on the Greenhouse Gas Pollution Standard

1 me age

[redacted] Thu, Sep 16, 2021 at 6:40 PM

To "dot rule @ tate co u " dot rule @ tate co u
Cc: "governorpolis@state.co.us" <governorpolis@state.co.us>

Our comments regarding the Greenhouse Gas Pollution Standard are attached in MS Word format.

Regards,
[redacted]

Comments on greenhouse gas reduction rule.docx
15K

[redacted]

Dear Colorado Department of Transportation
Cc: Governor Jared Polis

As a Palisade, Colorado resident, I'm writing in support of a stronger greenhouse gas reduction rule to reduce emissions, clean up our air and most importantly mitigate global climate change.

We are feeling the impacts of climate change firsthand. Here on the Western Slope our mega drought continues with flows in the Colorado River dropping to extremely low levels. Low flows in the Colorado River will also impact the Front Range as water diversions through the Rocky Mountains are junior to the 1922 River Compact and may be shut off one day soon when the Lower Basin states make a call.

Transportation is the biggest source of climate-busting carbon pollution in Colorado — and passenger cars and commercial trucks are a leading cause of the state's poor air quality, including here on the West Slope. We strongly support vehicle emissions testing here in the Grand Junction area, as we suffer from bad air quality from car and truck exhaust, especially in the winter during thermal inversions. Vehicle emissions testing will not only improve air quality but also reduce greenhouse gases as poorly running vehicles are repaired.

Colorado must meet the urgency of the moment and invest in changes TODAY that will protect all Coloradans, advance environmental justice, and provide a more livable climate and environment for generations to come.

Specially, I'm calling on the Colorado Department of Transportation to ensure this new rule:

* Requires regional transportation plans to cut emissions to meet Colorado's climate goals
* Requires investments in climate-friendly transportation and mobility options like electric vehicles, passenger rail trains, buses, bike-sharing programs, and safe walking and biking paths, that support healthy communities while cutting air pollution and traffic
* Stops the widening of freeways which just adds more cars to the road and pollution into the air
* Can be enforced to ensure these emissions reductions aren't just lost in the complicated planning processes of local transportation districts.

If successful, this rulemaking will be among the first of its kind in the country.

While the draft rule suggests good policies to mitigate transportation pollution, we need to set solid goals for pollution reduction that will enable us to meet our existing targets. Colorado is in an air quality crisis, with over 60 days and counting of unhealthy air quality due to ozone, transportation pollution, and wildfire smoke from climate change. This is not just a front range issue. Wildfire smoke in Western Colorado is an increasingly troublesome problem exacerbating respiratory problems including asthma, COPD, and Covid. The increase in wildfire activity is directly a result of CO_2 and methane emissions.

This rulemaking should center people and environmental justice, and right now, the draft rule fails us. Black, Indigenous, Latinx, and other people of color are hurt worst by transportation pollution. CDOT should develop a Transportation Equity Framework, and representatives of disproportionately impacted and marginalized communities need to be included in developing, monitoring and implementing the rule.

A transportation system built to serve cars limits how we can move. The state's climate roadmap calls for a 10% reduction in driving by 2030. We need to get cars off the road in a permanent, sustainable way that increases freedom of choice for urban and rural Coloradans.

Western Colorado is a hub for off-road biking, with many trails in the Redlands and Fruita areas. In town, however, safe bike lanes are sorely lacking. The Grand Junction area needs many more safe biking routes allowing people to use bicycles to go to work, school, restaurants and shops. The access roads next to our canals would make an ideal, safe routes for bikes. It's time to plow through the local resistance to such access and force the canal companies to open up their access roads. It's done all over back east. Why not here?

Imagine if instead of investing in gridlocked roads and highways, we expanded clean and affordable transit options that made walking, biking, and public transit as easy and convenient as driving.

Thank you for helping turn this vision into a reality. I'm counting on you to put in place a bold and equitable transportation rule that tackles the climate crisis and protects communities.

Our future depends on it.

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Regarding Green House Gas Reduction

1 me age

[redacted] Thu, Sep 16, 2021 at 7:42 PM

To "governorpoli @ tate co u " governorpoli @ tate co u , "dot rule @ tate co u " dot rule @ tate co u

Dear Colorado Department of Transportation
Cc: Governor Jared Polis

A a long tanding Colorado native, I USED to love Denver and the urrounding uburb But not anymore
Growth and expansion is a normal process, but the impractical and ridiculous rubber stamping of DENSE housing by our local municipalities has taken the current and soon future population to a point beyond what our infrastructure can adequately and safely handle and it is grossly contributing to our poor air quality problem!

Yes, we need stronger greenhouse gas reduction rules, but we also need to put a halt on the sheer volume. Transportation IS the biggest source of carbon pollution here and the insane density that keeps getting approved DIRECTLY causes all drivers to spend MUCH more time on the road (than should be necessary) substantially adding to thi pollution

CDOT (or some entity) needs to set sensible and safe boundaries for any and all expansion (it is apparent the cities are NOT and are assuming that CDOT will come in and resolve the transportation issues they create with their dense planning AFTER the fact) Development/e pan ion hould be forced to fall within afe and intelligent guideline
Additionally, it is irrational to assume that individuals who live in a community that has walkable, rideable, etc. amenities (or access by public transit) will also not want to utilize major roadways such as I-25 or I-70. These roads just CRAWL at times adding a huge amount of air pollution and this will happen with increases of population regardle of what i planned around a city or community

CDOT should . . .
* Set emission standards that can be measured and enforced AND also penalize some of the municipalities for contributing to den ity and poor traffic flow (thu air pollution)
* Require investments in climate-friendly transportation like bicycle, walking, or scooter paths, electric passenger vehicles, feasible mass transit, and electric trucking/delivery vehicles (including efficient/electric transit for shipping of goods and supplies).
* En ure that the e new inve tment happen in all communitie including in and through indu trial park , bu ine parks, shopping, neighborhoods, etc.
* Stop the need for the widening of freeways BY being able to limit local governments with their housing growth or expansion. Also, these bogged roads create major safety issues relative to any form of emergency vehicles being able to re pond in a timely manner

The change needs to happen today with someone who has oversight to all these contributing causes. Please look at the whole picture and help improve/preserve our quality of life in Colorado because it is quickly getting ruined and lo ing it de irability!

Thank you for your consideration,

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

PowerPoint Slides from Rulemaking Hearing Presentation on Sept 17, 2021

1 me age

[redacted] Fri, Sep 17, 2021 at 6:17 PM
To: "dot rules@state.co.us" <dot rules@state.co.us>
Cc [redacted]

Hello,

Per Rebecca White' reque t during the rulemaking hearing today, attached are the lide I hared via Zoom during my testimony. Please let me know if you have any questions.

Thanks,

[redacted]

[redacted]

[redacted]

[redacted]

CDOT GHG Rule Hearing Slides 9-17-2021 v1.pdf
274K

WELD COUNTY

CDOT GHG TRANSPORTATION PLANNING STANDARD (2 CCR 601-22)

Concerns and Recommendations

September 17, 2021

Presented by: [redacted]

RAMBOLL Bright ideas. Sustainable change.

CONCERN #1: The rule allows for different model(s) to be used to demonstrate compliance, as compared with the model(s) used to estimate the baseline.

Table 1. GHG emission factor changes in light-duty vehicles (LDVs) due to model updates between MOVES2014b and MOVES3*

Vehicle type	Model Year	MOVES2014b CO2 (g/mile)	MOVES3 CO2 (g/mile)	% Difference
Passenger Cars	2017	269	219	-19%
	2018	258	208	-19%
	2019	247	197	-20%
	2020	236	188	-20%
	2026	190	168	-12%
Light duty trucks	2017	348	295	-15%
	2018	340	285	-16%
	2019	332	278	-16%
	2020	324	270	-17%
	2026	250	243	-3%

- **GHG emission factors for LDVs are lower in MOVES3 than MOVES2014b due to recent model updates**
- In general, **GHG emission factors tend to decrease over time** due to improvements in fuel economy and other factors
- **Lower GHG emission factors means a greater VMT reduction will be required** to meet reduction targets

RECOMMEDNATION: The rule should be modified to require the same models for GHG budget setting and assessing compliance.

RAMBOLL

*MOVES3 is the latest version of the U.S. EPA's *MOtor Vehicle Emission Simulator* model and is the "Approved Air Quality Model" in the proposed rule

CONCERN #2: The timeframes specified in the proposed rule are problematic and may lead to implementation and/or compliance challenges.

8.04.1 At least forty-five (45) days prior to adoption of any Applicable Planning Document, CDOT for Non-MPO areas and the MPOs for their areas shall provide to APCD for review and verification of the technical data contained in the draft GHG Transportation Report required per Rule 8.02.5. If APCD has not provided written verification within thirty (30) days, the document shall be considered acceptable.

- GHG Transportation Reports may be considered acceptable without technical review
- There is no timeframe for the TC to complete their review of the GHG Transportation Reports

RECOMMEDNATION: The rule language should be modified to ensure that:

1. **GHG Transportation reports undergo technical review; and**
2. **The TC acts within a specified timeframe.**

RAMBOLL

CONCERN #3: Some numbers in Table 1 when added together do not meet the "TOTAL" reductions shown.

0.27 + 0.04 + 0.12 = 0.43

≠ 0.5

- **Actual emission reductions may fall short of estimated totals** even if rule requirements are met
- The discrepancy is greater than the reduction targets for many regional areas

Table 1: GHG Transportation Planning Reduction Levels in MMT of CO2e

Regional Areas	2025 Baseline Projections (MMT)	2025 Reduction Level (MMT)	2030 Baseline Projections (MMT)	2030 Reduction Level (MMT)	2040 Baseline Projections (MMT)	2040 Reduction Level (MMT)	2050 Baseline Projections (MMT)	2050 Reduction Level (MMT)
DRCOG	14.9	0.27	11.8	0.82	10.9	0.63	12.8	0.37
NFRMPO	2.3	0.04	1.8	0.12	1.9	0.11	2.2	0.07
PPACG	2.7	N/A	2.2	0.15	2.0	0.12	2.3	0.07
GVMPO	0.38	N/A	0.30	0.02	0.30	0.02	0.36	0.01
PACOG	0.50	N/A	0.40	0.03	0.30	0.02	0.4	0.01
CDOT/Non-MPO	6.7	0.12	5.3	0.37	5.2	0.30	6.1	0.18
TOTAL	27.4	0.5	21.8	1.5	20.6	1.2	24.2	0.7

RECOMMEDNATIONS:

1. **Clarify calculation of TOTAL row in Table 1; and**
2. **Provide guidance regarding the number of significant figures to be used in GHG emissions estimates.**

RAMBOLL

Thank you

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Greenhouse Gas Standards

1 me age

[redacted] Sun, Sep 19, 2021 at 11:20 AM
To: "dot_rules@state.co.us" <dot_rules@state.co.us>

Hello,

My name is [redacted], I'm a 6-year resident of Colorado and a University of Denver alumnus. I am writing to demand action in the form of concrete policy - the daily alerts I get about our declining air quality, the worsening seasonal storms, the unpredictable weather pattern , the raging wildfire are all con piring to how u that we are out of time

Even if we stopped all use of fossil fuels right now, we would not be able to stop the catastrophic effects of climate change and global warming. So congratulations on being useless. I hope you are satisfied with your lack of action and your complicity in the circum tance that will make it almo t impo ible for future generation to thrive I don't know how you all sleep at night.

Please consider at least passing mitigating policies that will significantly reduce emissions, such as FUNDING/SUPPORTING ROBUST PUBLIC TRANSIT, REGULATING CORPORATE EMISSIONS, ETC

Sincerely,
[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

In Support of Stronger GHG Reduction Rules

1 me age

[redacted] Mon, Sep 20, 2021 at 8:01 AM
To: dot_rules@state.co.us
Cc Governorpoli @ tate co u , je ie daniel on enate@ tate co u , kerry tipper hou e@ tate co u

Dear Colorado Department of Transportation
Cc: Governor Jared Polis, Senator Danielson, Representative Tipper,

A a Colorado re ident, I'm writing in upport of a tronger greenhou e ga reduction rule to reduce emi ion and ensure cleaner air.

Coloradans like myself are feeling the impacts of climate change firsthand. And transportation is the biggest source of climate bu ting carbon pollution in Colorado and pa enger car and commercial truck are a leading cau e of the state's poor air quality.

Colorado must meet the urgency of the moment and invest in changes TODAY that will protect all Coloradans, advance environmental ju tice, and provide a more livable climate and environment for generation to come

Specifically, I'm calling on the Colorado Department of Transportation to ensure this new rule:

* Require regional tran portation plan to cut emi ion to meet Colorado' climate goal
* Requires investments in climate-friendly transportation and mobility options like electric vehicles, passenger rail trains, buses, bike-sharing programs, and safe walking and biking paths, that support healthy communities while cutting air pollution and traffic
* En ure that the e new inve tment happen in low income communitie and communitie of color that often live near freeways, ports, and freight-hubs and disproportionately feel the impacts of pollution
* Is developed in coordinate with communities most impacted by the burdens of pollution
* Stops the widening of freeways which just adds more cars to the road and pollution into the air
* Can be enforced to en ure the e emi ion reduction aren't ju t lo t in the complicated planning proce e of local transportation districts.

Respectfully submitted,
[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Pollution Reduction Planning Standards Public Hearing

1 me age

[redacted] Mon, Sep 20, 2021 at 10:51 AM
To: dot_rules@state.co.us

Hello!

I am very concerned about climate change and air pollution. I support any and every measure to dramatically reduce pollution, especially carbon emissions and ozone.

Thank you,
[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Public Comment on Proposed Greenhouse Gas Pollution Reduction Standards

1 me age

[redacted]
To: dot_rules@state.co.us

Mon, Sep 20, 2021 at 5:31 PM

Dear CDOT Rulemaking Committee
I recently read the "COST-BENEFIT ANALYSIS FOR RULES GOVERNING STATEWIDE TRANSPORTATION PLANNING" and I wish to express my full support for a new standard to reduce greenhouse gas emissions within the transportation sector. As such, I wish to see CDOT prioritize multi-modal transportation infrastructure and especially e-bike acce ible recreation pathway I wi h to ee CDOT participate in the e pan ion of public EV charging tation infrastructure, and I wish to see CDOT limit new roadway constructions and roadway expansions to only those projects meant to address immediate life-safety concerns. You hold the power to help reshape and improve many Colorado communities and our collective future. Thank you for your thoughtful consideration in this important rulemaking process.

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Rules for Carbon Regulation

1 me age

[redacted] Tue, Sep 21, 2021 at 4:14 PM
To: dot_rules@state.co.us

- [redacted]
-
- Colorado is not on track to meet its climate targets, even though July was the hottest month ever recorded. It is critical that our state agencies embrace policies that drive broad scale decarbonization. The current draft rule has to be more ambitious to ensure that we meet our emissions reduction targets
- GHG reduction levels in the draft rules do not add up to the 12.7 million metric tons of CO2 reductions from Transportation by 2030 figure outlined in the state's GHG Pollution Reduction Roadmap.
- The draft rules rely heavily upon optimistic electric vehicle (EV) adoption rates and provide no alternative proposals for achieving these GHG reductions if EV adoption is slower than anticipated. This is the kind of wishful thinking that will get us nowhere.
- Instead of more highway expansion projects, Coloradans need more and better transportation alternatives to driving a vehicle -- affordable, efficient public transit (**with programs to make it comfortable for all those car drivers who have never been on a bus and think it beneath them**), expanded light rail and bus rapid transit along major routes, and better land use decisions to provide more bike lanes, sidewalks, and pedestrian-centric urban centers.
- We need more passenger trains in Colorado.
- This rule should impose a moratorium on highway expansions, as this strategy has only shown to increase traffic, air pollution and displace neighborhoods
- The draft rules do not account for all greenhouse gas sources from vehicles. Hydrofluorocarbons (HFCs) are not included in the definition of a greenhouse gas. This is a significant omission because HFCs from vehicle air conditioners and refrigeration trucks are powerful GHGs with Global Warming Potentials (GWPs) hundreds to thousands of times greater than that of CO2.
- Please develop a rule that truly addresses climate change instead of just sounding good to the general public.

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

(no subject)

1 me age

[redacted] Tue, Sep 21, 2021 at 4:17 PM
To: "dot_rules@state.co.us" <dot_rules@state.co.us>

Please pass the Greenhouse Gas Pollution Standard for Transportation Planning. This act goes toward tackling climate change which costs so much every year. Here's some facts that show how strongly action is needed.

- July was the hottest month ever recorded, our Earth is hotter than it's ever been since the beginning of the last ice age, and yet Colorado is not on track to meet its climate targets! **It is critical that our state agencies embrace bold, transformative policies that drive broad scale decarbonization.** The current draft rule i a good tart, but hould be more ambitiou to en ure that we meet our emissions reduction targets.

- A a matter of environmental ju tice, **disproportionately impacted communities and communities of color must be at the heart of any decision-making process** to ensure access to affordable, multimodal, transportation options that reduce toxic air pollution and traffic congestion. Please also develop an equity framework beyond this rulemaking that ensures that individuals from di proportionately impacted communitie are given a real eat at the deci ion making table

- **GHG reduction levels in the draft rules do not add up to the 12.7 million metric tons of CO2e reductions from Transportation by 2030 figure outlined in the state's GHG Pollution Reduction Roadmap** issued by Governor Polis' Office in January of this year. Coloradans deserve a clear, enforceable, and equitable plan to reduce GHG emissions from the transportation sector — not more account tricks.

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- Transportation models, assumptions, estimates and **figures used to guide transportation policy by CDOT must be transparent for the public** to engage in decision making processes that impact public health, traffic conge tion and our tate' GHG emi ion

Thank you, [redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Greenhouse Gas Pollution Standard for Transportation Planning

1 me age

[redacted] Tue, Sep 21, 2021 at 4:40 PM
To: dot_rules@state.co.us

To **DRCOG Board:**

- July was the hottest month ever recorded, our Earth is hotter than it's ever been since the beginning of the last ice age, and yet Colorado is not on track to meet its climate targets! **It is critical that our state agencies embrace bold, transformative policies that drive broad scale decarbonization.** The current draft rule i a good tart, but hould be more ambitiou to en ure that we meet our emissions reduction targets.

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- Transportation models, assumptions, estimates and **figures used to guide transportation policy by CDOT must be transparent for the public** to engage in decision making processes that impact public health, traffic congestion and our state's GHG emissions.

Thank you for your consideration and cooperation in these matters.

[redacted]

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Greenhouse Gas Pollution Standard for Transportation Planning

1 me age

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To: dot_rules@state.co.us

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Thank you for your consideration and cooperation in these matters.

[redacted]

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

GHG standards for transportation planning

1 me age

[redacted] Tue, Sep 21, 2021 at 4:56 PM
To "dot rule @ tate co u " dot rule @ tate co u

- **Instead of more highway expansion projects, Coloradans need more and better transportation alternatives to driving a vehicle** — like electric bicycles and scooters for shorter trips, affordable and efficient public tran it for longer trip , e panded light rail and bu rapid tran it along major route , and better land use decisions to provide more bike lanes, sidewalks, and pedestrian-centric urban centers. This rule should impose a moratorium on highway expansions, as this strategy has only shown to increase traffic, air pollution and displace neighborhoods.

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STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Decarbonize Transportation!

1 me age

[redacted] Tue, Sep 21, 2021 at 5:25 PM
To: dot_rules@state.co.us

To Whom It May Concern
Happy Tuesday Sept 21-21….
What are you waiting for…. The entire world to run out of water, endless fires , drought, famine , extinction, death, pandemics???
YOU CAN START WITH DECARBONIZING TRANSPORTATION!!!
Thanks, [redacted]

Sent from my iPhone

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Greenhouse Gas Pollution Standard for Transportation Planning

1 me age

[redacted] Tue, Sep 21, 2021 at 6:27 PM
To: dot_rules@state.co.us

We need to lower emissions from the transportation sector while improving equity, access, and multimodal transportation alternatives for all Coloradans.

- GHG reduction levels in the draft rules do not add up to the 12.7 million metric tons of CO2 reductions from Transportation by 2030 figure outlined in the state's GHG Pollution Reduction Roadmap issued by Governor Polis' Office in January of this year. Coloradans deserve a clear, enforceable, and equitable plan to reduce GHG emissions from the transportation sector — not more accounting tricks.

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- As a matter of environmental justice, disproportionately impacted communities and communities of color must be at the heart of any decision making process to ensure access to affordable, multimodal, transportation options that reduce toxic air pollution and traffic congestion. Please also develop an equity framework beyond this rulemaking that ensures that individuals from disproportionately impacted communities are given a real seat at the decision making table.

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- Transportation models, assumptions, estimates and figures used to guide transportation policy by CDOT must be transparent for the public to engage in decision making processes that impact public health, traffic congestion and our state's GHG emissions.

Please keep these points In mind while developing greenhouse gas pollution standards relative to transportation in Colorado.

[redacted]

[redacted]

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Greenhouse Gas Pollution Standard for Transportation Planning

1 me age

[redacted] Tue, Sep 21, 2021 at 7:25 PM
To: dot_rules@state.co.us

July was the hottest month ever recorded, our Earth is hotter than it's ever been since the beginning of the last ice age, and yet Colorado is not on track to meet its climate targets! **It is critical that our state agencies embrace bold, transformative policies that drive broad scale decarbonization.** The current draft rule i a good tart, but hould be more ambitiou to en ure that we meet our emi ion reduction targets.

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Transportation models, assumptions, estimates and **figures used to guide transportation policy by CDOT must be transparent for the public** to engage in deci ion making proce e that impact public health, traffic congestion and our state's GHG emissions.

Sincerely,
[redacted]

[redacted]

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Greenhouse Gas Pollution Standard for Transportation Planning

1 me age

[redacted] Tue, Sep 21, 2021 at 9:34 PM
To: "dot_rules@state.co.us" <dot_rules@state.co.us>

TO whom it may concern,

July was the hottest month ever recorded, our Earth is hotter than it's ever been since the beginning of the last ice age, and yet Colorado is not on track to meet its climate targets! It is critical that our state agencies embrace bold, transformative policies that drive broad scale decarbonization. The current draft rule is a good start, but should be more ambitious to ensure that we meet our emissions reduction targets.

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[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Climate change

1 me age

[redacted] Wed, Sep 22, 2021 at 9:10 AM
To: dot_rules@state.co.us

- July was the hottest month ever recorded, our Earth is hotter than it's ever been since the beginning of the last ice age, and yet Colorado is not on track to meet its climate targets! **It is critical that our state agencies embrace bold, transformative policies that drive broad scale decarbonization.** The current draft rule i a good tart, but hould be more ambitiou to en ure that we meet our emissions reduction targets.

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[redacted]

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STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Greenhouse Gas Pollution Standard for Transportation Planning

1 me age

[redacted] Wed, Sep 22, 2021 at 9:28 AM
To: "dot_rules@state.co.us" <dot_rules@state.co.us>

Hello,

I am a resident of Greeley, Colorado and have lived in Colorado all my life. I am concerned about the existential crisis climate change presents and would like to see
the Colorado Department of Transportation develop the Greenhouse Gas Pollution Standard for Transportation Planning to establish an innovative framework that would require planning agencies to meet specific carbon budgets, or face penalties. This should be as strong a rule as possible!
Reasons for this include

1) July was the hottest month ever recorded, our Earth is hotter than it's ever been since the beginning of the last ice age, and yet Colorado is not on track to meet its climate targets! **It is critical that our state agencies embrace bold, transformative policies that drive broad scale decarbonization.** The current draft rule is a good start, but should be more ambitious to ensure that we meet our emissions reduction targets.

2) As a matter of environmental justice, **disproportionately impacted communities and communities of color must be at the heart of any decision-making process** to ensure access to affordable, multimodal, transportation options that reduce toxic air pollution and traffic congestion. Please also develop an equity framework beyond this rulemaking that ensures that individuals from disproportionately impacted communities are given a real seat at the decision making table.

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[redacted]

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7) Transportation models, assumptions, estimates and **figures used to guide transportation policy by CDOT must be transparent for the public** to engage in decision making processes that impact public health, traffic congestion and our state's GHG emissions.

Thank you for your time and consideration,

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Greenhouse Gas Pollution Standard for Transportation Planning.

1 me age

[redacted] Wed, Sep 22, 2021 at 9:46 AM
To: dot_rules@state.co.us

CDOT Transportation Commission

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Thank you.

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

CDOT: greenhouse gas standards

1 me age

[redacted] Wed, Sep 22, 2021 at 4:48 PM

To: dot_rules@state.co.us

Dear CDOT Tran portation Committee member ,

I would like to urge you to develop very strong policies as you develop your Greenhouse Gas Pollution Standards for Transportation. As everyone now knows the world is at a crisis point with climate change. It will require serious efforts to curb greenhou e ga e   in any way, and for all of u   to be creative in the e effort   The reduction   in greenhou e ga e from transportation are key components- and they need to be real, accurate, fair, enforceable and accountable.

We can't rely on the voluntary transition to electric vehicles without adequate incentives or strong barriers to the continued u e of ga   u ing vehicle   We need   tricter carbon budget   not ju t optimi tic one   We do not need more road   or wider roads- we need less! We need better, more accessible mass transit- buses, light rail, etc. We need to make the roads safe for bicycles, golf-carts, e-bikes- anything but cars!

Tran portation model , a   umption , e timate   and figure   u ed to guide tran portation policy by CDOT mu t be transparent for the public to engage in decision making processes that impact public health, traffic congestion and our state's GHG emissions.

I do not want to live in a world in which I can't go out ide in the   ummer becau e of heat and poor air quality I don't want to worry about every drop of water that I use to water the garden. And I don't want to fear for the future for my grandchildren. You have a tough job; there will need to be some sacrifices, and costs now to pay for a future payback.

Thank you,

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Greenhouse Gas Reduction Planning

1 me age

[redacted] Thu, Sep 23, 2021 at 8:46 AM

To: dot_rules@state.co.us

Hello,

I fully support planning and action efforts to reduce greenhouse gas emissions in Colorado.

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Transportation Rulemaking

1 me age

[redacted] Thu, Sep 23, 2021 at 10:04 AM
To: dot_rules@state.co.us

Department of Transportation,

As a voter and Colorado taxpayer, my top priority issue is reducing greenhouse gas emissions to fight climate change. I understand that you are looking at rules that will help us get to Colorado's GHG emission goals in the transportation sector.

July was the hottest month ever recorded, our Earth is hotter than it's ever been since the beginning of the last ice age, and yet Colorado is not on track to meet its climate targets! **It is critical that our state agencies embrace bold, transformative policies that drive broad scale decarbonization.** The current draft rule is a good start, but should be more ambitious to ensure that we meet our emissions reduction targets.

We demand change now. The technologies are present, we just need the will to step forward into the future without fossil fuels. Please know that my family and I are closely watching your efforts. Thank you for your work.

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Please strengthen the Greenhouse Gas Pollution Standard

1 me age

[redacted] Thu, Sep 23, 2021 at 10:13 AM
Reply-To: [redacted]
To dot rule @ tate co u

Dear CDOT Rulemaking Comments,

As a 4th generation Colorado and resident of Denver for over a quarter of a century, I am distressed, saddened and quite frankly that the city ha become a car centric, traffic bound mini LA The approach to tran portation and the y tem that we have accepted has divided communities, polluted our air, and left Coloradans with few options for safely and conveniently moving around our state. I'm excited to see this rulemaking moving forward and have a few recommendations for improving the draft.

First, I urge you to strengthen the rule to center communities most harmed by the impacts of our existing transportation system. A Transportation Equity Framework should be developed as a part of this process and representatives of disproportionately impacted and marginalized communities should be included in developing, monitoring, and implementing thi rule

Second, while a goal of decreasing driving by 10% by 2030 is admirable, it isn't nearly enough or fast enough. This summer was apocalyptic with day after day of AQI alerts driving us indoors to watch the orange sky through our windows. Colorado i in an air quality cri i and tran portation i a top contributor We mu t take aggre ive action to reduce emissions or we will all continue to pay the price by way of air pollution and the ongoing impacts of the climate crisis. Please outline specific goals for pollution reduction that will enable us to meet existing air quality targets.

I urge you to con ider the e change and continue to trengthen thi rule through the revi ion proce

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

RE: Instructions – Virtual Rulemaking Hearing regarding the Proposed Greenhouse Pollution Reduction Standards for Transportation Planning on 9/24/ Instrucciones – Audiencia Virtual de Elaboración de Normas sobre las Normas Propuestas para la Reducción de

1 message

[redacted] Thu, Sep 23, 2021 at 3:14 PM

To CDOT Rule cdot rule @ tate co u

My written comments below:

My name is [redacted], a collaborative ensuring a racially equitable, resilient Denver metro region where community solutions are at the center of systems change.

As community advocates, we recognize the intersection between multiple competing crises – housing, health, and climate – and our Black, Brown and other communities of color. We call on CDOT to develop an implement a transportation equity framework that includes representatives from disproportionately impacted communities in the process - from development to implementation. We need to incentivize more equitable transportation systems and equitable zoning/land use practices to get to the root cause of our GHG emissions. It's time to shift how and where we plan and build our housing directly connects to how they will get to job centers and other critical services.

These crises need to be met with bold action. I look forward to reviewing a strengthen rule but for now, thank you for your time today

[redacted]

[redacted]

From CDOT Rule cdot rule @ tate co u
Sent: Thursday, September 23, 2021 3:11 PM
To: [redacted]
Subject: Re: Instructions – Virtual Rulemaking Hearing regarding the Proposed Greenhouse Pollution Reduction Standard for Tran portation Planning on 9/24/ In truccione Audiencia Virtual de Elaboración de Norma obre la Normas Propuestas para la Reducción de

Yes, that is acceptable. If you would like to provide a written comment please respond to this email account with your comment! Thank you for letting us know.

Best,

Rebecca Rathburn

[redacted] wrote:

> Hi there, I had originally planned to provide spoken testimony and was curious if I could provide written testimony instead. Please advise. Thank you.
>
> [redacted]
>
> ---
>
> **From** CDOT Rule cdot rule @ tate co u
> **Sent:** Thursday, September 23, 2021 1:14 PM
> **To:** Rebecca Rathburn - CDOT <rebecca.rathburn@state.co.us>
> **Subject:** Instructions – Virtual Rulemaking Hearing regarding the Proposed Greenhouse Pollution Reduction Standard for Tran portation Planning on 9/24/ In truccione Audiencia Virtual de Elaboración de Norma obre la Normas Propuestas para la Reducción de l...
>
> Stakeholder:
>
> You are receiving this email because you signed up to attend the rulemaking hearing on September 24, 2021, at 3 pm, virtually. This email contains instructions for how to join, listen, and provide testimony if you wish at the public hearing.
>
> **Listening and Watching the Public Hearing - English Only**
>
> We are going to live stream the public hearing on CDOT's YouTube Channel. If you do not wish to provide testimony, we strongly recommend that you listen and watch the public hearing on YouTube rather than joining the Zoom video

call. You can access the YouTube live stream from the link below or from CDOT's Proposed Rules and Public Hearing Dates website.

https://youtu.be/WkUq-KOXCTQ

Planning to Provide Public Testimony in English/Spanish and Listening to Spanish Interpretation
If you wi h to provide te timony, you mu t join the Zoom video call from the link below If you would like to li ten and/or provide testimony in Spanish please email CDOT_Rules@state.co.us as soon as possible so that we can accommodate that request.

https://cdot.zoom.us/j/97966686335?pwd=d2xmUm0yTWJoNkZtaVJzWVRvTWtkdz09

If requested, we will be offering simultaneous Spanish interpretation for each hearing through Zoom. When you log into Zoom at the beginning of the hearing, please select your language of choice (English/Spanish). Please watch a brief YouTube video e plaining how Zoom Simultaneou Interpretation work

Additionally, we reque t that you mute your microphone and do not hare your camera until the te timony pha e of the public hearing. During the testimony phase, the hearing officer will announce your name when it is your turn to provide your testimony. At that time, please unmute your microphone and share your camera if you wish. Your testimony will be time limited. Please speak clearly and slowly for the recording and transcription.

Technical Difficulties with Zoom

Please contact Jamie Grim at Jamie.Grim@state.co.us or 970.481.1024.

Thank you for participating in the rulemaking process.

Thank you,

Rebecca Rathburn

Accionista:

Usted recibió este correo electrónico porque se inscribió para asistir a la audiencia de elaboración de normas el 24 de septiembre de 2021 a las 3 pm en forma virtual. Este correo electrónico contiene instrucciones sobre cómo ingresar, escuchar y dar su testimonio, si lo desea, en la audiencia pública.

Escuchar y Ver la Audiencia Pública - Solo en Inglés

Vamos a transmitir la audiencia pública en vivo en el canal de YouTube del CDOT. Si usted no desea dar su te timonio, le recomendamo encarecidamente que e cuche y vea la audiencia pública en YouTube en lugar de unir e a la videollamada de Zoom. Usted puede acceder a la audiencia pública de YouTube desde el enlace a continuación o desde la página de Internet de Normas Propuestas y Fechas de Audiencia Pública del CDOT.

https://youtu.be/WkUq-KOXCTQ

Planificación para Brindar Testimonio Público en Inglés / Español y Escuchar la Interpretación en Español

Si usted desea brindar su testimonio, debe unirse a la videollamada de Zoom desde el enlace a continuación. Si usted le gustaría escuchar o brindar el testimonio en español, envíe un email a CDOT_Rules@state.co.us lo antes posible para que podamo acomodar el pedido

http //cdot zoom u /j/97966686335?pwd d2 mUm0yTWJoNkZtaVJzWVRvTWtkdz09

Si e olicita, ofreceremo interpretación imultánea en e pañol en cada audiencia a travé de Zoom Cuando u ted inicie la sesión en Zoom al comienzo de la audiencia, seleccione el idioma que prefiera (inglés / español). Mire un breve video de YouTube que explica cómo funciona la interpretación simultánea de Zoom.

Además, le recomendamos que apague su micrófono y no encienda su cámara hasta la fase de testimonio de la audiencia pública. Durante la fase de testimonio, el funcionario de audiencias anunciará su nombre cuando sea su turno de dar u te timonio En e e momento, encienda el micrófono y u cámara i lo de ea Su te timonio erá por tiempo limitado. Hable claro y despacio para la grabación y transcripción.

Dificultades Técnicas con Zoom

Comuníquese con Jamie Grim al Jamie.Grim@state.co.us o al 970.481.1024.

Gracias por participar en el proceso de elaboración de normas.

Gracias,

Rebecca Rathburn

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Greenhouse Gas Pollution Standard for Transportation Planning

1 me age

[redacted] Thu, Sep 23, 2021 at 5:38 PM
To: dot_rules@state.co.us

To whom it may concern at C DOT,

Thank you for undertaking the greenhouse gas standard in transportation planning. Please consider making this as strict as possible, as all of our futures depend on us taking the most direct and ambitious action possible. Even though it is hard to imagine wift and foundational change when it come to tran portation, I hope that you will under tand the gravity of this situation, and that you have the power to help many generations to come, but only if you take bold and unprecedented steps. Please, take this seriously, and do what you can to help us.

Sincerely,

[redacted]

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Greenhouse Gas Pollution Standard for Transportation Planning

1 me age

[redacted] Thu, Sep 23, 2021 at 6:18 PM
To: "dot_rules@state.co.us" <dot_rules@state.co.us>

Decarbonizing Transportation

This is the most critical issue we will face in our lifetimes. We MUST STOP this environmental suicide mission we are on

- July was the hottest month ever recorded, our Earth is hotter than it's ever been since the beginning of the last ice age, and yet Colorado is not on track to meet its climate targets! **It is critical that our state agencies embrace bold, transformative policies that drive broad scale decarbonization.** The current draft rule is a good start, but should be more ambitious to ensure that we meet our emissions reduction targets.

- As a matter of environmental justice, **disproportionately impacted communities and communities of color must be at the heart of any decision-making process** to ensure access to affordable, multimodal, transportation options that reduce toxic air pollution and traffic congestion. Please al o develop an equity framework beyond thi rulemaking that en ure that individual from disproportionately impacted communities are given a real seat at the decision making table.

- **GHG reduction levels in the draft rules do not add up to the 12.7 million metric tons of CO2e reductions from Transportation by 2030 figure outlined in the state's GHG Pollution Reduction Roadmap** issued by Governor Polis' Office in January of this year. Coloradans deserve a clear, enforceable, and equitable plan to reduce GHG emissions from the transportation sector — not more account trick

- **The draft rules rely heavily upon optimistic electric vehicle (EV) adoption rates** and provide no alternative propo al for achieving the e GHG reduction if EV adoption i lower than anticipated Therefore, this rule should adopt stricter carbon budgets that will allow us to meet our emissions reduction targets given the liklihood that EV adoption does not occur as fast as this rule anticipates.

- **Instead of more highway expansion projects, Coloradans need more and better transportation alternatives to driving a vehicle** — like electric bicycles and scooters for shorter trips, affordable and efficient public transit for longer trips, expanded light rail and bus rapid transit along major routes, and better land u e deci ion to provide more bike lane , idewalk , and pede trian centric urban centers. This rule should impose a moratorium on highway expansions, as this strategy has only shown to increase traffic, air pollution and displace neighborhoods.

- **The draft rules do not account for all greenhouse gas sources from vehicles.** Hydrofluorocarbons (HFCs) are not included in the definition of a greenhouse gas. This is a significant omission because HFCs from vehicle air conditioners and refrigeration trucks are powerful GHG with Global Warming Potential (GWP) hundred to thou and of time greater than that of CO2.

- Tran portation model , a umption , e timate and **figures used to guide transportation policy by CDOT must be transparent for the public** to engage in decision making processes that impact public health, traffic congestion and our state's GHG emissions.

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Comments re: Greenhouse Gas Pollution Standard for Transportation Planning.

1 me age

[redacted] Thu, Sep 23, 2021 at 8:53 PM
To: "dot_rules@state.co.us" <dot_rules@state.co.us>

To whom it may concern;

The proposed rule should be focused on helping Colorado lower emissions from the transportation sector while improving equity, access, and multimodal transportation alternatives for all Coloradans

The current draft rule is a good start, but should be more ambitious to ensure that we meet our emissions reduction targets. As a matter of environmental justice, disproportionately impacted communities and communities of color must be at the heart of any decision making process to ensure access to affordable, multimodal, transportation options that reduce toxic air pollution and traffic congestion. Please also develop an equity framework beyond this rulemaking that ensures that individuals from disproportionately impacted communities are given a real seat at the decision making table.

GHG reduction levels in the draft rules do not add up to the 12.7 million metric tons of CO_2e reductions from Transportation by 2030 figure outlined in the state's GHG Pollution Reduction Roadmap issued by Governor Polis' Office in January of this year. Coloradans deserve a clear, enforceable, and equitable plan to reduce GHG emissions from the transportation sector not more account tricks

The draft rules do not account for all greenhouse gas sources from vehicles. Hydrofluorocarbons (HFCs) are not included in the definition of a greenhouse gas. This is a significant omission because HFCs from vehicle air conditioners and refrigeration trucks are powerful GHGs with Global Warming Potentials (GWPs) hundreds to thousands of times greater than that of CO_2.

Transportation models, assumptions, estimates and figures used to guide transportation policy by CDOT must be transparent for the public to engage in decision making processes that impact public health, traffic congestion and our state's GHG emissions.

Sincerely,
[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Written comment on draft rule for greenhouse gas emissions reduction

1 me age

[redacted] Fri, Sep 24, 2021 at 10:00 AM

To dot rule @ tate co u

Dear CDOT:

I am writing in support of the proposed standard that requires CDOT to determine the total pollution and greenhouse gas emi ion increa e from future tran portation project

It is hard not to be disappointed with how CDOT plans projects and spends the budget. It seems widening highways and making roads faster, louder, and more dangerous to people on foot and bike is always the chosen option.

I look at pictures on the internet of cities with complete streets with shade trees and safe places for people walking and biking and wonder why we don't choose that. Why do we spend our money on streets that are so hostile to anyone not in a car and so damaging to our health?

There was a time when VMT was associated with increasing standard of living, but I think we passed the point long ago when increasing vehicle miles became a burden, not a benefit.

PLEASE take air pollution into account when planning your new project Give u a chance to choo e omething other than cars. Don't let your legacy be dirty air, sprawl, road deaths, bulldozed walkable neighborhoods, and a city that lives in a traffic jam.

Al o plea e revi e the propo al to include the 10% reduction in VMT What you build today will be the tran portation infrastructure of tomorrow. We can plan for a healthier city.

Thank you for reading,

[redacted]

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Weld County Initial Written Comments 2CCR601-22

1 me age

[redacted] Fri, Sep 24, 2021 at 12:05 PM
To: "dot_rules@state.co.us" <dot_rules@state.co.us>
Cc [redacted]

Please see the attached. Weld County will be participating in or listening to the various public rulemaking hearings scheduled over the next few weeks. Weld County reserves the right to submit additional comments on or before October 15th.

[redacted]

Confidentiality Notice: This electronic transmission and any attached documents or other writings are intended only for the person or entity to which it is addressed and may contain information that is attorney privileged and confidential, or otherwise protected from disclosure. If you have received this communication in error, please immediately notify sender by return e mail and de troy the communication Any di clo ure, copying, di tribution or the taking of any action concerning the contents of this communication or any attachments by anyone other than the named recipient is strictly prohibited

WeldCo_WrittenComments_2CCR601-22.pdf
281K

BEFORE THE DEPARTMENT OF TRANSPORTATION AND TRANSPORTATION COMMISSION
STATE OF COLORADO

IN THE MATTER OF PROPOSED REVISIONS TO 2 CCR 601-22

WRITTEN COMMENTS FROM THE BOARD OF COUNTY COMMISSIONERS OF WELD COUNTY, COLORADO

The Board of County Commissioners of Weld County ("Weld County") submits these comments in connection with the above-captioned rulemaking. Weld County appreciates the opportunity to participate in this rulemaking proceeding regarding the Colorado Department of Transportation's ("CDOT") revisions to 2 CCR 601-22, Rules Governing Statewide Transportation Planning Process and Transportation Planning Regions ("Proposed Rule") proposed by the Colorado Department of Transportation ("CDOT"). The Proposed Rule establishes greenhouse gas ("GHG") reduction targets for transportation and requires CDOT and the Metropolitan Planning Organizations ("MPOs") to demonstrate through travel demand modeling and approved air quality modeling that statewide and regional aggregate emissions resulting from its state or regional plans do not exceed a specified emissions level in total. The purpose of these requirements is to limit the GHG pollution that would result from the transportation system if the plans were implemented. If compliance cannot be demonstrated, even after committing to GHG mitigation measures, the Proposed Rule requires the Transportation Commission ("TC") to restrict the use of certain funds to projects that are recognized as approved mitigation measures and help reduce transportation emissions.

The transportation sector is one of the largest contributors to GHG and ozone precursor emissions. Therefore, Weld County generally supports efforts to increase multimodal options and provide more sustainable travel options to achieve reductions in air pollution, including GHG and ozone precursor emissions, from the sector. However, Weld County has several concerns about the Proposed Rule, and more generally, the rushed nature of the rulemaking and lack of data provided by CDOT. This lack of critical information impedes stakeholders' ability to evaluate the overall efficacy of the Proposed Rule and provide meaningful comments.

Therefore, Weld County is submitting these initial written comments on the Proposed Rule and requests CDOT provide the data requested by stakeholders, including the data requested in Weld County's CORA request, dated September 17, 2021 (see **Attachment A**). In addition, Weld County requests the Transportation Commission extend the deadline for written comments to no earlier than 30 days after receipt of the requested data, and schedule an additional hearing after the close of the extended comment period. Our request for additional data notwithstanding, Weld County intends to review the cost-benefit analysis ("CBA"), regulatory analysis, and any other data and information provided by CDOT and submit additional written comments before the close of the comment period.

Weld County's concerns about the Proposed Rule and its corresponding recommendations are outlined below.

Concern No. 1

CDOT has not provided sufficient time before the rulemaking hearings to review supporting documentation for the Proposed Rule, including the CBA, regulatory analysis, and other technical documentation.

- These supporting documents were not released with the notice of the rulemaking and Proposed Rule Language. CDOT has not provided key analyses, data, and the underlying documentation used to develop the Proposed Rule.
- Without such documents, stakeholders are unable to evaluate the accuracy or reasonableness of the GHG emission estimates in the Proposed Rule or the efficacy of the Proposed Rule.
- While CDOT has met the minimum time requirements for public release of the CBA and regulatory analysis, the scope and novelty of the Proposed Rule warrants additional time for stakeholders to review and comments on these documents. Extending the time period for review and comment would benefit stakeholders and the rulemaking process by allowing for more careful consideration and further refinement of the Proposed Rule.
  - A cost-benefit analysis is required under C.R.S. § 25-7-103(2.5) and a separate regulatory impact analysis is required under C.R.S. § 25-7-103(4.5).
  - Per the Department of Regulatory Agencies, a CBA must be made available to the public 10 days prior to the first hearing and the regulatory analysis must be completed and made available to the public 5 days prior to the first hearing.[1]

Weld County's Recommendation

- CDOT should provide supporting documentation—such as a technical support document—describing the methods used to conduct the analysis for the GHG estimates in Table 1 and Table 2 of the Proposed Rule.
- CDOT should provide additional time – beyond regulatory minimums – for stakeholders to review and comment on the CBA and regulatory analysis.

Concern No. 2

The rule allows for different model(s) to be used to demonstrate compliance, as compared with the model(s) used to estimate the baseline. Different models could yield different results complicating compliance with the rule.

- The rule allows for the use of MPO models or the Statewide Travel Model when performing GHG emissions analyses. Examples (emphasis added):

[1] Colo. Dep't of Regul. Agencies, *Colorado's Rulemaking and Cost-Benefit Analysis Process*, https://coprrr.colorado.gov/rulemaking-and-cost-benefit-analysis.

- “1.05 Baseline - estimates of GHG emissions for each of the MPOs, and for the non-MPO areas, prepared using the MPO Models or the Statewide Travel Model…”
  - “8.02.1 Analysis Requirements When Adopting or Amending an Applicable Planning Document - Each MPO and CDOT shall conduct a GHG emissions analysis using MPO Models or the Statewide Travel Model…”
  - “8.02.5.2 Identification and documentation of the MPO Model or the Statewide Travel Model and the Approved Air Quality Model used to determine GHG emissions in MMT of CO2e.”
- It is not clear why the definition of baseline would allow for use of the MPO Models or the Statewide Travel Model when the baseline represents a single set of GHG emission estimates that were presumably prepared using one of the modeling platforms (i.e., either the MPO Models, or the Statewide Travel Model, not both).
- Different models exhibit different sensitives to inputs and assumptions, whereby running two different models with the same inputs and assumptions could yield different results. Therefore, allowing different model(s) to be used in the GHG emissions analysis than was used in estimate of baseline GHG emissions and development of GHG reduction targets is problematic. For example, while the emission reduction levels shown in Table 1 may be achievable based on modeling conducted using the Statewide Travel Model, demonstrating compliance using the MPO Model(s) may be infeasible.
  - Further, the use of multiple different models among CDOT and the MPOs in their respective GHG emissions analyses complicates review of the GHG Transportation Reports by both APCD and the Transportation Commission (TC) as required in Sections 8.04.1 and 8.05, respectively.
- The role of Section 8.02.2 “Agreements on Modeling Assumptions and Execution of Modeling Requirements” in constraining/coordinating the “development and execution” of the models is not clear and should be clarified per our recommendations below.
- The definition for “Approved Air Quality Model” refers to “the most recent” model, meaning the approved air quality model used in future years to demonstrate compliance with the Proposed Rule may differ from the model that was used to estimate the baseline emissions and reduction targets. Similar to the concerns above, future updates to the approved air quality model (i.e. MOVES3, the Motor Vehicle Emissions Model) may alter the model’s sensitivity to key inputs (e.g., VMT, vehicle miles traveled) used in the GHG emissions analyses and compliance assessments.
  - Such changes may present compliance challenges. For example, if every vehicle is “cleaner” (i.e., lower GHG emissions per mile), then CDOT and MPOs would need to achieve greater VMT reductions to achieve the same GHG emission reductions.

Weld County’s Recommendation:

- The definition of baseline should be revised to refer to only the model(s) used to prepare the estimates of baseline GHG emission estimates and CDOT should provide a technical support document describing the methods and assumptions used to estimate the baseline emissions.

- Modify rule to require the same model(s) for GHG budget setting (i.e., Table 1 and 2 of the Proposed Rule) and assessing compliance (i.e., GHG emissions analyses and GHG Transportation Reports as required under the Proposed Rule), or outline process for continuity if model changes are determined to be critical.
  - To ensure the same air quality model is used for GHG budget setting and compliance assessments, either:
    - Revise the definition of Approved Air Quality Model to refer to the specific model used in the determination of the GHG emission estimates in Table 1 and Table 2 of the Proposed Rule; or
    - Revise the Proposed Rule to require the GHG emission estimates in Table 1 and Table 2 be updated following the release of a new (or update to an existing) Approved Air Quality Model.
- Should different models be allowed in the Proposed Rule, CDOT should conduct a sensitivity analysis to compare the sensitivity of different models to inputs and assumptions, specifically as related to Travel Choice, Transit, and Land Use considered in the development of the GHG estimates in Table 1 and Table 2 of the Proposed Rule.
- The specific requirements for and components of the "Intergovernmental Agreement" required per Section 8.02.2 should be specified in the rule language, particularly as related to model(s) used in the analyses and assumptions used in the modeling, to ensure consistent modeling methodology.

Concern No. 3

For areas outside the urban corridor (i.e., rural areas and/or those with a lower population density) the GHG mitigation measures specified in the Proposed Rule may be overly restrictive and may present compliance challenges for CDOT and/or MPOs.

- Urban and rural lifestyles, land usage, density, and thus transportation patterns are critically different. To date, most GHG mitigation strategies for the transportation sector have been targeted to more densely populated, urban areas.[2,3] According to the Transportation Research Board, "By far, and not surprisingly, most of the research on GHG emissions reduction strategies has focused on metropolitan areas or at the national and state levels." and that "…very little attention has been given to nonurban areas".[4] The

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[2] New England Transport Consortium, *Data and Information to Support Cost Effective Transportation GHG Mitigation in Rural Communities* (2020), https://www.newenglandtransportationconsortium.org/wp-content/uploads/N20ME2-GHG-Mitigation-1.pdf.

[3] Org. for Econ. Co-operation and Dev., *Decarbonising Urban Mobility with Land Use and Transport Policies: The Case of Auckland, New Zealand* (2020), https://www.oecd-ilibrary.org/sites/5181a1e0-en/index.html?itemId=/content/component/5181a1e0-en.

[4] PB Americas, Inc., Cambridge Systematics, Inc., E.H. Pechan & Assocs., Inc., EuQuant, Inc., Strategic Highway Rsch. Program Capacity Focus Area, Transp. Rsch. Bd., & Nat'l Academies of Scis., Eng'g, and Med., *Incorporating*

example GHG mitigation strategies given in Section 8.03 are less feasible and/or less effective in rural areas, especially given that rural roads tend to have lower traffic flows and thus have less traffic impacts.[5] For example, the California Air Pollution Control Officers Association finds that reducing VMT through carpooling measures is not applicable for implementation in rural areas.[6] Rural areas also have less financial and logistical resources, and may bear disproportionate financial burdens from higher taxes, and fuel and vehicle costs that are associated with GHG reduction strategies.[7,8]

- Examples of mitigation measures provided in Section 8.03 of the Proposed Rule are largely infeasible or ineffective outside of metropolitan areas and transportation GHG mitigation measures are generally less available in rural areas and/or areas with a lower population density.
- Additionally, per Section 1.19, GHG mitigation measures are defined as strategies that reduce transportation GHG pollution. Thus, mitigation measures that reduce GHG emissions from other sources or sectors would not qualify as mitigation measures to help achieve GHG Reduction Levels set forth in the Proposed Rule. This further constrains the availability of mitigation measures.

Weld County's Recommendation

- CDOT should evaluate the feasibility of, and provide examples of, transportation GHG mitigation measures for rural areas.
- The definition of GHG Mitigation Measures in the Proposed Rule should be revised to allow for strategies that reduce GHG pollution from sources and sectors other than transportation, provided that there is a transportation nexus.

Concern No. 4

The timeframes specified in the Proposed Rule are problematic and may lead to implementation and/or compliance challenges.

- First, the 30-day time window for APCD to provide review and verification of the technical data contained in the draft GHG Transportation Reports may be insufficient, and may allow for GHG Transportation Reports to be provided to the TC for compliance

Greenhouse Gas Emissions into the Collaborative Decision-Making Process, at 22805 (2012), https://doi.org/10.17226/22805.

[5] N. Singru, *Reducing Carbon Emissions from Transport Projects*, at 107 (2010), https://www.oecd.org/derec/adb/47170274.pdf.

[6] Cal. Air Pollution Control Officers Ass'n, *Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity* (2021), http://www.airquality.org/ClimateChange/Documents/Handbook%20Public%20Draft_2021-Aug.pdf.

[7] Marisa Beck, Nicholas Rivers, & Hidemichi Yonezawa, *A rural myth? Sources and implications of the perceived unfairness of carbon taxes in rural communities*, Ecological Economics, at 124, 124–134 (2016), https://doi.org/10.1016/j.ecolecon.2016.01.017.

[8] Cynthia J. Burbank, Greenhouse Gas (GHG) and Energy Mitigation for the Transportation Sector (2009), http://onlinepubs.trb.org/onlinepubs/sr/sr299GHG.pdf.

assessment without sufficient technical review. Per Section 8.04.1 of the Proposed Rule, "At least forty-five (45) days prior to adoption of any Applicable Planning Document, CDOT for Non-MPO areas and the MPOs for their areas shall provide to APCD for review and verification of the technical data contained in the draft GHG Transportation Report required per Rule 8.02.5. If APCD has not provided written verification within thirty (30) days, the document shall be considered acceptable."

    - As currently written, there is the potential for GHG Transportation Reports to be considered acceptable without having undergone technical review and verification from APCD. Presumably the technical review and verification from APCD is intended to ensure accuracy and validity of the GHG emissions estimates, so it is critical reports are reviewed by APCD prior to a compliance determination from the TC. It is unclear if APCD has provided feedback to CDOT regarding the feasibility of meeting this time requirement.
    - In the event the GHG Transportation Report is not reviewed by APCD and is considered acceptable after 30 days, it's not clear if the TC is equipped or expected to perform technical review and verification of the analysis. Thus, there is the potential for the TC to act upon the GHG emissions estimates presented in the GHG Transportation Report without such estimates having undergone technical review.
        - Similarly, Per Section 8.05, the TC shall review "the sufficiency of any GHG Mitigation Measures needed for compliance." However, the Proposed Rule does not specify what the review for "sufficiency" requires and it is not clear if the TC is equipped to perform this review (i.e., technical knowledge, time, resources, etc).
- Second, per Section 8.02.5, GHG Transportation Reports must be submitted to the TC at least thirty (30) days prior to adoption of any Applicable Planning Document.
    - Based on the timeframes specified in Section 8.04.1 and Section 8.02.5, it seems there the potential for a GHG Transportation Report to be submitted to the TC 15 days after submission to APCD, whereby the TC could potentially reach a compliance determination prior to the end of the 30-day APCD review period. In such a scenario, the TC could act upon the GHG emissions estimates presented in the GHG Transportation Report without such estimates having undergone technical review, or while technical review from APCD is still underway.
- Third, there is no timeframe for the TC to complete their review of the GHG Transportation Report and determine compliance per Section 8.05 of the Proposed Rule. Section 8.05 specifies the enforcement of the Proposed Rule, stating that "The Commission shall review all GHG Transportation Reports to determine whether the applicable reduction targets in Table 1 have been met and the sufficiency of any GHG Mitigation Measures needed for compliance." However, there is no timeframe specified.
- Finally, the Proposed Rule does not specify the timeline for enforcement actions taken under Section 8.05.2 of the Proposed Rule. Specifically, it is not clear when funding restrictions would be implemented or to which projects they would apply should the TC

restrict the use of funds pursuant to Rules 8.02.5.1.1 or 8.02.5.1.2, as applicable, to projects and approved GHG Mitigation Measures that reduce GHG.

Weld County's Recommendation

The rule language should be modified to ensure that:

- GHG Transportation reports undergo technical review and verification prior to a compliance determination from the TC;
- The TC reviews and evaluates the compliance of GHG Transportation Reports within a specified timeframe; and
- Enforcement timeframes are specified, particularly as related to the restrictions of funds.

Concern No. 5

Some numbers in Table 1 when added together do not meet the total reductions, possibly due to rounding, which may result in actual emission reductions falling short of estimated totals even when all rule requirements are met.

- For example, 2025 reduction levels are shown as 0.27, 0.04, and 0.12, the sum of which is 0.43, as compared with 0.5 reported for TOTAL. While the discrepancy may seem small in magnitude, it is greater than the reduction level for NFRMPO in this year.
- Therefore, even if DRCOG, NFRMPO, and CDOT meet their respective reduction targets of 0.27, 0.04, and 0.12 MMT CO2e, the total GHG emission reductions achieved would fall short of the 0.5 MMT CO2e estimated for total reductions in 2025.
    - A similar concern exists for compounding rounding errors in GHG emissions estimates reported by CDOT/MPOs. For example, if each regional area were to round estimated GHG reductions up to demonstrate compliance, actual GHG emission reduction may fall further short of estimated total. For example, 0.265, 0.035, 0.115 may be rounded to 0.27, 0.04, and 0.12 respectively, based on the number of significant figures reported, and would result in actual emission reductions of 0.415 MMT CO2e.

Weld County's Recommendation

- Clarify calculation of TOTAL row in Table 1 of the Proposed Rule. Table 1 should be revised to show the same significant figures for all of the values. Additional information should be presented in a supplemental technical support document.
- Provide guidance regarding the number of significant figures to be used in GHG emissions estimates, particularly as related to rounding for regional area totals compared against the values in Table 1 of the Proposed Rule.

Concern No. 6

The basis for waivers specified in Sections 8.05.2.1.1 and 8.05.2.1.2 of the Proposed Rule is vague, and it is not clear what criteria or guidelines will be used to ensure fair and equitable evaluation of waivers.

- Per Section 8.05.2.1, a waiver can be requested from the TC imposing restrictions on specific projects not expected to reduce GHG emissions, and the TC may waive the restrictions on specific projects based on the requirements in Sections 8.05.2.1.1 and 8.05.2.1.2. However, the criteria in Sections 8.05.2.1.1 and 8.05.2.1.2 are not quantitative in nature.
    - For example, it is not clear how "significant effort and priority" will be determined, or what is a "substantial increase in GHG emissions when compared to the required reduction levels."
- Furthermore, waivers (or reconsideration requests) are deemed denied if no action is taken by the TC within 30 days (or at the next regularly scheduled TC meeting), which may result in automatic denial simply due to inaction.

Weld County's Recommendation

CDOT should clarify, through revised rule language or a guidance document accompanying the Proposed Rule, the criteria used to evaluate waivers. For example, guidance on how "significant effort" will be evaluated should be provided, and a "substantial increase in GHG emissions when compared to the required reduction levels" should be quantified.

Concern No. 7

The Proposed Rule and statement of basis and purpose do not address potential interactions between actions taken by CDOT/MPOs as a part of the Proposed Rule and actions taken by the enterprises[9] created in SB21-260 to reduce GHG emissions.

- By definition in SB21-260, the four enterprises are created "to serve the primary business purpose of reducing and mitigating the adverse environmental and health impacts of air pollution and greenhouse gas emissions…" Additionally, the specific function of the first three Enterprises is focused primarily on electrification (including infrastructure) and the non-attainment area (NAA) mitigation Enterprise is focused on traffic/VMT reduction, along with projects that "directly reduce air pollution." Examples in the last category include "retrofitting of construction equipment, construction of roadside vegetation barriers, and planting trees along medians."
- While it seems unlikely the Enterprises would undertake a "regionally significant project" as defined in the Proposed Rule, the Enterprises may undertake projects that could qualify as GHG Mitigation Measures under the Proposed Rule. It's not clear from

[9] SB21-260 created the community access enterprise, the clean fleet enterprise, the clean transit enterprise, the nonattainment area air pollution mitigation enterprise. *See* Colo. SB 21-260, https://leg.colorado.gov/sites/default/files/2021a_260_signed.pdf.

the Proposed Rule language if projects that reduce GHG emissions undertaken by the Enterprises could be used as mitigation measures by CDOT/MPOs to meet the reduction targets specified in the Proposed Rule. Accurate accounting of GHG reduction projects is critical to avoid double counting and understand the compliance options available to CDOT and MPOs.

  - Additionally, it's unclear if the modeling conducted for the Proposed Rule (i.e., values in Table 1 and Table 2) account for any Enterprise projects, either in the baseline or the reduction targets.

Weld County's Recommendation

CDOT should clarify, through revised rule language or a guidance document accompanying the Proposed Rule, how Enterprise activities interact with the actions taken by CDOT/MPOs as a part of the Proposed Rule, particularly as related to GHG mitigation measures.

Concern No. 8

No guidance is provided as to how modeling should be conducted to demonstrate compliance with the applicable reduction targets in Table 1.

- It's not clear from the language in the Proposed Rule what model inputs, assumptions, and methodology can or should be used by CDOT/MPOs to estimate GHG emissions. Further, it's not clear if CDOT/MPOs must meet the reduction levels in Table 1, or if they must meet an absolute GHG emissions target determine based on the baseline projects and reduction levels in each target year.
  - For example, would NFRMPO need to meet a GHG emission level of 2.3-0.04=2.26 MMT CO2e in 2025? Or would they need to demonstrate, by modeling two or more scenarios, that they have met a reduction level of 0.04 MMT CO2e?
- Per Section 8.02.1, "The emissions analysis must estimate total CO2e emissions in million metric tons (MMT) for each year in Table 1 and compare these emissions to the Baseline specified in Table 1." Thus, this section suggests total CO2e emissions must be compared to the baseline.
- However, other sections (i.e., 8.02.4.1, 8.02.5.1, 8.02.5.3, 8.05, etc) specifically refer to meeting or demonstrating compliance with the reduction levels. In particular, Section 8.05 states "The Commission shall review all GHG Transportation Reports to determine whether the applicable reduction targets in Table 1 have been met and the sufficiency of any GHG Mitigation Measures needed for compliance."
  - Therefore, it's not clear why Section 8.02.1 requires comparing emissions to the baseline if compliance is assessed based on meeting reduction levels.

Weld County's Recommendation

CDOT should revise the rule language to clarify how compliance is assessed and develop a guidance document that describes the modeling methodology that should be used to determine compliance with the Proposed Rule.

Conclusion

Weld County appreciates the opportunity to participate in this rulemaking and thanks CDOT and the TC in advance for their attention to these initial written comments. Given the concerns outlined above, Weld County requests the Transportation Commission extend the deadline for written comments to no earlier than 30 days after receipt of the requested data, and schedule an additional hearing after the close of the extended comment period.

Respectfully submitted this 24th day of September, 2021.

BOARD OF COUNTY COMMISSIONERS
OF WELD COUNTY, COLORADO

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Public comment: Greenhouse Gas Pollution Standard

1 me age

[redacted] Fri, Sep 24, 2021 at 12:24 PM
To: dot_rules@state.co.us

Hello,

Attached please find a public comment created at an advocacy workshop on August 5, 2021, which focused on the Greenhouse Gas Pollution Standard rulemaking. The workshop had 50 attendees from around the state, mainly gra root activi t The comment i ubmitted on behalf of them and their communitie , not any organization

At the workshop, we spoke to participants about the upcoming rulemaking, then asked them to share their stories about transportation planning in Colorado. We used the interactive software of Google Jamboards to create a collaborative vi ion, and I have attached the final re ult a a PDF

The comment addresses the following questions in a visual format:

Where are you from?
How do you get where you need to go?
How do you *wish* you could get there?
What frustrates you about transportation where you live?
What transportation project would you like in your community?

This is a powerful way to collect public comment. The atmosphere was friendly and comfortable, participants felt no pressure to participate in a certain way, names are not attached, and the format for making comments was easy and accessible. We hope that moving forward, CDOT will consider more innovative methods of community outreach, and creative form of te timony

Thank you for the opportunity to center the voices of the community in this rulemaking. We look forward to a strong Greenhouse Gas Pollution Standard.

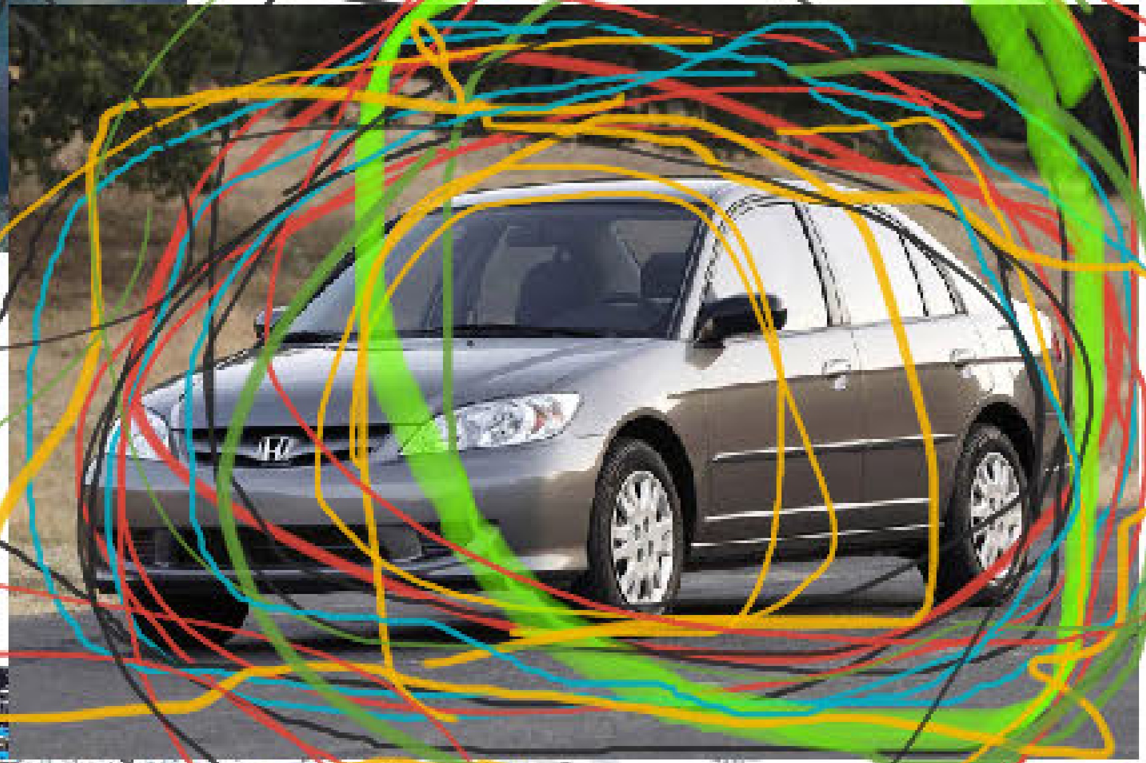
--

[redacted]

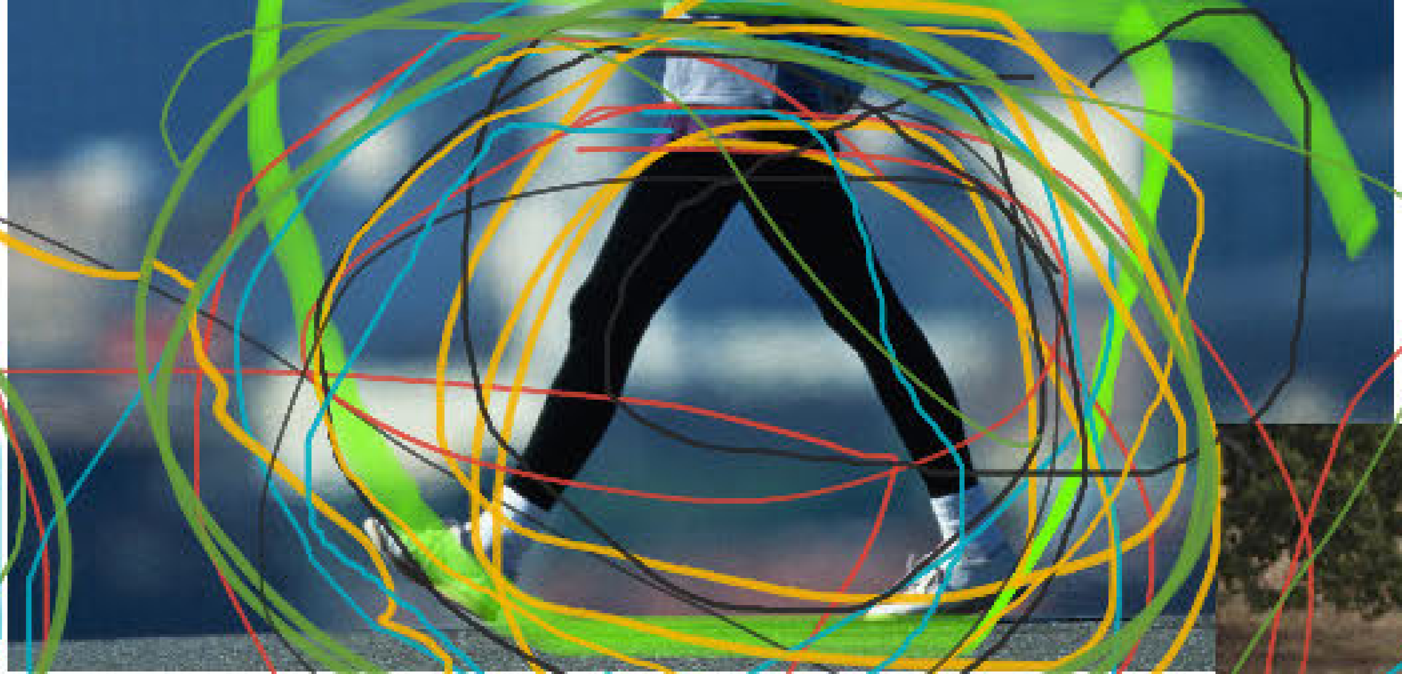
Conservation **Colorado**

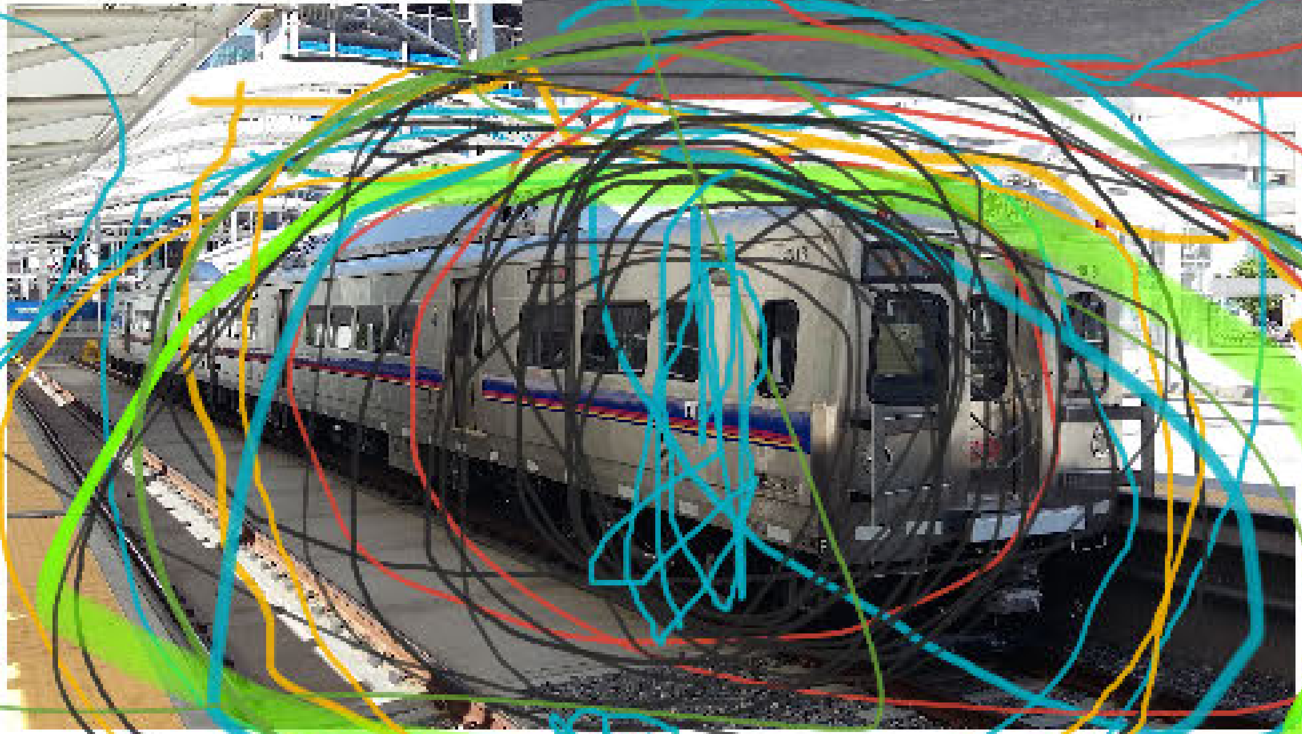
Tran portation Vi ion Advocacy Work hop (1) pdf
4092K

COLORADO
FT. COLLINS
PINE BLUFFS
SIDNEY
STERLING
JULESBURG
DINOSAUR NAT'L MON
CRAIG
STEAMBOAT SPRINGS
GREELEY
FORT MORGAN
ROCKY MOUNTAINS NAT'L PK
GRANBY
DINOSAUR
BOULDER
DENVER
GLENWOOD SPRINGS
VAIL
RIFLE
STRASBERG
GRAND JUNCTION
ASPEN
LIMON
BURLINGTON
COLORADO NAT'L MON
COLORADO SPRINGS
GUNNISON
SALIDA
MONTROSE
PUEBLO
TELLURIDE
LA JUNTA
LAMAR
CANYONS OF THE ANCIENTS NAT'L MON
CORTEZ
DURANGO
ALAMOSA
MESA VERDE NAT'L PK
TRINIDAD



How do you get where you need to go?
¿Cómo llegas a donde necesitas ir?





How do you wish you could get there?
¿Cómo le gustaría poder llegar allí?

What frustrates you about transportation where you live?
¿Qué le frustra del transporte donde vive?

Bus doesn't go where I need it to

Transit stops are far away

Bus never comes when it's supposed to

Not enough frequent transit service

Not enough affordable housing near transit

Lack of options and safety.

Bike lanes are deadly instead of safe

Lack of protected/good bike lanes on the roads

Dangerous to ride a bike.

It's EXPENSIVE!

It takes 3 times as long to get to work by transit than by car.

The transit time for a bus to Denver takes 2 hours vs. 30 minutes in a car.

Transit takes 1 hour 15 min to get to work with transfer. Too long.

not dense enough to be walkable

Pathetic bicycle facilities.

Dangerous bike/walk routes

Lack of connecting bike lanes.

Breathing in air pollution when I ride my bike.

City planners don't understand & promote bicycling!

No enforcement of blocked bike lanes.

Need more bus routes & frequency, need rapid rail.

Not enough 5-15min neighborhoods

transit too far away, doesn't run as often as I need, it's usually almost halfway to my destination to use transit, so I often end up driving

Virtually no public transportation. There is a bus from Durango to Grand Junction and back every day but doesn't go thru at a time that is useful. Rural areas the only choice is don't go or drive!

Difficulty taking any transit into the mountains for weekend or evening recreation

That the US 36 commuter rail train does not go to Boulder.

congestion, bus routes don't connect well, ozone pollution

Even when biking, it is hard to bike near the main roads due to trouble breathing as well near cars, construction (like asphalt), and fires

I live in Fort Collins, and we have excellent all-around transportation. It would be great if we could have a bike trail that takes us to Denver or elsewhere!

What frustrates you about transportation where you live?
¿Qué le frustra del transporte donde vive?

Air pollution

GHG

Air quality this summer :(

Too many tailpipes

Too many cars causes too much air pollution

Too much ground level ozone & wild fire smoke

Trouble breathing in the exhaust

Too many cars

traffic is wack

Traffic is awful, and parking is scarce

Congestion. People forgot how to drive

Car-centric sprawl landscape

Traffic

Congestion! The way people drive. Like they forgot how to drive during the pandemic. Rude & run red lights all the time.

6 lane streets

Too often road building

Too many people drive to school

Coal Rollers!!

What transportation project would you like in your community?
¿Qué proyectos de transporte le gustaría ver en su comunidad?

- Walkable or free bus
- Better mass transit.
- affordable housing near transit
- Faster buses
- Trains run on clean energy
- Trains run on renewable/ clean energy
- Hover craft. walk all places.
- Extensive transit routes/ free
- All transit comes at least every 10 minutes.
- Bus stations with dignity
- Dedicated bus lanes
- dedicated bus lanes and transit signal priority (esp FF in Boulder) + high frequent service
- We need electric buses and routes for all the people who need to work & shop for groceries, etc
- Pollution controls on trains, and transition to electrification!
- Various size buses all electrified
- I wish I could walk everywhere I need to go within 10-15 minutes
- Transportation organizations from CDOT to DoPIRG to Bike Fort Collins to assemble all models & specs on electric bikes for public perusal.
- State & Cities to organize electric bike traveling shows which include as many e bikes as available for comparisons and introduction.
- Desperate need for rural transportation & it needs to be electric also.
- Need subsidies for public transit and for EVs including used so everyone can afford them.
- flatiron flyer should be free
- World class active transportation network throughout the front range
- To complete the northwest rail line.
- More RTD or shuttles from Boulder to Eldora in winter
- Transit priority for Flatiron Flyer through downtown Boulder
- More CDOT Bustang service, including from Boulder to mountains
- Electric Buses with a rapid transit route to Denver
- frequent transit service along I70 corridor
- Train to the mountains
- Seconding the train to the mountains!
- Mass transit connecting Pueblo to Fort Collins.
- Bike transportation all across Colorado!! From Northern Colorado all the way to Southern Colorado would be awesome!!

What transportation project would you like in your community?
¿Qué proyectos de transporte le gustaría ver en su comunidad?

all vehicles must be electric

Turn in your ICE car for an EV!

Drastically reduced number of SOVs and combustion engines

Less parking provided with developments

Reduced commitment (and space dedication) to car infrastructure

on current roads and retrofitting current cars with a way to attach to the track system and run on electricity thru the system which is made from solar and wind power and from the turning of all the wheels and breaking in the system.

Rebates for eBikes

Dedicated Bike, ped transit routes

more protected bike lanes

More bike lanes.

sperated bike facilities

better bike storage on light rail cars

Bike lanes and better bike cars on the light rail

Walkable neighborhood connected to residences via bike trails

Fix intersection light timing to improve driver safety, lower excess hard braking, and lower congestion related air pollution

Current cars retrofitted to run on tracks on current roads using electricity from sun, wind and the cars themselves!

traffic-separated bike lanes throughout the city!!!!

Congestion charge for downtown denver which funds real Dutch style protected bike lanes.

Full network of protected bike lanes. Wide sidewalks. Frequent transit.

Improve incident management, coordination between agencies and the removal of disabled vehicles from travel way quickly.

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Testimony re: greenhouse gas planning rule

1 me age

[redacted] Fri, Sep 24, 2021 at 6:03 PM
To: dot_rules@state.co.us

Te timony to the Colorado Tran portation Commi ion

Regarding Greenhouse Gas Transportation Planning Rules

Sept. 23, 2021

My name is [redacted] and I'm speaking for myself. I commend CDOT for acknowledging the phenomenon of induced demand, which was originally expressed as the result of adding lanes to expressways. If we add lanes, congestion of the expressway temporarily reduces. But because it's easier to drive, more people drive, so the congestion returns. We are seeing this now with the T-Rex project through south Denver. It was wide-open for some years after construction, but now often fills up. It's not just that our population has expanded. It's the fact that we are driving more.

I believe that CDOT and the Commission have not come to a full reckoning with the reality of induced demand. Our state plan to build many e pan ion to highway I find it particularly galling that we till plan to widen I 25 we t of downtown That project will certainly induce more demand for automobile travel and it will come at the expense of major disruption and con umption of e tremely valuable downtown land It will increa e our collective greenhou e ga footprint Thi project should be abandoned.

What we must learn, but today refuse to learn, is that EVERY investment that makes it easier to drive will result in more people driving more miles. When we make local roads smoother, or straighten them, or improve their signals, those actions make it easier to drive. When we build slip lanes to improve the flow of traffic at intersections, that too makes it easier to drive.

As long as we continue to spend our public transportation money on making it easier to drive, VMT will increase and traffic conge tion will alway , eventually return We cannot build out way out of traffic conge tion by building bigger or better roads. So CDOT must remove from its greenhouse gas calculations any improvements alleged to come with road improvement You may temporarily reduce idling at inter ection or lowdown on arterial But tho e change will not last.

If we fully electrify our automobile fleet, and charge those batteries only with renewable energy, the greenhouse gas calculation would be different. However, the induced demand problem would remain the same. People will still be frustrated by congestion because every investment we make in our road system causes a collective increase in our driving. We cannot solve congestion by improving road facilities.

The answer is to invest instead in alternatives to roads and cars. We need far more frequent buses. We need trains that connect all our citie and town We need le prawl, more conci e urban environment where it' ea y and afe to get to most destinations by walking and bicycling.

I know that does not meet the concerns of rural Coloradoans, where public transportation may always be sparse and distances are too long for walking and bicycling. So how about we rededicate to roads in rural Colorado much of the money that would otherwise go to demand-inducing roads in the Front Range cities.

I urge CDOT to revi e the rule and modeling to better account for the induced demand for driving cau ed by nearly all road investments.

[redacted]

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Train

1 me age

[redacted] Sun, Sep 26, 2021 at 3:34 PM
To: dot_rules@state.co.us

To whom it may concern,

I saw the DOT is trying to reduce greenhouse gas emissions.

With the population in CO booming and with thi , increa ed tate ta revenue , inve ting in a train from Denver to the mountains is overdue.

Traffic is constantly at a standstill on 70.

What's more, out of towners will be more inclined to visit for ski season if they don't have to rent a car and drive on 70 during the winter…adding to your tourism revenue.

The Swi have figured thi out a long time ago if you want to look omewhere for an e ample

Everyone is desperate for this.

Thank ,
[redacted]

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Written comment for proposed Greenhouse Gas Standards

1 me age

[redacted] Mon, Sep 27, 2021 at 8:41 AM
To: dot_rules@state.co.us

To the Colorado Department of Tran portation

Thank you for hosting a hearing on your proposed greenhouse gas standards. I am submitting a written comment in advance of the hearing.

The only way to reduce our greenhouse gas emissions in the travel sector is to *greatly* reduce the number of personal vehicle miles driven. I mean this in an absolute sense, not in a per-capita sense. We need to have goals to vastly reduce personal vehicles on the road, even if our population continues to increase.

This needs to be done in two ways: 1) Strongly incentivize walking/biking/mass transit, and make those modes of travel both convenient and safe for citizens of all ages and abilities, and 2) *Disincentivize* personal vehicle travel, especially in densely-populated metro areas. Repeal all parking minimums. Set goals to convert open-air parking lots into usefully-developed land (e g , public park , hou ing, bu ine e , or ideally a multi u e mi of all of the above), e pecially near city cores. Dedicate more streets to be car-free, a la Denver's 16th Street Mall. Work with the legislature to ban single-housing exclusionary zoning statewide, and use policy to pressure localities to allow more density in their jurisdictions. And more--these are just a few examples of goals we should set, and I am in favor of bold, sweeping action to convert our citie into pede trian and bike friendly communitie

Also, set *aggressive* timeline goals. It's fine to have goals for 2040 or 2050, but we need to take aggressive action to reduce greenhouse gas emissions, and we need to see real change by 2025 if we are to avoid the worst of climate change outcome

Thank you again,

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Yes on Carbon budgets!

1 me age

[redacted] Mon, Sep 27, 2021 at 9:01 AM
To: dot_rules@state.co.us

I am writing today in upport of e tabli hing rule for carbon budget , and to encourage you to go farther We need bold moves for our state to meet (or how about we exceed) our goals for reduction of pollution.

GHG reduction levels in the draft rules do not add up to the 12.7 million metric tons of CO2e reductions from Transportation by 2030 figure outlined in the state's GHG Pollution Reduction Roadmap issues by Governor Polis' Office in January of this year. Coloradans deserve a clear, enforceable, and equitable plan to reduce GHG emissions from the transportation sector — not more account tricks.

I urge you to press forward and make Colorado a leader in the important moves needed to reduce greenhouse gas emissions. Let's lead the way!

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

PPRTA Chair [redacted] Testimony on 9/24/21

1 me age

[redacted] Mon, Sep 27, 2021 at 9:13 AM
To: "dot rules@state.co.us" <dot rules@state.co.us>
Cc [redacted]

There a Taku hi,

Plea e find attached a copy of the te timony given by Pike Peak RTA Chair Randy Helm at CDOT' Rule Making Public Hearing on September 24, 2021 in Colorado Springs.

[redacted]

cdot.ghg_20210927100747.pdf
72K

[redacted]

Colorado Department of Transportation GHG Rule-Making Public Hearing: September 24, 2021.

[redacted], Chair of the Pikes Peak Rural Transportation Authority provided the following public comments on behalf of the Pikes Peak Rural Transportation Authority's Board of Directors.

1. Implementation of the proposed rules should be delayed to no earlier than January 1, 2023 would allow much needed additional time for review, revisions, assessment of impact, feasibility assessments of various mitigation measures, planning, budgeting, and implementation.

2. Without a proposed draft of the Administrative Process for GHG Mitigation Measures, which has not been released, there is no way to meaningfully consider if or how the Regional GHG Planning Reduction Levels set forth in Table 1 can be achieved.

3. The proposed definition of "Regionally Significant Project" should be revised to clarify that it applies only to transportation projects that are facilitated by CDOT or an MPO thereby removing ambiguity related to projects facilitated by other entities.

4. The waiver requirements appear to only be available to projects that won't "substantially increase" GHG emissions, but there is no definition of what constitutes a "substantial increase". Further, the availability of this waiver could result in it not being a meaningful option for important projects that may have net economic, societal, and environmental benefits.

5. The proposed rules do not, but should, account for regions that have continued to remain in attainment with federally-regulated air quality standards.

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Comments on Greenhouse Gas Pollution Standard for Transportation Planning

1 me age

[redacted] Mon, Sep 27, 2021 at 12:29 PM
To: dot_rules@state.co.us

To whom it may concern,

Below are my comments on the Greenhouse Gas Pollution Standard for Transportation Planning rulemaking process.

Colorado i failing to meet it emi ion reduction target , part of the We t face unprecedented drought, and climate change is having profound impacts on every continent. The time for delay is long past. Anything less than a bold policy to aggressively reduce transportation emissions would be a dangerous abdication of our responsibility to our citizens, humanity, and future generations.

The draft rules will not result in adequate emissions reductions, missing out on the already-inadequate 12.7 million metric tons CO2e target set in the state GHG Pollution Reduction Roadmap. Stop failing to do your jobs. The final rule must exceed the target, and not depend on accounting tricks, overoptimistic projections (for example related to EV adoption), or other phonine The final rule hould include contingencie for how to make up for any hortfall that occur a a result of inaccurate projections or unforeseen circumstances.

I would like to see a halt to new highway construction as a matter of state policy, with a redirection of focus towards better tran it and land u e deci ion that enable low emi ion tran portation

Any rule must account for and address the need for low income communities to have affordable, multimodal options for transportation that simultaneously reduce emissions.

Finally, COMPREHENSIVE DETAILS FOR ALL MODELING, ESTIMATES, AND ASSUMPTIONS MUST BE MADE AVAILABLE FOR REVIEW BY THE PUBLIC. There should be no hiding behind impenetrable bureaucracy. Transparency is crucial.

Thank you,

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Comments on The GHG Pollution Reduction Planning Standard

1 me age

[redacted] Mon, Sep 27, 2021 at 4:01 PM
To: dot_rules@state.co.us

To the Rule Making Committee

I live in Centennial and my medical practice is in Highlands Ranch

Thank you for making this great step forward to fight the devastating effects of Green House Gases, but the current draft does not go far enough

The impact of the last 40 years of rapid growth in Metro Denver has impacted me personally and professionally
The landscape has transformed dramatically with increased construction displacing green scape, and increased population density leading to more vehicles on the road and traffic congestion
As a result, quality of life and health indices have deteriorated in Colorado, once an icon to healthy living and lifestyle
I can't believe how many days we could not see the mountains because of this summer's air pollution!

As a medical doctor, I am very concerned about the health effects of increasing amounts of air pollution and the increasing number of days of unhealthy air in Colorado
Just last week, the World Health Organization revised its air quality guidelines on the basis of evidence based data and the awareness that no amount air pollution is safe for human beings

To act with conviction and commitment to ensure our children and grandchildren have clean air to breathe in Colorado, I urge CDOT to strengthen the rule in 3 specific ways

1 Explicitly prioritize projects that focus on reducing VMT
2 Make the 10% reduction in VMT statutory
3 Rather than overseeing regionally significant projects, create specific project level modeling maximizing GHG and VMT reduction

Thank you for your work on this profoundly important issue

Sincerely,

[redacted]

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Comments to the Rule Governing Statewide Transportation Planning Process and Transportation Planning Regions 2 CCR 601-22 (8/31/2021)

1 message

[redacted] Mon, Sep 27, 2021 at 5:51 PM
To: dot_rules@state.co.us
Cc: "Takushi - CDOT, Theresa" <theresa.takushi@state.co.us>

Natalie Lutz

CDOT Formal Comments to Rule Governing Statewide Transportation Planning Process and Transportation Planning Regions 2 CCR 601-22 (8/31/2021)

My name i [redacted] and I repre ent the Climate Reality Project

I am a former environmental consultant to CDOT and the Federal Highway Administration

The propo ed rulemaking feel and mell ju t like the old planning proce that promote increa ed y tem capacity and vehicle miles traveled without making the hard GHG reduction decisions.

Environmental Justice populations need to be integrated into the planning discussions regarding GHG reductions; these population are mo t at ri k for GHG emi ion and climate change impact I have not noted any EJ population giving testimony. I urge that CDOT follow their EJ policy and integrate these populations. CDOT needs to contact the Chief Equity Officer for Environmental Justice and Community Partnerships.

At what point doe CDOT determine that they cannot meet the GHG reduction target and need to go into the mitigation options? It is not clear how mitigation options can be selected since there are no mass CO2 reduction established for each option. It is not clear what if the transportation plan and mitigation option does not meet the GHG reduction target. The project should go back to the “drawing board” and not allowed to continue until GHG reduction targets are fully met.

CDOT contains the largest population of engineers in the state and their interests are to build road infrastructure and not manage GHG reductions. How does CDOT plan to reconcile increased system capacity (i.e. increased roads and lane age) and vehicle miles traveled with decreasing GHG emission requirements? Electric vehicles alone (as mentioned by a confu ed Governor Poli during an interview) will not olve thi VMT/GHG problem

It is my understanding according to the Roadmap that the Clean Truck Strategy considered a mitigation option? This action should be on going and it is not clear if a planning project that cannot make the GHG reduction target will take a credit from the Clean Truck Strategy Thi need clarification

A strong working relationship with RTD, DRCOG, CDOT, and the Governor is needed to improve transit problems in the Denver Area. Significant VMT reductions can only be realized if there is an increase in light rail, rail, carpooling and bus ervice in the large metro area ; thu , decrea ing GHG emi ion

CDOT and MPOs needs to re-evaluate previous transportation plans that are within the past 5-year window and address their GHG emissions with new proposed projects

Transportation Plans that address GHG reductions need to be made for public review/comment; transportation plans that address GHG emissions and climate change need to be transparent and not made behind the curtain without public oversight and feedback to the MPO and CDOT

The rule proposes a State Interagency Consulting Team made up of CDOT and CDPHE management and MPO Directors, but their function is not defined in the rule making; nowhere is there a mention of a public representative from an environmental organization. Decisions need to be made in a transparent fashion

Waivers are an easy way for large transportation projects to avoid GHG reduction-based transportation plans. They need to be the extreme exception and not the rule. The criteria and approval mechanisms for waivers need to be identified with public notification.

The proposed rule dares to mention CDOT experience in Clean Air Act conformity when ozone compliance aided by transportation is nonexistent.

How does CDOT plan to measure success with this new rule making and what adaptive management actions will be considered?

CDOT need to compile all of the TRP reduction for all MPO and po t them to the public annually and evaluate the e data to the required regulatory reductions.

CDOT will need at least 3-4 Full Time Equivalent employees experienced in planning to manage this proposed rule change with direct over ight by upper planning management at the MPO/CDOT region level

The CDOT NEPA process needs to referenced the TRP GHG reduction plan for projects to ensure compliance to established GHG emission reductions. The NEPA manual needs to be revised to address the planned GHG reductions for project

[redacted]

"Unless someone like you cares a whole awful lot,
Nothing is going to get better. It's not."

"*I speak for the trees, for the trees have no tongues.*"
— Dr. Seuss, The Lorax

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Comments to CDOT Transportation Commission

1 me age

[redacted] Mon, Sep 27, 2021 at 6:35 PM
To: dot_rules@state.co.us

1.Support zero-emission transit services and charging stations and expand transit routes.

2.Give tax incentives to anyone buying new or used electric vehicles until 2025.

3.Work with Amtrak to build a transit service from Pueblo to Fort Collins with transfers to local light rail and/or bus transit into cities and add and/or expand extra parking lots with added rapid charging stations for electric and hybrid/electric vehicles parked in the lots.

4.Give hotels along highways tax incentives to add charging stations to their parking lots.

5.Give restaurants/fast food places/truck stops along highways (between hotels with charging stations) tax incentives to add rapid charging stations and the same for large malls in cities over 100 thousand.

6.Give tax incentives or rebates to current vehicle owners who retrofit hybrid motors in newer vehicles purchased within last 5 years.

7.The state might set up a fund to help new and used car dealers to add hybrid motors to vehicles worth five to seven thousand dollars until 2025. The state must have a plan to get fossil fueled vehicles off the road by 2030.

8.Prioritize deploying zero emission heavy-duty vehicles in communities and magnet facilities such as commercial warehouses in same communities.

9.Support transit and zero-emission services and charging stations and expand transit routes in metro areas of 100 thousand or more. Light rail stations should have shuttle buses to business hubs and bus systems should expand services.

10.Use railway services to bring in loaded trailers that are transferred to local zero emission heavy duty trucks and/or have goods transferred to smaller zero-emission trucks for distribution.

11.Need a law transitioning from gasoline/diesel fueled vehicles and heavy duty trucks and farm equipment to zero emission vehicles by 2030.

12. Require cities of 100 thousand or more to replace their fossil fueled buses with zero emission busses by 2030. Provide incentives to cities with zero emission busses in 2030 by 2035 to add zero emission shuttles between 6AM to 9AM and 3PM to 6PM in underserved residential neighborhoods to transport riders to designated bus stops.. Not everyone has a car or can afford one.

13. Require hybrid owners to switch to zero-emission vehicles by 2035.

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Geenhouse Gas Pollution Standards

1 me age

[redacted] Wed, Sep 29, 2021 at 1:50 PM
To: dot_rules@state.co.us

- July wa the hotte t month ever recorded, our Earth i hotter than it' ever been ince the beginning of the last ice age, and yet Colorado is not on track to meet its climate targets! **It is critical that our state agencies embrace bold, transformative policies that drive broad scale decarbonization.** The current draft rule is a good start, but should be more ambitious to ensure that we meet our emi ion reduction target

- A a matter of environmental ju tice, **disproportionately impacted communities and communities of color must be at the heart of any decision-making process** to ensure access to affordable, multimodal, transportation options that reduce toxic air pollution and traffic congestion. Please also develop an equity framework beyond this rulemaking that ensures that individuals from di proportionately impacted communitie are given a real eat at the deci ion making table

- **GHG reduction levels in the draft rules do not add up to the 12.7 million metric tons of CO2e reductions from Transportation by 2030 figure outlined in the state's GHG Pollution Reduction Roadmap** issued by Governor Polis' Office in January of this year. Coloradans deserve a clear, enforceable, and equitable plan to reduce GHG emissions from the transportation sector — not more account trick

- **The draft rules rely heavily upon optimistic electric vehicle (EV) adoption rates** and provide no alternative proposals for achieving these GHG reductions if EV adoption is slower than anticipated. Therefore, this rule should adopt stricter carbon budgets that will allow us to meet our emissions reduction targets given the liklihood that EV adoption does not occur as fast as this rule anticipates.

- **Instead of more highway expansion projects, Coloradans need more and better transportation alternatives to driving a vehicle** like electric bicycle and cooter for horter trip , affordable and efficient public transit for longer trips, expanded light rail and bus rapid transit along major routes, and better land use decisions to provide more bike lanes, sidewalks, and pedestrian-centric urban centers. This rule should impose a moratorium on highway expansions, as this strategy has only hown to increa e traffic, air pollution and di place neighborhood

- **The draft rules do not account for all greenhouse gas sources from vehicles.** Hydrofluorocarbons (HFCs) are not included in the definition of a greenhouse gas. This is a significant omission because HFCs from vehicle air conditioners and refrigeration trucks are powerful GHGs with Global Warming Potentials (GWPs) hundreds to thousands of times greater than that of CO2

[redacted]

- Transportation models, assumptions, estimates and **figures used to guide transportation policy by CDOT must be transparent for the public** to engage in deci ion making proce e that impact public health, traffic congestion and our state’s GHG emissions.

Finally, plea e remember the Rule of the Nine P' Plea e Prioritize People and Planet over Profit, Politic , Poi on , Power, and Partisanship!

Sincerely,

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Greenhouse Gas Emissions Reduction Opportunities-Public hearing 9/29/21 Limon Colorado

1 message

[redacted] Wed, Sep 29, 2021 at 3:06 PM

To: dot_rules@state.co.us

Hello,

I tried to attend the public meeting scheduled for Limon on 9/29/21, but was not able to gain access to the virtual meeting, this link simply did not work for me...

9/29/2021	2-5 p.m.	CDOT Regional Office Big Sandy Conference Room 2738 Victory Highway Limon, CO 80828	Sept. 29 Virtual Registration Form (Registration closes at 11 am on Sept. 28)	Sept. 29 YouTube Hearing Link (Viewing Only)

I admit I have **not** read all 207 pages of the Colorado Greenhouse Gas Pollution Reduction Roadmap, so I'm going to re pond with the following ba ed on my e perience of living between Ru h and Boone Colorado

Where I reside we are stuck with dirt roads that are **not** maintained at all in my opinion. When I moved here in 2014 I would see a road grader working my dirt road on Whittemore Road about once every other month or so, and after severe weather they would arrive within a few day to fi the damage cau ed by bad weather

Today, the above activity has been reduced to once every six months if at all. When it rains this road and the surrounding dirt roads become quagmires and completely impassable, this is where ditch bogging and **extreme** four wheel driving come into play So I know if I leave my property, there i no way for me to return until the road dry out, or I take my chances to see how bad the ditches are.

Due to these extreme road conditions I face living out here, I must use a diesel pickup truck on steroids to get myself to the grocery tore and then home again I truly believe there will never be an electric vehicle that will match the torque requirements needed to traverse these horrible dirt roads, especially in an emergency situation. Hence the reason I won't buy an electric vehicle, leave alone never being able to afford one.

I've contacted El Pa o County a king when my area will ever ee our road paved, and to thi day I till remember the full belly laugh the party answering the phone gave after I stated my query.
Also I have to keep on hand a large diesel tractor to traverse these horrible dirt roads that I use mainly to pull my poor tired old diesel truck home once it becomes stuck in these quagmire washboard roads we are forced to use out here.

So I'm writing to request a waiver to any changes made by this new proposal that will affect me personally.
Thank you for your consideration in this matter
[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Concern

1 me age

[redacted] Wed, Sep 29, 2021 at 4:19 PM
To: "dot_rules@state.co.us" <dot_rules@state.co.us>

I’m [redacted], Environmental Manager for Smithfield Hog Production in Yuma, CO. We are concerned with the propo ed change a to how it will work with the rural highway tructure We not only u e highway to tran fer our animals across state lines. We use local highways in commuting to our different farms, with our feed truck, staff, and contractors. Eastern Colorado seems to be on the lowest priority list in getting these roads fixed. We understand the concern for greenhouse gas emissions and we are striving to reduce this at our locations nationwide. We feel that by huffling funding to promote infra tructure along the front range where the non attainment area are, will once again impact us in rural Colorado. We agree that something must be done with traffic along the Front Range of Colorado and the amount of emissions that are polluting the air along the mountains. Sitting in Eastern Colorado on a daily basis and looking out my west window is sickening. We believe that funding of this is again placed on the backs of rural commuters a we mu t drive more mile ju t to get e ential ervice We already pay more at the pump due to the mile we travel this is a double whammy to all of our pocket books. Besides, we are very concerned with how these initiatives will impact our most vulnerable in our society. Public Transit availability may impede these persons in our society from getting the services they need as well. We believe we must all pay our share of these improvements to our state, the influ of people have been along the Front Range of Colorado and they are the contributor to the problem, o they should bear this burden financially.

Sent from Mail for Windows

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Comments: Greenhouse Gas Pollution Standard for Transportation Planning

1 me age

[redacted] Thu, Sep 30, 2021 at 8:03 PM
To: dot_rules@state.co.us

As a Colorado taxpayer and employee of a transportation modeling company I am writing to urge you to develop strong policie to reduce and eventually eliminate greenhou e ga e from tran portation in Colorado Tran portation i Colorado's largest source of greenhouse gas emissions and for the safety of our species and planet we must take immediate steps to set carbon budgets, enforce penalties for breaking budgets and develop a plan to eliminate greenhouse gases from the transportation sector entirely.

As a regular user of public transit and biking infrastructure I can see we have much work to do to provide efficient and afe alternative to car **Electric vehicle alone will not enable u to meet our target and more highway ju t result in more pollution, traffic and unproductive commute time. We must provide better bus, train, pedestrian and biking infrastructure that will not only improve mobility but strengthen communities.**

Please employ the following points in your plan:

- GHG reduction levels in the draft rules do not add up to the 12.7 million metric tons of CO2e reductions from Transportation by 2030 figure outlined in the state's GHG Pollution Reduction Roadmap issued by Governor Polis' Office in January of thi year Coloradan de erve a clear, enforceable, and equitable plan to reduce GHG emissions from the transportation sector.
- Instead of more highway expansion projects, Coloradans need more and better transportation alternatives to driving a vehicle, like electric bicycles and scooters for shorter trips, affordable and efficient public transit for longer trip , e panded light rail and bu rapid tran it along major route , and better land u e deci ion to provide more bike lanes, sidewalks, and pedestrian-centric urban centers. This rule should impose a moratorium on highway expansions, as this strategy has only shown to increase traffic, air pollution and displace neighborhoods.
- The draft rules do not account for all greenhouse gas sources from vehicles. Hydrofluorocarbons (HFCs) are not included in the definition of a greenhou e ga Thi i a ignificant omi ion becau e HFC from vehicle air conditioners and refrigeration trucks are powerful GHGs with Global Warming Potentials (GWPs) hundreds to thousands of times greater than that of CO2.
- Transportation models, assumptions, estimates and figures used to guide transportation policy by CDOT must be tran parent for the public to engage in deci ion making proce e that impact public health, traffic conge tion and our state's GHG emissions.

Thank you for the work you do to ensure Coloradans like myself have access to employment, recreation and nature. I trust you will take the steps necessary to strengthen our great state and protect us from the effects of climate change.

Thank you
[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Public Comment: GHG Reduction for Transportation

1 me age

[redacted] Sat, Oct 2, 2021 at 8:20 AM
To: dot_rules@state.co.us

Dear Colorado Department of Transportation and Governor Polis,

Thank you for the opportunity to comment on the Greenhouse Gas Pollution Reduction for Transportation Planning Proposed Standards, 2 CCR 601-22, and for your efforts in this rulemaking process.

I am submitting this comment in a personal capacity but, as a Board Member and Treasurer at Holy Cross Energy, I am familiar with the opportunities and challenges associated with transitioning to a cleaner energy economy.

Here in the state's mountain communities we see the traumatic impacts of increasing fires and fire intensity, mudslides, hotter days (and nights) and the impairment of water flow in our rivers. And with river flows lower and reservoirs dropping now we face disruptions to electricity supply as generating capacity drops. Climate change caused by GHG emissions is an existential crisis.

Materially addressing transportation emissions is an important step to mitigating these threats as well of course of improving air quality and hence health outcomes especially for more marginalized communities forced to live near major traffic routes.

I strongly support a robust GHG standard for future transportation projects because such standards will help the state reach its emissions reduction goals, encourage multimodal transportation methods that reduce Vehicle Miles Traveled, and improve the health and safety of *all* Colorado residents.

I would add that in my view, based on the recent IPCC "Code Red" report, our climate reduction goals are themselves not adequate. We need to do more and faster to forestall the worst climate and air quality outcomes. I look forward to more state legislation in this regard in 2022.

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Yes to the GHG Pollution Reduction Planning Standard

1 me age

[redacted] Sat, Oct 2, 2021 at 2:43 PM
To: dot_rules@state.co.us

Dear CDOT,

I strongly support the proposed GHG Pollution Reduction Planning Standard. For too long, our state transportation development has prioritized unsafe and energy-intensive motor vehicle travel over all other forms of travel. We have paid the price for tho e pa t choice in the form of thou and of traffic fatalitie and evere injurie , urban prawl, wor ening motor vehicle traffic, and some of the worst air quality in the nation. The number of air quality alerts this past summer was appalling. I had to spend many summer days indoors with the air conditioner on to escape the pollution.

I want to be able to afely travel via foot, bike, tran it, or car, and I can't do that becau e of how dangerou the road are throughout Colorado. I have no hope that we can address climate change and the major GHG contributions from the transportation sector unless we make it easy and safe for people to choose alternatives to motor vehicle travel. Climate change is a crisis and CDOT can give it the emergency treatment it deserves by implementing the GHG Pollution Reduction Planning Standard Thi change cannot come fa t enough

Sincerely,
[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Yes to the GHG Pollution Reduction Planning Standard

1 me age

[redacted] Sat, Oct 2, 2021 at 2:43 PM
To: dot_rules@state.co.us

Dear CDOT,

I strongly support the proposed GHG Pollution Reduction Planning Standard. For too long, our state transportation development has prioritized unsafe and energy-intensive motor vehicle travel over all other forms of travel. We have paid the price for tho e pa t choice in the form of thou and of traffic fatalitie and evere injurie , urban prawl, wor ening motor vehicle traffic, and some of the worst air quality in the nation. The number of air quality alerts this past summer was appalling. I had to spend many summer days indoors with the air conditioner on to escape the pollution.

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Sincerely,
[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Public Comment: GHG Pollution Standards rulemaking

1 me age

[redacted] Mon, Oct 4, 2021 at 2:43 PM
To: "dot_rules@state.co.us" <dot_rules@state.co.us>
Cc [redacted]

Dear CDOT,

Attached is a sign-on letter in response to the GHG Pollution Standards rulemaking that captures the voices of community member , e pecially Spani h peaking individual who live in home mo t impacted by highway e pan ion

This letter is still open, and we anticipate additional sign-ons by the end of public comment; however, we felt that it was important to share this message and signatures as of October 4 to help inform the process.

Sincerely,
[redacted]

[redacted]

10.4.21 Letter to Transportation Commissioners.pdf
71K

October 4, 2021

Note: This letter is still active, and we anticipate that additional community members will sign-on before the end of public comment; however, we felt it was worthy of submitting this letter in English and Spanish as of October 4 as a preview.

Two community members also shared their comments on video:
[redacted]

Letter Supporting Equitable and Ambitious Transportation Rule //
Carta de apoyo a la regla de transporte equitativo y ambicioso

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Dear Commissioner,

Thank you for your work on the Greenhouse Gas (GHG) Pollution Standards Rulemaking.

This rulemaking is a chance to clean up the dirty air that is harming our health, especially our kids, elderly friends and family, and communities located near busy highways, and I am asking you to stand up for clean air, safe streets, and healthy neighborhoods.

As the Colorado Department of Transportation (CDOT) revises the draft GHG Pollution standard over the next few months, we are asking CDOT to:

1. Center EQUITY in all decision-making processes,
2. Elevate COMMUNITY VOICES through robust public participation processes that include language translation, targeted outreach, and early publication of hearings,
3. Set MORE AMBITIOUS pollution reduction targets.

This is Colorado's opportunity to make good on our climate and environmental justice commitments, prioritize investments in public transit, and include a public engagement process that centers communities most impacted by transportation pollution.

Estimado Comisario,

Gracias por su trabajo pertinente a la reglamentación de los estándares de contaminación de los gases de efecto invernadero (GEI).

Esta reglamentación es una oportunidad de limpiar el aire sucio que está dañando nuestra salud, especialmente a nuestros niños, amigos y familiares ancianos que viven en comunidades cerca carrteras muy tráficadas, y les pido que defendan el aire limpio, calles seguras y barrios saludables.

A medida que el Departamento de Transporte de Colorado (CDOT) revisa la guia de (GEI) durante los próximos meses, le pedimos a CDOT lo siguiente:

1. Centrar la EQUIEDAD durante el proceso de tomar decisiones,

2. Elevar las VOCES DE LA COMUNIDAD a través de procesos sólidos de participación públicas que incluyen traducción de idiomas, divulgación directa, y publicación temprana de audiencias.

3. Establecer objetivos de la reducción de contaminación MÁS AMBISIOSOS.

Esta es la oportunidad de Colorado para cumplir con nuestros compromisos de justicia ambiental y climática, priorizar las inversiones en el transporte publico e incluir un proceso de partcipación pública que se enfoque en las comunidades más afectadas por la contaminacón del transporte.

Sincerely // Attentamente,

Name, County:

[redacted]

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Proposed Greenhouse Pollution Reduction Standards.

1 me age

[redacted] Mon, Oct 4, 2021 at 3:00 PM
To: "CDOT_Rules@state.co.us" <CDOT_Rules@state.co.us>

Here are my thoughts on the Transportation Section of the rule making.

1. One-to-one vehicle replacement problem – The private trucking sector and the transit industry will struggle with the limited range of the battery electric bu /truck for a while until the ervice range get to a point that one vehicle can cover a service route for a whole day. If the vehicle can't cover the service route for a whole day, the it will need to be pulled out of service to be charged or you will have to make payments at higher utility rates for prime time charging while on route. It is also hard to justify the compound impact of paying a premium for the electric bu /truck technology and then having to purcha e two vehicle to cover what one did Given that the electric vehicle may only cover 1/2 the service day, you would need two vehicles to make the service work. The reserves do not exist within an agency to provide a replacement to continue the service for every route. So, you will need two vehicles to cover what one did before. I am sure the manufacturers are searching for batteries with greater range I know the e i ue are a challenge for the tran portation indu try a a whole The ooner we get to longer battery range or Hydrogen fueling, the more likely the industry will get on board with a one-to-one vehicle replacement.
2. Hydrogen fuel cell technology has the possibility of being a one-to-one vehicle replacement option. Researching how to develop local hydrogen fueling tation for local commercial vehicle and/or even private vehicle hould be looked into. A Public Private Venture in creating a shared fueling facility would help to increase the conversion to this technology by a broader base of users both public and private. This is a concept much like the subsidies used to establish CNG fueling stations.
3. To addre the battery range i ue it i often ugge ted that looking at your route tructure and hift planning i a way to bring the electric vehicle back to the facility to charge and send the new bus out for the rest of a shift. Regardless to the solution for covering the service day, funding operations to facilitate the additional time need for the bus switching would be in order. Regardless, the need to be switching vehicles into and out of service will have operational impact that hould be addre by operational funding
4. I am very glad to see Land Use planning being included to increase efficiency and help reduce VMT. I have been suggesting this for some time. I believe that Urban Growth Boundaries were one solution for addressing this issue, but I believe what is being proposed is even more inclusive of transit options connected to land use. Integrating tran it acce in development ubmi ion would help make alternative more acce ible to re ident Encouraging urban core redevelopment is another way to put housing close to where jobs are as well and thereby reduce VMT. Regentrification of core property has had a negative impact on equity within a community. It tends to price out low income and minority groups. Land owners may cry foul on having greater restrictions on developing rural property, which would need to be addre ed
5. I believe the Aviation statement is too anemic on requiring integration with transit/rail systems. Airports should be required to make strong connections to transit and alternative modes of transportation to help reduce VMT and GHG emissions. A premium should be paid to rent private cars from airports and the rental fleets should be required to be electric vehicle predominately A premium hould be required for ga /die el vehicle for long distance travel. Too often it seems that transit/rail options have to be reverse engineered into airport facilities.

These are my thoughts fast and dirty. Good luck

[redacted]

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Comments: Proposed Transportation Commission regulations on GHG emissions from transportation

1 message

[redacted] Mon, Oct 4, 2021 at 3:02 PM
To: dot_rules@state.co.us
Cc [redacted]

Plea e accept the following comment on the Propo ed Tran portation Commi ion regulation on GHG emi ion from transportation:

Thank you for both this groundbreaking work that Colorado is embarking on, and for this opportunity to provide comment on it.

Well before my time a county commi ioner, Eagle County ha been aware of the pecific threat of climate change to our environment, our economy, and our quality of life. More than a decade ago, the county began investing in alternative energy and resource efficiency. Six years ago we commissioned a study to determine the community's baseline greenhouse gas emissions. We then developed a plan to mitigate those emissions and created a community wide climate action collaborative to help achieve the goal of that plan

Just this year, the county cooperated in a study for our mountain resort region conducted by the Rocky Mountain Climate Organization. The findings were dire…and unsurprising: Higher temperatures, chaotic precipitation, and unpredictable weather pattern that threaten an already delicate mountain eco y tem and touri t economy

As a society, we knew the probability of these outcomes decades ago, yet we failed to act systemically when that action would have been both less costly and a better return on the investment in our economy. The need to act has never dimini hed; that need ha ju t become more urgent Which bring me to pecific comment on the e draft rule

We need stronger GHG reduction targets as well as targets for reducing Vehicle Miles Traveled. There is still a gap in achieving the goals of the GHG roadmap.
CDOT hould develop a Tran portation Equity Framework to en ure marginalized communitie both benefit from our efforts and become eager participants in our shared climate goals.
Loopholes are always a concern in a policy so novel and complex. I'll just reference and emphasize comments provided by Colorado Communities for Climate Action for some potential loopholes to be aware of. (Eagle County is an enthu ia tic member of CC4CA, by the way)
I will also emphasize CC4CA comments here that project-level modeling must be improved and reference those comments for specifics on how and why.

Even though action now may eem more difficult and co t can appear high in the hort term, the return on inve tment remain the same: A more efficient economy that is safer and healthier for all Coloradans. CDOT has never taken on a project this important or big. Most economists agree that systemic policies implemented 30 years ago would have gone nearly unnoticed in our daily lives and in our economy. We would simply have a more resilient, robust, and equitable economy

We missed that window, but we humans do like a little drama. Now's our chance to go big, make a splash, and lead the nation in transforming our economy from the wheels up.

Thanks again to the Commission for your time and consideration of the community's perspective on this unprecedented work you are undertaking.

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Invest Federal Funds in Transit

1 me age

[redacted] Mon, Oct 4, 2021 at 3:37 PM
To: dot_rules@state.co.us

Dad Sir/Madam,
In the event Colorado receives federal infrastructure funds now being considered by the Congress, I would ask you to please invest these funds in bike, bus, and rail transit alternatives rather than continue expanding highway lanes throughout the state. In the future people need to move about more efficiently, i. e. Consuming less energy and land area to get around A car oriented culture wa te energy, heat the planet, and occupie a great deal of pace if you take roads as well as parking lots into consideration. Besides, everyone can utilize transit. Not everyone can afford automobile transportation or are able to drive.

Thank you,
[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Why to spend Fed $ on ebikes & bike lanes, not cars!

1 me age

[redacted] Mon, Oct 4, 2021 at 4:24 PM
To: dot_rules@state.co.us [redacted]

1. The world's famous Rocky Mountain Institute says the current spend plan will worsen pollution and congestion! https://rmi.org/if-you-build-it-the-cars-and-the-pollution-will-come/. We've understood this for decades. This will violate the climate and pollution reduction law passed in 2019, HB 1261. "First, do no harm."

2. We all learned by high school that bicycles are the most efficient means of transportation in both the artificial and natural worlds. Electric bikes are actually ***even more*** efficient because electricity is far cheaper to produce than the extra food a hard-working bicyclist requires.

E-bikes typically take 10-30 times less electricity than an electric car and up to 100 times less energy than a gas car! My e-bike will go about 50 miles for about $0.15 worth of electricity, at an average speed of 20 mph. No other form of transportation can compete.

3. Ebikes save a huge amount of space, which is even more important than saving fuel in crowded cities. Saving space reduces congestion. Planners figure a bike in motion takes only one-seventh the space of a car in motion. They save even more space when parked.

4. Ebikes are great exercise and physical therapy and total fun - IF we're protected from speeding drivers on their cell phones!!

Here in North Boulder there are hundred of familie out on their ebike for fun and doing errand together I regularly ee a young mother with her three daughters on her $1900 cargo ebike.

I suggest subsidizing *cargo* e-bikes to encourage people to replace local car trips, not just recreate.

5. It's only fair and equitable. Colorado gives electric car buyers a $5,000 tax break. I **suggest a $500 tax break for electric bikes.** Since there are now excellent $1,000 e-bikes (like https://lectricebikes.com/) a $500 subsidy will make them affordable for most people.

6. Using an e-bike or bike for local trips preserves your car much longer, reducing the embodied GHGs that come with car repair and replacement. Combustion car engines wear out far faster in local stop and go traffic than on the highway.

7 Bike and e bike effectively **never** wear out the path and treet , unlike car and e pecially large truck and bu e That's another huge savings in embodied greenhouse gases necessary to pave and repave. Concrete and asphalt both have large carbon footprints.

Unle your origin and de tination are both along the ame bu route, an ebike i going to be much fa ter, a well a u e far less fuel and not damage the roads. People have fled the buses because of the pandemic and with ebikes becoming ubiquitous and affordable, there is no going back. Many bus routes, like most in Boulder, can be far more efficiently served with 15 passenger vans than the 7/8-empty full-size buses now clogging and rutting our roads. Dial-a-ride service can replace bu route that don't get u ed much

8. One of the biggest sources of microplastics in the environment is car tires and brakes. With a person on an e-bike weighing some 12-25 times less than a person in a car, that's 15 to 30 times less microplastics and asbestos to poison u

9. Ebikes remove most obstacles to cycling: distance, cargo, hills, wind, time, age, disability, everything except weather. A "rain cape" can deal with precipitation, and regular ski clothes are fine for winter biking.

I spearheaded getting Boulder City Council to legalize e-bikes on our path system in 2013. I haven't had a car since 1989. I know a good deal about e-bikes, having had three and I'm happy to share my knowledge.

[redacted]

[redacted]

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

CDOT greenhouse gas reduction rules comment

1 me age

[redacted] Mon, Oct 4, 2021 at 4:26 PM
To: "dot_rules@state.co.us" <dot_rules@state.co.us>

To whom it concerns,

I am a Denver resident and would like to provide comment on CDOT's drafted rules ensuring greenhouse gas reduction in tran portation planning

I applaud CDOT plan to comply with Colorado' ambitiou goal to cut emi ion of greenhou e ga e

However I worry that the new rule will till allow for the con truction high emi ion project including new highway and highway expansions which will induce—not inhibit—reliance on cars. Especially with new federal infrastructure funding likely coming to the state, it is imperative that funds be directed to support transit-oriented, low-carbon lifestyles throughout Colorado.

Regarding the drafted new rule specifically, I worry about the enforcement mechanism and the language around enforcement which eem vague and may allow for new, high emi ion project to go forward In the drafted rule in section 8.05.02, a waiver may be issued if "significant effort and priority" to reduce greenhouse emissions has been placed and won't be issued if it results in "substantial increases" in emissions. This qualitative language worries me. What do these words "significant" and "substantial" mean? Who's to say? I worry that such language will be weaponized by tho e who do not care to reduce emi ion with tran portation planning

The will of the people of Colorado to reduce greenhou e ga emi ion i clear Thi rule and it enforcement mechani m should also be clear. Please take care not to introduce a vague loophole. The law is only as good as its enforcement.

I urge CDOT to be as ambitious and thorough as possible with its emission reduction goals and the enforcement of those goals. Thank you for your time.

Sincerely,

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Fwd: Public testimony for GWS hearing

1 me age

[redacted] Mon, Oct 4, 2021 at 5:56 PM
To: dot_rules@state.co.us

Thank you for the opportunity to provide written testimony and comment. My name [redacted], and I am the Director of Protégete, an organizing-focused program that advocates for equitable access to a healthy environment, especially for Colorado's Latine communities. I speak on behalf of our membership, as well as my community in New Castle, the Roaring Fork, Colorado River and Eagle Valleys and all the rural central mountains, in support of a revised Greenhouse Gas Pollution Standard that accounts for our needs and advances racial equity.

In the central mountain , the need of our community look different than on the Front Range Our region i home to many Latine worker and familie who upport the local economy by working long hour , often for low wage , a hou ekeeper , land caper , re ort taff, con truction worker , and proven during COVID 19 clo er , frontline worker Some of our public chool can't be acce ed via public tran portation, o even that i hard to acce via current public tran portation option The affordable hou ing cri i ha di placed many worker and led to extremely long commute , often between town that are eparated by fifty mile or more Our community i under erved by public tran it that work for the e indu trie and the remote place where we work Unfortunately infra tructure like bike and walking path are not reali tic option for people who work on their feet all day, the e are lu urie we can't afford

The proposed rule is estimated to shift 28% of transportation funding to "clean" projects by 2050. For our communities, this is not enough. We need to prioritize land use decisions that build affordable housing with easy access to transit, and transit systems that connect us directly to the places we need to go -- and we need this now, not in the next thirty years.

House Bill 21-1266 defines in statue "disproportionately-impacted community," and includes "the proportion of households that are housing cost-burdened is greater than forty percent" in that definition. This includes vast swaths of the Roaring Fork and Colorado River Valleys. CDOT's more narrow definition must be expanded to comply with the law, and the rule must direct investments accordingly -- meaning that a certain percentage of benefits must be focused in disproportionately-impacted communities, at least 25% if not more.

I would love to see public transportation connect to all schools and colleges in our area. Connecting Parachute and Battlement Mesa to Glenwood Springs, affordably and frequently. A comprehensive analysis for where people live and work to get a good sense of commute patterns in our communities. We need transportation that is not only for tourists but for people that live and work here. Special busses for construction and landscape workers, and workforce where people can carry their tools, cleaning supplies, special equipment and have smaller shuttles move them to their place of work.

Just like RFTA, CDOT has not done an adequate job of engaging our community. While this rule is in motion, it can still be revised to doing better, and we ask you to include the development of a Transportation

Equity Framework to codify outreach practices and direct policy decisions to advance environmental justice and economic justice. We deserve and can accomplish world class, celan, reliable transportation for ALL. This framework must be created with community members and give them decision-making power.

Thank you for the opportunity to provide te timony today

[redacted]

PROTÉGETE
Nuestro futuro vale la lucha

"All things are connected. Whatever befalls the earth befalls the children of the earth" - *Chief Seattle, Suqwamish and Duwamish*

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Comment on your proposed transportation rule

1 me age

[redacted] Tue, Oct 5, 2021 at 4:40 AM
To: dot_rules@state.co.us

To the CDOT rulemaking board,

My name i [redacted] and I am a re ident of Logan County Colorado I am writing to you today to provide feedback on your proposed rule 2 CCR 601-22. I have some questions for you and some concerns I'd like to bring to your attention.

Our government is founded upon the belief that the decisions should be made by the people; i.e. that the people are the ones best equipped to make the kinds of value judgments that governments are required to make on a daily basis. Our government, Colorado especially, also is founded upon the idea of local control.

It is true that everyday people may not have the expertise to understand bridge design, and it's common to delegate those kind of deci ion to people with the pecialized knowledge, education, and e perience needed to build our infra tructure correctly.

If your rule were strictly about those kinds of decisions--the ones that it is proper for engineers and CDOT boards to decide--I would have fewer concerns. It is not. The rulemaking we are here to discuss is rather a value judgment. One that says more about what you think about climate change than it does about the soundness of a design.

As such, I wonder why it is seemingly that a group of unelected officials in Denver have taken it upon themselves to make deci ion for the whole tate Perhap I've mi under tood

Will your rule be tepping in to tell local, elected official what to do with regard to de igning their tran portation infrastructure?

Will you be telling people, say, on the Western Slope from Denver how they need to lay out their roads and what choices they need to make with regard to transportation modalities?

How many of the people participating in this rulemaking have been outside Denver for any length of time? How many times, for example, has Ms. Lew visited Sterling? How many visits to Las Animas?

If you do continue on the path you seem to be set on, how much will you be dictating to local people and how much will you be vi iting and di cu ing their tran portation plan ?

If your an wer are that you are planning to overrule local wi he and that you're planning to do o from your office buildings in Denver, I disagree strongly. I urge you to remember the foundational principles of this country and our state. Local people who will pay for projects should be able to have a voice in how their roads are laid out.

I would also like to point out one last thing. I live in a rural area as do many other Coloradans. Your proposed rule ignores one simple fact for the outlying parts of our state. Transit is fine. Bike lanes are fine. I do not disagree with having either a appropriate Let me repeat that la t bit a appropriate What rural Colorado need i a phalt not tran it Simply driving outside of the Metro area would be enough to convince you of that. To have a board focusing on bussing and bike lanes while the roads in many parts of the state are crumbling speaks to misdirected priorities at best. Perhaps this should be placed at a higher priority.

Thank you for your time.

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Fwd: Oct. 5 meeting

1 me age

Grim - CDOT, Jamie <jamie.grim@state.co.us> Tue, Oct 5, 2021 at 10:03 AM
To: CDOT Rules <cdot_rules@state.co.us>

Hey-

Can you add this to the written comments?

Thanks!
Jamie

Jamie Grim
Federal and Local Government Liaison
Office of Policy and Government Relations

C: 970.481.1024
2829 W. Howard Place, Denver, CO 80204
Jamie.Grim@state.co.us | www.codot.gov | www.cotrip.org

COLORADO
Department of Transportation
Office of Policy and Government Relations

---------- Forwarded message ---------
From [redacted]
Date Fri, Oct 1, 2021 at 11 59 AM
Subject: Oct. 5 meeting
To: <Jamie.Grim@state.co.us>

Propo ed Greenhou e Pollution Reduction Standard for Tran portation Planning Rebecca Rathburn CDOT rebecca.rathburn@state.co.us CDOT Rules cdot_rules@state.co.us

Dear Jamie Grim,

Do you have a description of the topics that will be presented for comment?

I seriously agree in general that the GHG pollution is incredibly important to the survival of our very lives. This is what drives global warming and hence climate change. The destruction of I70 in the Glenwood Canyon is just one small example.

Building more roadway is not a solution, rather it creates still more traffic and therefore more GHG. More roadway encourage more development which produce till more traffic

The hort an wer i imply to ta the fuel and the vehicle Thi provide fund for better ma tran it and reduce individual travel. Special arrangements are needed for lower income people. That could include free mass transit options and possibly a card to buy gas that provide a discount for low income people. Such as a City Market value card that allows discounted gas.

The same could work for toll roads.

[redacted]

Other options are car pooling. Company multi-passenger vehicles, possibly with park-n-rides. More “zoom” office options. 3 shifts per day. 4 day weeks. Less hours per week. Higher wages for carpoolers and late shift workers. More paid vacation

Another tack i provide more authority and latitude for town , citie and countie to take tronger action on fo il fuel burning vehicles. London, UK has created zones within the city where vehicles are fined, or taxed, for being present. Their license plates are recorded and bills are sent automatically. The express lanes east bound on I70 are a similar example. I have happily used those lanes myself. One might even have a secure account to automatically pay the fees. Thi might offer a di count on the fee

One could con ider limiting auto licen e plate Even numbered plate would drive only on even numbered day Exceptions for special work and fees for driving on the “wrong” day. All this could be programmed into the registration system. Similar to packaging sorting at Amazon.

Fees would be adjusted in amount to achieve desired results.

Hybrids and EVs and alternative fuels would see different rates. Same for HOVs, trades and other service people.

I suspect building such a system is cheaper than adding more roadway, both in the short run and the long run. Plus air quality would improve greatly. Switching to alternative fuels would be incentivized.

Mileage driven should also be considered.

Thanks for your concern,

[redacted]

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

submittal of written comments on planning regulation

1 me age

[redacted] Tue, Oct 5, 2021 at 5:28 PM
To: dot_rules@state.co.us

Please find attached written comments that I would like submit on CDOT's proposed draft planning regulation (2 CCR601-22) Thank you!

[redacted]

[redacted]

Written Comments on GHG Planning Regulation - [redacted] - 10-14-2021.pdf
196K

October 14, 2021

Transportation Commission of Colorado

Re: Notice of Proposed Rulemaking - Rules Governing Statewide Transportation Planning Process and Transportation Planning Regions 2 CCR 601-22

Via email to: dot_rules@state.co.us

I present my written comments herein on the draft planning regulation based on three decades of air quality permitting and analysis, including running the mobile source models that are proposed for regional and project scale air emissions analysis. To substantiate the basis upon which I make my comments, I relay that my training is in air quality (**MS, Atmospheric Sciences, UW)** and engineering **(BS, Aerospace Engineering, UVa),** my engineering license is in Colorado, and I have permitted and analyzed the impacts of mobile and stationary sources in over 20 US states, including Colorado.

Some examples of how modeling and analysis solved transportation pollutant problems of the past include those in New England, where carbon monoxide exceedances were occurring at ski resorts at lift-closing, as well as at crowded intersections in downtown Boston and Cambridge; where mesoscale analysis of emissions for Mass DOT and Mass Pike projects were used to design lower-impact alternatives for regional ozone attainment plans; and in Virginia, where citizens living adjacent to highways had been poorly represented as stakeholders within DOT and FHWA highway expansion projects. My client list includes governmental organizations; environmental advocacy organizations; mall developers; citizens; manufacturers; and energy producers.

I review this recent history of analysis to solve transportation-derived air quality issues because it is important that we all understand that the approaches and methods necessary to solve the issue of GHG emission reduction from transportation are already embodied in the Clean Air Act, and that the Clean Air Act is also the statutory authority from which many of CDOT's historic and current environmental requirements derive. CDOT should not only avoid reinventing the wheel, it must use the already-proven approaches of the Clean Air Act within a more powerful and fair 2 CCR601-22 if Colorado is to be successful in meeting the regulation's targets.

The current draft regulation, as it stands, will fall short of success because it does not include the necessary stepping-stones for permitting of transportation projects. While the targets are essential elements of the rule, project sponsors deserve clarity, and citizens deserve clarity, of exactly the steps by which these targets will be achieved. I list below multiple concepts and processes, already demonstrated as successful approaches within the Clean Air Act that I recommend CDOT include as permitting stepping-stones in its next draft of 2 CCR 601-22:

- **Within the regulation, the entire state of Colorado should be deemed a severe nonattainment area for each of the GHGs.** From this status can flow the rigorous planning and permitting requirements that the Clean Air Act dictates. I remind CDOT that the US east and west coasts had many severe and serious nonattainment regions prior to the 2000's, many of which have achieved attainment status because of the nonattainment methodology of the Clean Air Act. I also remind CDOT that the entire eastern US suffered chronic acid rain events in the 1980s and 1990s, all of which have now been alleviated because of the Clean Air Act concept of capping and trading of emissions. The offset concept for new emissions proposed here essentially rests on the same mechanism of a cap-and-trade program.
- **The new regulation should then use the concept of low triggers in nonattainment permitting to require that new project sponsors find emission offsets at ratios greater than 1:1** for

Regionally Significant Projects. To iterate, this is the approach by which previously successful Clean Air Act programs brought their states or regions into compliance with other pollutants.

- Given that our GHG concentrations must be on the order of 15% lower to meet an "attainment" concentration, any **Regionally Significant Project should be required to offset their new emissions at a 1.15 to 1.0 ratio in their build scenarios.**
- **The sponsor of any Regionally Significant Project can obtain offsets by working with municipalities and private entities on any GHG reduction project,** and CDOT should allow cross-boundary, intra-regulatory projects, including stationary source reductions, to provide for ample flexibility on where project sponsors can obtain offsets for their new mobile source projects.
- **The definition of Regionally Significant Project that is currently in the regulation must include an emissions threshold within its definition.**
- Just as existing DOT regulations stipulate that a certain category of projects always require microscale analysis to assure compliance with the particulate matter standards, such as bus terminals, so should **this new regulation require that any new or modified parking lot over a low threshold be defined as a Regionally Significant Project,** i.e, that any sponsor of a parking lot over a certain threshold should be required to find offsets for the emissions that it indirectly creates. Again, this approach is already defined in the CAA, wherein indirect emissions associated with air pollutant sources must quantify the emissions that a project induces at offsite locations. This more fairly places the burden of these indirect emissions on the source owner/operator that profits from them. For instance, the city of Breckenridge just announced the opening of a new 1,000 car parking lot, yet there was no analysis of the GHG emissions of the vehicles on Summit County roadways that the town will attract with this new lot. Keystone Resort enlarged a parking lot a few years ago yet felt no need (apparently) to implement any trip or emission reduction scheme on the Summit, Clear Creek, and Jefferson Counties and Denver highways that experience the increase in these induced GHG emissions. Vail Resorts, in recent correspondence, very carefully avoided any ownership responsibility for the GHG vehicle emissions that their resorts induce, and from which Vail Resorts profits. Similarly, Amazon distribution facilities attract 1000's of workers and their vehicles, while Colorado tax-payers alone foot the bill for the associated growth in GHG emissions that are so negatively impacting our economy.
- **To iterate, under the new regulation, any construction project that includes modifying or building a new parking lot should be defined as a Regionally Significant Project, thereby requiring review and the need to obtain offsets for their indirect emissions.** The threshold, or trigger to be defined as a Regionally Significant Project, should be lower for a new parking lot, while for an already-existing parking lot of a certain size, the threshold should be much lower to reflect that those who are already major contributors to our nonattainment status will be expected to find offsets at lower expansion thresholds.
- **CDOT should brook no objection to low triggers, i.e., thresholds, for Regionally Significant Projects.** As one of those who has run both stationary source and mobile source models, I can assure the sponsors of transportation projects that an emissions evaluation required of a Regionally Significant Projects is far less complex than dispersion air modeling analyses that are regularly required of many new air sources in Colorado. Most transportation projects will have already used traffic engineers to define their traffic volumes and traffic movements, so that once the roadway volumes and movements have been defined, summing the GHG emissions for these build scenarios using US EPA's MOVES according to guidelines is essentially just a math problem.
- **Multiple other states' approaches on this issue should be researched and methods should be developed in concert.** I apologize if I missed them, but I have not seen any results of research by CDOT rule writers of what other US states have successfully implemented in their own parallel DOT planning regulations for GHG mitigation, and how CDOT has incorporated them in drafting 2 CCR 601-22. Although, Colorado elected officials often extoll how revolutionary are the state's new regulations, sometimes these elected officials and leaders they appoint to our agencies (including the Air Pollution Control Division, and I say this based on involvement in several highly contentious air quality proceedings in Colorado) use "enforcement discretion" to not only

undermine new regulations but ignore existing Clean Air Act requirements that in other states are regularly enforced. Therefore, it is important that CDOT consult with other states' transportation departments, not only to work towards multi-state uniformity, but to avoid regulatory approaches that make enforcement difficult.

- **Other commenters have raised the issue of ground-truthing modeling estimates of traffic volumes and emissions of projects.** When developing the modeling guidelines that this draft regulation references, CDOT should review Colorado-specific highway and regionally important projects, to compare traffic volumes between the predicted build scenario and the actual build outcomes, to develop a generally agreeable factor for volume unpredictability that should be applied in developing all traffic volume forecasts.

In conclusion, I urge CDOT to take more time to draft a more powerful and fair 2 CCR 601-22. Throughout the past 30 years since I completed my graduate work in atmospheric radiative warming, i.e., the physical process by which global warming occurs, I, like so many citizens, have anxiously waited for the day when our air agencies and departments of transportation create the means to regulate and mitigate our GHG sources. Now, after 30 years, we finally see such a draft transportation regulation in Colorado, but it was cast just in weeks and only cites targets, instead of also prescribing the stepping-stones by which project sponsors, DOT and MPOs can arrive at these targets.

Thank you.

[redacted]

I'm [redacted]. I've lived in this community since 1966 and am a transportation cyclist with over 120,000 miles since 1995. My remarks may be controversial because they are retrogressive, but over the years this GHG-reducing solution has been superseded by "progress."

Simply put, concrete and asphalt roads are dangerous for cyclists in inclement weather. Crusher fines paths, like the rec district builds, are useless during mud season, silt up our creeks and require excessive maintenance. Worse yet is when crusher fines meet concrete. There is an easy, effective, solution; well-known since the 1810s: Macadam bike roads.

John Loudon McAdam discovered that rock foundations were unnecessary, and asserted that native soil alone would support the road and traffic upon it, as long as it was covered by a road crust that would protect the soil underneath from water and wear. Macadam roads work for the same reason that railroad grades work: They are built on a raised, drained grade, and the cover material is small, interlocking rocks with a crown of less than 1%, maintained by roller compaction and appropriate use. The result is permeable and durable when used by appropriate traffic.

The issue of crown is significant because cyclists ride on the margin, where the roadway is sometimes pitched excessively. This can lead to falls in icy weather. If bike roads are to be useful in all seasons they need to be designed for all seasons. And they should be built as roads, with appropriately banked curves as best practice.

Why are cyclists not clamoring for macadam roads? Because it's never been an option. As far as I can tell, I AM the macadam lobby.

Please note that concrete and asphalt, with their large GHG hits, are not involved here. I am talking about a true macadam road of unbound, angular aggregate. Macadam has become a generic term that has expanded far beyond the materials and techniques useful for cycling roads. Maybe we should call it McAdams' macadam to differentiate?

Since the capture of transportation by automobiles and trucks, cyclists in the US are viewed as recreationalists out for exercise, an appendix to the transportation colon, the tail trying to wag the dog. To accommodate cyclists, a fraction of roads was apportioned to them, bypassing the prevailing knowledge that cyclists fare best with their own, separate infrastructure. And they don't need roads built to accommodate trucks and cars. Macadam roads are perfect for cyclists.

Colorado is known for leading the nation in good things -- I work as an Election Judge and Colorado makes me proud. We can take a big step forward by taking a big step backward. I'm hoping that CDOT will test macadam bike roads as part of it's GHG reduction strategies.

Thank you. Questions?

For more on macadam please refer to "*A Practical Essay on the Scientific Repair and Preservation of Public Roads*" McAdams' 1819 book

This document's URL:
https://docs.google.com/document/d/1ZAzOLZvm4cNDltN69nhyAMiky1jzlYqyHFUQJRq6scQ/edit?usp=sharing

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Written comments on the GHG standard in transportation planning rules

1 me age

[redacted] Wed, Oct 6, 2021 at 9:39 PM
To: dot rules <dot_rules@state.co.us>
Cc [redacted]

[redacted] on GHG Standard for Transportation Planning Proposed Rule

My name is [redacted] and I am a resident of Longmont and a retired EPA attorney and retired RTD Director. Thank you for thi opportunity to comment on CDOT' propo ed regulatory change to create a greenhou e ga ("GHG") pollution reduction standard applicable to major transportation projects. The idea to require proposed transportation projects to be reviewed for their carbon footprint is a good one. I do have some major concerns, however, about what I see as underlying deficiencies of the proposed program which take away from its actual effectiveness in truly reducing emi ion

My primary concern is that the proposed regulatory program continues to treat the funding of major transportation projects in a "business as usual" manner, although we are living in anything but business-as-usual time. The implication underlying thi regulation cheme i that major tran portation project uch a new highway con truction will continue to be funded and will not be denied merely because the standards aren't being met. In my opinion, this means that the regulation is effectively ignoring the elephant in the room – that such projects are toxic to the climate survival of our society and should not be tolerated except under highly unusual circumstances.

Instead of business-as-usual funding, if serious the program would impose moratoriums on construction of major highway expansions unless alternative modalities are first considered, with an overwhelming preference given to such alternatives. Also, enforcement should really be bolstered, with true teeth provided when standards will not be met. In addition, the reduction tandard propo ed in Table 1, in my opinion, are dangerou ly low, predicated upon a umption that as yet unwritten regulations will effectively increase electric vehicle usage and reduce transportation emissions in a wished-for, substantial amount. These are unproven assumptions and should not in good conscience be used to justify low reduction standards in this regulation. Finally, to be most impactful, these regulatory requirements should be e tended to tran portation project already approved in the pipeline, o that the e project will al o be ubject to carbon reduction requirements. The fact that projects have already been approved makes them no less toxic to society's climate survival than newer projects. The same deadly climate science applies to both.

Thank you for the work and effort already e pended on the propo ed regulation I rai e the e tough comment and suggestions because these are not ordinary times.

[redacted]

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Cleaner Air and Better Transportation Options

1 me age

[redacted] Thu, Oct 7, 2021 at 12:10 PM
To: dot_rules@state.co.us

Hello!

I just wanted to write and ask that our beautiful mountain towns continue to be made accessible for those who wish to travel there without risking life and limb on the overpopulated I-70, and other roads.

Electric buses that run more often and are more attractive to more people as a safe alternative to driving a personal vehicle will entice a commuter mentality. These buses should have convenient storage for luggage and other items if possible, so more multi-day visitors, hikers, and campers will use this alternative.

Small electric vans that transport groups might also be nice. Every car that is off those roads increases the likelihood that our air will become cleaner, and will minimize the wear and tear on roads, along with decreasing the chances of costly accidents.

Thank you for your time, and best of luck with this important endeavor!

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Comments on 2 CCR 601-22 draft rule

1 me age

[redacted] Thu, Oct 7, 2021 at 6:59 PM
To: "dot_rules@state.co.us" <dot_rules@state.co.us>

My comment are regarding the a umption that GHG emi ion reduction from tran portation project will be greatly enhanced by rapid growth in adoption of EV and whether this aspiration should be addressed in acceptable mitigation measures.
Table 1 establishes GHG emissions planning levels at 5-year intervals from 2025 to 2050. Considering population growth, there will be only a very mall overall reduction in ba eline GHG (3 2 MMT CO2e which i 11 7% reduction from 2025 baseline) by 2050 resulting from the most recent transportation plans. If we can assume rapid growth in electric vehicles, then the reduction in GHG emissions will be much greater than estimated (i.e., Table 2). That is, to a baseline of 8.9 MMT CO2e (which is 67% of baseline 2025).
Colorado i encouraging con umer adoption of EV by program uch a e panding and publicizing the EV charging infrastructure, tax credits for purchase, and requiring electric utilities to provide incentives such as EV purchase rebates and assistance with home high-voltage charging installation.
The proposed rules should include examples of additional mitigation measures that would promote EV adoption. Current e ample GHG mitigation include addition of tran it re ource ; improved bike acce ; adding more EV charging infrastructure. These listed examples assume that there is a ready consumer market to use these resources and that costs are affordable to these consumers.
In addition, I would urge supporting more direct incentives for consumer adoption of EV (including eBikes) that have been hown to be ucce ful in tudie and in other tate uch a

- Point-of-sale rebates on the purchase of EV. This kind of program should include purchase of used EV as well as new models.
- “Cash for Clunkers” –type programs to remove older, less fuel-efficient ICE from our roads. This could be provided in the form of tran it voucher a an alternative to ca h
- Discounts and/or rebates for the purchase of eBikes or eScooters.

These additional mitigation measures would support the goal of reducing VMT in polluting, ICE vehicles.

Re pectfully,

[redacted]

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Transportation and clean air

1 me age

[redacted] Fri, Oct 8, 2021 at 4:43 PM
To: dot_rules@state.co.us

“If you build it, they will come ” It’ no urpri e that the more convenient you make driving, the more car will be on the road. This has been documented many times in many cities in our country. We also know that more protected bike paths encourage biking for short distance trips. So that, coupled with reliably efficient and extensive public transportation, will take many vehicles off the roads. All of these facts have been proven over and over.

Transportation money needs to go into building safe bike lanes and good public transport. It’s a no brainer. Our terrible air quality is strong evidence that we must do this ASAP. There’s not another valid choice.

Plea e re pon ibly Time i of the e ence We can wait any longer

Sent from AOL Mobile Mail

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Environmental Coalition comments on draft planning rule

1 me age

[redacted] Fri, Oct 8, 2021 at 1:27 PM
To: dot_rules@state.co.us
Cc "White CDOT, Rebecca" rebecca white@ tate co u

Colorado Department of Tran portation Rule Admini trator

Plea e find, attached, the Environmental Coalition' comment on CDOT' draft planning rule

Plea e call or email if there are any que tion or problem with thi tran mi ion

Thank you,

[redacted]

[redacted]

3 attachments

Environ Coalition comments on CDOT rulemaking to reduce GHG and VMT.pdf
835K

Environ Coalition redlines of CDOT rulemaking.pdf
479K

Env Coalition 1-7 Exhibits.pdf
10646K

BEFORE THE COLORADO TRANSPORTATION COMMISSION
COLORADO DEPARTMENT OF TRANSPORTATION

COMMENTS ON RULEMAKING
BY CONSERVATION COLORADO, NATURAL RESOURCES DEFENSE COUNCIL, SIERRA CLUB, AND SOUTHWEST ENERGY EFFICIENCY PROJECT (COLLECTIVELY, THE "ENVIRONMENTAL COALITION")

IN THE MATTER OF PROPOSED REVISIONS TO 2 CCR 601-22, RULES GOVERNING STATEWIDE TRANSPORTATION PLANNING PROCESS AND TRANSPORTATION PLANNING REGIONS

October 8, 2021

TABLE OF CONTENTS

<u>LIST OF ORGANIZATIONS SUBMITTING COMMENTS</u>
<u>(Collectively, the "Environmental Coalition"</u>

Conservation Colorado is a statewide grassroots environmental non-profit with the mission to protect Colorado's land, air, and water for future generations. Conservation Colorado believes in addressing the root causes of climate change, defending our state's wild places, protecting our stressed rivers and drinking water, accelerating the transition to a clean energy future, and elevating voices from impacted communities to help ensure all Coloradans are represented and engaged in order to build a powerful conservation movement.

Natural Resources Defense Council (NRDC) is an international nonprofit environmental organization with more than 3 million members and online activists, of which 30,000 are Coloradans. Since 1970, our lawyers, scientists, and other environmental specialists have worked to protect the world's natural resources, public health, and the environment.

Sierra Club, Colorado is a powerful collective of more than 100,000 grassroots changemakers working together across the state to advance climate solutions, act for justice, get outdoors, and protect lands, water, air, and wildlife. Sierra Club believes in the power of working together to make change happen.

Southwest Energy Efficiency Project (SWEEP) is a nonprofit organization dedicated to advancing energy efficiency and clean transportation in Arizona, Colorado, Nevada, New Mexico, Utah, and Wyoming in order to save customers money, protect the environment, address the climate crisis, and build a more resilient, sustainable economy.

COMMENTS ON CDOT'S PROPOSAL

We appreciate the opportunity to comment on CDOT's Proposed GHG Planning rule. Transportation is the top source of GHG pollution in Colorado and we need bold policies to reduce and electrify vehicle travel in the coming years. The proposed GHG Planning Rule is ground-breaking, and we commend CDOT, the MPOs, local governments, and other organizations for collaborating on the proposed rule. While the proposed GHG Planning Rule is innovative climate policy, we believe it needs to be strengthened in order to meet our state climate targets, maximize the environmental and economic benefits for Coloradans, and advance equity, particularly in disproportionately impacted communities.

1. TARGETS: GHG Pollution Reduction and VMT Reduction Targets.

1.1. Increase the GHG reduction targets to at least 0.60 MMT by 2025 and 2.0 MMT by 2030. (Alt. Rule 8.02.2)

Stronger GHG Reduction targets will:

- Implement the state's GHG Pollution Reduction Roadmap and help Colorado reduce transportation GHG pollution 25% by 2025 and 40% by 2030 compared to 2005 levels,
- Maximize the economic and societal benefits of the policy by increasing total cost savings and improving health outcomes for Colorado residents,
- Limit funding for new highway capacity projects, which induce more vehicle travel and air pollution,
- Compensate for the withdrawal of the Employer Traffic Reduction Program (ETRP) rule, and

- Leverage federal infrastructure dollars to advance our state climate targets.

Colorado needs to cut 12.7 MMT of transportation GHG pollution by 2030 to hit the HB-1261 climate targets.[1] CDOT anticipates about 8 MMT of GHG reductions from replacing light-duty vehicles with more fuel-efficient and electric vehicles (EVs).[2] Implementing the state's Clean Trucking Strategy, including potential adoption of the Advanced Clean Truck Rule, could deliver another 1.5 MMT reduction in GHGs in the most optimistic scenario. The remaining 3.2 MMT, or 25% of the required GHG reductions from transportation by 2030, must be achieved by reducing vehicle miles traveled (VMT).

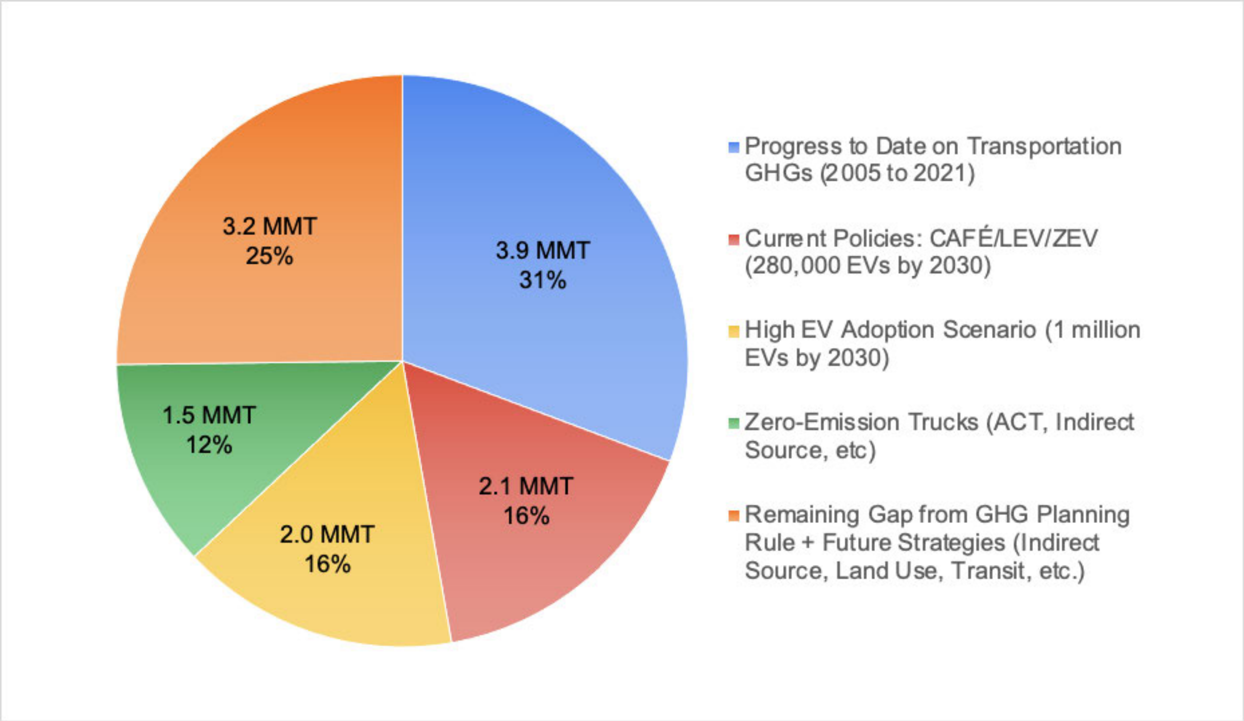

Figure 1. Progress Toward Colorado's 2030 Transportation GHG Targets:
Source: Southwest Energy Efficiency Project using modeling from the Colorado GHG Pollution Reduction Roadmap. Scenario assumes the adoption of future policies to increase the share of zero-emission medium- and heavy-duty vehicle sales to 40% by 2030.

Colorado has a statutory obligation to meet the state's HB19-1261 climate targets for 2025, 2030, and 2050[3], and doing so will require bold action on transportation, the largest source of GHG pollution both statewide and nationally. The GHG Planning Rule will influence how we

[1] Colorado Governor Jared Polis, Greenhouse Gas Pollution Reduction Roadmap, January 14, 2021. https://drive.google.com/file/d/1jzLvFcrDryhhs9ZkT_UXkQM_0LiiYZfq/view

[2] Colorado Department of Transportation, Greenhouse Gas Pollution Reduction Standard for Transportation Planning Frequently Asked Questions, August 30, 2021. https://www.codot.gov/programs/environmental/greenhousegas/faq.pdf

[3] "HB19-1261 Climate Action Plan to Reduce Pollution", Colorado State Legislature (2019): https://leg.colorado.gov/bills/hb19-1261

spend nearly $28 billion on transportation infrastructure over the next 28 years[4], and the projects we choose to build influence how we travel and the amount of pollution our system produces.

As a result, it is essential that the scale of the rule's GHG reduction targets be commensurate with the scale of the climate challenge. In the near-term, it is imperative that we hit the 2025 and 2030 GHG reduction targets. The IPCC's Special Report on Global Warming warns that "without increased and urgent mitigation ambition in the coming years, leading to a sharp decline in greenhouse gas emissions by 2030, global warming will surpass 1.5°C in the following decades, leading to irreversible loss of the most fragile ecosystems, and crisis after crisis for the most vulnerable people and societies."[5]

Good for the planet, good for the economy.

In addition to the environmental benefits, the proposed rule will deliver overwhelming economic and societal benefits to Colorado residents. The rule's Cost-Benefit Analysis (CBA) estimates about $40 billion in economic benefits to Coloradans, primarily in the form of lower vehicle operating costs, safety benefits, and less congested roads from reduced Vehicle Miles Traveled (VMT).[6] It also shows a proportional relationship between the amount of GHG emission reductions and the economic benefits, meaning the more we invest in strategies that reduce GHGs and VMT, the more money Colorado consumers save on their transportation and healthcare costs – strong justification for more aggressive GHG reduction targets.

According to the CBA, the policy would divert around 16% of the 2022-2030 transportation budget to "multimodal and environmentally-beneficial projects" to achieve a 1.5 MMT reduction in GHGs by 2030. One-sixth of our transportation budget is not nearly enough to address the scale of the climate emergency and the air quality crisis along the Front Range. Colorado has the funding to pursue more aggressive GHG and VMT reduction targets, and climate must be a top priority for CDOT and the MPOs if we hope to limit global warming to 1.5°C.

We have been underinvesting in transit, biking, and pedestrian infrastructure for decades, so there is no shortage of opportunities to build a more connected and safer multimodal transportation system. Denver Regional Council of Government's (DRCOG) 2040 Metro Vision compared the region's unconstrained transportation plan to one that's fiscally-constrained by available funding in the state, and of all the transportation project categories, "Regional Transit

[4] Colorado Department of Transportation, "Cost-Benefit Analysis for Rules Governing Statewide Transportation Planning," 2021. https://www.codot.gov/business/rules/documents/cdot-cost-benefit-analysis-for-ghg-rule-sept-2021.pdf

[5] "IPCC Special Report: Global Warming of 1.5 °C," (2021): https://www.ipcc.ch/sr15/about/foreword/

[6] Colorado Department of Transportation, Cost-Benefit Analysis for Rules Governing Statewide Transportation Planning, August 31, 2021. https://www.codot.gov/business/rules/documents/cdot-cost-benefit-analysis-for-ghg-rule-sept-2021.pdf

System Capacity" showed the largest gap in funded projects.[7] The 2040 Metro Vision included $28 billion worth of transit capacity projects between 2016 and 2040, with funding for only $6 billion, or just 22% of those projects.

Limiting funding for roadway expansion projects.

Stronger GHG and VMT reduction targets will limit funding for new highway expansion projects, which from a climate perspective, is one of the most impactful adjustments we can make to the current transportation planning process.[8] In addition to investing in multimodal transportation options, we must also "stop the bleeding" of induced travel from new roadway capacity projects. These types of projects have proven to exacerbate our pollution problems, undermine investments in multimodal transportation by making driving the more appealing option, and monopolize transportation funding at the expense of cleaner and more efficient options.[9]

The research shows a proportional relationship between roadway expansion and VMT, meaning a 1% increase in freeway lane miles will deliver 1% increase in systemwide VMT within 5 to 10 years. In 2021, Rocky Mountain Institute adapted the National Center for Sustainable Transportation's Induced Travel Calculator to estimate the induced travel from Colorado's current and planned highway widening projects.[10] Controlling for population growth, this set of highway projects would increase statewide VMT by 2%, adding 600,000 metric tons of new GHG pollution by 2030. That is the equivalent of putting 70,000 more cars on our roads every year – almost twice as many EVs as we currently have in Colorado. Highway expansion projects like Central I-70 and I-270 also increase local pollutants in disproportionately impacted communities, intensifying existing social and health inequities.

Highway expansion projects are counterproductive to our climate and air quality goals and cancel out many of the benefits of electrification and multimodal transportation investments. More aggressive transportation planning GHG reduction targets are necessary to focus more investment directly on projects that reduce pollution. Colorado will not meet its goals if we

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[7] Denver Regional Council of Governments (DRCOG), 2040 Metro Vision Regional Transportation Plan, April 18, 2018, Pg. 79. https://drcog.org/sites/default/files/resources/FINAL%20-%202040%20MVRTP%20-%20April%202018_1.pdf

[8] M. G. Boarnet and S. L. Handy. "Impact of Highway Capacity and Induced Travel on Passenger Vehicle Use and Greenhouse Gas Emissions." California Air Resources Board: Policy Brief, 2014. https://ww2.arb.ca.gov/sites/default/files/2020-06/Impact_of_Highway_Capacity_and_Induced_Travel_on_Passenger_Vehicle_Use_and_Greenhouse_Gas_Emissions_Policy_Brief.pdf.

[9] M. G. Boarnet and S. L. Handy. "A Framework for Projecting the Potential Statewide Vehicle Miles Traveled (VMT) Reduction from State-Level Strategies in California." University of California Davis, 2017. **<Exhibit 1>** https://escholarship.org/content/qt2z48105j/qt2z48105j.pdf?t=psmhhh&v=lg

[10] Rocky Mountain Institute. "If You Build It, the Cars (and the Pollution) Will Come," 2021. https://rmi.org/if-you-build-it-the-cars-and-the-pollution-will-come/

continue building roadway capacity projects then attempt to mitigate the additional pollution and VMT through accessory multimodal elements.

CDOT and the MPOs deserve credit for focusing new highway expansions on High-Occupancy Vehicle (HOV) and High-Occupancy Toll (HOT) lanes instead of general-purpose lanes. However, studies from Caltrans have shown there's "little evidence to suggest that adding HOV lanes will reduce GHG emissions, and some research to suggest that HOV lanes increase GHG emissions…. New HOV and Express Lanes induce new vehicle travel so any traffic flow improvements will be offset by new VMT."[11]

All the new Express Lanes (HOT and HOV lanes) in Colorado – on I-25, C-470, US-36, and I-70 – have been constructed as additional lane miles, which induce new VMT in urbanized areas. To improve the effectiveness of Express Lanes and reduce both VMT and GHG pollution, CDOT should convert existing general-purpose lanes to Express Lanes and add frequent and reliable transit service in those lanes. Express Lanes should prioritize carpooling, vanpooling, and transit over SOV travel and the occupancy requirements and toll rates for Express Lanes should be high enough to preserve the performance of the Express Lanes and ensure fast and reliable travel times for transit users.

Compensating for the withdrawal of ETRP.

The GHG Planning Rule should compensate for the withdrawal of the Employer Traffic Reduction Program (ETRP) rule by absorbing at least a portion of its proposed GHG benefits. When CDOT began working with stakeholders on the GHG Planning Rule, the state's Air Pollution Control Division (APCD) was developing an ETRP rule at the Air Quality Control Commission (AQCC). According to the proposal, the ETRP rule would have cut 0.68 MMT of annual GHG pollution by 2025, about 5% of the 12.7 MMT needed to hit the 2030 target, by working with the state's largest employers to reduce single-occupancy vehicle (SOV) commute rates.[12] In July, the APCD withdrew the proposal and in August, the AQCC voted to abandon the rulemaking.

The GHG Roadmap counted the ETRP rule as an important strategy to achieve Colorado's 2030 transportation climate targets and its cancellation must be addressed by other policies to reduce GHGs.[13] In practical terms, the Transportation Demand Management (TDM) strategies proposed in the ETRP proposal are also included in DRCOG's Transportation Improvement Program

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[11] Caltrans Division of Transportation Planning, "Caltrans Greenhouse Gas Emissions and Mitigation Report," Final Report August 2020. Pg. 21. **<Exhibit 2>** https://dot.ca.gov/-/media/dot-media/programs/transportation-planning/documents/office-of-smart-mobility-and-climate-change/ghg-emissions-and-mitigation-report-final-august-2-2020-revision9-9-2020-a11y.pdf

[12] Colorado Department of Health and Environment, "Economic Impact Analysis: AQCC Regulations Number 11, 20, and 22", 2021. https://drive.google.com/file/d/1nQJfz3YUL7uOJxL3JQj_sSSq_dlTZeX4/view?usp=sharing

[13] Polis, Greenhouse Gas Pollution Reduction Roadmap. Pg. 64.

(TIP) and other transportation planning documents. "Adoption of transportation demand management practices that reduce VMT," is listed as a potential GHG Mitigation Measure in the proposed rule (8.03.9).

Leveraging federal funding to advance state climate targets.
Lastly, it is possible the federal government will pass an infrastructure bill that would bring another $746 million to Colorado's state transportation budget over the next 5 years.[14] Such a funding boost could increase our capital infrastructure budget by about 15%. This should be viewed as an opportunity to implement the state's GHG Roadmap and direct more funding toward transportation projects that reduce VMT and GHG pollution.

1.2. The rule should translate the proposed GHG reduction targets into total VMT and VMT per capita reduction targets. (Alt. Rule 8.01.5)

VMT Reduction Targets will:

- Focus investment on projects that improve access to clean multimodal transportation options,
- Provide greater clarity on how to comply with the rule and ease implementation.
- Address the overreliance on electric vehicles to meet our transportation GHG reduction targets on their own. Colorado needs both EVs and VMT reduction to hit our climate targets,
- Prevent the use of traffic operations improvements as a strategy to reduce GHG pollution – benefits that are unreliable, short-lived, and "generally overstated" in the modeling, and
- Maximize the co-benefits to improve safety, congestion, health, access, affordability, and equity.

The state and regional transportation planning process determines how Colorado allocates its transportation funding, which directly influences how people travel to work, school, grocery stores, hospitals, and other services. It is important to recognize that our car-dependent travel behavior is less a reflection of personal choice and more a result of policies and planning decisions that have directed the vast majority of transportation funding toward SOV infrastructure. The GHG Planning Rule is an opportunity to align transportation spending with our environmental and social goals by shifting investments toward projects that improve access to more efficient, low-carbon mobility options by increasing transit service, expanding bicycle and pedestrian infrastructure, promoting TDM programs, and encouraging transportation-efficient land use patterns. VMT reduction is the best measure to guide these investments and track our progress.

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[14] Email from Jeffrey Sudmeier, CFO, Colorado Department of Transportation, August 12, 2021. (Describing the potential effect of the "Infrastructure investment and Jobs Act" on CDOT's budget.)

The more we reduce VMT, the less we must rely on vehicle electrification to hit our climate targets. A recent study from Carnegie Mellon University analyzed the relationship between VMT and EV adoption in the U.S., and found that, if total VMT increases to 4 trillion (a 37% increase), at least 73% of vehicles would need to be electric to reduce GHG emissions by 80%.[15] If VMT drops to 2 trillion (a 32% decrease), less than 50% of vehicles would need to be electric to achieve the same GHG reduction. In the near-term, allowing VMT growth to continue at current rates would cancel out most of the GHG reductions from EVs between 2022 and 2030.

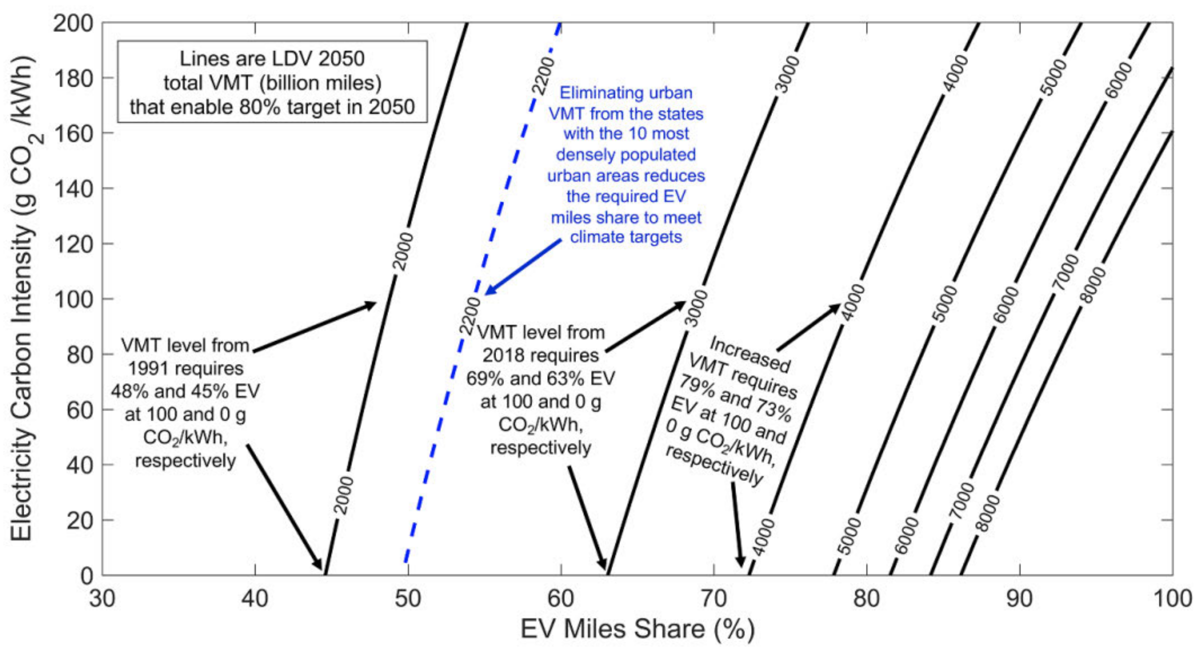

Figure 2. The combinations of the travel demand, electricity generation CO_2 intensity, and EV miles share to meet a 2050 LDV CO_2 target of 250 million metric tons (an 80% reduction from 2005 levels). The impact from the reduced or increased travel is illustrated with the contour lines. The dashed 2.2 trillion miles line represents the impact of eliminating all of the 1.1 trillion LDV the urban miles from the US states with the 10 most densely populated metropolitan areas [58, 59]. Urban LDV miles traveled in all US states comprise about 70% of total current US LDV travel.

Source: Alarfah, A., Griffin, W., Samaras, C., "Decarbonizing US passenger vehicle transport under electrification and automation uncertainty has a travel". 2020. Pg. 6. **<Exhibit 3>** https://iopscience.iop.org/article/10.1088/1748-9326/ab7c89

CDOT and MPOs like DRCOG have recognized the importance of VMT reduction as a guiding performance measure for transportation planning. In 2020, CDOT updated Policy Directive 14 to include a 10% VMT reduction goal for 2030.[16] Similarly, DRCOG adopted a VMT performance

[15] Alarfah, A., Griffin, W., Samaras, C., "Decarbonizing US passenger vehicle transport under electrification and automation uncertainty has a travel," 2020. Pg. 5. **<Exhibit 3>** https://iopscience.iop.org/article/10.1088/1748-9326/ab7c89

[16] State of Colorado Transportation Commission, Resolution #TC-2020-11-11 Adoption of updated Policy Directive 14.0 "Policy Guiding Statewide Plan Goals & Objectives," November 19, 2020.

measure with the goal of reducing VMT per capita per day by 10% by 2040 compared to 2010 levels.[17] But these goals are merely aspirational and not enforceable. From 2010 to 2019, VMT per capita per day *increased* by 1%, which demonstrates the need for a stronger commitment to VMT reduction through rulemaking.

As a metric, VMT is a good proxy for GHG pollution. It is also easier to measure and track than GHG emissions, which are an aggregate of collective emissions in the atmosphere from every sector of the economy. In addition, focusing the rule on VMT reduction will simplify implementation and avoid confusion around the complex relationship between EV adoption, total VMT, and transportation GHG pollution.

A focus on VMT reduction will also preclude the use of traffic operations improvements as a strategy to reduce GHG pollution – benefits that are unreliable and difficult to model. Traditionally, state DOTs and MPOs have relied on traffic operational improvements such as traffic signal management, ramp metering, traffic incident management, and roundabouts to improve traffic flow and minimize idling, which can reduce pollution. However, the Caltrans Greenhouse Gas Emissions and Mitigation Report from 2020 raises serious concerns about relying on traffic operational strategies to deliver GHG reductions:

> "The emissions impacts of traffic operations strategies are complex and not well understood. One reason for this is that evaluating the impacts of traffic operations strategies using controlled field experiments is difficult and costly. Thus, most studies use simulation models, which inherently raises questions about how well these models reflect actual conditions. In addition, when traffic operations strategies succeed in reducing delay, they can also induce new vehicle travel, which can potentially offset the emissions benefits of speed improvements. The available research is insufficient to make definitive statements about the conditions under which traffic operations strategies will reduce emissions and by how much. Nearly all of the published research does not consider induced vehicle traffic effects, so reports of GHG emissions benefits are generally overstated."[18]

The proposed rule would require CDOT and MPOs to model the total system wide GHG emissions from their transportation plans and programs. Such an analysis would bundle hundreds

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https://www.codot.gov/about/transportation-commission/approved-resolutions/2020-approved-resolutions/nov2020/tc_res_2020_11_11-pd-14.pdf

[17] DRCOG, 2040 Metro Vision Regional Transportation Plan, Pg. 111; DRCOG Website visited on October 6, 2021. (Updating progress on VMT Metro Vision target) https://metrovision.drcog.org/in_practice/performance_measures/#vehicle_miles_traveled_(VMT)

[18] Caltrans Division of Transportation Planning, "Caltrans Greenhouse Gas Emissions and Mitigation Report" Pg. 48. **<Exhibit 2>**

of individual transportation projects, including traffic operational strategies, and produce a total system wide GHG impact.

This has played out in other states. For example, Massachusetts passed a similar transportation GHG rule in 2017, setting GHG reduction targets for state and regional transportation plans.[19] The ensuing 2017-2021 STIP shows 50% of the projected GHG reductions from traffic operation improvements like traffic signals and intersection reconstruction.[20] As written, the proposed CDOT rule would also allow the GHG benefits of traffic operation improvements to be counted toward compliance with the proposed targets – reductions that are unreliable, short-lived, and "generally overstated" in the modeling. A more straight-forward and effective rule would set strong and enforceable VMT reduction targets to guarantee progress toward our climate targets and provide much-needed funding for multimodal projects.

In addition, strategies that reduce total driving deliver significant co-benefits for Coloradans. Reducing VMT not only reduces GHGs, it also cuts local pollution, improves safety and connectivity for cyclists and pedestrians, promotes physical activity and health, stimulates economic development in local communities, relieves congestion on our roadways, reduces vehicle ownership and household transportation costs, and advances equity for underserved communities.[21]

According to the rule's Cost-Benefit Analysis, the economic benefits of the proposed rule are directly tied to VMT reduction and over 95% of the $40 billion in estimated benefits is attributed to lower vehicle operating costs, improved safety, time travel savings, and more physical activity. We need to give Coloradans cleaner, safer, and more affordable travel options. The more we reduce total VMT, the greater the environmental and economic benefits for all Coloradans.

VMT reduction strategies would directly advance other state and regional transportation goals to address safety, air quality, congestion, transit access, multimodal mobility, affordability, equity, and environmental justice. As part of their Metro Vision process, DRCOG established a series of performance measures to guide transportation investments:

[19] Massachusetts Department of Transportation, Edits to "60.05: Global Warming Solutions Act Requirements for Transportation," adopted July 27, 2017. https://www.mass.gov/doc/final-regulation-4/download

[20] Massachusetts Department of Transportation, "Statewide Transportation Improvement Program 2017-2021", https://www.mass.gov/files/documents/2017/10/17/STIP17-21_Final.pdf

[21] Kevin Fang and Jamey Volker, "Cutting Greenhouse Gas Emissions is Only the Beginning: A Literature Review of the Co-Benefits of Reducing Vehicle Miles Traveled," National Center for Sustainable Transportation, 2017. University of California. **<Exhibit 4>** https://escholarship.org/uc/item/4h5494vr

DRCOG Metro Vision Performance Measures
Increase the share of the region's total housing units located in urban centers.
Increase the share of the region's total employment located in urban centers.
Increase the population-weighted average of the density of each census tract in the region.
Increase the share of workers using a travel mode other than driving alone to commute to work.
Decrease the average weekday vehicle miles of travel per capita.
Increase the average variation in travel time on roadway segments when comparing peak to off-peak conditions.
Limit the average weekday person travel delay per capita.
Reduce the annual total of traffic-related fatalities resulting from crashes occurring in the region.
Reduce the surface transportation related emissions of greenhouse gases.
Increase the land protected from development for outdoor recreation; wildlife habitat; natural resources; prominent geographical, geologic, or cultural features; ranching; farming; visual buffering; and/or community separation.
Limit the share of the region's housing in areas with wildfire Fire Threat Index (FTI) values of 4 or 5 ("high threat" and "highest threat") and/or Special Flood Hazard Areas (SFHA), which are areas with a 1 percent chance of inundation per year (often referred to as the "100-year floodplain")
Increase the share of the region's population living in areas with housing and transportation costs that do not exceed 45 percent of the annual income of the typical household in the region, where the typical household earns the median income for the region, with both the average household size and average number of commuters per household for the region
Increase the total number of jobs in the region
Increase the share of the region's housing within ½ mile of rapid transit stations, or within ¼ mile of bus stops with 96 or more departures per weekday (average of 4 per hour)
Increase the share of the region's employment within ½ mile of rapid transit stations, or within ¼ mile of bus stops with 96 or more departures per weekday (average of 4 per hour)

Source: DRCOG Metro Vision Performance Measures[22]

State legislation also requires a focus on both GHG and VMT reduction targets. Senate Bill 21-260 requires CDOT and the MPOs to take additional steps in their planning process "to account for the impacts on the amount of statewide greenhouse gas pollution and **statewide vehicle miles traveled** that are expected to result from such projects." C.R.S §43-1-128. The legislation also defines a "Greenhouse Gas Mitigation Project" as any project "that helps achieve compliance

[22] DRCOG Website visited on October 6, 2021. (Progress report on Metro Vision targets) https://metrovision.drcog.org/in_practice/performance_measures/

with federal or state laws or rules that regulate transportation-related greenhouse gas emissions by **reducing vehicle miles traveled** or increasing multimodal travel." C.R.S §43-1-1102.

1.3. The rule should set stronger post-2030 VMT reduction targets. (Alt. Rule 8.01.5)

Table A.11 in the Cost-Benefit Analysis shows the estimated VMT reductions from the proposed rule in 2030, 2040, and 2050. Dividing those totals by population projections from the State Demography Office produces the estimated VMT per capita in each of those years.[23] The proposed rule would result in a 6.8% reduction in VMT per capita between 2020 and 2030, a 0.9% reduction from 2030 to 2040, and a 1.6% *increase* from 2040 to 2050. In other words, the policy aims to cut annual VMT per capita from 9,288 in 2022 to 8,650 in 2030, then hold that number relatively steady out to 2050.

At some point, VMT reduction will play less of a role in GHG reductions as a higher percentage of the vehicle fleet is electrified, but that point is not 2030 or even 2035. Even in an optimistic scenario, just 16% of the light-duty fleet will be electric by 2030. In addition, the CBA outlines a number of economic benefits from VMT reduction strategies such as lower vehicle operating costs, savings on healthcare from fewer crashes and more physical activity, and congestion benefits. The economic and environmental benefits of this policy justify continued progress toward lower VMT.

As a result, the rule should continue to put downward pressure on total VMT and VMT per capita for the duration of the policy. The Minnesota DOT recently proposed a 20% VMT reduction target for 2050 to achieve its state climate targets.[24] We have proposed that Colorado also set a 20% VMT reduction target by 2050. Alt. Rule 8.01.5.

1.4. Set VMT per capita reduction targets and measure the VMT per capita impacts of individual transportation projects. (Alt. Rules 8.01.5 Table 3; 8.02.2.5)

The rule should translate the total VMT reduction targets into VMT per capita reduction targets to encourage smart growth policies at the local level. The modeling in the CBA assumes that 75% of new growth in the DRCOG region is focused in urban mixed-use areas, a land use pattern that generally facilitates low-VMT lifestyles through shorter vehicle trips, greater walkability and bikeability, and transit-supportive density. However, increasing population and

[23] State of Colorado, Dept. of Local Affairs website "Population Totals for Colorado and Sub-State Regions" Visited on 10/6/21. https://demography.dola.colorado.gov/population/population-totals-colorado-substate/#population-totals-for-colorado-and-sub-state-regions

[24] Minnesota Department of Transportation, "2020 Sustainable Transportation Advisory Council Recommendations," April 28, 2021. http://www.dot.state.mn.us/sustainability/docs/advisory%20council/stac-recommendations-response-2020.pdf

employment density will also increase total VMT and GHGs both locally and regionally, creating a potential disincentive to pursue transportation-efficient land use policies.

Throughout this rulemaking process, local governments have expressed concerns that they will be penalized for population growth. This policy should avoid inadvertently promoting "No Growth" policies such as residential growth caps and exclusionary zoning in the pursuit of community wide GHG reductions. Such policies may reduce local pollution, but they increase statewide pollution by restricting infill development, and therefore, deflecting growth to other less-efficient land use patterns. This is one reason DRCOG set a VMT per capita performance measure in its 2050 Metro Vision.[25] The GHG Planning rule should set total VMT reduction targets for state and regional plans, but also create a tool to measure the VMT per capita impacts of individual transportation projects.

2. **EQUITY: Advance equity in the transportation planning process and improve health outcomes in disproportionately impacted communities. (Alt. Rules 1.12; 4.02.1; 4.02.5.4; 4.06.1.9; 8.02.2.3; 8.02.3; 8.02.5.3.4; and 8.05.3)**

Colorado House Bill 21-1266, the Environmental Justice Act, finds that "all people have the right to breathe clean air, drink clean water, participate freely in decisions that affect their environments, live free of dangerous levels of toxic pollution, [and] experience equal protection provided by environmental policies." It also finds that **"less-burdened communities have benefitted from relationships that impose burdens on other communities, which is a tangible debt that must be repaid through financial reinvestment,"** and that "The state government has a responsibility to achieve environmental justice, health equity, and climate justice for all communities by avoiding and mitigating harm." In other words, climate policy and clean investments are not exempt from perpetuating environmental racism, and the State of Colorado is responsible for imbuing all climate policy with e*nvironmental justice* -- the urgent practice of rectifying disparities in pollution burdens, infrastructure, and access.

All throughout the state, we see the same pattern: the highway-adjacent communities are home to high percentages of people with low incomes, mostly Latine, Black, Indigenous, and other people of color. Toxic vehicle emissions lead to high rates of asthma, headaches, nosebleeds, low birth weights, and cancer, and communities near highways suffer the most.[26] This is the result of decades of environmental inequity in transportation planning -- these communities have long borne the brunt of policy choices that prioritize the health of wealthy and white communities at

[25] DRCOG, 2050 Metro Vision Regional Transportation Plan, April 21, 2021, Pg. 27. https://drcog.org/sites/default/files/resources/2050_RTP.pdf
[26] American Lung Association website, "Living Near Highways and Pollution," visited October 6, 2021. https://www.lung.org/clean-air/outdoors/who-is-at-risk/highways

the expense of low-income communities of color. A 2018 study from the National Academy of Sciences[27] found that air pollution is disproportionately caused by non-Hispanic White Americans and disproportionately inhaled by black and Hispanic Americans, leading to greater risk of disease and higher healthcare costs.

In addition, low-income and minority communities tend to pay a higher percentage of their household income on transportation costs and often lack mobility options that would help them reach jobs, medical care, and other services – obstacles that perpetuate existing economic and health inequities. On average, low-income households spend 37% of their income on transportation, almost twice the percentage of middle-income households.[28] As a result, these communities have the most to gain from greater investment in clean and affordable transportation options. A data-driven policy would account for these racial and socioeconomic inequities, and be proactive about closing the gaps while improving access to opportunity for disproportionately impacted communities.

HB21-1266 broadens the definition of "disproportionately-impacted community" to include "a community that is in a census block group, as determined in accordance with the most recent United States census, where the proportion of households that are low income is greater than forty percent, the proportion of households that identify as minority is greater than forty percent, or the proportion of households that are housing cost-burdened is greater than forty percent; or is any other community as identified or approved by a state agency, if: the community has a history of environmental racism perpetuated through redlining, anti-Indigenous, anti-immigrant, anti-Hispanic, or anti-Black laws; or the community is one where multiple factors, including socioeconomic stressors, disproportionate environmental burdens, vulnerability to environmental degradation, and lack of public participation, may act cumulatively to affect health and the environment and contribute to persistent disparities [...] "Cost-burdened" means a household that spends more than thirty percent of its income on housing, and "low income" means the median household income is less than or equal to two hundred percent of the federal poverty guideline." **This definition, wider than the one currently in place in the rulemaking language, is estimated by CDPHE to include one third of Colorado's population. We have proposed expanding the definition in the rules to include the expanded definition required by HB21-1266.**

So far, the rulemaking has failed to address equity and environmental justice. To be sure, it is a daunting endeavor; however, from both a legal and ethical standpoint, environmental justice must be incorporated into all climate policy in Colorado. **Excluding equity from this**

27 Christopher W. Tessum et. al., "Inequity in consumption of goods and services adds to racial-ethnic disparities in air pollution exposure." 2019. **<Exhibit 5>** https://www.pnas.org/content/116/13/6001

28 U.S. Department of Transportation Bureau of Transportation Statistics website, "Household Spending on Transportation: Average Household Spending" viewed on 10/6/21. https://data.bts.gov/stories/s/ida7-k95k

rulemaking will result in a severe loss of trust from environmental justice organizations and community leaders. This will jeopardize the success of CDOT's forthcoming Environmental Justice branch.

Colorado is home to some of the worst local air pollution in the country,[29] and we cannot continue to perpetuate existing economic and health inequities with more investment in highway expansion, particularly in the most affected communities. To solve this, we recommend a two-pronged approach:

1. Ensure proportionate benefits from this rule are felt by disproportionately impacted communities. Our draft would require that GHG and VMT reductions obtained through GHG Mitigation Measures must directly benefit disproportionately impacted communities at a level equal to or greater than the percentage of the population within disproportionately impacted communities within that planning area. Statewide, the percentage of Colorado's population within a disproportionately impacted community is 30% but that number may be higher or lower in individual MPOs or TPRs.
2. No Applicable Planning Document, including the near-term Four-Year Prioritized Plans and Transportation Improvement Programs (TIPs), shall produce a net increase in greenhouse gas or co-pollutant emissions in disproportionately impacted communities that is already experiencing high levels of pollution relative to the state population unless those impacts are entirely mitigated.

2.1. The rule should direct CDOT's new Environmental Justice Division to create a Transportation Equity Framework. (Alt. Rules 1.56; 4.02.5.4; 4.03.7; and 4.04.1.6)

Community engagement opportunities can take a toll on the public's time, resources, and energy. While CDOT has made new efforts during this rulemaking process, current practices still make engagement inaccessible to many Coloradans.

One simple thing that this rulemaking can do quite easily is mandate the creation of a *Transportation Equity Framework* to guide CDOT and MPOs moving forward. Equity frameworks are in use across the country, including at the Colorado Department of Public Health and Environment, which published its draft Climate Equity Framework this year. It includes best practices for community engagement as well as requirements for the Air Quality Control Commission (AQCC) in evaluating future policy concepts. Given that the AQCC was the initial venue for this rulemaking, the considerations in the Framework and legal requirements in HB-21-1266 should be applied to the Transportation Commission. However, the State's draft Climate Equity Framework does not include transportation planning. It is the role of CDOT and the Commission to fill this gap.

[29] American Lung Association website, "Most Polluted Cities," visited October 6, 2021. https://www.lung.org/research/sota/city-rankings/most-polluted-cities

Luckily, we have models to turn to. In California, a [Mobility Equity Framework] commissioned by the Greenlining Institute finds that "Decades of local, regional, and state transportation plans and investments in California have not adequately responded to the mobility needs of low-income communities of color, reinforcing unequal land-use patterns and contributing to disproportionate health and economic impacts."[30] This level of study is needed in Colorado in order to determine our course of action. The Framework also details a community engagement plan in order to "embrace an equitable deployment of investments and policy interventions to prioritize the mobility needs of low-income individuals of color and address the historical neglect they have experienced."[31]

Other equity models are listed below:

Equity Frameworks and Tools Summary Table	
Framework/Tool	**Description**
Colorado's Draft Climate Equity Framework **(CDPHE)**	Puts forth 6 principles to promote equity in the development of climate change strategies, to provide a "menu of options that the state can use to build equity considerations into the greenhouse gas reduction rulemaking process."
Mobility Equity Framework: How to Make Transportation Work For People **(Greenlining Institute, CA)**	3-step framework utilizing 12 "mobility equity indicators". Posits social equity and community power as primary values in transportation planning and decision-making, framework can help "elevate these values and address structural inequities through an adaptable, customizable process for community, advocates, and transportation decision- makers."
Transit Justice Principles **(National Campaign for Transit Justice & Transit Center)**	List of 5 principles for improving transit justice in the U.S. Makes specific recommendations to improve transit justice at the local, state and federal level.

[30] The Greenlining Institute, "Mobility Equity Framework," 2018. Pg. 5. https://greenlining.org/wp-content/uploads/2019/01/MobilityEquityFramework_8.5x11_v_GLI_Print_Endnotes-march-2018.pdf
[31] *Id.*

Seattle Racial Equity Toolkit **(Seattle, WA)**	6-step toolkit for all Seattle government departments to use to "guide the development, implementation and evaluation of policies, initiatives, programs, and budget issues to address the impacts on racial equity."
Oregon Transportation Equity Framework **(Oregon Department of Transportation)**	Framework developed for the Oregon Department of Transportation (ODOT) to evaluate the equity impacts of new tolling projects in the state. Distinguishes between "process" and "outcome" equity.
Equitable Development Principles & Scorecard **(Twin Cities, MN)**	Tool designed for use by governments and planners when conducting activities such as "planning with a focus on equity," "evaluating the impacts of policy on the needs of the community," "making policy change recommendations", and more.

Environmental justice advocates and members of the public have made it overwhelmingly clear that we need to see equity addressed in this rulemaking, not postponed for another rulemaking or until the Environmental Justice branch of CDOT is active. **We are asking for the rule to include a directive to develop the *Transportation Equity Framework*, initiated no later than spring of 2022.**

Our suggestions for the *Transportation Equity Framework* are not meant to serve as a complete outline. Ultimately, members of the communities most impacted by inequality in transportation planning must be consultants, with their input weighed heavily in decision-making.

The *Transportation Equity Framework* should:

- Identify all Colorado communities disproportionately impacted by transportation pollution and, possibly in collaboration with other state agencies, track emission sources and pollution levels (including co-pollutants) on an ongoing basis. This data should be transparent, in plain language, and publicly accessible.
- Codify best practices for community engagement for rulemakings, Applicable Planning Documents, and approval of regionally significant transportation projects
    - Use multiple methods of outreach, including community hubs like local schools, social media, social and activity clubs, libraries, or other services. Hold public meetings at locations that are trusted by and accessible to community members, rather than in government buildings.
    - Create outreach materials concerning the proposed action that:
        - Are in plain language and avoid the use of jargon.
        - Are translated in a timely manner into the primary languages spoken in a community, using professional translation services.

    - Schedule variable times of day, and days of the week, for opportunities for public input on the proposed actions, including at least one weekend time, one evening time, and one morning time.
    - For prolonged engagement opportunities such as advisory boards and task forces, provide transportation support, childcare, and funding for community members to reduce costs of participating.
- Establish inclusive and equitable decision-making processes for future rulemakings
    - All Commissioners should either attend hearings or read transcriptions of public comment in full -- not summaries.
    - All rule language should explicitly analyze the equity implications of its components and refer directly to public input.
    - If CDOT chooses to reject community recommendations, rule language or associated documents should document the specific reasons for doing so and include a plan for addressing concerns in the future.
- Identify near-term actions for immediate relief of toxic air pollution.
- Develop criteria for analyzing regionally significant projects for their impacts on public health, displacement and affordable housing, social factors such as noise pollution, neighborhood connectivity, and other factors gathered directly from public input.

2.2. Disproportionately impacted communities should receive direct benefits from lowering GHG pollution and VMT from transportation planning. The percentage of direct benefits must be commensurate or greater than the proportion of disproportionately impacted population in the affected planning area. (Alt. Rules 8.02.3 and 8.02.5.3.4)

Increasing access and reducing pollution in disproportionately impacted communities supports both geographic and racial equity. The policy should avoid focusing climate and air quality benefits in wealthier communities at the expense of disproportionately impacted communities that are already suffering from toxic levels of air pollution and spend a higher percentage of their household income on transportation.

The benefits from reducing GHG pollution and VMT should be directed to disproportionately impacted communities at a level that is at least commensurate with the percentage of the population living in disproportionately impacted communities. Recent projections by the CDPHE's Environmental Justice Program indicate that 30% of Colorado's population lives within a disproportionately impacted community (as defined by that agency). If we are to address historic inequities, the benefits from reducing GHG pollution and VMT should be directed to disproportionately impacted communities at levels greater than 30%.

To improve equity and air quality, and lower transportation costs in disproportionately impacted communities, the rule should:

- Require reductions in GHG pollution and VMT to directly affect disproportionately impacted communities in a percentage commensurate with the percentage of population within that planning area living within a disproportionately impacted community as defined by HB21-1261. This level is estimated to be 30% statewide but will vary within individual MPOs and TPRs. (Alt. Rules 8.02.3; 8.05.3)
- Avoid making a bad situation worse in our most-polluted communities by including a requirement that no Applicable Planning Document, including the near-term Four Year Prioritized Plans and Transportation Improvement Programs (TIPs), shall produce a net increase in greenhouse gas or co-pollutant emissions in disproportionately-impacted communities already experiencing degraded environmental conditions relative to the state population unless those environmental or public health impacts are entirely mitigated. (Alt. Rule 8.05.3)

3. **MODELING: Ensure the modeling accurately estimates the GHG and VMT impacts of current and future transportation projects.**

3.1. Include more specific provisions in the Intergovernmental Agreement to improve modeling accuracy and require periodic review. (Alt. Rules 8.02.2; 8.02.5.2)

The effectiveness of this policy hinges on the modeling and how accurately it estimates the VMT and GHG impacts of individual transportation projects and the Applicable Planning Documents as a whole. A recent study from researchers at UC-Davis found that environmental reviews of highway expansion projects from state DOTs and MPOs around the country consistently underestimate the impact of new lane miles on systemwide VMT, and by extension, GHG pollution.[32] It is widely understood that an increase in roadway capacity generally leads to a proportional increase in vehicle travel on the network over a 5 to 10 year period. The basic law of supply and demand applies to vehicle travel, where increasing the supply of lane miles increases average speeds, which in turn reduces the perceived "cost" of driving and thereby induces more driving.

[32] Volker, Jamey Lee, Amy Handy, Susan. "Environmental Reviews Fail to Accurately Analyze Induced Vehicle Travel from Highway Expansion Projects," 2021. **<Exhibit 6>** https://escholarship.org/uc/item/14b0x0nm

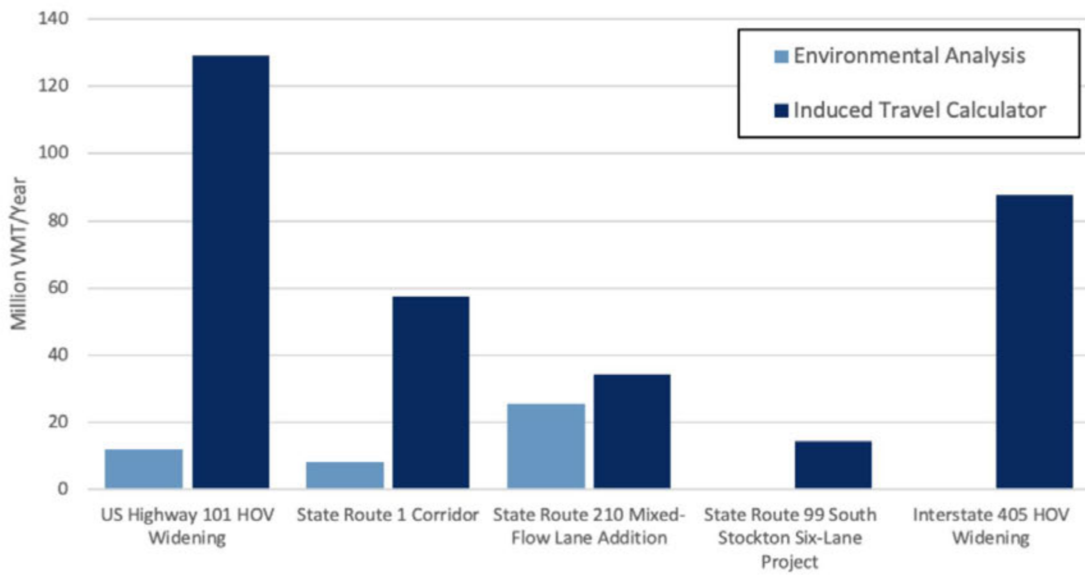

Figure 3. Comparison of induced VMT estimates in highway expansion project environmental analysis versus the induced Travel Calculator (analyses for the State Route 99 and Interstate 405 projects did not estimate induced travel.)
Source: Volker, Jamey Lee, Amy Handy, Susan. "Environmental Reviews Fail to Accurately Analyze Induced Vehicle Travel from Highway Expansion Projects," 2021. **<Exhibit 6>** https://escholarship.org/uc/item/14b0x0nm

CDOT has acknowledged this phenomenon, and SB21-260 established new modeling requirements for CDOT and the MPOs to modify their guiding documents to measure "the impact on emissions of greenhouse gas pollutants of induced demand resulting from transportation capacity projects." C.R.S §43-1-128

In July, CDOT published a GHG Briefing Memo describing the purpose and key challenges for the GHG Planning Rule. On the topic of modeling, CDOT explains the difference between the traditional "trip-based model" and the newer "activity-based model," the latter of which can more accurately model future land use patterns to predict induced demand from new capacity projects.[33] Both CDOT and DRCOG are now using the activity-based model to evaluate the impacts of transportation capacity projects.

However, based on the most recent planning documents, CDOT has yet to incorporate induced demand into their environmental review process. In August, CDOT released an Environmental Assessment for the expansion of I-70 from Floyd Hill to Veterans Memorial Tunnels, a project that would add 16.5 new lane miles to one of Colorado's most congested highways. According to the project's Air Quality Technical Report the "No Action" scenario, where the existing highway stays at two lanes in each direction, would generate more VMT and pollution than a scenario that

[33] Colorado Department of Transportation, "Transportation GHG Roadmap Briefing Update" July 13, 2021. Pgs. 9-10. https://www.codot.gov/programs/environmental/greenhousegas/ghg-briefing-memo-july-2021.pdf

expands the roadway capacity to three lanes.[34] This analysis clearly contradicts the principles of induced demand whereby any increase in roadway capacity encourages people to drive longer distances and take more trips.

The proposed rule's Cost-Benefit Analysis appears to correct for some of this by stating, "capacity expansion projects consider the effects of "induced demand", or increased traffic that is observed to result over time after roads are expanded. This increased traffic may lead to net increases in greenhouse gas emissions as a result of the project.... The long-run demand elasticity is assumed to be 0.67 for freeways and 0.5 for arterials. This elasticity represents the ratio of percent growth in VMT to percent growth in lane-miles." In contrast, the I-70 Floyd Hill Environmental Assessment uses an induced demand elasticity of 0, and as a result, finds minimal impact on air quality and climate from the additional lane miles.

This is not meant to challenge the safety and other potential benefits of the I-70 Floyd Hill project, but only to highlight the discrepancies between the VMT modeling results. If we are going to evaluate transportation plans and programs for compliance based on the projected VMT and GHG impacts, then the models need to be as accurate as possible.

We urge CDOT to consider using the NCST Induced Travel Calculator, which Caltrans is now using alongside their state travel demand model to measure the VMT and GHG impacts of proposed capacity projects. The NCST Calculator and CDOT's activity-based model can be run side by side and the delta between the two examined to improve the accuracy of the modeling. According to Caltrans' 2020 Induced Travel Analysis:[35]

> "In general, two approaches exist for induced travel assessment. The first is the empirical approach, which applies elasticities from empirical studies that quantify the induced travel effect (the National Center for Sustainable Transportation (NCST) Induced Travel Calculator applies this approach. The other is the travel demand model-based approach. The general guideline is to use both methods and disclose both induced travel numbers wherever applicable."

To bolster confidence, we request that CDOT apply their activity-based model (ABM) to past and current highway expansion projects in Colorado, like the I-25 TREX expansion and the central I-70 widening, to see how they compares to real-world data, and use the results to develop a Colorado-specific empirical model. (Alt. Rule 8.02.2.6). We recognize the modeling is

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[34] Colorado Department of Transportation, "I-70 Floyd Hill to Veterans Memorial Tunnels State Air Quality Technical Report". 2021. https://www.codot.gov/projects/i70floydhill/assets/ea/appendixa/floyd-hill-state-aq-technical-report.pdf

[35] California Department of Transportation, "Draft Transportation Analysis Framework: Induced Travel Analysis," 2020. Pg. 2. **<Exhibit 7>** https://dot.ca.gov/-/media/dot-media/programs/transportation-planning/documents/sb-743/2020-04-13-taf-a11y.pdf

extremely challenging and we recommend incorporating a periodic reassessment of accuracy of the relevant models in the rulemaking and policy directives. (Alt. Rule 8.02.2.4).

As mentioned above, the CBA describes an induced travel elasticity of 0.67, the most conservative estimate in the literature. Such a low elasticity is likely to overestimate the traffic congestion relief benefits and underestimate the environmental impacts of highway capacity projects. A recent study from leading experts on the subject of induced vehicle travel, which was also cited in the CBA, recommends using an induced travel elasticity of 1.0 for freeways and 0.75 for arterials.[36] We have incorporated these limits in Alt. Rule 8.02.2.1. We recognize the induced demand elasticity for a new Express Lane carrying HOV, HOT, and transit vehicles may be lower than that of a new general purpose lane, but the research suggests that new Express Lanes still create additional VMT on the system.[37] CDOT and MPOs should work together to establish a reliable induced demand elasticity for different roadway lane types.

In addition to the higher induced demand elasticity, we recommend adding provisions to Section 8.03.2 to create requirements for the Intergovernmental Agreement on the modeling. These recommendations will ensure that CDOT and all the MPOs are using consistent models and assumptions, and create a process to periodically review, reassess, and refine the models based on how well they perform against real-world data.

3.2. Require CDOT and MPOs to consider local land use when modeling the GHG and VMT impacts of individual transportation projects and establish criteria to reward projects that reduce VMT per capita through additional transportation-efficient land use strategies.

In order to achieve a 1.5 MMT reduction by 2030, CDOT's model assumes that 75% of new population and employment growth will occur in urban mixed-use areas in the DRCOG region and 50% for other MPOs. This scenario is the inverse of current trends where 76% of lots under development in the Denver metro-area are in Adams, Arapahoe, and Douglas counties – mostly new subdivisions on undeveloped land with little access to transit or jobs and services within walking distance.[38] While it's possible for some of the proposed GHG Mitigation Measures to promote infill development, hitting such targets will require a more comprehensive approach to better integrate transportation and land use planning.

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[36] Volker, Jamey M. B., et al. "Induced Vehicle Travel in the Environmental Review Process." Transportation Research Record, vol. 2674, no. 7, July 2020, pp. 468–479, doi:10.1177/0361198120923365.

[37] Caltrans Division of Transportation Planning, "Caltrans Greenhouse Gas Emissions and Mitigation Report," Pg. 22. **<Exhibit 2>**

[38] John Aguilar, DENVER'S SUBURBS LOOKING DECIDEDLY MORE URBAN, BUT ARE THEY AFFORDABLE ENOUGH? Denver Post, June 6, 2021. https://www.denverpost.com/2021/06/06/denver-suburbs-housing-market-design-affordability/

To maximize the VMT and GHG reductions, the rule should harness the synergistic effects of multiple transportation and land use policies working together. More investment in multimodal transportation is essential to reducing VMT, but it must be coupled with smart land use policies to locate housing, jobs, schools, grocery stores, and other services in close proximity to one another. Such policies reduce the number and distance of vehicle trips while also creating enough density to support high-frequency transit service and commercial development within walking distance.

DRCOG's Metro Vision 2050 Scenario Modeling compares a number of different transportation and land use scenarios to identify potential pathways to achieve their Metro Vision GHG and VMT performance measures.[39] One scenario would invest $16 billion in transit over 30 years, resulting in a 2% decrease in VMT per capita by 2050 against a business-as-usual scenario. A second scenario combines the same $16 billion transit investment with a land use scenario that focuses two-thirds of all new housing and employment in existing urban centers and along high-frequency transit corridors. The result is a 25% reduction in VMT per capita. Smart land use is a force multiplier for GHG and VMT reductions.

CDOT and MPOs are required by Senate Bill 21-260 to "consider the role of land use in the transportation planning process and develop strategies to encourage land use decisions that reduce vehicle miles traveled and greenhouse gas emissions." C.R.S §43-1-128. The rule should incorporate land use metrics in the evaluation of each transportation project by requiring CDOT and MPOs to:

- Measure the VMT and VMT per capita impacts of individual transportation projects in all planning and programming, including the RTPs and 10 Year Plans, and the TIP and Four-Year Prioritized Plan project selection process,
- Consider local land use and development patterns and the extent to which they contribute to VMT per capita reductions for the proposed transportation project,
- Prioritize projects that incorporate additional smart growth strategies such as upzoning, mixed-use infill development, and transit-oriented development, and
- Create a bonus for projects that advance equity by incorporating affordable housing and TDM programs that lower the combined housing and transportation costs for low-income households.

CDOT should develop a calculator that shows the VMT per capita reductions possible from all types of projects, including zoning reform, adding housing, residential and commercial density, travel demand management, parking reform, parking pricing, roadway pricing, managed lanes, bike lanes, sidewalks, and transit service. The Virginia DOT's Smart Scale uses a land use metric to evaluate project benefits based on the proposed or projected square footage of each

[39] DRCOG, 2050 Metro Vision Regional Transportation Plan Scenario Planning, Technical Memo, August 2020. https://drcog.org/sites/default/files/Scenario_Planning_Technical_Memo.pdf

development site, proximity to the transportation project, project status, and disproportionately-impacted community status to reflect the magnitude of the GHG and VMT impact.[40] The scoring rubric also includes accessibility criteria to measure a project's ability to improve access to jobs for the community as a whole, and for disproportionately-impacted populations.

Another example is the City of San Jose's VMT Evaluation Tool, which measures the degree to which a proposed land use project impacts VMT. The City established VMT per capita "thresholds" or targets at 15% below the city-wide average. New developments that are found to exceed those thresholds must implement VMT reduction strategies to increase density, support housing affordability, improve multimodal infrastructure, reduce auto parking supply, or implement TDM programs.[41] CDOT and the MPOs should work with local governments to develop similar tools that calculate the VMT impacts of proposed transportation projects in different land use scenarios. Projects that integrate and leverage multiple VMT reduction strategies (land use, multimodal infrastructure, parking policies, and TDM programs) should be prioritized for funding.

3.3. Track our progress on transportation-efficient land use by including housing, transit access, and location-efficiency metrics in the GHG Transportation Report.

Some examples might include:

- Total number of housing units and jobs within each city and county,
- Share of housing and employment within half-mile of high-frequency transit stations or within a quarter mile of high-frequency bus stops *,
- A description of steps taken to promote infill development in urban mixed-use areas and near transit stations,
- Change in the share of population and employment located in areas with high non-work accessibility **,
- Changes in regional population-weighted density *,
- Share of the region's population living in areas with affordable housing and transportation costs *,
- Share of population in disproportionately impacted communities with access to high-quality transit, biking, and walking infrastructure.

* Existing DRCOG Metro Vision performance measure
** Virginia DOT Smart Scale criteria

[40] Virginia Department of Transportation, "Smart Scale Technical Guide: Funding the Right Transportation Projects in Virginia," 2020. http://smartscale.org/documents/2020documents/rd3tord4trackchanges06012020.pdf
[41] City of San Jose, "Transportation Analysis Handbook," 2020. https://www.sanjoseca.gov/home/showpublisheddocument/28461/637378425915570000

4. IMPLEMENTATION AND ENFORCEMENT

4.1. Continue to include CDOT's Four Year Prioritized Plans and the MPO TIPs in the definition of Application Planning Documents.

In addition to the long-term 10-Year Plan and Regional Transportation Plans (RTPs), the GHG and VMT reduction targets must also apply to the short-term Four-Year Prioritized Plans and TIPs, as currently proposed in the rule. Our true transportation policy is how we spend our money, so the GHG Planning Rule must apply to both plans and programs. The TIP process is where individual transportation projects in the RTPs compete for funding and are prioritized based on their ability to advance our safety, mobility, environmental, and other goals. It is important to note that not all the projects listed in the RTPs are funded or built, so the projected GHG benefits from the full list of projects are not guaranteed. In contrast, projects in the TIP are awarded funding and advanced toward the construction phase.

Colorado should learn from the experience of California. In 2008, the California legislature passed Senate Bill 375, which created transportation GHG budgets for each MPO in the state. The state followed up in 2013 with Senate Bill 743, establishing VMT as the most appropriate metric to evaluate transportation impacts on climate and setting statewide and per capita VMT reduction targets. Despite these ambitious policies and targets, California has been unsuccessful in curbing VMT and transportation GHG pollution, partially because SB375 only applies to the long-term plans and not the near-term programs (TIPs). A review of the policy from researchers at UC Berkeley suggested that "allocation formulae could reward MPOs for reducing VMT and GHG emissions sooner rather than later, discouraging MPOs from delaying implementation of GHG-reducing projects like transit and active transportation to later years." [42]

4.2. Create interim GHG and VMT reduction targets to align with the adoption of the TIPs and CDOT's Four-Year Prioritized Plans.

RTPs, like DRCOG's Metro Vision 2050, outline 10-year "staging periods" and assign projects for each decade: 2021-2030, 2031-2040, and 2041-2050. In contrast, the TIPs cover a four-year project funding cycle and are adopted every two years (e.g., DRCOG's 2020-2023 and 2022-2025 TIPs). To address this, the rule should set linear GHG and VMT reduction paths with annual targets that align with the adoption of transportation plans and programs.

[42] Sciara, Gian-Claudia Lee, Amy E. "Allocating Transportation Revenues to Support Climate Policies in California and Beyond." 2018. https://escholarship.org/uc/item/6vs3v6wh

4.3. Update the definition of "multimodal" to focus on transit, biking, walking, TDM and other projects that increase access to non-auto modes of transportation and reduce VMT and GHGs. (Alt. Rule 1.34)

Change the definition of "multimodal" to match the definition of "multimodal projects" in Senate Bill 260.

- Current definition in Section 1.33: "Multimodal - an integrated approach to transportation that takes into account all modes of travel, such as bicycles and walking, personal mobility devices, buses, transit, rail, aircraft, and motor vehicles."
- Proposed alternative definition from Senate Bill 260, Section 50: ""Multimodal projects" means capital or operating costs for fixed route and on-demand transit, transportation demand management programs, multimodal mobility projects enabled by new technology, multimodal transportation studies, modeling tools, greenhouse gas mitigation projects, and bicycle or pedestrian projects."

4.4. Apply the targets to all five MPOs on the same timeline and create interim GHG and VMT reduction targets to align with the adoption of the TIPs and CDOT's Four-Year Prioritized Plans. (Alt. Rule 1.03 - definition of "Applicable Planning Documents")

Unlike local air pollutants, GHG emissions are a global issue. Therefore, any statewide climate policy should apply to all five MPOs on the same timeline. Combined, the three MPOs that are exempt from meeting the 2025 GHG reduction targets in the proposed rule – Grand Valley, Pikes Peak Area Council of Governments (COG), and Public Area COG – represent nearly a quarter of the total state population. These organizations also represent some of the most urban communities in the state and therefore, have the greatest potential to reduce transportation pollution through shorter vehicle trips, greater walkability and bikeability, and transit-supportive density. By applying the rule to all five MPOs on the same timeline, CDOT will increase the near-term GHG reductions from the rule and maximize our chances of hitting the HB21-1261 climate targets.

4.5. Restrict use of waivers. If a waiver is granted, funds should be restricted until the MPO or TPR comes back into compliance with VMT and GHG reduction targets. (Alt. Rule 8.05.2.1.3)

The Environmental Coalitions' proposal attempts to limit waivers to a one-time use only. Once a waiver has been granted, the funds should be restricted to the MPO or TPR until they can demonstrate compliance with both GHG pollution and VMT reductions.

CONCLUSION

Our present transportation planning policies are failing us. Whether it is measured by increased traffic, sprawling subdivisions, poor air quality, or our changing climate – our present path is unsustainable.

House Bill 121-1266 and Senate Bill 21-260 represent a sea change in Colorado. The rules are a fair but inadequate effort to meet either the requirements of the legislation or the challenges of our time. We look forward to continuing to work with the CDOT staff and other stakeholders to design a rule that will reduce GHG pollution, address inequities in our transportation planning policies, and offer a better future for Colorado.

Respectfully submitted on October 8th, 2021,

[redacted]

LIST OF EXHIBITS

1. M. G. Boarnet and S. L. Handy. "A Framework for Projecting the Potential Statewide Vehicle Miles Traveled (VMT) Reduction from State-Level Strategies in California." University of California Davis, 2017. https://escholarship.org/content/qt2z48105j/qt2z48105j.pdf?t=psmhhh&v=lg

2. Caltrans Division of Transportation Planning, "Caltrans Greenhouse Gas Emissions and Mitigation Report," Final Report August 2020. https://dot.ca.gov/-/media/dot-media/programs/transportation-planning/documents/office-of-smart-mobility-and-climate-change/ghg-emissions-and-mitigation-report-final-august-2-2020-revision9-9-2020-a11y.pdf

3. Alarfah, A., Griffin, W., Samaras, C., "Decarbonizing US passenger vehicle transport under electrification and automation uncertainty has a travel," 2020. Pg. 5. https://iopscience.iop.org/article/10.1088/1748-9326/ab7c89

4. Kevin Fang and Jamey Volker, "Cutting Greenhouse Gas Emissions is Only the Beginning: A Literature Review of the Co-Benefits of Reducing Vehicle Miles Traveled," National Center for Sustainable Transportation, 2017. University of California. https://escholarship.org/uc/item/4h5494vr

5. Christopher W. Tessum et. al., "Inequity in consumption of goods and services adds to racial-ethnic disparities in air pollution exposure." 2019. https://www.pnas.org/content/116/13/6001

6. Volker, Jamey Lee, Amy Handy, Susan. "Environmental Reviews Fail to Accurately Analyze Induced Vehicle Travel from Highway Expansion Projects," 2021. https://escholarship.org/uc/item/14b0x0nm

7. California Department of Transportation, "Draft Transportation Analysis Framework: Induced Travel Analysis", 2020. https://dot.ca.gov/-/media/dot-media/programs/transportation-planning/documents/sb-743/2020-04-13-taf-a11y.pdf

ENVIRONMENTAL COALITION'S 10/8/2021 REDLINES

DEPARTMENT OF TRANSPORTATION

Transportation Commission

RULES GOVERNING STATEWIDE TRANSPORTATION PLANNING PROCESS AND TRANSPORTATION PLANNING REGIONS

2 CCR 601-22

[Editor's Notes follow the text of the rules at the end of this CCR Document.]

August 13, 2021, Version

Please note the following formatting key:

Font Effect	Meaning
Underline	New Language
~~Strikethrough~~	Deletions
[Blue Font Text]	Annotation
Blue underlined	Conservation Community edits

STATEMENT OF BASIS AND PURPOSE, ~~AND~~ STATUTORY AUTHORITY AND PREAMBLE

The purpose of the Rules Governing the Statewide Transportation Planning Process and Transportation Planning Regions (Rules) is to prescribe the statewide transportation planning process through which a long-range ~~multimodal~~Multimodal, comprehensive ~~statewide~~ Statewide ~~transportation~~ Transportation ~~plan~~ Plan will be developed, integrated, updated, and amended by the Colorado Department of Transportation (Department or CDOT), in cooperation with local governments, Metropolitan Planning Organizations (MPOs) , Regional Planning Commissions, Indian tribal governments, relevant state and federal agencies, the private sector, transit and freight operators, ~~special interest groups,~~ and the general public. This cooperative process is designed to coordinate regional transportation planning, guided by the statewide transportation policy set by the Department and the ~~transportation~~ Transportation ~~commission~~ Commission of Colorado ("Commission"), as a basis for developing the ~~statewide~~ Statewide ~~transportation~~ Transportation ~~plan~~Plan. The result of the statewide transportation planning process shall be a long-range, financially feasible, environmentally sound, ~~multimodal~~ Multimodal transportation system plan for Colorado that will reduce traffic and smog and reduce Colorado's Greenhouse Gas (GHG) emissions.

Further, the purpose of the Rules is to define the state's Transportation Planning Regions for which long-range Regional Transportation Plans are developed, prescribe the process for conducting and initiating transportation planning in the non-MPO Transportation Planning Regions and coordinating with the ~~Metropolitan Planning Organizations~~MPOs for planning in the metropolitan areas. Memoranda of Agreement (MOA) that serve as the Metropolitan Planning Agreements (MPAs) ~~per~~ pursuant to 23 C.F.R. § 450 between the Department, each MPO, and applicable transit provider(s) further prescribe the transportation planning process in the MPO ~~transportation~~ Transportation ~~planning~~ Planning ~~regions~~Regions. In addition, the purpose of the Rules is to describe the organization and function of the

Statewide Transportation Advisory Committee (STAC) as established by § 43-1-1104, Colorado Revised Statutes (C.R.S.).

The Rules are promulgated to meet the intent of both the U.S. Congress and the Colorado General Assembly for conducting a continuing, cooperative, and comprehensive statewide performance-based ~~multimodal~~ Multimodal transportation planning process for producing a Statewide Transportation Plan and Regional Transportation Plans that address the transportation needs of the ~~state~~State. This planning process, through comprehensive input, results in systematic project prioritization and resource allocation.

The Rules, governing the statewide planning process, emphasize Colorado's continually greater integration of Multimodal, cost-effective, and environmentally sound means of transportation which leads to cleaner air and reduced traffic. The Rules reflect the Commission's and the Department's focus on Multimodal transportation projects including highways, transit, rail, bicycles and pedestrians. Section 8 of these Rules establishes an ongoing administrative process for identifying, measuring, confirming, and verifying those best practices and their impacts, so that CDOT and MPOs can easily apply them to their plans in order to achieve the pollution and Vehicle Miles Traveled reduction levels required by these Rules.

The Rules are promulgated by the Commission pursuant to the specific statutory authority in § 43-1-1103 (5), C.R.S., and § 43-1-106 (8)(k), C.R.S.

Preamble for 2018 Rulemaking

In 2018, rulemaking was initiated to update the rules to conform to recently passed federal legislation, update expired rules, clarify the membership and duties of the ~~Statewide Transportation Advisory Committee~~STAC pursuant to HB 16-1169 and HB 16-1018, and to make other minor corrections. ~~The Rules are intended to be consistent with and not be a replacement for the federal transportation planning requirements contained in 23 United States Code (U.S.C.) §§ 134, 135 and 150, Pub. L. No. 114-94 (Fixing America's Surface Transportation Act or the "FAST Act") signed into law on December 4, 2015, and its implementing regulations, where applicable, contained in 23 Code of Federal Regulations (C.F.R.) Part 450, including Subparts A, B and C and 25 C.F.R. § 170.421 in effect as of August 1, 2017, which are hereby incorporated into the Rules by this reference, and do not include any later amendments. All referenced laws and regulations shall be available for copying or public inspection during regular business hours from the Office of Policy and Government Relations, Colorado Department of Transportation, 2829 W. Howard Pl., Denver, Colorado 80204.~~

~~Copies of the referenced United States Code may be obtained from the following address:~~

~~Office of the Law Revision Counsel~~
~~U.S. House of Representatives~~
~~H2-308 Ford House Office Building~~
~~Washington, DC 20515~~
~~(202) 226-2411~~

~~Copies of the referenced Code of Federal Regulations may be obtained from the following address:~~

~~U.S. Government Publishing Office~~
~~732 North Capitol Street, N.W.~~
~~Washington, DC 20401~~
~~(202) 512-1800~~

~~The Statewide Planning Rules, governing the statewide planning process, emphasize Colorado's continually greater integration of multimodal, cost-effective and environmentally sound means of transportation. The Rules reflect the Department's focus on multimodal transportation projects including highways, aviation, transit, rail, bicycles and pedestrians.~~

~~The Rules are promulgated by the Commission pursuant to the specific statutory authority in § 43-1-1103 (5), C.R.S., and § 43-1-106 (8)(k), C.R.S. The Commission may, at their discretion, entertain petitions for declaratory orders pursuant to § 24-4-105(11), C.R.S.~~

Preamble for 2021 Rulemaking

Overview

Section 8 of these Rules establishes Greenhouse Gas (GHG) pollution reduction planning levels for transportation that will improve air quality, reduce smog, start to address inequities in our transportation system, and provide more sustainable options for travelers across Colorado. The purpose of these requirements is to limit the GHG pollution and provide more transportation options which would result from the transportation system if the plan was implemented, consistent with the state greenhouse gas pollution reduction roadmap. This is accomplished by requiring CDOT and MPOs to establish plans that meet targets through a mix of long-range and short-term projects that limit and mitigate air pollution and improve quality of life and Multimodal options. CDOT and MPOs will be required to demonstrate through travel demand modeling and approved air quality modeling that statewide and regional aggregate emissions and net Vehicle Miles Traveled resulting from its state or regional plans do not exceed a specified levels. In the event that a plan fails to comply, CDOT and MPOs have the option to commit to implementing GHG Mitigation Measures that provide travelers with cleaner and more equitable transportation options such as safer pedestrian crossings and sidewalks, better transit and transit-access, or infrastructure that supports access to housing, jobs, and retail.

Examples of these types of mitigations, which also benefit quality of place and the economic resilience of communities, will include but not be limited to: adding bus rapid transit facilities and services, enhancing first-and-last mile connections to transit, adding bike-sharing services including electric bikes, improving pedestrian facilities like sidewalks and safe accessible crosswalks, investments that support vibrant downtown density and local zoning decisions that favor sustainable building codes and inclusive multi-use facilities downtown, and more. The process of identifying and approving mitigations will be established by a policy process that allows for ongoing innovations from MPOs, local governments, impacted communities, and other partners to be considered on an iterative basis.

The process of identifying and approving mitigations will also be conducted in conjunction with Disproportionately Impacted Communities to ensure that approved mitigations are equitable. This process will be facilitated by the adoption, by rule or policy, of a Transportation Equity Framework. In order to address past inequities, and to prevent perpetuating inequitable practices, no projects will be allowed that will cause adverse environmental or public health impacts to a Disproportionately Impacted Community that is already experiencing degraded environmental conditions relative to the state population unless those environmental or public health impacts are entirely mitigated. Additionally, the benefits of projects and mitigation measures to decrease GHG pollution and VMT should directly benefit populations in Disproportionately Impacted Communities at a percentage that is commensurate with the percentage of population in the planning area within Disproportionately Impacted Communities.

If compliance still cannot be demonstrated, even after committing to GHG Mitigation Measures, the Commission shall restrict the use of certain funds, requiring that dollars be focused on projects that help reduce transportation emissions, reduce Vehicle Miles Traveled, and are recognized as approved mitigations. These requirements address the Colorado General Assembly's directive to reduce statewide GHG pollution in § 25-7- 102(2)(g), C.R.S., while reducing vehicle miles traveled, § 43-1-128(3), C.R.S as well as the directive for transportation planning to consider environmental stewardship and reducing GHG emissions, § 43-1-1103(5), C.R.S. in a manner that addresses the inequities of our current transportation system on disproportionately impacted communities. § 43-1-128 C.R.S.

Context of Section 8 of these Rules Within Statewide Objectives

The passage of House Bill (HB)19-1261 set Colorado on a course to dramatically reduce GHG emissions across all sectors of the economy. In HB 19-1261, now codified in part at §§ 25-7-102(2) and 105(1)(e), C.R.S., the General Assembly declared that "climate change adversely affects Colorado's economy, air quality and public health, ecosystems, natural resources, and quality of life[,]" acknowledged that "Colorado is already experiencing harmful climate impacts[,]" and that "many of these impacts disproportionately affect" certain Disproportionately Impacted Communities. *see* § 25-7-102(2), C.R.S. The General Assembly also recognized that "[b]y reducing [GHG] pollution, Colorado will also reduce other harmful air pollutants, which will, in turn, improve public health, reduce health care costs, improve air quality, and help sustain the environment." *see* § 25-7-102(2)(d), C.R.S.

Since 2019, the State has been rigorously developing a plan to achieve the ambitious GHG pollution reduction goals in § 25-7-102(2)(g), C.R.S. In January 2021, the State published its Greenhouse Gas Pollution Reduction Roadmap (Roadmap). The Roadmap identified the transportation sector as the single largest source of statewide GHG pollution as of 2020, with passenger vehicles the largest contributor within the transportation sector. Additionally, the Roadmap determined that emissions from transportation are a "significant contributor to local air pollution that disproportionately impacts lower-income communities and communities of color." *see* Roadmap, p. XII.

A key finding in the Roadmap recognized that "[m]aking changes to transportation planning and infrastructure to reduce growth in driving is an important tool" to meet the statewide GHG pollution reduction goals. *see* Roadmap, p. 32. Section 8 of these Rules also advances the State's goals to reduce emissions of other harmful air pollutants, including ozone.

Why the Commission is Taking This Action

Senate Bill 21-260, signed into law by the Governor on June 17, 2021, and effective upon signature, includes a new § 43-1-128, C.R.S., which directs CDOT and MPOs to engage in an enhanced level of planning, modeling and other analysis to minimize the adverse environmental and health impacts of planned transportation capacity projects. Section 43-1-128, C.R.S. also directs CDOT and the Commission to take steps to account for the impacts of transportation capacity projects on GHG pollution and Vehicle Miles Traveled and to help achieve statewide GHG pollution targets established in § 25-7-102(2)(g), C.R.S.

Under Colorado law governing transportation planning, CDOT is charged with and identified as the proper body for "developing and maintaining the state transportation planning process and the state transportation plan" in cooperation with Regional Planning Commissions and local government officials. *see* § 43-1-1101, C.R.S.

The Commission is responsible for formulating policy with respect to transportation systems in the State and promulgating and adopting all CDOT financial budgets for construction based on the Statewide Transportation Improvement Programs. *see* § 43-1-106(8), C.R.S. The Commission is statutorily charged "to assure that the preservation and enhancement of Colorado's environment, safety, mobility and economics be considered in the planning, selection, construction and operation of all transportation projects in Colorado." *see* § 43-1-106(8)(b), C.R.S. In addition, the Commission is generally authorized "to make all necessary and reasonable orders, rules and regulations in order to carry out the provisions of this part . . ." *see* § 43-1-106(8)(k), C.R.S.

As such, CDOT and the Commission are primarily responsible for ensuring compliance with GHG and Vehicle Miles Traveled reductions in transportation planning.

What Relevant Regulations Currently Apply to Transportation Planning

Transportation planning is subject to both state and federal requirements. Under federal law governing transportation planning and federal-aid highways, it is declared to be in the national interest to promote transportation systems that accomplish a number of mobility objectives "while minimizing transportation-related fuel consumption and air pollution through metropolitan and statewide transportation planning processes…" *see* 23 U.S.C. § 134; *see also* 23 U.S.C. § 135(a)(1). In the metropolitan planning process, consideration must be given to projects and strategies that will "protect and enhance the environment, promote energy conservation, improve the quality of life…" *see* 23 U.S.C. § 134(h)(1)(E); *see also* 23 C.F.R. Part 450, Subpart B (federal regulations governing statewide transportation planning and programming). The same planning objective applies to statewide transportation planning. *see* 23 U.S.C. § 135(d)(1)(E); *see also* 23 C.F.R. Part 450, Subpart C (governing metropolitan transportation planning and programming). Further, the Statewide Transportation Plan shall be developed, as appropriate, in consultation with State...local agencies responsible for...environmental protection…" *see* 23 U.S.C. § 135(f)(2)(D)(i).

Under conforming Colorado law, the Statewide Transportation Plan is developed by integrating and consolidating Regional Transportation Plans developed by MPOs and regional transportation planning organizations into a "comprehensive statewide transportation plan" pursuant to rules and regulations promulgated by the Commission. *see* § 43-1-1103(5), C.R.S. The Statewide Transportation Plan must adress a number of factors including, but not limited to, "environmental stewardship" and "reduction of greenhouse gas emissions." *see* § 43-1-1103(5)(h) and (j), C.R.S.

Regional Transportation Plans must account for the "expected environmental, social, and economic impacts of the recommendations in the plan, including a full range of reasonable transportation alternatives...in order to provide for the transportation and environmental needs of the area in a safe and efficient manner." *see* § 43-1-1103(1)(d), C.R.S. Further, in developing Regional Transportation Plans, MPOs "[s]hall assist other agencies in developing transportation control measures for utilization in accordance with state...regulations...and shall identify and evaluate measures that show promise of supporting clean air objectives." *see* § 43-1-1103(1)(e), C.R.S.

Putting Section 8 of these Rules into Perspective

Section 8 establishes GHG regulatory requirements that are among the first of their kind in the U.S. However, from an air pollutant standpoint, connecting transportation planning to emissions is not a new policy area. In fact, transportation conformity provisions within the Clean Air Act approach ozone much the same way. Transportation conformity ensures that federally funded or approved highway and transit activities within a Nonattainment Area are consistent with or "conform to" a state's plan to reduce emissions. Colorado's front range has been in ozone nonattainment for many years, which has required the North Front Range and the Denver Regional Council of Governments' MPOs to demonstrate conformity with each plan adoption and amendment.

However, because the transportation sector encompasses the millions of individual choices people make every day that have an impact on climate, a variety of strategies are necessary to achieve the State's climate goals. Section 8 of these Rules is one of many steps needed to achieve the totality of reduction goals for the transportation sector.

Purpose of GHG Mitigation Measures

The transportation modeling conducted for this rulemaking may demonstrate that certain projects increase GHG pollution for a variety of reasons. These reasons may include factors such as induced demand as a result of additional lane mileage attracting additional vehicular traffic, or additional traffic facilitated by access to new commercial or residential development in the absence of public transit options or bicycle/pedestrian access that provides consumers with other non-driving options. Transportation infrastructure itself can also increase or decrease GHG and other air pollutants by virtue of factors like certain construction materials, removal or addition of tree cover that captures carbon pollution, or integration with vertical construction templates of various efficiencies that result in higher or lower levels of per capita energy use. The pollution impacts of various infrastructure projects will vary significantly depending on their specifics and must be modeled in a manner that is context-sensitive to a range of issues such as location, footprint of existing infrastructure, design, and how it fits together with transportation alternatives.

Furthermore, other aspects of transportation infrastructure can facilitate reductions in Vehicle Miles Traveled and emissions and thus serve as mitigations rather than contributors to pollution. For example, the addition of transit resources in a manner that can displace Vehicle Miles Traveled can reduce emissions. Moreover, improving downtown pedestrian and bike access, particularly in areas that allow individuals to shift multiple daily trips for everything from work to dining to retail, can improve both emissions and quality of life.

Reduction of Vehicle Miles Traveled through planning is one of the more effective GHG Mitigation measures. It is also a separate goal identified in legislation. See § 43-1-128, C.R.S. Reducing Vehicle Miles Traveled is necessary for meeting Colorado's GHG reduction goals, but there are numerous co-benefits such as reductions in vehicle fatalities, air pollution, water pollution, wildlife mortality, and traffic congestion, while improving public health, worker productivity, and Colorado's economy.

There is an increasing array of proven best practices for reducing pollution and smog and improving economies and neighborhoods that can help streamline decision-making for state and local agencies developing plans and programs of projects.

[Note: The Commission proposes to repeal Section 1 of these Rules in its entirety and re-enact Section 1 of these Rules below to re-format the numbering of the administrative rules into alphabetical order.]

[Note: The Commission proposes to add nineteen (19) new definitions. New proposed defined terms include: Applicable Planning Document, Approved Air Quality Model, Baseline, Carbon Dioxide Equivalent, Congestion Mitigation and Air Quality, Disproportionately Impacted Communities, Four-Year Prioritized Plan, Greenhouse Gas, Greenhouse Mitigation Measures, Greenhouse Gas Reduction Levels, Mitigation Action Plan, MPO Model, Multimodal Transportation and Mitigation Options Fund, Regionally Significant Project, State Interagency Consultation Team, Statewide Travel Model, Surface Transportation Block Grant, Vehicle Miles Traveled, and 10-Year Plan. Only minor non-substantive changes, such as correcting grammar errors or capitalizing defined terms, were made to the existing forty-six (46) defined terms.]

1.00 Definitions.

1.01 Accessible - ensure that reasonable efforts are made that all meetings are reachable by persons from households without vehicles and that the meetings will be accessible to persons with disabilities in accordance with the Americans with Disabilities Act (ADA), and also accessible to persons with Limited English Proficiency. Accessible opportunities to comment on planning related matters include those provided on the internet and through such methods as telephone town halls.

1.02 Activity-Based Model - estimates travel demand based on individual daily activity patterns. The model predicts the type of activity, the time the activity occurs, the activity location, the activity duration, the number of individual trips, and the travel mode choice.

1.03 Applicable Planning Document - refers to MPO Fiscally Constrained RTPs,TIPs for MPOs ~~in NAAs~~, CDOT's 10-Year Plan and Four-Year Prioritized Plan in non-MPO areas, and amendments to the MPO RTPs and CDOT's 10-Year Plan and Four-Year Prioritized Plan in non-MPO areas that include the addition of Regionally Significant Projects.

1.04 Approved Air Quality Model - the most recent Environmental Protection Agency issued model that quantifies GHG emissions from transportation.

1.05 Attainment Area - any geographic region of the United States that meets the national primary or secondary National Ambient Air Quality Standards (NAAQS) for the pollutants as defined in the Clean Air Act (CAA) (Amendments of 1990).

1.06 Baseline - estimates of GHG emissions for each of the MPOs, and for the non-MPO areas, prepared using the MPO Models or the Statewide Travel Model. Estimates must include GHG emissions resulting from the existing transportation network and implementation of the most recently adopted RTP for all MPOs and the 10-Year Plan in non-MPO areas as of the effective date of these Rules.

1.07 Carbon Dioxide Equivalent (CO2e) - a metric measure used to compare the emissions from various GHG based upon the 100-year global warming potential (GWP). CO2e is multiplying the mass amount of emissions (metric tons per year), for each GHG constituent by that gas's GWP, and summing the resultant values to determine CO2e (metric tons per year). This calculation allows comparison of different greenhouse gases and their relative impact on the environment over different time periods.

1.08 Commission - the Transportation Commission of Colorado created by § 43-1-106, C.R.S.

1.09 Congestion Mitigation and Air Quality (CMAQ) - a federally mandated program established in 23

U.S.C § 149 to improve air quality in Nonattainment and Maintenance Areas for ozone, carbon monoxide, and particulate matter. References related to this program include any successor programs as established by the federal government.

1.10 Corridor - a transportation system that includes all modes and facilities within a described geographic area.

1.10 Corridor Vision - a comprehensive examination of a specific transportation Corridor, which includes a determination of needs and an expression of desired state of the transportation system that includes Transportation Modes and facilities over a planning period.

1.11 Department or CDOT - the Colorado Department of Transportation created by § 43-1-103, C.R.S.

1.12 Disproportionately Impacted Communities - defined in § 24-38.5-302(3), C.R.S. as a community that is in a census block group, as determined in accordance with the most recent United States Decennial Census where the proportion of households that are low income is greater than forty percent (40%), the proportion of households that identify as minority is greater than forty percent (40%), or the proportion of households that are housing cost-burdened is greater than forty percent (40%); or is any other community as identified or approved by a state agency, if: the community has a history of environmental racism perpetuated through redlining, anti-Indigenous, anti-immigrant, anti-Hispanic, or anti-Black laws; or the community is one where multiple factors, including socioeconomic stressors, disproportionate environmental burdens, vulnerability to environmental degradation, and lack of public participation, may act cumulatively to affect health and the environment and contribute to persistent disparities.

1.13 Division - the Division of Transportation Development within CDOT.

1.14 Division Director - the Director of the Division of Transportation Development.

1.15 Fiscally Constrained - the financial limitation on transportation plans and programs based on the projection of revenues as developed cooperatively with the MPOs and the rural TPRs and adopted by the Commission that are reasonably expected to be available over the long-range transportation planning period and the TIP and STIP programming periods.

1.16 Four-Year Prioritized Plan - a four-year subset of the 10-Year Plan consisting of projects prioritized for near-term delivery and partial or full funding.

1.17 Greenhouse Gas (GHG) - for purposes of these Rules, GHG is defined as the primary transportation greenhouse gases: carbon dioxide, methane, and nitrous oxide.

~~1.18 Greenhouse Gas (GHG) Reduction Level - the amount of the GHG expressed as CO2e, reduced from the projected Baseline that CDOT and MPOs must attain through transportation planning.~~

1.19 Greenhouse Gas (GHG) Mitigation Measures - non-Regionally Significant Project strategies implemented by CDOT and MPOs that reduce transportation GHG pollution and reduce VMT and help meet the GHG and VMT Reduction Levels.

1.20 Induced Travel Elasticity - the percentage change in VMT / the percentage change in lane miles. An elasticity of 1.0 indicates that a given percent increase in lane miles will cause the same percent increase in VMT.

1.21 Intergovernmental Agreement - an arrangement made between two or more political subdivisions that form associations for the purpose of promoting the interest and welfare of said subdivisions.

1.22 Intermodal Facility - a site where goods or people are conveyed from one mode of transportation to another, such as goods from rail to truck or people from passenger vehicle to bus.

1.23 Land Use - the type, size, arrangement, and use of parcels of land.

1.24 Limited English Proficiency - individuals who do not speak English as their primary language and who have a limited ability to read, speak, write, or understand English.

1.25 Long-Range Planning - a reference to a planning period with a minimum 20-year planning horizon.

1.26 Maintenance Area - any geographic region of the United States previously designated by the U.S. Environmental Protection Agency (EPA) as a Nonattainment Area pursuant to the Clean Air Act (CAA) Amendments of 1990 and subsequently redesignated to attainment subject to the requirement to develop a maintenance plan under § 175A of the CAA, as amended in 1990.

1.27 Memorandum of Agreement (MOA) - a written agreement between two or more parties on an intended plan of action.

1.28 Metropolitan Planning Agreement (MPA) - a written agreement between the MPO, the State, and the providers of public transportation serving the Metropolitan Planning Area that describes how they will work cooperatively to meet their mutual responsibilities in carrying out the metropolitan planning process.

1.29 Metropolitan Planning Area - a geographic area determined by agreement between the MPO for the area and the Governor, in which the metropolitan transportation planning process is carried out pursuant to 23 U.S.C. § 134.

1.30 Metropolitan Planning Organization (MPO) - an organization designated by agreement among the units of general purpose local governments and the Governor, charged to develop the RTPs and programs in a Metropolitan Planning Area pursuant to 23 U.S.C. § 134.

1.31 Mitigation Action Plan - an element of the GHG Transportation Report that specifies which GHG Mitigation Measures shall be implemented that help achieve the GHG Reduction Levels.

1.32 Mobility - the ability to move people, goods, services, and information among various origins and destinations.

1.33 MPO Models - one (1) or more of the computer-based models maintained and operated by the MPOs which depict the MPO areas' transportation systems (e.g., roads, transit, etc.) and development patterns (i.e., number and location of households and jobs) for a defined year (i.e., past, present, or forecast) and produce estimates of roadway VMT, delays, operating speeds, transit ridership, and other characteristics of transportation system use.

1.34 Multimodal Projects - capital or operating costs for fixed route and on-demand transit, transportation demand management programs, multimodal mobility projects enabled by new technology, multimodal transportation studies, modeling tools, greenhouse gas mitigation projects, and bicycle or pedestrian projects.

1.35 Multimodal Transportation and Mitigation Options Fund (MMOF) - a program created in the State Treasury pursuant to § 43-4-1003, C.R.S. which funds bicycle, pedestrian, transit and other Multimodal Projects as defined in § 43-4-1002(5), C.R.S. and GHG Mitigation projects as defined in § 43-4-1002(4.5), C.R.S.

1.36 National Ambient Air Quality Standards (NAAQS) - are those established by the U.S. Environmental Protection Agency for air pollutants considered harmful to public health and environment. These criteria pollutants are: carbon monoxide, lead, nitrogen dioxide, ozone, small particles, and sulfur dioxide.

1.37 Nonattainment Area - any geographic region of the United States which has been designated by the EPA under section 107 of the CAA for any pollutants for which a NAAQS exists.

1.38 Non-Metropolitan Area - a rural geographic area outside a designated Metropolitan Planning

Area.

1.39 Plan Integration - a comprehensive evaluation of the statewide transportation system that includes all modes, an identification of needs and priorities, and key information from other related CDOT plans.

1.40 Planning Partners - local and tribal governments, the rural TPRs and MPOs.

1.41 Project Priority Programming Process - the process by which CDOT adheres to 23 U.S.C. § 135 and 23 C.F.R. Part 450 when developing and amending the STIP.

1.42 Regional Planning Commission (RPC) - a planning body formed under the provisions of § 30-28-105, C.R.S., and designated under these Rules for the purpose of transportation planning within a rural TPR.

1.43 Regionally Significant Project - a transportation project that is on a facility which serves regional transportation needs (such as access to and from the area outside of the region, major activity centers in the region, major planned developments such as new retail malls, sports complexes, etc., or transportation terminals as well as most terminals themselves) and would normally be included in the modeling of a metropolitan area's transportation network or state transportation network, including at a minimum all principal arterial highways and all fixed guideway transit facilities that offer an alternative to regional highway travel. If the MPOs have received approval from the EPA to use a different definition of regionally significant project as defined in 40 C.F.R. § 93.101, the State Interagency Consultation Team will accept the modified definition. Necessary specificity for MPO Models or the Statewide Travel Model will be approved by the State Interagency Consultation Team.

1.44 Regional Transportation Plan (RTP) - a long-range plan designed to address the future transportation needs for a TPR including, but not limited to, Fiscally Constrained or anticipated funding, priorities, and implementation plans, pursuant to, but not limited to, § 43-1-1103, C.R.S. and 23 C.F.R. Part 450. All rural and urban TPRs in the state produce RTPs.

1.45 State Interagency Consultation Team - consists of the Division Director or the Division Director’s designee, the Colorado Department of Public Health and Environment (CDPHE) Director of Air Pollution Control Division or the Director’s designee, and the Director of each MPO or their designee.

1.46 State Transportation System - refers to all state-owned, operated, and maintained transportation facilities in Colorado, including, but not limited to, interstate highways, other highways, and aviation, bicycle and pedestrian, transit, and rail facilities.

1.47 Statewide Transportation Advisory Committee (STAC) - the committee created by § 43-1-1104, C.R.S., comprising one representative from each TPR and one representative from each tribal government to review and comment on RTPs, amendments, and updates, and to advise both the Department and the Commission on the needs of the transportation system in Colorado.

1.48 Statewide Transportation Improvement Program (STIP) - a Fiscally Constrained, multi-year, statewide, Multimodal program of transportation projects which is consistent with the Statewide Transportation Plan and planning processes, with Metropolitan Planning Area plans, Transportation Improvement Programs and processes, and which is developed pursuant to 23 U.S.C. § 135.

1.49 Statewide Travel Model - the computer-based model maintained and operated by CDOT which depicts the state’s transportation system (roads, transit, etc.) and development scale and pattern (number and location of households, number and location of firms/jobs) for a selected year (past, present, or forecast) and produces estimates of roadway VMT and speed, transit, ridership, and other characteristics of transportation system use.

1.50 Statewide Transportation Plan - the long-range, comprehensive, Multimodal statewide transportation plan covering a period of no less than 20 years from time of adoption, developed through the statewide transportation planning process described in these Rules and 23 U.S.C. § 135, and adopted by the Commission pursuant to § 43-1-1103, C.R.S.

1.51 Surface Transportation Block Grant (STBG) - a flexible federal funding source established under 23 U.S.C. § 133 for state and local transportation needs. Funds are expended in the areas of the State based on population. References related to this program include any successor programs established by the federal government.

1.52 System Continuity - includes, but is not limited to, appropriate intermodal connections, integration with state modal plans, and coordination with neighboring RTPs, and, to the extent practicable, other neighboring states' transportation plans.

1.53 Traditionally Underserved - refers to groups such as seniors, persons with disabilities, low-income households, minorities, and student populations, which may face difficulties accessing transportation systems, employment, services, and other amenities.

1.54 Transit and Rail Advisory Committee (TRAC) - an advisory committee created specifically to advise the Executive Director, the Commission, and the Division of Transit and Rail on transit and rail-related activities.

1.55 Transportation Commonality - the basis on which TPRs are established including, but not limited to: Transportation Commission Districts, the Department's Engineering Regions, Travelsheds, Watersheds, geographic unity, existing Intergovernmental Agreements, and socioeconomic unity.

1.56 Transportation Equity Framework – policy to be created by the Department's Environmental Justice Division, that is informed by the state's Climate Equity Framework, and the Climate Equity Advisory Committee, codifying outreach practices and community empowerment in transportation planning and policy decisions. The Transportation Equity Framework must be developed in collaboration with environmental justice advocates and members of disproportionately-impacted communities.

1.57 Transportation Improvement Program (TIP) - a staged, Fiscally Constrained, multi-year, Multimodal program of transportation projects developed and adopted by MPOs, and approved by the Governor, which is consistent with an MPO's RTP and which is developed pursuant to 23 U.S.C. § 134.

1.58 Transportation Mode - a particular form of travel including, but not limited to, bus, motor vehicle, rail, transit, aircraft, bicycle, pedestrian travel, or personal mobility devices.

1.59 Transportation Planning and Programming Process - all collaborative planning-related activities including the development of regional and Statewide Transportation Plans, the Department's Project Priority Programming Process, and development of the TIPs and STIP.

1.60 Transportation Planning Region (TPR) - a geographically designated area of the state, defined by section 2.00 of these Rules in consideration of the criteria for Transportation Commonality, and for which a regional transportation plan is developed pursuant to the provisions of § 43-1-1102 and 1103, C.R.S. and 23 U.S.C. § 134. The term TPR is inclusive of these types: non-MPO TPRs, MPO TPRs, and TPRs with both MPO and non-MPO areas.

1.61 Transportation Planning Reduction Level - the amount of reduction of VMT and GHG (expressed as CO2e) from the projected Baseline that CDOT and MPOs must attain through transportation planning.

1.62 Transportation Systems Planning - provides the basis for identifying current and future deficiencies on the state highway system and outlines strategies to address those deficiencies and make improvements to meet Department goals.

1.63 Travelshed - the region or area generally served by a major transportation facility, system, or Corridor.

1.64 Tribal Transportation Improvement Program (TTIP) - a multi-year Fiscally Constrained list of proposed transportation projects developed by a tribe from the tribal priority list or tribal long-range transportation plan, and which is developed pursuant to 25 C.F.R. Part 170. The TTIP is incorporated into the STIP without modification.

1.65 Urbanized Area - an area with a population of 50,000 or more designated by the Bureau of the Census.

1.66 Vehicle Miles Traveled (VMT), Net, the traffic volume of a roadway segment or system of roadway segments multiplied by the length of the roadway segment or system.

1.67 Vehicle Miles Traveled (VMT), Per Capita - is calculated as the total annual miles of vehicle travel divided by the total population in the state or in an urbanized area.

1.68 Watershed - a land area that drains to a common waterway, such as a stream, lake, estuary, wetland, or ultimately the ocean.

1.69 10-Year Plan - a vision for Colorado's transportation system that includes a specific list of projects categorized across priority areas as identified in the Statewide Transportation Plan.

2.00 Transportation Planning Regions (TPR).

2.01 Transportation Planning Region Boundaries. ~~Transportation Planning Region~~TPRs are geographically designated areas of the state with similar transportation needs that are determined by considering transportation commonalities. Boundaries are hereby established as follows:

2.01.1 The Pikes Peak Area ~~Transportation Planning Region~~TPR comprises the Pikes Peak Area Council of Governments' metropolitan area within El Paso and Teller counties.

2.01.2 The Greater Denver ~~Transportation Planning Region~~TPR, which includes the Denver Regional Council of Governments' planning area, comprises the counties of Adams, Arapahoe, Boulder, Broomfield, Clear Creek, Denver, Douglas, Gilpin, Jefferson, and parts of Weld.

2.01.3 The North Front Range ~~Transportation Planning Region~~TPR comprises the North Front Range Transportation and Air Quality Planning Council's metropolitan area within Larimer and Weld counties.

2.01.4 The Pueblo Area ~~Transportation Planning Region~~TPR comprises Pueblo County, including the Pueblo Area Council of Governments' metropolitan area.

2.01.5 The Grand Valley ~~Transportation Planning Region~~TPR comprises Mesa County, including the Grand Valley Metropolitan Planning Organization's metropolitan area.

2.01.6 The Eastern ~~Transportation Planning Region~~TPR comprises Cheyenne, Elbert, Kit Carson, Lincoln, Logan, Phillips, Sedgwick, Washington, and Yuma counties.

2.01.7 The Southeast ~~Transportation Planning Region~~TPR comprises Baca, Bent, Crowley, Kiowa, Otero, and Prowers counties.

2.01.8 The San Luis Valley ~~Transportation Planning Region~~TPR comprises Alamosa, Chaffee, Conejos, Costilla, Mineral, Rio Grande, and Saguache counties.

2.01.9 The Gunnison Valley ~~Transportation Planning Region~~TPR comprises Delta, Gunnison, Hinsdale, Montrose, Ouray, and San Miguel counties.

2.01.10 The Southwest ~~Transportation Planning Region~~TPR comprises Archuleta, Dolores, La Plata, Montezuma, and San Juan counties, including the Ute Mountain Ute and Southern Ute Indian Reservations.

2.01.11 The Intermountain ~~Transportation Planning Region~~TPR comprises Eagle, Garfield, Lake, Pitkin, and Summit counties.

2.01.12 The Northwest ~~Transportation Planning Region~~TPR comprises Grand, Jackson, Moffat, Rio Blanco, and Routt counties.

2.01.13 The Upper Front Range ~~Transportation Planning Region~~TPR comprises Morgan County, and the parts of Larimer and Weld counties, that are outside both the North Front Range and the Greater Denver (metropolitan) TPRs.

2.01.14 The Central Front Range ~~Transportation Planning Region~~TPR comprises Custer, El Paso, Fremont, Park, and Teller counties, excluding the Pikes Peak Area Council of Governments' metropolitan area.

2.01.15 The South Central ~~Transportation Planning Region~~TPR comprises Huerfano, and Las Animas Counties.

2.02 Boundary Revision Process.

2.02.1 TPR boundaries, excluding any MPO-related boundaries, will be reviewed by the Commission at the beginning of each regional and statewide transportation planning process. The Department will notify counties, municipalities, MPOs, Indian tribal governments, and RPCs for the TPRs of the boundary review revision requests. MPO boundary review shall be conducted pursuant to 23 U.S.C. § 134 and 23 C.F.R. Part 450 Subpart B and any changes shall be provided to the Department to update the Rules. All boundary revision requests shall be sent to the Division Director, and shall include:

2.02.1.1 A geographical description of the proposed boundary change.

2.02.1.2 A statement of justification for the change considering transportation commonalities.

2.02.1.3 A copy of the resolution stating the concurrence of the affected ~~Regional Planning Commission~~RPC.

2.02.1.4 The name, title, mailing address, telephone number, fax number and electronic mail address (if available) of the contact person for the requesting party or parties.

2.02.2 The Department will assess and STAC shall review and comment (as set forth in these Rules) on all ~~non~~Non-~~metropolitan~~ Metropolitan ~~area~~ Area TPR boundary revision requests based on transportation commonalities and make a recommendation to the Commission concerning such requests. The Department will notify the Commission of MPO boundary changes. The Commission may initiate a rule-making proceeding under the ~~State~~ Colorado Administrative Procedure Act, § 24-4-103, C.R.S. to consider a boundary revision request. Requests received for a MPO or non-metropolitan TPR boundary revision outside of the regularly scheduled boundary review cycle must include the requirements identified above.

2.02.3 In the event that the Commission approves a change to the boundary of a TPR that has a ~~Regional Planning Commission~~RPC, the RPC in each affected TPR shall notify the Department of any changes to the ~~intergovernmental~~ Intergovernmental ~~agreement~~ Agreement governing the RPC as specified in these Rules.

2.03 Transportation Planning Coordination with MPOs.

2.03.1 The Department and the MPOs shall coordinate activities related to the development of ~~Regional Transportation Plan~~RTPs, the Statewide Transportation Plan, TIPs, and the STIP in conformance with 23 U.S.C. § 134 and 135 and § 43-1-1101 and § 43-1-1103, C.R.S. The Department shall work with the MPOs to resolve issues arising during the planning process.

2.04 Transportation Planning Coordination with Non-MPO RPCs.

2.04.1 The Department and RPCs shall work together in developing ~~Regional Transportation Plan~~RTPs and in planning future transportation activities. The Department shall consult with all RPCs on development of the Statewide Transportation Plan; incorporation of RTPs into the Statewide Transportation Plan; and the inclusion of projects into the STIP that are consistent with the RTPs. In addition, the Department shall work with the RPCs to resolve issues arising during the planning process.

2.05 Transportation Planning Coordination among RPCs.

2.05.1 If transportation improvements cross TPR boundaries or significantly impact another TPR, the RPC shall consult with all the affected RPCs involved when developing the ~~regional transportation plan~~RTP. In general, RPC planning officials shall work with all ~~planning~~ Planning ~~partners~~ Partners affected by transportation activities when planning future transportation activities.

2.06 Transportation Planning Coordination with the Southern Ute and the Ute Mountain Ute Tribal Governments.

2.06.1 Regional transportation planning within the Southwest TPR shall be coordinated with the transportation planning activities of the Southern Ute and the Ute Mountain Ute tribal governments. The long-range transportation plans for the tribal areas shall be integrated in the Statewide Transportation Plan and the ~~Regional Transportation Plan~~RTP for this TPR. The TTIP is incorporated into the STIP without modification.

3.00 Statewide Transportation Advisory Committee (STAC).

3.01 Duties of the ~~Statewide Transportation Advisory Committee (~~STAC~~)~~. Pursuant to § 43-1-1104 C.R.S. the duties of the STAC shall be to meet as necessary and provide advice to both the Department and the Commission on the needs of the transportation system in Colorado including, but not limited to: budgets, ~~transportation improvement programs~~TIPs of the ~~metropolitan planning organizations~~MPOs, the ~~Statewide Transportation Improvement Program~~STIP, transportation plans, and state transportation policies.

The STAC shall review and provide to both the Department and the Commission comments on:

3.01.1 All ~~Regional Transportation Plan~~RTPs, amendments, and updates as described in these Rules.

3.01.2 Transportation related communication and/or conflicts which arise between RPCs or between the Department and a RPC.

3.01.3 The integration and consolidation of RTPs into the Statewide Transportation Plan.

3.01.4 Colorado's ~~mobility~~ Mobility requirements to move people, goods, services, and information by furnishing regional perspectives on transportation problems requiring interregional and/or statewide solutions.

3.01.5 Improvements to modal choice, linkages between and among modes, and transportation system balance and ~~system~~ System ~~continuity~~Continuity.

3.01.6 Proposed TPR boundary revisions.

3.02 Notification of Membership

3.02.1 Each RPC and tribal government shall select its representative to the STAC pursuant to § 43-1-1104(1), C.R.S. The Ute Mountain Ute Tribal Council and the Southern Ute Indian Tribal Council each appoint one representative to the STAC. Each TPR and tribal government is also entitled to name an alternative representative who would serve as a proxy in the event their designated representative is unable to attend a STAC meeting and would be included by the Department in distributions of all STAC correspondence and notifications. The Division Director shall be notified in writing of the name, title, mailing address, telephone number, fax number and electronic mail address (if available) of the STAC representative and alternative representative from each TPR and tribal government within thirty (30) days of selection.

3.03 Administration of ~~Statewide Transportation Advisory Committee~~STAC

3.03.1 STAC recommendations on Regional and Statewide Transportation Plans, amendments, and updates shall be documented in the STAC meeting minutes, and will be considered by the Department and Commission throughout the statewide transportation planning process.

3.03.2 The STAC shall establish procedures to govern its affairs in the performance of its advisory capacity, including, but not limited to, the appointment of a chairperson and the length of the chairperson's term, meeting times, and locations.

3.03.3 The Division Director will provide support to the STAC, including, but not limited to:

3.03.3.1 Notification of STAC members and alternates of meeting dates.

3.03.3.2 Preparation and distribution of STAC meeting agendas, supporting materials, and minutes.

3.03.3.3 Allocation of Department staff support for STAC-related activities.

4.00 Development of Regional and Statewide Transportation Plans.

4.01 ~~Regional Planning Commission~~RPCs, MPOs, and the Department shall comply with all applicable provisions of 23 U.S.C. § 134 and § 135, 23 C.F.R. Part 450, and § 43-1-1103, C.R.S. and all applicable provisions of Commission policies and guidance documents in development of regional and statewide transportation plans, respectively.

4.02 Public Participation

4.02.1 The Department, in coordination with the RPCs of the rural TPRs, shall provide early and continuous opportunity for public participation in the transportation planning process. The process shall be proactive and provide timely information, adequate public notice, reasonable public access, and opportunities for public review and comment at key decision points in the process. Adequate public participation for Disproportionately Impacted Communities requires utilizing best practice notice and engagement methods as outlined in the Transportation Equity Framework. The objectives of public participation in the transportation planning process include: providing a mechanism for directly-impacted communities to provide leadership, share perspectives, needs, and ideas to be considered in the planning process; developing the Department's and public's understanding of the problems and opportunities facing the transportation system; demonstrating explicit consideration and response to public input through a variety of tools and techniques; and developing consensus on plans. The Department shall develop a documented public participation process pursuant to 23 C.F.R. Part 450.

4.02.2 Statewide Plans and Programs. Pursuant to 23 C.F.R. Part 450 Subpart B, the Department is responsible, in cooperation with the RPCs and MPOs, for carrying out public participation for developing, amending, and updating the ~~statewide~~ Statewide ~~transportation~~ Transportation ~~plan~~Plan, the ~~Statewide Transportation Improvement Program (~~STIP), GHG Mitigation Plans, and other statewide transportation planning activities.

4.02.3 MPO Plans and Programs. Pursuant to 23 C.F.R. Part 450 Subpart C, the MPOs are responsible for carrying out public participation for the development of ~~regional transportation plan~~RTPs, ~~transportation improvement programs~~TIPs, GHG Mitigation Plans, and other related regional transportation planning activities for their respective ~~metropolitan~~ Metropolitan ~~planning~~ Planning ~~areas~~Areas. Public participation activities carried out in a metropolitan area in response to metropolitan planning requirements shall by agreement of the Department and the MPO, satisfy the requirements of this subsection.

4.02.4 Non-MPO TPR Plans and Programs. ~~Regional Planning Commission~~RPCs for non-MPO TPRs are responsible for public participation related to regional planning activities in that TPR, in cooperation with the Department. Specific areas of cooperation shall be determined by agreement between the ~~Regional Planning Commission~~RPC and the Department.

4.02.5 Public Participation Activities. Public participation activities at both the rural TPR and statewide level shall include, at a minimum:

4.02.5.1 Establishing and maintaining for the geographic area of responsibility a list of all known parties interested in transportation planning including, but not limited to: elected officials; municipal and county planning staffs; affected public agencies; local, state, and federal agencies eligible for federal and state transportation funds; local representatives of public transportation agency employees and users; freight shippers and providers of freight transportation services; public and private transportation providers; representatives of users of transit, bicycling and pedestrian, aviation, and train facilities; private industry; environmental and other interest groups; Indian tribal governments and the U.S. Secretary of the Interior when tribal lands are involved; and representatives of persons or groups that may be underserved by existing transportation systems, such as minority, low-income, seniors, persons with disabilities, Disproportionately Impacted Communities, and those with ~~limited~~ Limited English ~~proficiency~~Proficiency; and members of the general public expressing such interest in the transportation planning process.

4.02.5.2 Providing reasonable notice and opportunity to comment through mailing lists and other various communication methods on upcoming transportation planning-related activities and meetings. Reasonable notice for Disproportionately Impacted Communities requires the notice to be translated in the major languages spoken in the community.

4.02.5.3 Utilizing reasonably available internet or traditional media opportunities, including minority and diverse media, to provide timely notices of planning-related activities and meetings to members of the public, including ~~LEP~~ Limited English Proficiency individuals, and others who may require reasonable accommodations. Methods that will be used to the maximum extent practicable for public participation could include, but not be limited to, use of the internet; social media, news media, such as newspapers, radio, or television, mailings and notices, including electronic mail and online newsletters.

4.02.5.4 Implementation of the Transportation Equity Framework. Seeking out those persons, ~~or~~ groups, and communities Disproportionately Impacted or ~~traditionally~~ Traditionally ~~underserved~~ Underserved by existing transportation systems including, but not limited to, seniors, persons with disabilities, minority groups, low- income, and those with ~~limited~~ Limited English ~~proficiency~~Proficiency, for the purposes of exchanging information, increasing their involvement, ~~and~~ considering their transportation needs in the transportation planning process, responding to public input, and providing leadership opportunities to propose transportation projects in coordination with the Environmental Justice and Equity Branch. Pursuant to § 43-1-601, C.R.S., the Department shall prepare a statewide survey identifying the transportation needs of seniors and of persons with disabilities.

4.02.5.5 Consulting, as appropriate, with ~~Regional Planning Commission~~RPCs, and federal, state, local, and tribal agencies responsible for land use management, natural resources, environmental protection, conservation and historic preservation concerning the development of long-range transportation plans.

4.02.5.6 Providing reasonable public access to, and appropriate opportunities for public review and comment on criteria, standards, and other planning-related information. Reasonable public access includes, but is not limited to, ~~LEP~~ Limited English Proficiency services and access to ADA-compliant facilities, as well as to the internet.

4.02.5.7 Where feasible, scheduling the development of regional and statewide plans so that the release of the draft plans may be coordinated to provide for the opportunity for joint public outreach.

4.02.5.8 Documentation of Responses to Significant Issues. ~~Regional Planning Commissions~~RPCs and the Department shall respond in writing to all significant issues raised during the review and comment period on transportation plans, and make these responses available to the public.

4.02.5.9 Review of the Public Involvement Process. All interested parties and the Department shall periodically review the effectiveness of the Department's public involvement process to ensure that the process provides full and open access to all members of the public. When necessary, the process will be revised and allow time for public review and comment per 23 C.F.R. Part 450.

4.03 Transportation Systems Planning. ~~Regional Planning Commission~~RPCs, and the Department, shall use an integrated ~~multimodal~~ Multimodal ~~transportation~~ Transportation ~~systems~~ Systems ~~planning~~ Planning approach in developing and updating the long-range ~~Regional Transportation Plans~~RTPs and the long-range Statewide Transportation Plan for a minimum 20-year forecasting period. ~~Regional Planning Commission~~RPCs shall have flexibility in the methods selected for ~~transportation~~ Transportation ~~systems~~ Systems ~~planning~~ Planning based on the complexity of transportation problems and available resources within the TPR. The Department will provide guidance and assistance to the ~~Regional Planning Commission~~RPCs regarding the selection of appropriate methods.

4.03.1 Transportation ~~systems~~ Systems ~~planning~~ Planning by ~~Regional Planning Commission~~RPCs and the Department shall consider the results of any related studies that have been completed. ~~Regional Planning Commission~~RPCs and the Department may also identify any ~~corridor~~Corridor(s) or sub-area(s) where an environmental study or assessment may need to be performed in the future.

4.03.2 Transportation ~~systems~~ Systems ~~planning~~ Planning by ~~Regional Planning Commission~~RPCs shall consider ~~corridor vision~~ needs and desired state of the transportation system including existing and future land use and infrastructure, major activity centers such as industrial, commercial and recreation areas, economic development, environmental protection, and modal choices.

4.03.3 Transportation ~~systems~~ Systems ~~planning~~ Planning by ~~Regional Planning Commission~~RPCs shall include operational and management strategies to improve the performance of existing transportation facilities to relieve vehicular congestion and maximize the safety and ~~mobility~~ Mobility of people goods, and services.

4.03.4 Transportation ~~systems~~ Systems ~~planning~~ Planning by the Department should include capital, operations, maintenance and management strategies, investments, procedures, and other measures to ensure the preservation and most efficient and effective use of the ~~state~~ State ~~transportation~~ Transportation ~~system~~System.

4.03.5 Transportation ~~systems~~ Systems P~~p~~lanning by the Department shall consider and integrate all modes into the Statewide Transportation Plan and include coordination with Department modal plans and modal committees, such as the ~~Transit and Rail Advisory Committee (~~TRAC).

4.03.6 Transportation Systems Planning by RPCs and the Department shall consider and integrate GHG Roadmap objectives into the Statewide Transportation Plan and include coordination and review with APCD and the Colorado Energy Office,

4.03.7 Transportation Systems Planning by RPCs and the Department shall implement the Transportation Equity Framework for community engagement and identifying projects that effectively promote racial equity and economic justice while meeting transportation and GHG Roadmap objectives.

4.03.8 Transportation Systems Planning by the Department shall provide for the establishment and use of a performance-based approach to transportation decision-making to support the national goals described in 23 U.S.C. § 150 (FAST Act, P.L. 114-94). Performance targets that the Department establishes to address the performance measures described in 23 U.S.C. § 150, where applicable, are to be used to track progress towards attainment of critical outcomes for the state. The state shall consider the performance measures and targets when developing policies, programs, and investment priorities reflected in the Statewide Transportation Plan and STIP.

4.04 Regional Transportation Plans (RTP). Long-range ~~regional transportation plans~~RTPs shall be developed, in accordance with federal (23 U.S.C. § 134 and § 135) and state (§ 43-1-1103 and § 43-1-1104, C.R.S.) law and implementing regulations. Department selection of performance targets that address the performance measures shall be coordinated with the relevant MPOs to ensure consistency, to the maximum extent practicable.

4.04.1 Content of ~~Regional Transportation Plan~~RTPs. Each RTP shall include, at a minimum, the following elements:

4.04.1.1 Transportation system facility and service requirements within the MPO TPR over a minimum 20-year planning period necessary to meet expected demand, and the anticipated capital, maintenance and operating cost for these facilities and services.

4.04.1.2 State and federal transportation system planning factors to be considered by ~~Regional Planning Commission~~RPCs and the Department during their respective ~~transportation~~ Transportation ~~systems~~ Systems ~~planning~~ Planning shall include, at a minimum, the factors described in § 43-1-1103 (5), C.R.S., and in 23 U.S.C. § 134 and § 135.

4.04.1.3 Identification and discussion of potential environmental mitigation measures, ~~corridor~~ Corridor studies, or ~~corridor~~ Corridor ~~visions~~Visions, including a discussion of impacts to minority and low-income communities.

4.04.1.4 A discussion of potential environmental mitigation activities and potential areas to carry out these activities, including activities that may have the greatest potential to restore and maintain the environmental functions affected by the plan.

4.04.1.5 Include an analysis of how the RTP is aligned with Colorado's climate goals and helps reduce, prevent, and mitigate GHG pollution throughout the Region.

4.04.1.6 Include an analysis of how the RTP is aligned with the Transportation Equity Framework in engaging the community and identifying projects that effectively promote racial equity and economic justice.

4.04.1.7 For rural RTPs, the integrated performance-based ~~multimodal~~ Multimodal transportation plan based on revenues reasonably expected to be available over the minimum 20-year planning period. For metropolitan RTPs, a ~~fiscally~~ Fiscally ~~constrained~~ Constrained financial plan.

4.04.1.8 Identification of reasonably expected financial resources developed cooperatively among the Department, MPOs, and rural TPRs for ~~long~~Long-~~range~~ Range ~~planning~~ Planning purposes, and results expected to be achieved based on regional priorities.

4.04.1.9 Documentation of the public notification and public participation process pursuant to these Rules.

4.04.1.10 A resolution of adoption by the responsible ~~Metropolitan Planning Organization~~MPO or the ~~Regional Planning Commission~~RPC.

4.04.2 Products and reviews

4.04.2.1 Draft Plan. ~~Transportation Planning Region~~TPRs shall provide a draft of the RTP to the Department through the Division ~~of Transportation Development~~.

4.04.2.2 Draft Plan Review. Upon receipt of the draft RTPs, the Department will initiate its review and schedule the STAC review (pursuant to these Rules). The Department will provide its comments and STAC comments to the ~~Transportation Planning Region~~TPR within a minimum of 30 days of receiving the draft RTP. ~~Regional transportation plan~~RTPs in metropolitan areas completed pursuant to the schedule identified in 23 C.F.R. § 450.322 shall be subject to the provisions of this section prior to being submitted to the Department for consideration as an amendment to the ~~statewide~~ Statewide ~~transportation~~ Transportation ~~plan~~Plan.

4.04.2.3 Final Plan. ~~Transportation Planning Region~~TPRs shall provide the final RTP to the Department through the Division ~~of Transportation Development~~.

4.04.2.4 Final Plan Review. Upon receipt of the final RTP, the Department will initiate its review and schedule the STAC review (pursuant to these Rules) of the final RTPs to determine if the plans incorporate the elements required by the Rules. If the Department determines that a final RTP is not complete, including if the final RTP does not incorporate the elements required by these Rules, then the Department will not integrate that RTP into the statewide plan until the ~~Transportation Planning Region~~TPR has sufficiently revised that RTP, as determined by the Department with advice from the STAC. The Department will provide its comments and STAC comments to the ~~Transportation Planning Region~~TPR within a minimum of 30 days of receiving the final RTP. ~~Transportation Planning Region~~TPRs shall submit any RTP revisions based on comments from the Department and STAC review within 30 days of the Department's provision of such comments. ~~Regional transportation plans~~RTPs in metropolitan areas completed pursuant to the schedule identified in 23 C.F.R. § 450.322 shall be subject to the provisions of this section prior to being submitted to the Department for consideration as an amendment to the ~~statewide~~ Statewide ~~transportation~~ Transportation ~~plan~~Plan.

4.05 Maintenance and Nonattainment Areas. Each RTP, or RTP amendment, shall include a section that:

4.05.1 Identifies any area within the TPR that is designated as a ~~maintenance~~ Maintenance or ~~nonattainment~~ Nonattainment ~~area~~Area.

4.05.2 Addresses, in either a qualitative or quantitative manner, whether transportation related emissions associated with the pollutant of concern in the TPR are expected to increase over the ~~long~~Long-~~range~~ Range ~~planning~~ Planning period and, if so, what effect that increase might have in causing a ~~maintenance~~ Maintenance ~~area~~ Area for a~~n~~ NAAQS pollutant to become a ~~nonattainment~~ Nonattainment ~~area~~Area, or a ~~non-attainment~~Nonattatinment ~~area~~ Area to exceed its emission budget in the approved State Implementation Plan.

4.05.3 If transportation related emissions associated with the pollutant are expected to increase over the ~~long~~Long-~~range~~ Range ~~planning~~ Planning period, identifies which programs or measures are included in the RTP to decrease the likelihood of that area becoming a ~~nonattainment~~ Nonattainment ~~area~~ Area for the pollutant of concern.

4.06 Statewide Transportation Plan. The ~~Regional Transportation Plans~~RTPs submitted by the ~~Regional Planning Commissions~~RPCs shall, along with direction provided through Commission policies and guidance, form the basis for developing and amending the Statewide Transportation Plan. The Statewide Transportation Plan shall cover a minimum 20-year planning period at the time of adoption and shall guide the development and implementation of a performance-based ~~multimodal~~ Multimodal transportation system for the State.

4.06.1 The Statewide Transportation Plan shall:

4.06.1.1 Integrate and consolidate the RTPs and the Department's systems planning, pursuant to these Rules, into a long-range 20-year ~~multimodal~~ Multimodal transportation plan that presents a clear, concise path for future transportation in Colorado.

4.06.1.2 Include the long-term transportation concerns of the Southern Ute Indian Tribe and the Ute Mountain Ute Tribe in the development of the Statewide Transportation Plan.

4.06.1.3 Coordinate with other state and federal agencies responsible for land use management, natural resources, environmental protection, conservation, and historic preservation.

4.06.1.4 Include a discussion of potential environmental mitigation activities and potential areas to carry out these activities that may have the greatest potential to restore and maintain the environmental functions affected by the plan developed in consultation with federal, state, and tribal wildlife, land management and regulatory agencies.

4.06.1.5 Include a comparison of transportation plans to state and tribal conservation plans or maps and to inventories of natural or historical resources.

4.06.1.6 Provide for overall ~~multimodal~~ Multimodal transportation system management on a statewide basis.

4.06.1.7 The Statewide Transportation Plan shall be coordinated with metropolitan transportation plans pursuant to 23 C.F.R. Part 450, § 43-1-1103 and § 43-1-1105, C.R.S. Department selection of performance targets shall be coordinated with the MPOs to ensure consistency, to the maximum extent practicable.

4.06.1.8 Include an analysis of how the Statewide Transportation Plan is aligned with Colorado's climate goals and helps reduce, prevent, and mitigate GHG pollution throughout the State.

4.06.1.9 Include an analysis of how the Statewide Transportation Plan helps prevent, reduce, and mitigate GHG pollution and hazardous co-pollutants within Disproportionately Impacted Communities.

4.06.1.10 Includes the 10-Year Plan as an appendix.

4.06.2 Content of the Statewide Transportation Plan. At a minimum, the Statewide Transportation Plan shall include priorities as identified in the RTPs, as identified in these Rules and pursuant to federal planning laws and regulations. The Statewide Transportation Plan shall be submitted to the ~~Colorado Transportation~~ Commission for its consideration and approval.

4.06.3 Review and Adoption of the Statewide Transportation Plan.

4.06.3.1 The Department will submit a draft Statewide Transportation Plan to the Commission, the STAC, and all interested parties for review and comment. The review and comment period will be conducted for a minimum of 30 days. The Statewide Transportation Plan and appendices~~The publication~~ will be available in physical form upon request~~at public facilities, such as at the Department headquarters and region offices, state depository libraries, county offices, TPR offices, Colorado Division offices of the Federal Highway Administration and Federal Transit Administration~~, and made available on the internet.

4.06.3.2 The Department will submit the final Statewide Transportation Plan to the ~~Colorado Transportation~~ Commission for adoption.

5.00 Updates to Regional and Statewide Transportation Plans.

5.01 Plan Update Process. The updates of ~~Regional Transportation Plan~~RTPs and the Statewide Transportation Plan shall be completed on a periodic basis through the same process governing development of these plans pursuant to these Rules. The update cycle shall comply with federal and state law and be determined in consultation with the ~~Transportation~~ Commission, the Department, the STAC and the MPOs so that the respective update cycles will coincide.

5.02 Notice by Department of Plan Update Cycle. The Department will notify ~~Regional Planning Commission~~RPCs and the MPOs of the initiation of each plan update cycle, and the schedule for completion.

6.00 Amendments to the Regional and Statewide Transportation Plans.

6.01 Amendment Process

6.01.1 The process to consider amendments to ~~Regional Transportation Plan~~RTPs shall be carried out by rural RPCs and the MPOs. The amendment review process for ~~Regional Transportation Plan~~RTPs shall include an evaluation, review, and approval by the respective RPC or MPO.

6.01.2 The process to consider amendments to the Statewide Transportation Plan shall be carried out by the Department, either in considering a proposed amendment to the Statewide Transportation Plan from a requesting RPC or MPO or on its own initiative.

6.01.3 The process to consider amendments to the 10-Year Plan shall be carried out by CDOT in coordination with the rural RPCs and the MPOs.

7.00 Transportation Improvement Programs (TIPs) and Statewide Transportation Improvement Program (STIP).

7.01 TIP development shall occur in accordance with 23 C.F.R. Part 450, Subpart C. The Department will develop the STIP in accordance with 23 C.F.R. Part 450, Subpart B.

7.02 The Department will work with its ~~planning~~ Planning ~~partners~~ Partners to coordinate a schedule for development and adoption of TIPs and the STIP.

7.03 A TIP for an MPO that is in a ~~non-attainment~~Nonattainment or Maintenance Area must first receive a conformity determination by FHWA and FTA before inclusion in the STIP pursuant to 23
C.F.R. Part 450.

7.04 MPO TIPs and Colorado's STIP must be ~~fiscally~~ Fiscally ~~constrained~~Constrained. Under 23 C.F.R. Part 450, each project or project phase included in an MPO TIP shall be consistent with an approved metropolitan RTP, and each project or project phase included in the STIP shall be consistent with the long-range ~~statewide~~ Statewide ~~transportation~~ Transportation ~~plan~~Plan. MPO TIPs shall be included in the STIP either by reference or without change upon approval by the MPOs and the Governor.

8.00 GHG Emission and VMT Transportation Planning Reduction Requirements

8.01 Establishment of Regional GHG and VMT Transportation Planning Reduction Levels

8.01.1 The GHG emission reduction levels within Table 1 apply to MPOs and the Non-MPO area within the state of Colorado as of the effective date of these Rules. Baseline values are specific to each MPO and CDOT area and represent estimates of GHG emissions resulting from the existing transportation network and implementation of the most recently adopted RTP for all MPOs and the 10-Year Plan in non-MPO areas as of the effective date of these Rules. Table 2 reflects the difference in Baseline levels from year to year assuming a rapid growth in electric vehicles across the State (940,000 light duty electric vehicles in 2030, 3.38 million in 2040 and a total of 97% of all light duty vehicles in 2050).

Values in both tables include estimates of population growth as provided by the state demographer.

8.01.2 Regional GHG Transportation Planning Reduction Levels

Table 1: GHG Transportation Planning Reduction Levels in MMT of CO2e

Regional Areas	2025 Baseline Projections (MMT)	2025 Reduction Level (MMT)	2030 Baseline Projections (MMT)	2030 Reduction Level (MMT)	2040 Baseline Projections (MMT)	2040 Reduction Level (MMT)	2050 Baseline Projections (MMT)	2050 Reduction Level (MMT)
DRCOG	14.90	0.32	11.80	1.13	10.90	0.94	12.80	0.60
NFRMPO	2.30	0.05	1.80	0.16	1.90	0.18	2.20	0.10
PPACG	2.70	0.06	2.20	0.21	2.00	0.18	2.30	0.11
GVMPO	0.38	0.01	0.30	0.03	0.30	0.03	0.36	0.02
PACOG	0.50	0.01	0.40	0.04	0.30	0.03	0.40	0.02
CDOT/Non-MPO	6.70	0.15	5.30	0.51	5.20	0.46	6.10	0.28
TOTAL	27.40	0.59	21.80	2.06	20.60	1.78	24.20	1.12

8.01.3 Baseline Emissions Due to Projected Number of Light Duty Electric Vehicles

Table 2: Baseline Emissions Due to Projected Number of Light Duty Electric Vehicles

	2025 Projections (MMT)	2030 Projections (MMT)	2040 Projections (MMT)	2050 Projections (MMT)
TOTAL	27.0	20.0	14.0	8.9

8.01.4 The VMT reduction levels within Table 3 apply to MPOs and the Non-MPO area within the state of Colorado as of the effective date of these Rules. Baseline values are specific to each MPO and CDOT and represent estimates of net VMT resulting from the existing transportation network and implementation of the most recently adopted RTP for all MPOs and the 10-Year Plan in non-MPO areas as of the effective date of these Rules. The figures below represent a 15% reduction in net VMT for each MPO and CDOT by 2030 and maintaining the 15% VMT reduction (adjusting for estimated population growth).

8.01.5 Regional VMT Transportation Planning Reduction Levels

Table 3: VMT Transportation Planning Reduction Levels (in millions of miles)

Regional Areas	2025 Baseline Projections	2025 Reduction Level	2030 Baseline Projections	2030 Reduction Level	2040 Baseline Projections	2040 Reduction Level	2050 Baseline Projections	2050 Reduction Level
DRCOG	30,855	2,160	33,364	5,005	37,311	6,529	41,258	8,252

NFRMPO	5,387	377	5,826	874	6,515	1,140	7,204	1,441
PPACG	5,877	411	6,355	953	7,107	1,244	7,859	1,572
GVMPO	980	69	1,059	159	1,184	207	1,310	262
PACOG	980	69	1,059	159	1,184	207	1,310	262
CDOT/Non-MPO	14,693	1,028	15,888	2,383	17,767	3,109	19,647	3,929
Total VMT	58,771	4,114	63,551	9,533	71,069	12,437	78,587	15,717
VMT per Capita (miles)	8,969	672	8,254	1,457	8,017	1,701	7,964	1,991
% VMT Reduction vs Baseline		7.00%		15.00%		17.50%		20.00%

*Assumes GHG and VMT targets apply to all MPOs and CDOT on the same timeframe.

8.02 Process for Determining Compliance

8.02.1 Analysis Requirements When Adopting or Amending an Applicable Planning Document - Each MPO and CDOT shall conduct a GHG emissions and a net VMT analysis using MPO Models or the Statewide Travel Model, and the Approved Air Quality Model, to estimate total CO2e emissions and net VMT. Such analysis shall include the existing transportation network and implementation of Regionally Significant Projects.

8.02.1.1 The emissions analysis must estimate total CO2e emissions in million metric tons (MMT) for each year in Table 1 and compare these emissions to the Baseline specified in Table 1. This provision shall not apply to MPO TIP amendments.

8.02.1.2 The net VMT analysis will estimate the expected net VMT that would result from the Regionally Significant Projects in the applicable planning document as compared to the reductions required in net VMT in the chart above. This provision shall apply to MPO TIP amendments.

8.02.2 Agreements on Modeling Assumptions and Execution of Modeling Requirements. Prior to the adoption of the next RTP for any MPO, CDOT, CDPHE, and each MPO shall enter into an Intergovernmental Agreement which outlines CDOT, CDPHE, and MPO responsibilities for development and execution of MPO Models or the Statewide Travel Model, and Approved Air Quality Model.

8.02.2.1 The Induced Travel Elasticity for roadway capacity projects shall be set at 1.0 for freeways and 0.75 for arterials.

8.02.2.2 MPOs will agree to participate in measuring actual VMT on regionally significant projects to assess the accuracy of the models used in predicting VMT.

8.02.2.3 Regionally Significant Projects will be run through an equity analysis. Parties to the intergovernmental agreement will commit that no Regionally Significant Project will cause adverse environmental or public health impacts to a Disproportionately Impacted Community that is already experiencing degraded environmental conditions relative to the state population unless those environmental or public health impacts are entirely mitigated.

8.02.2.4 Every five years the parties will reassess and improve the models based on how well they have performed against past Induced Travel and GHG emissions data. Third-party experts will be invited to evaluate the modeling and share those findings publicly.

8.02.2.5 The Parties will work to develop calculators to accurately estimate the GHG and VMT impacts of individual projects, on both a total and per capita level, including the smaller projects on the GHG Mitigation Menu.

8.02.2.6 By January 1, 2023, CDOT and MPOs are required to use a consistent Activity-Based Model.

8.02.3 By April 1, 2022, CDOT shall establish an ongoing administrative process, through a public process, for selecting, measuring, confirming, and verifying GHG Mitigation Measures, so that CDOT and MPOs can incorporate one or more into each of their plans in order to reach the Regional GHG and VMT Transportation Planning Reduction Levels in Table 1 and Table 3. Such a process shall include, but not be limited to, determining the relative impacts of GHG Mitigation Measures, measuring and prioritizing localized impacts to communities and Disproportionately Impacted Communities in particular. The percentage of GHG and VMT reductions obtained through GHG Mitigation Measures must directly benefit Disproportionately Impacted Communities at a level equal to or greater than the percentage of population represented by Disproportionately Impacted Communities within that MPO or TPR. The scoring of competing projects shall be public and transparent. The mitigation credit awarded to a specific solution shall consider both aggregate and community impact.

8.02.4 Timing for Determining Compliance

8.02.4.1 By October 1, 2022, CDOT shall update their 10-Year Plan and DRCOG and NFRMPO shall update their RTPs pursuant to § 43-4-1103, C.R.S. and meet the reduction levels in Table 1 and Table 3 or the requirements pursuant to § 43-4-1103, C.R.S and restrictions on funds.

8.02.4.2 After October 1, 2022

8.02.4.2.1 CDOT must for each Applicable Planning Document, meet either the reduction levels within Table 1 and in Table 3 for Non-MPO areas or the requirements as set forth in Rule 8.05.

8.02.4.2.2 MPOs must meet either the corresponding reduction levels within Table 1 and in Table 3 for each Applicable Planning Document, or the relevant MPO and CDOT each must meet the requirements as set forth in Rule 8.05.

8.02.5 Demonstrating Compliance. At least thirty (30) days prior to adoption of any Applicable Planning Document, CDOT for Non-MPO areas and the MPOs for their areas shall provide to the Commission a GHG Transportation Report containing the following information:

8.02.5.1 GHG emissions and VMT analysis demonstrating that the Applicable Planning Document is in compliance with the GHG Reduction Levels in MMT of CO2e for each compliance year in Table 1 and net VMT for each compliance year in Table 3 or that the requirements in Rules 8.02.5.1.1 or 8.02.5.1.2., as applicable, have been met.

8.02.5.1.1 In non-MPO areas or for MPOs that are not in receipt of federal suballocations pursuant to the CMAQ and/or STBG programs, the Department utilizes 10-Year Plan funds anticipated to be expended on Regionally Significant Projects in those areas on projects that reduce GHG emissions and reduce VMT.

8.02.5.1.2 In MPO areas that are in receipt of federal suballocations pursuant to the CMAQ and/or STBG programs, the MPO utilizes those funds on projects or approved GHG Mitigation Measures that reduce GHG emissions, and CDOT utilizes 10-Year Plan funds anticipated to be expended on Regionally Significant Projects in that MPO area, on projects that reduce GHG emissions and reduce VMT.

8.02.5.2 Identification and documentation of the MPO Model or the Statewide Travel Model and the Approved Air Quality Model used to determine GHG emissions in MMT of CO2e and net VMT.

8.02.5.2.1 The technical methodology must be found to yield accurate estimates of GHG emissions and VMT.

8.02.5.2.2 The data or documentation provided to support the estimates of GHG emissions and VMT must be sufficient for AQCC and CDOT to review.

8.02.5.2.3 To improve transparency, the GHG Transportation Report will include:

- Changes in population.
- Changes in regional population-weighted density.
- Share of housing and employment with ½ mile of high-frequency transit.
- Share of low-income households and disproportionately impacted communities with access to high-quality transit, biking, and walking infrastructure.
- Total number of housing units and employment density for each local government.

8.02.5.3 A Mitigation Action Plan that identifies GHG Mitigation Measures needed to meet the reduction levels for each compliance year within Table 1 and Table 3 shall include:

8.02.5.3.1 The anticipated start and completion date of each measure.

8.02.5.3.2 An estimate, where feasible, of the GHG emissions reductions in MMT of CO2e achieved by any GHG Mitigation Measures and the anticipated net VMT reductions.

8.02.5.3.3 Quantification of specific co-benefits including reduction of co-pollutants (PM2.5, NOx, etc.) as well as travel impacts (changes to per capita VMT within the project area, pedestrian/bike use, transit ridership numbers, etc. as applicable).

8.02.5.3.4 Description of direct benefits to Disproportionately Impacted Communities and a demonstration that the percentage of GHG and VMT reductions anticipated from the mitigation measures will benefit Disproportionately Impacted Communities at a level equal to or greater than the percentage of the population within Disproportionately Impacted Communities in the affected TPR or MPO.

8.02.6 Reporting on Compliance- Annually by April 1, CDOT and MPOs must provide a status report to the Commission on an approved form with the following items for each GHG Mitigation Measure identified in their most recent GHG Transportation Report:

8.02.6.1 The implementation timeline;

8.02.6.2 The current status;

8.02.6.3 For measures that are in progress or completed, quantification of the benefit or impact of such measures; and

8.02.6.4 For measures that are delayed, cancelled, or substituted, an explanation of why that decision was made.

8.03 GHG Mitigation Measures. When assessing compliance with the GHG and VMT Reduction Levels, CDOT and MPOs shall have the opportunity to utilize approved GHG Mitigation Measures as set forth in Rules 8.02.3 and 8.02.5.3 to offset emissions, reduce VMT, and demonstrate progress toward compliance. Illustrative examples of GHG Mitigation Measures include, but are not limited to:

8.0.3.1 The addition of transit resources in a manner that can displace VMT.

8.03.2 Improving pedestrian and bike access, particularly in areas that allow individuals to reduce multiple daily trips.

8.03.3 Encouraging local adoption of more effective forms of vertical development and zoning plans that integrate mixed use in a way that links and rewards transportation project investments with the city making these changes.

8.03.4 Improving first-and-final mile access to transit stops and stations that make transit resources safer and more usable by consumers.

8.03.5 Improving the safety and efficiency of crosswalks for pedestrians, bicyclists, and other non-motorized vehicles, including to advance compliance with the ADA.

8.03.6 Adopting locally driven changes to parking policies and physical configuration that encourage more walking and transit trips.

8.03.7 Incorporating medium/heavy duty vehicle electric charging and hydrogen refueling infrastructure -- as well as upgrading commensurate grid improvements -- into the design of key freight routes to accelerate truck electrification.

8.03.8 Establishing policies for clean construction that result in scalable improvements as a result of factors like lower emission materials, recycling of materials, and lower truck emissions during construction.

8.03.9 Adoption of transportation demand management practices that reduce VMT.

8.04 Air Pollution Control Division (APCD) Confirmation and Verification

8.04.1 At least forty-five (45) days prior to adoption of any Applicable Planning Document, CDOT for Non-MPO areas and the MPOs for their areas shall provide to APCD for review and verification of the technical data contained in the draft GHG Transportation Report required per Rule 8.02.5. If APCD has not provided written verification within thirty (30) days, the document shall be considered acceptable.

8.04.2 At least thirty (30) days prior to adoption or amendment of policies per Rule 8.02.3, CDOT shall provide APCD the opportunity to review and comment. If APCD has not provided written comment within forty-five (45) days, the document shall be considered acceptable.

8.05 Enforcement. The Commission shall review all GHG Transportation Reports to determine whether the applicable reduction targets in Table 1 and Table 3 have been met, ~~and~~ the sufficiency of any GHG Mitigation Measures needed for compliance, and adverse environmental or public health impacts to Disproportionately Impacted Communities are avoided or entirely mitigated.

8.05.1 If the Commission determines the requirements of Rule 8.02.5 have been met, the Commission shall, by resolution, accept the GHG Transportation Report.

8.05.2 If the Commission determines, by resolution, the requirements of Rule 8.02.5 have not been met, the Commission shall restrict the use of funds pursuant to Rules 8.02.5.1.1 or 8.02.5.1.2, as applicable, to projects and approved GHG Mitigation Measures that reduce GHG and VMT. Prior to the enforcement of such restriction, an MPO, CDOT or a TPR in a non- MPO area, may, within thirty (30) days of Commission action, issue one or both of the following opportunities to seek a waiver or to ask for reconsideration accompanied by an opportunity to submit additional information:

8.05.2.1 Request a waiver from the Commission imposing restrictions on specific projects not expected to reduce GHG emissions or VMT. The Commission may waive the restrictions on specific projects on the following basis:

8.05.2.1.1 The GHG Transportation Report reflected significant effort and priority placed, in total, on projects and GHG Mitigation Measures that reduce GHG emissions and VMT; and

8.05.2.1.2 In no case shall a waiver be granted if such waiver results in a substantial increase in GHG emissions or VMT when compared to the required reduction levels in this Rule.

8.05.2.1.3 If a waiver on a specific project is granted, an MPO, CDOT, or a TPR in a non-MPO area will not be considered in compliance, and the use of funds will continue to be restricted pursuant to Rule 8.05.2, until the VMT and GHG requirements of Rule 8.02.5 have been met.

8.05.2.2 Request reconsideration of a non-compliance determination by the Commission and provide written explanation of how the requirements of Rule 8.02.5 have been met.

8.05.2.3 The Commission shall act, by resolution, on a waiver or reconsideration request within thirty (30) days of receipt of the waiver or reconsideration request or at the next regularly scheduled Commission Meeting, whichever is later. If no action is taken within this time period, the waiver or reconsideration request shall be deemed to be denied.

8.05.3 In its resolution, the Commission shall certify that the Applicable Planning Documents referenced in the GHG Transportation Report will not cause adverse environmental or public health impacts to a Disproportionately Impacted Community that is already experiencing degraded environmental conditions relative to the state population unless those environmental or public health impacts are entirely mitigated.

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8.05.4 Notwithstanding any other provision of this Rule, CDOT, DRCOG and NFRMPO must meet the requirements of § 43-4-1103, C.R.S.

8.06 Reporting. Beginning July 1, 2025, and every 5 years thereafter, the Executive Director on behalf of CDOT shall prepare and make public a comprehensive report on the statewide GHG and VMT reduction accomplishments.The report shall contain, without limitation, the following information:

8.06.1 Whether the state is meeting GHG emission and VMT reductions required by Rule 8.02.5 statewide, for each TPR, and for each MPO.

8.06.2 If the report indicates that statewide VMT and GHG reductions required by Rule 8.02.5 are not projected to be met under existing rules, CDOT shall develop and propose additional requirements to the Commission, no later than December 31 of the same year, to be adopted no later than March 31 of the following year, which must be designed to make up the difference between VMT and GHG reductions achieved and the VMT and GHG reductions necessary to comply with Rule 8.02.5.

8.06.3 The number of projects affecting Disproportionately Impacted Communities and the net effect on VMT and GHG emissions of those projects.

8.06.4 A review of the mapping tools and any updates required by the analysis required by 8.03.2.4.

9.00 Materials Incorporated by Reference

9.01 The Rules are intended to be consistent with and not be a replacement for the federal transportation planning requirements in Rule 9.01.1 and federal funding programs in Rules 9.01.2 and 9.01.3, which are incorporated into the Rules by this reference, and do not include any later amendments.

9.01.1 Fixing America's Surface Transportation Act or the "FAST Act"), 23 U.S.C. §§ 134, 135 and 150, Pub. L. No. 114-94, signed into law on December 4, 2015, and its accompanying regulations, where applicable, contained in 23 C.F.R.Part 450, including Subparts A, B and C in effect as of November 29, 2017, and 25 C.F.R. § 170 in effect as of November 7, 2016.

9.01.2 Congestion Mitigation and Air Quality Improvement (CMAQ) Program, 23 U.S.C. § 149, in effect as of March 23, 2018.

9.01.3 Surface Transportation Block Grant (STBG) Program, 23 U.S.C. § 133, in effect as of December 4, 2015.

9.02 Also incorporated by reference are the following federal laws and regulations and do not include any later amendments:

9.02.1 Americans with Disabilities Act (ADA), 42 U.S.C. § 12101, *et. seq*., in effect as of January 1, 2009.

9.02.2 Clean Air Act (CCA), 42 U.S.C. §§ 7407-7410, and 7505a, in effect as of November 15, 1990.

9.02.2 Transportation Conformity Regulations, 40 C.F.R. § 93.101, in effect as November 24,1993.

9.03 Also incorporated by reference are the following documents, standards, and models and do not include any later amendments:

9.03.1 Greenhouse Gas Pollution Reduction Roadmap by the Colorado Energy Office and released on January 14, 2021.

9.03.2 MOVES3 Motor Vehicle Emissions Model for SIPs and Transportation Conformity released by the U.S. Environmental Protection Agency, in effect as of January 7, 2021.

9.04 All referenced laws and regulations are available for copying or public inspection during regular business hours from the Office of Policy and Government Relations, Colorado Department of Transportation, 2829 W. Howard Pl., Denver, Colorado 80204.

9.05 Copies of the referenced federal laws and regulations, planning documents, and models.

9.05.1 Copies of the referenced United States Code (U.S.C.) may be obtained from the following address:

Office of the Law Revision Counsel
U.S. House of Representatives
H2-308 Ford House Office Building
Washington, DC 20515
(202) 226-2411
https://uscode.house.gov/browse.xhtml

9.05.2 Copies of the referenced Code of Federal Regulations (C.F.R.) may be obtained from the following address:

U.S. Government Publishing Office
732 North Capitol State, N.W.
Washington, DC 20401
(866) 512-1800
https://www.govinfo.gov/

9.1.5.3 Copies of the Greenhouse Gas Pollution Reduction Roadmap (Roadmap) may be obtained from the following address:

Colorado Energy Office
1600 Broadway, Suite 1960
Denver, CO 80202
(303) 866-2100
energyoffice.colorado.gov

9.1.5.4 To download MOVES3 released by the U.S. Environmental Protection Agency may be obtained from the following address:

U.S. Environmental Protection Agency
The Office of Transportation and Air Quality
1200 Pennsylvania Ave, N.W.
Washington, DC 20460
(734) 214–4574 or (202) 566-0495
mobile@epa.gov
https://www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves

10.00 Declaratory Orders

10.01 The Commission may, at their discretion, entertain petitions for declaratory orders pursuant to § 24-4-105(11), C.R.S.

Editor's Notes

History

Entire rule eff. 12/15/2012.

Section SB&P eff. 05/30/2013.

Entire rule eff. 09/14/2018.

Annotations

Rules 1.22, 1.25, 1.42, 2.03.1 – 2.03.1.4, 4.01, 4.02.1 – 4.02.3, 4.02.5.9, 4.04.2.2, 4.04.2.4, 4.06.1.7, 6.01.2, 7.01, 7.03 – 7.04 (adopted 10/18/2012) were not extended by Senate Bill 13-079 and therefore expired 05/15/2013.

Exhibit 1

A Framework for Projecting the Potential Statewide Vehicle Miles Traveled (VMT) Reduction from State-Level Strategies in California

March 2017

A White Paper from the National Center for Sustainable Transportation

[redacted], University of Southern California

[redacted], University of California, Davis

National Center for Sustainable Transportation

METRANS Transportation Center USC | CSULB

ITS UCDAVIS INSTITUTE OF TRANSPORTATION STUDIES

About the National Center for Sustainable Transportation

The National Center for Sustainable Transportation is a consortium of leading universities committed to advancing an environmentally sustainable transportation system through cutting-edge research, direct policy engagement, and education of our future leaders. Consortium members include: University of California, Davis; University of California, Riverside; University of Southern California; California State University, Long Beach; Georgia Institute of Technology; and University of Vermont. More information can be found at: ncst.ucdavis.edu.

U.S. Department of Transportation (USDOT) Disclaimer

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NCST

A Framework for Projecting the Potential Statewide Vehicle Miles Traveled (VMT) Reduction from State-Level Strategies in California

A National Center for Sustainable Transportation White Paper

March 2017

[redacted], Sol Price School of Public Policy, University of Southern California

[redacted], Institute of Transportation Studies, University of California, Davis

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A Framework for Projecting the Potential Statewide Vehicle Miles Traveled (VMT) Reduction from State-Level Strategies in California

EXECUTIVE SUMMARY

The California Global Warming Solutions Act of 2006 (Assembly Bill 32) created a comprehensive, multi-year program to reduce greenhouse gas (GHG) emissions in the state to 80% below 1990 levels by 2050. With the recent passage of Senate Bill 32, the State of California has adopted an additional target of reducing greenhouse gas emissions to 40% below 1990 levels by 2030. To meet these goals, analysis shows that California will need to achieve an additional 7.5 percent reduction in light-duty vehicle miles of travel (VMT) by 2035, and an additional 15 percent reduction in light-duty VMT by 2050.

The California Air Resources Board (ARB) is thus considering a wide range of strategies for the 2016 Scoping Plan Update that focus on reducing demand for driving. These strategies fall into four general categories: Pricing, Infill Development, Transportation Investments, and Travel Demand Management Programs. The State has the ability to directly implement some of these strategies through state policy; for other strategies, the State can adopt policies that encourage or require the implementation of the strategy on the part of regional agencies, local governments, and/or the private sector.

In this paper, we consider the evidence available and assumptions needed for projecting statewide VMT reductions for each category of strategies. Our goal is to provide a framework for projecting the magnitude of reductions that the state might expect for the different strategies. This framework helps to illuminate the sequence of events that would produce VMT reductions and highlights important gaps in knowledge that increase the uncertainty of the projections. Despite uncertainties, the evidence justifies state action on these strategies: the available evidence shows that the strategies considered in this paper are likely to reduce VMT if promoted by state policy.

We do not in this paper examine the potential co-benefits of VMT-reduction strategies, including health, equity, and other benefits, but the evidence of these benefits is also strong and further justifies state action.

Strategy Category	**State Policy to VMT Link**	**Effect on Individual VMT**	**Potential for Statewide Implementation and Adoption – Strategy Extent**
Pricing	Most direct	Strong effect Solid evidence	Can be applied state-wide (fuel taxes, VMT fees) and in targeted areas (link pricing, cordon pricing, parking pricing). Most effective where individuals have good alternatives to driving. Strategies have equity implications. Generates revenues that can be invested in transportation system.
Infill Development	Direct and indirect	Moderate effect Solid evidence	Most applicable in metro areas. Will affect populations living and working in infill areas. May depend on changes in local land use policy. May require financial incentives. Land use changes and VMT effects accrue over the long term.
Transportation Investments			
Bike/Ped	Direct and indirect	Small effect Moderate evidence	Most applicable in metro areas. Will affect populations living and working where investments are made. May depend on changes in local investments. May require financial incentives. May require package of strategies. Many co-benefits.
Transit	Direct and indirect	Small effect Moderate evidence	Most applicable in metro areas. Will affect populations living and working where investments are made. May depend on changes in transit agency action. May require financial incentives. May require package of strategies. Many co-benefits.
Highways	Direct	Strong *induced VMT* effect Solid evidence	New capacity that reduces travel times leads to VMT growth. Effect is greatest in congested areas. Operational improvements that reduce travel times can also induce VMT.
Transportation Demand Management	More indirect	Moderate effect Solid evidence	Most applicable in metro areas. Generally implemented by large employers in response to state or local requirements or financial incentives. Some applications appropriate for rural areas.

Introduction

The California Global Warming Solutions Act of 2006 (Assembly Bill 32) created a comprehensive, multi-year program to reduce greenhouse gas (GHG) emissions in the state to 80% below 1990 levels by 2050. With the recent passage of Senate Bill 32, the State of California has adopted an additional target of reducing greenhouse gas emissions to 40% below 1990 levels by 2030.

The AB 32 Scoping Plan, first adopted in 2008, outlines how the state will meet these targets. In 2015, Governor Brown directed the California Air Resources Board (ARB) to update the Scoping Plan. The transportation sections of previous Scoping Plans were primarily focused on cleaner fuels and cleaner vehicles; VMT reduction strategies were limited to continuing implementation of SB 375. With the 2016 Scoping Plan Update, the California Air Resources Board (ARB) is considering a wider range of strategies that focus on reducing demand for driving. ARB projects that vehicle miles of travel (VMT) will grow 11 percent from today to 2030. A recent visioning scenario analysis done by ARB for the Mobile Source Strategy, which will be incorporated into the updated Scoping Plan, concluded that in addition to existing initiatives such as continued implementation of SB 375 and improvements in vehicle and fuel technology, California will need to achieve an additional 7.5 percent reduction in light-duty VMT by 2035, and an additional 15 percent reduction in light-duty VMT by 2050, in order to meet the State's overall GHG goals.[1]

State-level policies, priorities, and investments will have a profound effect on trends in VMT and are critical to shifting the state from the projected increases in VMT to the needed reductions in VMT. There is extensive evidence on strategies that can reduce VMT, as documented in a series of research briefs we produced for ARB.[2] In response to SB 375, the State has already taken action to implement some of the strategies that research shows are likely to reduce VMT. State-funded grant programs, for example, provide funding and financing for infill development, transit, bicycle facilities, and other changes to the built environment that will enable Californians to reduce their driving. At the same time, it is important to recognize that many long-standing state policies are likely to contribute to increased VMT trends even though this was not their primary objective. Most notably, decades of expansions of the state highway system, declines in the inflation-adjusted state gas tax, and financial and policy barriers to infill development and housing production have contributed to an upward VMT trend.[3] State policies often work against each other in influencing how much the state's residents drive.

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[1] Mobile Source Strategy, May 2016. Available at:

[2] Senate Bill 375 - Research on Impacts of Transportation and Land Use-Related Policies. Available at: https://arb.ca.gov/cc/sb375/policies/policies.htm

[3] For a summary of the evidence on how highway capacity increases lead to move VMT, see the ARB policy brief on highway capacity and induced travel, at https://www.arb.ca.gov/cc/sb375/policies/hwycapacity/highway_capacity_brief.pdf.
https://www.arb.ca.gov/cc/sb375/policies/hwycapacity/highway_capacity_brief.pdf.

The strategies for reducing driving that the State is considering for the Scoping Plan Update fall into four general categories: Pricing, Infill Development, Transportation Investments, and Travel Demand Management Programs. The State has the ability to directly implement some of these strategies, particularly pricing and some infrastructure strategies, through state policy and direct investment. For other strategies, the State can adopt policies that encourage or require the implementation of the strategy on the part of regional agencies, local governments, and/or the private sector. Infill development, for example, depends largely on local land use policies. For some strategies, such as bicycle infrastructure, state policy can both directly and indirectly influence its implementation.

Projecting the state-wide impact of state policy on VMT thus depends on two components: the "strategy effect," the effect of the strategy, when implemented, on the behavior of Californians and the amount that they drive; and the "strategy extent," the extent of the implementation of the strategy across the state in response to state policy and other forces. The evidence base on strategy effect is strong for most of the strategies under consideration: we can be confident that, if implemented, these strategies will produce a reduction in VMT, even if the magnitude of that reduction is uncertain. In contrast, the evidence on how to increase the strategy extent is often more limited.

Strategy Effect and Strategy Extent

Strategy Effect: The strategy effect is how a strategy (or policy) would change VMT. For example, if the fuel tax in the state were increased by ten percent, how would one driver's VMT change?

Strategy Extent: Strategy extent is how many drivers (or persons) can or would be affected by a strategy. For example, if the State offers incentives for infill development, how many more infill units will be built, and hence how many persons are affected by the strategy?

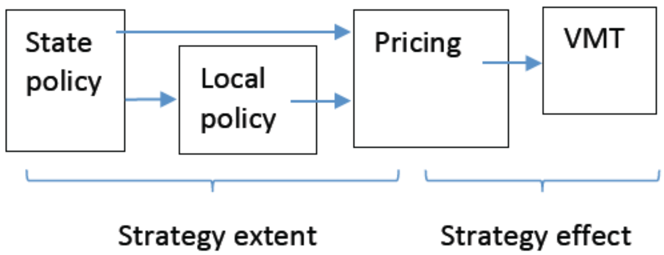
We can simplify by imagining that the overall policy impact is the strategy effect multiplied by the strategy extent.

For example, the influence of state subsidies or affordable housing policy on the actions that local governments take with regard to providing more infill development is sometimes debated, suggesting a need for more research on actions the state could take to foster more infill development. The existing evidence base, however, clearly shows that increased infill development leads to reduced VMT. For infill development, the question is not whether infill development would lead to reduced driving – it will – but rather which state policies would lead to more infill and, if those policies are implemented, how much would VMT be reduced. This is only one example; we discuss the difference between strategy effect and strategy extent for all four categories of policies that are covered in this document. In this paper, we consider the evidence available and assumptions needed for projecting statewide VMT[4] reductions for each category of strategies. Our goal is to provide a framework for at least roughly projecting the magnitude of reductions that the state might expect for the different strategies. The projection methods differ for each strategy depending on its "causal chain" – the sequence of events triggered by state policy that ultimately produce reductions in VMT, including both strategy extent (the causal chain from state policy to strategy implementation) and strategy effect (the causal chain from strategy implementation to VMT reduction). The form in which each strategy effect is reported in the literature also determines the projection method; in discussing strategy effect we rely on our reviews of the evidence base as reported in the ARB Research Briefs, mentioned above. We also outline the critical gaps in knowledge, data, or methods that must be filled before more robust projections are possible. California has staked a cutting-edge position with its GHG reduction framework, and that gives the state an opportunity to push our knowledge base forward. By highlighting knowledge gaps we are noting areas where California can continue and extend its tradition of leadership in environmental policy and environmental science.

We do not in this paper examine the potential co-benefits of VMT-reduction strategies, though they are potentially substantial. Reducing VMT not only reduces GHG emissions, it also reduces emissions of pollutants that harm human health as well as agricultural productivity and natural habitats. Infill development coupled with investments in transit services and bicycle and pedestrian infrastructure expands transportation options, reducing the need for owning a private vehicle and the financial burden that comes with it for lower-income households. Evidence of the benefits of VMT-reduction strategies for human health, social equity, the environment, and the economy is strong, and it further justifies state action to promote these strategies.

[4] For most of the strategies we examine here, the available research examines the effect of the strategy on VMT or other aspects of travel behavior rather than GHG emissions. While VMT reductions translate relatively directly into GHG emissions reductions, other factors may come into play. If, in addition to VMT reductions, the strategy also leads to changes in driving speeds (not just averages but distributions of speeds over the course of trips) or changes in the types of vehicles Californian's drive, then the conversion to GHG emissions is less straightforward. Infill development, for example, might reduce driving distances but also encourage smaller vehicles and produce more congestion and thus lower speeds. For the most part, the literature provides little basis for developing more nuanced conversions of VMT to GHG emissions for these strategies.

1. Pricing



Pricing is a particularly promising policy tool to reduce VMT and associated GHG emissions, for two reasons. First, the effect size from pricing interventions to VMT is larger than the effect size for other policy or planning tools. Second, pricing can be applied to a broad base, and state action can be particularly effective here. In other words, pricing can achieve a broad strategy extent quickly. Recall that the effect of a policy is the effect size (e.g. the amount that a driver's VMT would be reduced if the policy were applied to that driver) multiplied by the number of drivers exposed to the policy.

Pricing revenues can be used to expand non-automobile travel options, making the pricing policies themselves more effective at VMT reduction. Similarly, pricing policies can be used to address equity concerns, for example by expanding bus service, providing pedestrian or bicycle improvements, or mitigating environmental impacts in low-income neighborhoods.

Pricing also has the advantage of raising revenue to fund needed transportation projects. Statewide, our cities and counties have transportation needs that outstrip available revenue. For example, the State Transportation Plan identifies a $294 billion funding gap – funding only 45 percent of the State's transportation system needs through 2020.[5] Pricing and vehicle fees can fund infrastructure improvements, manage congestion, and maintain roadways while also improving air quality and better manage our transportation infrastructure.

There are several different ways to use pricing. We define those briefly here:

Link Tolls: Charge a toll to drive on a portion of a highway. The toll typically varies with congestion levels. Examples include the high-occupancy toll lanes on San Diego's SR-125 and Los Angeles I-110, and congestion priced toll lanes on SR-91 in Orange County. In the San Diego and Los Angeles examples, the toll adjusts based on traffic levels (more traffic implies a higher

[5] See http://www.dot.ca.gov/hq/tpp/californiatransportationplan2040/Final%20CTP/CTP2040-Appendices-WebReady.pdf.

toll) while the toll on the SR-91 in Orange County is based on time of day (peak periods have higher tolls.)[6]

Cordon Tolls: Charge a toll to cross into a downtown central business district or other congested area. There are currently no examples of cordon toll pricing in the U.S. Well known international examples of cordon tolls include London's toll ring, around the center of the city, and the cordon toll in Singapore.

VMT fees: Drivers are charged a fee based on miles driven (VMT). Oregon launched a VMT fee pilot experiment which enrolled drivers in pilot programs to test replacing the state's fuel tax with a VMT fee. California launched a similar pilot in 2016.[7] In 2008-2010, the University of Iowa led a national pilot program that examined VMT fees in lieu of fuel taxes in twelve locations. No VMT fee has moved beyond the pilot/study phase in the U.S.

Fuel taxes: Fuel taxes are applied by every state in the U.S. and the federal government. At-the-pump fuel taxes are assessed on a cents per gallon basis, and so are not adjusted for inflation. A relatively minor exception is cases where sales taxes are also applied to per-gallon fuel taxes. Increased fuel efficiency implies that persons can drive more per gallon, hence fuel taxes raise less revenue per mile driven as vehicle fuel efficiency increases.

Parking prices: There are many parking pricing schemes, from fixed-priced street meters to workplace parking cash-out schemes that offer employees cash in lieu of subsidized free parking to policies that charge employees or non-work travelers for parking to real-time metered parking prices that adjust to equilibrate supply and demand. All have been applied in California. To date, parking pricing policy in the state has been exclusively the domain of local governments, though AB 744 reduced parking space requirements statewide for affordable senior housing.[8]

Pay-as-you-go insurance: This policy proposes to change vehicle insurance from a monthly or six-month fee, which is typically assessed independent of driving, to a per-mile fee.

Freight low emission zones: This proposal would establish low emission zones, usually near residential areas, where trucks would either have to use low emission technology or pay a fee. The prospect of combining pricing with careful land use considerations is a promising way to

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[6] Some highways in California use tolls that do not vary with time of day or congestion. The toll roads in south Orange County (portions of SR 73, 133, 241, and 261) have flat rate pricing. The tolls on those lanes were not designed to manage congestion, but are solely a financing tool. There is little evidence on whether and how flat-rate tolls reduce driving, although one can infer that the price effect may be similar. We focus our attention on congestion tolls, which bring the added benefit of congestion management and for which the evidence base is larger.

[7] See https://www.californiaroadchargepilot.com and, for a related discussion, Marlon G. Boarnet, "Policy Approaches for California's Transportation Future," California Central, 2016, available at http://californiacentral.usc.edu/wp-content/uploads/2016/06/CA-Central-transportation-6-13-16.pdf.

[8] See https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB744.

address environmental justice implications of truck emissions that disproportionately affect low-income communities. Yet this policy, because it is a hybrid of pricing, emission technology requirements, and land use patterns that would interact with the transportation network, is less a pure pricing strategy. Also, the response of truck traffic to pricing depends on the nature of driver contractual relationships with trucking companies and hence is best informed by evidence that is specific to pricing and trucking. For those reasons, we believe the existing pricing evidence, largely from passenger travel and mostly from pure pricing experiments or policies, cannot be as easily applied to low emission zones. We note, though, that the same basic theory applies to trucks as to passengers – higher prices would discourage driving activity in the locations and at the times for which the price is higher – and it is only the magnitude and detailed effect of a low emission zone that we do not discuss further here.

Strategy Effect: Impacts of Pricing on Individual or Household VMT

The available evidence on effect sizes can be grouped into four categories: (1) link and cordon tolls, (2) VMT fees, (3) Fuel prices (and hence fuel taxes), and (4) parking pricing. We know of no available evidence on the effect size of pay-as-you-go insurance, and for the reasons mentioned above we believe that freight low emissions zones, while promising, should be a separate topic of study.

Importantly, both theory and evidence suggest that the effect sizes are similar across the different pricing tools for which data are available. A price is a price, and, as an approximation, drivers should not care if they pay a dollar to buy gas, drive on the highway, or park; the effect of the price on driving might be quite similar for those different policies. As it turns out, the empirical range of pricing effect sizes across different policies are similar, and that allows some confidence to interpret from the existing evidence base to policies, such as pay-as-you-go insurance, for which there is not currently an effect size evidence base. It is reasonable to assume, for example, that pay-as-you-go insurance would look to drivers like a VMT fee, and hence that the VMT fee evidence would apply. As mentioned above, freight low emission zones, because they are a hybrid of pricing, emission technology requirements, and land use, would require additional evidence not discussed here.

The range of effect sizes in Table 1 is large in some cases (e.g. the long-run elasticity of VMT with respect to fuel price.) We note that a conservative estimate of an elasticity would be -0.1, which is toward the low end of the range for link and cordon tolls and for fuel prices. Similarly, results from the Oregon VMT fee pilot program suggest that replacing a fuel tax with a VMT fee in a revenue-neutral way could reduce VMT by 11 to 14 percent. Overall, we suggest that an elasticity of VMT with respect to pricing of -0.1 is a conservative estimate that might be used to apply across different pricing programs.

Most of the evidence on parking pricing relates price to the demand for parking spaces, and inferring a VMT elasticity for parking pricing can be more difficult. However, a recent program in San Francisco, SF*park*, adjusts on-street parking prices based on occupancy – raising the metered price for an on-street parking space when more than 80 percent of the spaces on a block are occupied (Millard-Ball, et al., 2014). Recent studies of SF*park* suggest that the program and it's demand-based pricing may reduce cruising for parking by 50 percent (Millard-Ball, et al., 2014).

Table 1: Effect Sizes for Pricing Policies

Pricing Policy	Elasticity (unless otherwise noted)	Source
Link and Cordon Tolls	-0.1 to -0.45	ARB policy brief on road user pricing
VMT fees	-11% to -14.6% reduction from shifting gas tax to VMT fee	ARB brief on road user pricing, from Oregon VMT fee experiment
Fuel prices	-0.026 to -0.1 (short-run) -0.131 to -0.762 (long-run)	ARB brief on gas price
Parking pricing	-0.3 for demand for parking spaces	ARB parking pricing and parking management brief

Source: ARB policy briefs, at https://arb.ca.gov/cc/sb375/policies/policies.htm

Strategy Extent: Impact of State Policy on Pricing

Pricing can be implemented in ways that achieve broad strategy extent. VMT fees and fuel prices can affect every driver in the state. Again, this paper provides a framework for at least roughly projecting the magnitude of reductions that the state might expect for the different strategies. There are few other State actions that could similarly achieve universal coverage without collaboration or leadership from a broad range of municipal governments. Link and cordon tolls have typically been the purview of local governments, and because such congestion pricing is applicable in congested locations, link and cordon tolls would likely continue to be a local government activity. But Caltrans is the owner operator of the state highway system, and so the State has many opportunities to encourage link pricing, in particular, on state highway routes. The State could, for example, offer subsidies or incorporate pricing more explicitly into the SB 375 Sustainable Communities Strategy (SCS) process. Similarly, the State could work closely with local governments and county transportation agencies to encourage innovative programs that use pricing while also addressing the equity questions that are raised by road or VMT pricing. Other efforts, such as pay-as-you-go insurance, could be implemented through State action. Overall, State action in pricing can have a broad extent and can take effect quickly, as opposed to land use policies which would have a sizeable effect but over a longer period of time as the built environment is modified.

The steps to use in quantifying the impact of State-level pricing strategies on VMT are shown in Table 2 below. Table 2 has four panels, for fuel taxes, VMT fees, link or cordon tolls, and pay-as-you-go insurance. Parking pricing is not shown, because the link from those policies to VMT has been less studied, although the nascent evidence from SF*Park* is promising and suggests that priced parking can substantially reduce the amount that drivers "cruise" to find parking spaces (Millard-Ball, Weinberger, and Hampshire, 2014).

Note that the data on the fuel prices gives direct estimates of the effect of changes in fuel prices (from, e.g., tax changes) on VMT; relatively few assumptions are needed compared to other policies that we discussed in this paper. The data on VMT fees similarly require few assumptions, although the state would require advances in modeling the location of traffic across the state and into and from neighboring states for a complete analysis. While the VMT fee data are from pilot programs, those programs and the current pilot in California provide an opportunity to get good evidence on the effect of VMT fees on driving. Tolls require an assumption about the amount of driving that would be diverted to routes or times of day that are not tolled, and the evidence on that is more limited. Leape (2006) estimates that a quarter of the traffic reduction within the London cordon toll ring was diverted to other routes. Pay-as-you-go insurance requires an assumption that the elasticities from VMT fee or fuel tax studies apply, but such as assumption is theoretically sound. Overall, quantifying the effect of pricing on driving requires relatively few assumptions compared with other policies.

Table 2: Assumptions and Data Needed to Estimate Effect of State-Level Pricing Strategies on VMT

Panel A: Fuel Prices			
Step	**Assumptions or Data Needed**	**Validity of Assumption (Scale: 1 = poor, 5 = excellent)**	**Future research tasks to strengthen assumptions and data**
1. Quantify percentage increase in fuel price	Compare proposed tax increases to existing fuel prices	Validity = 5 (excellent) Data are available on fuel prices, by state and for areas within the state. Fuel prices vary over time, often substantially so, and so analysts would have to address that variation over time in assessing the "base" (before-tax-increase) fuel price.	Data are available.
2. Determine population that will be affected by tax	Fuel taxes typically affect everyone in the state	Validity = 4 (good) to 5 (excellent) The literature on passenger travel and fuel taxes gives good evidence; less literature on freight travel and fuel taxes	To refine future estimates, the state can study how freight travel responds to fuel taxes and whether the strategy effect, from mostly passenger vehicle studies, applies to freight traffic.
3. Apply strategy effect to affected population	Use elasticity of -0.1 (minus 0.1), per discussion above	Validity = 4 (good) to 5 (excellent)	Studies on the effect size are high quality. Future research should examine how variation in fuel prices over time affect VMT, given the high month-to-month and year-to-year volatility in fuel prices. Over the long-term, taxes might be designed to adjust in the opposite direction of market fuel price variation, holding at-the-pump fuel prices more constant.

Panel B: VMT Fee			
Step	**Assumptions or Data Needed**	**Validity of Assumption (Scale: 1 = poor, 5 = excellent)**	**Future research tasks to strengthen assumptions and data**
1. Assess extent of VMT fee	Fees could be statewide or for sub-sets of state	Validity = 4 (good) to 5 (excellent)	Traffic will cross borders if VMT fee does not apply to entire state, and even if statewide, some traffic will enter and leave the state. Some improvement in statewide travel modeling could be needed to account for border effects.
2. Quantify whether VMT fee will be revenue neutral	Assumption about revenue neutrality will translate to amount of the VMT fee	Validity = 4 (good) to 5 (excellent)	Continue pilot programs to understand how revenue responds to fee levels
3. If fee is revenue neutral, apply evidence on effect	Oregon pilot program suggests revenue neutral VMT fee will reduce driving by 11 to 14 percent	Validity = 3 (fair) to 4 (good)	Evidence from California pilot program (now underway) should be used to supplement the Oregon evidence

Panel C: Link or Cordon Tolls			
Step	**Assumptions or Data Needed**	**Validity of Assumption (Scale: 1 = poor, 5 = excellent)**	**Future research tasks to strengthen assumptions and data**
1. Estimate toll amount and resulting change in cost of travel	Data on pre-existing travel needed -- use estimates of number of persons passing link from Caltrans link travel data (e.g. AADT), and estimate pre-toll dollar cost of travel based on average trip lengths	Validity = 3 (fair) Data on link travel can be obtained, but the literature does not clarify if the time-cost of travel should be included in the base amount to analyze change in travel cost.	California has existing toll lanes, and data from those lanes should be used to get better information about the appropriate measure of the population affected and how to measure toll costs for purposes of applying the elasticity of the strategy effect.
2. Estimate reduction in traffic in tolled area	Apply elasticities, which for link and cordon tolls will usually predict reduction in traffic in the tolled area, not reductions in VMT	Validity = 3 (fair) to 4 (good)	Continue research, particularly on cordon tolls which have not been implemented in U.S. and so require research from international settings
3. Estimate diverted traffic	Estimate the amount of driving that moved from the tolled area to a different route	Validity = 2 (poor)	The evidence on how tolls divert traffic is limited. Leape (2006) estimates 1/4 of reduced traffic in London cordon toll was diverted to other routes. Toll lane price changes in California can provide an opportunity for before-after studies of traffic diversion.
4. Estimate VMT reduction	Use data or assumptions about average trip lengths (before tolling), reduction in trips, and the fraction of trips diverted to get estimate of reduced VMT.	Validity = 2 (poor) to 3 (fair)	Diverted traffic is the weakest link here, and future research should focus on how toll price changes divert traffic.

Panel D: Pay-As-You-Go-Insurance			
Step	**Assumptions or Data Needed**	**Validity of Assumption (Scale: 1 = poor, 5 = excellent)**	**Future research tasks to strengthen assumptions and data**
1. Assess Population Affected by Pay-As-You-Go Insurance	If program is voluntary, use data from pilot programs or other markets to assess how many drivers would opt for pay-as-you-go insurance	Validitity = 3 (fair)	There is very limited experience with pay-as-you-go insurance. Pilot programs are advisable to understand the "take up" rate for this insurance product, particularly if pay-as-you-go competes with traditional flat-rate insurance.
2. Quantify percentage increase in cost of driving	Compare proposed pay-as-you go fees (per mile basis) to existing per-mile driving costs	Validity = 4 (good) to 5 (excellent)	Data are available on per-mile driving costs.
3. Determine effect size for drivers	Assume pay-as-you-go strategy effect is similar to VMT fees or fuel taxes, hence elasticity = -0.1	Validity = 4 (good)	The price effect is likely very similar to VMT fees or fuel taxes which change the marginal (e.g. per-mile) cost of driving. Pilot programs should be developed to confirm this theoretical prediction.
4. Apply effect size to affected population	Direct calculation from steps above	Validity = 4 (good) to 5 (excellent)	Again, if pay-as-you-go competes with flat-rate insurance, understanding consumer demand for pay-as-you-go will be important

Policy Considerations for Pricing

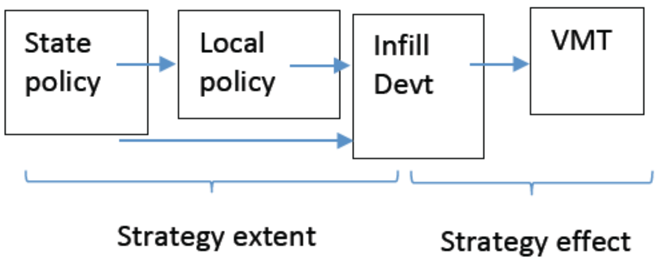
Pricing policies generate a revenue stream. That is an important potential benefit. Pricing also brings substantial policy advantages beyond VMT reduction. Pricing revenues can be used to expand non-automobile travel options, making the pricing policies themselves more effective at VMT reduction. Similarly, pricing policies can be used to address equity concerns, for example by expanding bus service, providing pedestrian or bicycle improvements, or mitigating environmental impacts in low-income neighborhoods.

Sales tax finance has become the primary means of transportation finance in most large California metropolitan areas. The sales tax is regressive, meaning that sales taxes are a larger fraction of income for lower income persons than for high income persons. Sales taxes are paid by persons irrespective of their use of roads, raising both efficiency and equity issues. From an efficiency perspective, sales taxes provide no nexus between revenues raised and use of the transportation system. From an equity perspective, sales taxes are paid by persons who do not use the system, with lower income persons paying a larger share of their income in sales taxes. Schweitzer and Taylor (2008) compared the toll-road finance of the SR-91 in Orange County with an equivalent (revenue-neutral) sales tax finance and found that under reasonable assumptions toll road finance would be more equitable, and that sales tax finance could in many cases place a larger burden on lower income households. Pricing policies have the prospect of providing much needed revenues for transportation, in ways that build a link between use of the system and financing while being more equitable than current transportation finance policies.

Pricing policies will be more effective in reducing VMT when and where there are easily available non-automobile options. Hence policymakers should be aware that implementing pricing in locations with many travel options, or with a plan to expand travel options, would be a preferred approach. Fortunately, congestion and parking pricing would likely be implemented first in congested urban areas or in locations where land values are high, which are typically the same locations with non-automobile transportation options.

While evidence suggests that state intervention to increase the price of driving is highly likely to yield reductions in VMT, estimating a more precise degree of impact from state actions – for the purposes of modeling by ARB and others to quantify anticipated VMT reductions from specific strategies – would require further analysis. Table 2 presents an outline of suggested steps for gaining more precision and clarity in this estimation.

2. Infill Development



Land use in California has long been a local domain, but many State actions and laws, such as Regional Housing Needs Assessment (RHNA) allocations and the California Environmental Quality Act (CEQA) influence outcomes. The State also provides subsidies, such as the Affordable Housing and Sustainable Communities (AHSC) program, which can assist localities that are pursuing infill development. State policy, and the link from state policy to local policy, is important. Yet the evidence is most clear on the strategy effect, the effect from land uses associated with infill development to VMT.

Many land use policies have the potential to reduce VMT. The ARB policy briefs discuss the effect of residential density, employment density, land use mix, street connectivity, distance to transit, regional accessibility to jobs, and jobs-housing balance. The literature provides strong evidence that persons who live in more centrally located, dense, mixed use developments with walkable infrastructure and near transit options will drive less. The effect of land use on reducing driving is, at least in part and possibly in largest part, causal, meaning that when persons move to a mixed-use transit-oriented or walkable neighborhood, the land use causes them to drive less (Cao, Mokhtarian, and Handy, 2009; National Research Council, 2009; Duranton and Turner, 2016.)

We will first discuss that body of evidence on the effect of land use and infill development on VMT (i.e. the strategy effect), then turn to the upstream question of the effect of state and local policy on infill development (i.e. the strategy extent). Note that policies to promote infill development are policies that will place more residents in locations that are more accessible to jobs and transit, with higher densities, more mixed land uses, and better street connectivity. Hence we use "infill development" as a summary measure of land use, both because it is a meaningful measure and because it clarifies policy approaches to metropolitan area planning. State policies can affect the prospects for infill development, and recent state actions (e.g. SB 743) are attempts to measure impacts in ways that change the attributed traffic/transportation impact of infill versus outlying development to more appropriately give environmental credit to infill projects that will reduce VMT in large metropolitan areas.

Strategy Effect: Impact of Infill Development on Individual or Household VMT

The first question is how to measure the effect of infill development on individual or household travel behavior.[9] We suggest that the best proxy measure for infill development is regional access to jobs. Both lay audiences and policy-makers often think about residential density when measuring land use, because density is intuitive (persons or dwelling units per land area) and easy to measure. Yet residential density is among the land use variables with the weakest links to VMT. The strategy effect size of residential density on VMT has an elasticity from -0.05 to -0.12, meaning that if density doubled, household VMT would be reduced by from 5 to 12 percent. The strategy effect size of regional job access is twice as large – an elasticity of from -0.13 to -0.25.[10] This implies that density alone is a less meaningful metric for VMT reduction than proximity to job centers. However, in practice, increased density is likely also needed to increase the number of households near job centers.

Not only is the strategy effect of density smaller than the strategy effect of regional job access, regional job access is a policy with a potentially broader strategy extent. Doubling residential density would be, in most locations, outside of the realm of feasible policy changes. As we show in the appendix, infill policies can double a household's regional job access in California's urban areas simply by providing housing options that are closer to job concentrations, and are likely feasible in ways that doubling density is usually not. Overall, regional job access is a much better measure of the strategy effect and the policy possibility (strategy extent) of infill development.

Improving regional access to jobs implies a planning focus on where, in the metropolitan area, new growth occurs. Would new growth be near the center, where more jobs are located and hence where access to jobs is good, or on fringe, where access to jobs is weaker?

A typical measure of jobs access is called a "gravity variable." Most gravity variables are a sum of the jobs that a resident can reach from their household, multiplying jobs by the inverse of the distance from a household's home to the job. Jobs that are closer to where a household lives count for more, and jobs farther away count for less. There are different mathematical formulations in the literature. Some authors sum only jobs within five miles of a household (for an application, see Salon, 2014, or Boarnet and Wang, 2016.) Other studies (e.g. Zegras, 2010) use distance from the downtown by itself, noting that a household's distance from downtown is strongly correlated with gravity variable measures of job access. For now, note that distance from downtown (e.g., whether a household live 10 miles from downtown, or 20 miles from downtown) is easier to measure than a gravity variable that sums all jobs in the metropolitan

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[9] Often times the academic literature looks at household travel, because family members within a household can trade trips, such that one person might go to the store while the other does the banking, or vice versa. Using household data allows researchers to treat the household as the behavioral unit. When the overall literature is summarized, as we do here, the disaggregate data are typically from studies of individual travelers or drivers, or from households.

[10] See the ARB Research Briefs on residential density and regional access to jobs, at https://www.arb.ca.gov/cc/sb375/policies/density/residential_density_brief.pdf and https://arb.ca.gov/cc/sb375/policies/regaccess/regional_accessibility_brief120313.pdf, respectively.

area weighted by the inverse of the distance from the household to those jobs. Having said that, much of the literature has used gravity variables, and so we discuss gravity variables first.

Figure 1 shows gravity variable measures of job access for the greater Los Angeles region, in five categories, or quintiles. Figure 1 shows that locations near downtown have the best job access, and job access declines as one moves further from downtown. The ARB policy brief for regional job accessibility suggests an elasticity of VMT with respect to job access ranging from -0.13 to -0.25, meaning that if job access were doubled (a 100 percent increase), household VMT would decline by from 13 to 25 percent. Note that high end of the range of this strategy effect is almost exactly the same as what you would get if you used a simpler measure of distance from downtown, for which the ARB policy briefs suggest an effect size of 022 to 0.23, meaning that if a household moves from 10 to 20 miles away from downtown (a 100 percent increase in their distance to downtown), their VMT would increase by 22 to 23 percent.[11]

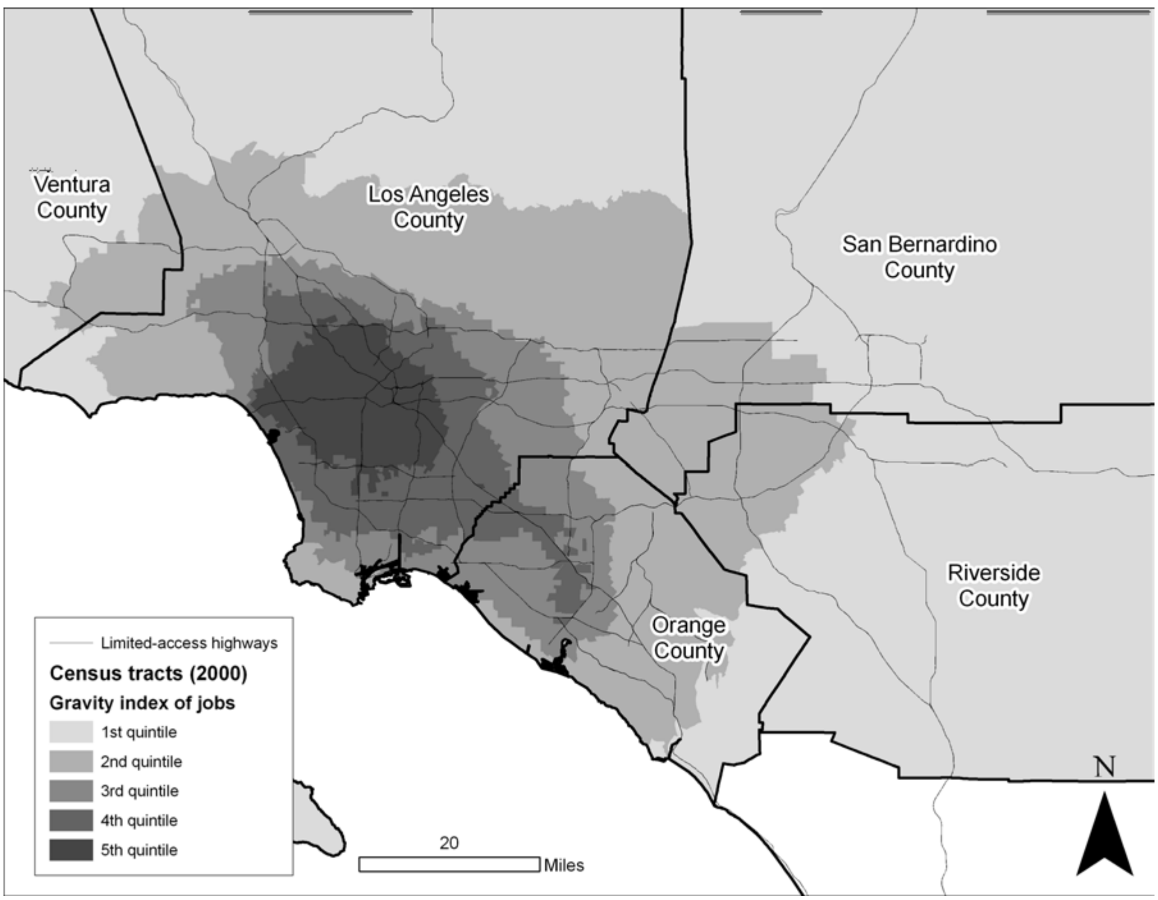


Figure 1. Gravity Variable of Regional Access to Jobs, metropolitan Los Angeles, 2000 (reprinted from Boarnet, Houston, Ferguson, and Spears, 2011, Figure 7.3)

[11] See the ARB Research Briefs on regional access to jobs, https://arb.ca.gov/cc/sb375/policies/regaccess/regional_accessibility_brief120313.pdf.

The strategy effect would measure moving persons (or changing the location of new development) from places with poor to better job access. As an example, the Southern California Association of Governments has proposed to focus almost half of the region's future growth and new development in high quality transit areas, defined as places within a half-mile of fixed-route transit or bus transit with peak-period transit service of 15 minutes or less.[12] Many other metropolitan areas have engaged in scenario planning exercises to simulate changes in growth patterns that would favor infill development. Referring back to the map in Figure 1, the darkest shaded areas have the best job access (they are in the fifth, or highest, quintiles of access.) The next darkest areas are in the fourth quintile, and the next highest areas are in the third quintile, and so forth. Example communities in those areas are shown in Table 3 below.

Table 3: Examples of Municipalities in 3rd, 4th, and 5th Quintile of Regional Access to Employment

Job access quintile [a]	Example neighborhood/municipality
5th quintile (highest job access)	Downtown Los Angeles Hollywood West Los Angeles Crenshaw Echo Park
4th quintile	Santa Ana Orange Fullerton Lakewood La Mirada Southern San Fernando Valley
3rd quintile	North Orange County Covina

An ideal measure of the effect of infill development would measure the effect of changing the location of development on VMT – for example, what would happen if, instead of building new residences near Covina (the third quintile of job access in Figure 1), the Los Angeles region added new residences in communities such as Santa Ana (the fourth quintile of job access) or Echo Park (the fifth or highest quintile of job access.) One method would be to assess, numerically, how much a measure of a household's job access would increase when they locate in, for example, Santa Ana or Echo Park as opposed to Covina. Such a method is outlined in the appendix. This approach would require several computational steps, and for simplicity we do

[12] SCAG's 2016 Regional Transportation Plan projects that 46 percent of new residential growth and 55 percent of new employment growth will be on the three percent of the region's land that is in high quality transit areas. See Southern California Association of Governments, 2016 RTP/SCS, Executive Summary, p. 8, http://scagrtpscs.net/Documents/2016/final/f2016RTPSCS_ExecSummary.pdf.

not go over that here, although we note that the estimated strategy effect computed in the appendix is similar to what we present here using simpler methods.

Rather than use a gravity variable for regional access to jobs, one could use distance from the downtown to approximate the change in the job access measure. Following the example, Covina is approximately 24 miles (driving distance) from downtown Los Angeles, while Echo Park is approximately 4 miles from downtown Los Angeles, a reduction in distance from downtown of 83 percent if infill development could allow a household to locate in Echo Park rather than Covina. Multiplying that change in distance by the 0.22 effect size of distance from downtown, this implies that moving households from Covina to Echo Park could reduce their driving by 18 percent. Using more sophisticated regression techniques, Boarnet and Wang (2016, Table 12, p. 36) predict that a household move across similar distances in the Los Angeles region could be associated with even larger VMT reductions – as large as 33 percent.[13]

We can use the literature, with effect sizes drawn from changes in gravity variables or simpler changes to distance from downtown, to predict the effect of increased infill development. Table 4 gives an illustration of the steps and the data and assumptions needed.

[13] See Marlon G. Boarnet and Xize Wang, Urban Spatial Structure and the Potential for Reducing Vehicle Miles Traveled, National Center for Sustainable Transportation research report, April, 2016, available at http://ncst.ucdavis.edu/wp-content/uploads/2014/08/04-18-2016-NCST-Urban-Spatial-Structure-Boarnet-4_10_16.pdf, accessed Sept. 24, 2016.

Table 4: Assumptions and Data Needed to Estimate Effect of Infill Development on Household VMT

Step	Assumptions or Data Needed	Validity of Assumption (Scale: 1 = poor, 5 = excellent)	Future research tasks to strengthen assumptions and data
1. Measure land use patterns associated with infill development	Choose a measure that will proxy location in the region, and hence infill policies: Regional job access measures as a gravity variable or distance from downtown	Validity = 3 (fair) to 4 (good) If access to transit and access to non-auto transportation are included elsewhere in the analysis, evidence indicates that remaining land use patterns are correlated with regional job access; the evidence suggests that the size of the strategy effect is very similar whether measured by gravity variables or distance from downtown, even in highly sub-centered metro areas	Develop statewide GIS measures of land use characterized by either (1) distance from metropolitan area downtown, (2) gravity measure of regional access to jobs, or (3) the land use categories developed in research by Salon (2014) which can likely be analogs to regional job access
2. Use data across different locations to proxy infill development – translate infill to changes in a job access gravity variable or changes in distance from downtown.	Need assumptions or information from scenario models about different growth scenarios for metropolitan areas to understand how regional job access would change, and for how many households	Validity = 2 to 3 (poor to fair) There are several scenario tools, but all such tools are possible policy futures. There will be uncertainty regarding the amount of infill development, and we suggest modeling several possible future infill growth scenarios, from aggressive use of infill to somewhat less aggressive, to bound possibilities.	Recommend using or updating the scenario tool developed as part of Salon (2014) for statewide simulations of moves across development types.
3. Use an elasticity of household VMT with respect to regional job access to calculate percentage changes in household VMT	Use regional job access elasticity from ARB regional accessibility brief.	Validity = 4 (good) Job access elasticities vary within metropolitan areas, as demonstrated by Boarnet et al. (2010) and Salon (2014), but regional averages give a good mid-point or average effect.	Use ranges of elasticities from, e.g., Boarnet et al. (2010) or Salon (2014), or adapt and use the scenario tool from Salon (2014)
4. Apply predicted percentage change in household VMT to a base-year measure of household VMT to obtain predicted change in household VMT.	Apply predicted percentage change in household VMT to average household VMT for a metropolitan area or the state.	Validity = 2 to 3 (poor to good) The CHTS has data on household VMT in different locations. These data are available and reliable. The difficulty is understanding where households might have located absent infill policies, a point currently not sufficiently addressed in the literature. Scenario models can be used to assess where households would have lived absent infill policies.	More research on how changes in housing supply in specific locations (e.g. infill) affect residential location choices of households.

Table 4 illustrates four steps, (1) measuring land use patterns, (2) simulating changes in development patterns (e.g. from infill development) and translating those changes in development patterns into changes in a measure of regional job access or distance from downtown, (3) using elasticities in the literature to measure the impact of a change in regional access to jobs (or distance to downtown) on VMT, and (4) apply the predicted change in VMT to a base year level of household VMT.

Table 4 starts with a first step of measuring land use, either with gravity variables or with simpler measures of distance from downtown. Note that the Air Resources Board recently funded research by Salon (2014) which developed statewide categories of neighborhood types, and those neighborhood types might be close approximations to regional job access, and so we add those neighborhood types developed by Salon (2014) to the list of possible regional job access measures. A complementary approach could be based on the California Statewide Travel Demand Model, which has employment data for zones statewide.[14] The second step would assess how changes in the amount of infill development would lead to changes in job access and how many persons (households) would be affected by those changes. We suggest bounding possible amounts of new development in this second step, from a modest amount of infill to aggressive use of infill, relying on local policy expertise to inform how modest and aggressive would be quantified in terms of number of new housing units and hence the number of households affected. Step 3 in Table 4 applies elasticities from the ARB job access policy brief. We note that there is a nascent literature (Boarnet, 2011; Salon, 2014) that gives evidence that the strategy effect of regional job access on VMT varies depending on where, in the metropolitan area, a household lives, but we also note that mid-point or average estimates of the policy effect will both work well and, if anything, understate the VMT effect of infill development.[15] The last step would be to apply the strategy effect (percent reduction in VMT) to the number of households affected by the strategy.

The evidence is consistent and very strong that households that live in more central locations in urban areas drive less. That relationship is very common in the data, and sophisticated studies that attempt to control for household location choices suggest that more central locations with better multi-modal transportation access cause households to drive less (e.g. Duranton and Turner, 2016; Spears, Houston, and Boarnet, 2016.) While we suggest, in Step 4 of Table 4, that the state continue to research *how* different households choose their residential location, and hence which households would move into infill developments, we note that such information will be more important to understand questions of equity (e.g. gentrification and displacement)

[14] See the SB 743 Impact Assessment Web page, at http://www.dot.ca.gov/hq/tpp/offices/omsp/SB743.html. The data available there can provide a basis for measures of employment in zones throughout California, and hence for measures of employment access.

[15] The strategy effect of regional access to jobs might be larger in centrally located areas, implying that using the metropolitan-wide average effects from the ARB policy briefs might understate the VMT-reducing effect of infill development. For a discussion and evidence, see Boarnet et al. (2010) and Salon (2014).

rather than to understand whether households in central locations drive less. The literature provides strong evidence that households in more central parts of urban areas drive less.

Strategy Extent: Impacts of State Policies on Infill Development

While there is strong, evidence-based correlation between infill development and VMT reduction, estimating state-wide VMT effects of State policies to encourage infill development requires additional assumptions about the effectiveness of state policies in making infill development happen. There is still a lack of empirical literature on *how* state policies lead to more (or less) infill development, but the state's existing policy framework, including but not limited to SB 375, provide an opportunity to study how state goals and requirements influence development activity. For now, we note that the state has many policy tools that can influence development.

State Policy Considerations for Infill Development

The state has interests in increasing infill development, and the literature demonstrates that doing so will advance State VMT reduction goals (as well as multiple other State policy priorities). SB 743 changed the traffic impact metric in CEQA, and Governor Brown recently proposed a by-right housing proposal which was not acted upon by the legislature. The state has also recently taken action on auxiliary dwelling units.

More could be done by continued changes in the measurement of impacts required by state legislation (e.g. CEQA), or with legislation that allows (or even requires) streamlined development approval when certain conditions (possibly infill location and/or providing affordable housing) are met. The state could also subsidize infill development, or provide tax reductions, which could incentivize increased infill development, although we note that such tools, in isolation, would not get around restrictive local land use regulations. Additionally, the State could add to the "toolbox" of existing financing tools for infill development and also the financing that is available for critical, infill-supportive infrastructure, which would also likely incentivize an increased share of infill development. Financing tools are likely to be particularly critical in shaping future development patterns in areas of the state where infill is at an economic disadvantage compared to greenfield or more remote development due to market conditions and/or distressed conditions in infill areas. Finally, the State could directly incentivize consumer choice, for example through low-VMT housing rebates or "live where you work" incentive programs. The location of infrastructure, including highways, transit, schools, and major public buildings, can also influence growth patterns.[16] Aligning state infrastructure spending with infill goals, e.g. through performance metrics or other criteria, would be one way to ensure better leverage these investments to further VMT and GHG reduction goals.

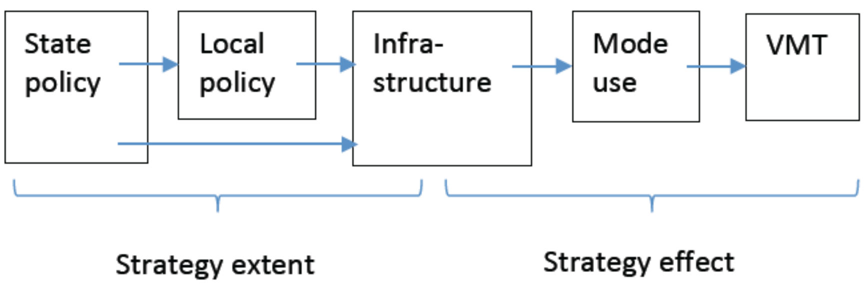
[16] For evidence of the effect of highways on growth patterns, see Funderburg, et al. (2010) and Baum-Snow (2007).

While evidence suggests that state intervention to increase infill development is highly likely to yield reductions in VMT, estimating a more precise degree of impact from state actions – for the purposes of modeling by ARB and others to quantify anticipated VMT reductions from specific strategies – would require further analysis. Table 4 presents an outline of suggested steps for gaining more precision and clarity in this estimation.

3. Transportation Investments

In this section, we separately consider the VMT impacts of three categories of transportation investments: bicycle and pedestrian infrastructure, transit service, and highway capacity. Although the impacts of bicycle infrastructure are distinct from the impacts of pedestrian infrastructure, the methods for projecting their impacts are similar, so we consider them together. The subsection on transit focuses on the impact of expansions in transit service rather than infrastructure per se, given the nature of the research available. We consider only intra-regional transit service, rather than inter-regional service such as high-speed rail, the potential GHG impacts of which have been quantified using an ARB-approved methodology.[17] The subsection on highway capacity differs from the first two in that the available research provides evidence on *increases* in VMT resulting from increases in capacity.

3.1 Bicycle and Pedestrian Infrastructure



Strategy Effect: Impact of Bicycle and Pedestrian Infrastructure on Individual or Household VMT

Investments in bicycle and pedestrian infrastructure have the potential to reduce VMT by encouraging a shift from driving to these active travel modes. A growing body of research shows a strong connection between the extent of bicycle and pedestrian infrastructure and the amount of bicycling and walking in a community. Many of the available studies focus on commute trips rather than active travel for all purposes; some studies do not separate active travel from recreational walking and bicycling. Most studies measure infrastructure investments in terms of miles of facilities or percentage increases in miles of facilities without accounting for the quality of the new facilities or their impact on the connectivity of the bicycle or pedestrian network, though current studies are beginning to provide insights into the effects of facility characteristics and network connectivity, not just extent (e.g. Monsere, et al. 2014).

As summarized in the ARB Research Briefs, differences between the studies do not enable a consensus estimate of the strategy effect, though results from individual studies could be used. A relatively recent study of 24 California cities found that a 1% increase in the percent of street length with bike lanes in a city was associated with an increase of about 0.35% in the share of

[17] https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/hsrinterimqm.pdf

workers commuting by bicycle (Marshall and Garrick, 2010). These results suggest that in a city where 1% of commuters bicycle, a 100% increase (i.e. a doubling) in the percent of streets with bike lanes would increase the bicycle commuter share to 1.35%. For walking, a North Carolina study found that a 1% increase in the portion of the route with sidewalks was associated with a 1.23% increase in the share of walk commuting (Rodriguez and Joo, 2004), though other studies suggest a much more modest effect.

While the literature strongly suggests that bike and pedestrian infrastructure increase biking and walking and therefore decrease VMT, quantifying the precise reductions in VMT is tricky. First, studies suggest that the effects of investments depend on the context, including the adoption of other strategies to promote walking and bicycling, such as educational programs or promotional events (Pucher, et al., 2010). Comprehensive efforts that combine strategic and high-quality infrastructure investments with promotion and education over a period of time have been shown to produce substantial increases in bicycling. In addition, investments in facilities that connect important destinations and contribute to the overall connectivity of the network will have more impact than stand-alone facilities that do not serve important destinations or help to build a larger network. Second, new walking and biking trips do not necessarily replace driving trips; they may replace transit trips, for example, or they may be entirely new trips. The degree to which walking and biking trips substitute for driving trips is difficult to pinpoint, as discussed by Piatokowski, et al. (2015). Third, when these trips do substitute for driving, they may be shorter than the trips they replace, particularly for non-commute trips. For example, an individual may choose to bike to a nearby store rather than driving to a store across town, in which case a measure of the increase in bicycling distance would underestimate the reduction in driving distance. Fourth, reductions in VMT from non-commute trips are also likely to occur. Thus, projected reductions in VMT based on the commute effects are almost certainly lower than the probable reductions. Projecting statewide reductions in VMT resulting from investments in bicycle and pedestrian infrastructure requires assumptions about each of these possibilities, as outlined in Table 5.

Strategy Extent: Impact of State Policy on Bicycle and Pedestrian Infrastructure

Investments in bicycle and pedestrian infrastructure are mostly made at the local level by cities and sometimes counties. State policy can influence such investments through grant programs, for example, Caltrans' Active Transportation Program. The state can (and indeed does) encourage such investments by allowing Metropolitan Planning Organizations to develop their own grant programs using the state and federal funds allocated to the MPO. However, research shows that simply allowing MPOs to spend federal funds on bicycle and pedestrian infrastructure does not guarantee that they will (Handy and McCann, 2011).

Estimating statewide reductions in VMT resulting from State policies and programs that support the expansion of bicycle and pedestrian infrastructure requires an estimate of the increase in bicycle and pedestrian infrastructure over a specified period of time (see Table 5, Step 2). This increase depends on what policies the state adopts, how MPOs and local governments respond to these policies, and how State actions influence the investments that local governments choose to make with their own funds – all very difficult to predict with precision. One approach to estimating the percent increase in bike/ped infrastructure is to estimate the funding available for these investments for the specified period of time, then convert this amount to miles of bike facilities and sidewalks using data on the per mile costs of such facilities. Another approach is to analyze increases in infrastructure for selected cities where good data on the extent of infrastructure at two or more points in time is available. San Francisco, for example, is planning to double its miles of protected bike lanes (from 15 to 30 miles) in the next 15 months.[18] Because bicycle facilities are less ubiquitous than pedestrian facilities, a given length of new facility will represent a larger percentage increase for bicycle infrastructure.

State Policy Considerations for Bike/Ped Infrastructure

The available evidence shows a strong connection between the extent of bicycle and pedestrian infrastructure and the amount of walking and bicycling. Although projecting the VMT impacts of new investments in such infrastructure involves a number of critical assumptions, given limitations in the available evidence, this strategy shows strong potential for reducing VMT, in addition to producing other benefits for the community (see Sallis, et al. 2015 for a discussion of co-benefits).

Research suggests that state actions to increase bicycle and pedestrian infrastructure would be most effective in reducing VMT if implemented in conjunction with promotional and educational programs (Pucher, et al. 2010). In addition, emerging evidence suggests that higher quality infrastructure, such as protected bicycle lanes, are more effective in promoting increases in active travel (e.g. Monsere, et al. 2014), so state actions could prioritize such high-quality infrastructure to ensure maximum VMT reduction per mile of infrastructure. Network connectivity is also now recognized as a critical consideration in prioritizing investments in bicycle and pedestrian infrastructure (Mekuria, et al. 2012), so state actions that prioritize connectivity improvements could again help to ensure the highest VMT reductions per mile of infrastructure.

State policy currently encourages such investments in bicycle and pedestrian infrastructure through grant programs and by giving MPOs flexibility in how they spend their state and federal funds. Stronger state measures could require MPOs to spend a certain share of state funding on these modes or set performance standards for walking and bicycling that MPOs must meet in order to receive funding. Additionally, the State could allocate a greater portion of state transportation funds to direct investments in pedestrian and bicycle infrastructure. Any of these measures can help ensure maximum VMT reduction per mile created by incorporating the considerations in the paragraph above into guidelines for the allocation of funds.

[18] https://www.sfmta.com/about-sfmta/blog/new-generation-bikeways-coming-san-francisco

While evidence suggests that state intervention to increase bicycle and pedestrian infrastructure is highly likely to yield reductions in VMT, estimating a more precise degree of impact from state actions – for the purposes of modeling by ARB and others to quantify anticipated VMT reductions from specific strategies – would require further analysis. Table 5 presents an outline of suggested steps for gaining more precision and clarity in this estimation.

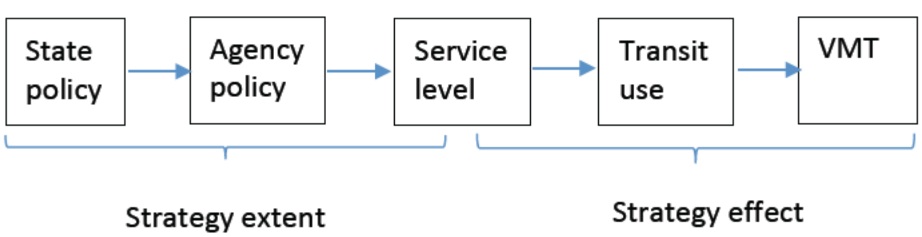
Table 5. Suggested Steps for Calculating VMT Impacts of Bicycle and Pedestrian Infrastructure Investments

Step	**Assumptions or Data Needed**	**Validity of Assumption (Scale: 1 = poor, 5 = excellent)**	**Future research tasks to strengthen assumptions and data**
1. Measure existing bicycle/pedestrian infrastructure	Most common measure is percent of street length with bike/ped facilities	Validity = 3 (fair) Most common measure does not account for quality of facilities or the connectivity of the network.	Develop statewide GIS database of bike/ped facilities, including characteristics of facilities. Develop measures of network connectivity.
2. Measure *changes in bicycle/pedestrian infrastructure* as percentage of current infrastructure	Estimate additional bike or ped infrastructure that could be constructed given funding available, for state or by region.	Validity = 3 (fair) Costs of infrastructure vary by facility type and context.	
3. Use an elasticity of % bike/ped commuting with respect to bike/ped infrastructure to calculate *percentage increase in %bike/ped commute trips*	Use bike or ped elasticity from ARB bicycle or pedestrian infrastructure brief.	Validity = 3 (fair) Bike/ped elasticities may vary by context. Available elasticities account only for bike/ped commuting, not bike/ped travel for other purposes.	Conduct studies of the impacts of bike/ped infrastructure investments that measure changes in all bicycling or walking trips, by trip purpose.
4. Apply predicted percentage change in %bike/ped commute trips to a base-year measure of annual statewide or regional bike/ped commute trips to estimate *increase in total annual bike/ped commute trips*	Use estimate of annual statewide bike/ped commute trips or estimates by region.	Validity = 4 (good) The CHTS has data on bike/ped commute trips statewide and by region. Bike/ped trips may be underreported. (Note that American Community Survey data reports only usual commute mode.)	Improve survey design to better capture bike/ped trips by purpose.

Table 5. Suggested Steps for Calculating VMT Impacts of Bicycle and Pedestrian Infrastructure Investments (Continued)

Step	Assumptions or Data Needed	Validity of Assumption (Scale: 1 = poor, 5 = excellent)	Future research tasks to strengthen assumptions and data
5. Adjust number of trips to reflect switching from modes other than driving to estimate *reduction in total annual driving commute trips*	Apply driving commute mode share for state or by region.	Validity = 2 (weak) Propensity to shift to bike/ped commuting may vary by current mode and by context.	Conduct studies of the impacts of bike/ped infrastructure investments that measure shifts between modes. Conduct such studies in different contexts.
6. Convert reduction in total annual driving commute trips to *reduction in total annual commute VMT*	Use estimate of average commute distance for bike/ped commuters statewide or by region.	Validity = 3 (fair) The CHTS has data on average commute distance for bike/ped commuters statewide and by region. Driving commute trips eliminated by new bike/ped trips may be longer (or shorter) than current bike/ped commute distances.	Conduct studies of the impacts of bike/ped infrastructure investments that measure commute distance for new bike/ped commuters.

3.2 Transit Investments



Strategy Effect: Impact of Transit Investments on Individual or Household VMT

Investments in transit service have the potential to reduce VMT by encouraging a shift from driving to transit. Many different types of investments are possible, including improved access to bus stops and rail stations, coordinated schedules and transfers between systems, real-time information about arrivals and departures, and electronic farecards. As summarized in the ARB Transit Service research brief, however, most research focuses on the effects of changes in fares, changes in service frequency (or changes in headways), or changes in miles of service. Most studies examine the effects of these changes for bus systems, though some report effects for rail systems. Outcomes are measured in terms of changes in transit ridership, i.e. the number of transit trips made for the specified period of time.

According to the ARB research brief, the available research shows that a 1 percent increase in service frequency will lead to a ridership increase of approximately 0.5 percent and that a 1 percent increase in service hours or miles could lead to a higher increase of around 0.7 percent. Effect sizes are likely to be higher in cases where the investments target "choice" riders who are not dependent on transit, higher-income riders, off-peak and non-commute trips, and small cities and suburban areas. These findings are applicable to metropolitan areas but not necessarily to rural areas where transit service is sparse.

As with bicycle and pedestrian investments, although transit investments are likely to reduce VMT, quantifying the effects of transit investments on VMT is not straightforward. First, studies suggest that the effects of investments depend on the context, as noted above. Second, not all new transit trips replace driving trips; they may instead replace bicycling or riding in a carpool, or they may be entirely new trips that would not otherwise have been made. Third, new transit trips may be shorter (or longer) in length than any driving trips they replace. For example, an individual may choose to take the bus to the nearest store rather than driving to a store across town, in which case a measure of the increase in transit distance would underestimate the reduction in driving distance. Projecting statewide reductions in VMT resulting from investments in transit service requires assumptions about each of these possibilities, as outlined in Table 6.

A recent study of the opening of the Expo Line in Los Angeles provides some of the most direct evidence available of the impact of transit investments on VMT (Spears, et al. 2016). This study, which measured VMT for households living near the new light-rail line before and after the opening of the line, found that households living within 1 mile of a new Expo station drove almost 11 miles less per day because of the new line 18 months after its opening. The authors conclude that large investments in light rail, coupled with supportive land use policies, have "the potential to help achieve climate policy goals."

Strategy Extent: Impact of State Policy on Transit Investments

Because much of the funding for intra-regional transit flows directly from the US DOT to transit agencies, the state role in promoting transit investments is more limited than it is for other modes. In addition, transit improvements are increasingly funded through county and regional sales tax measures, such as the upcoming ballot measures in Sacramento, the Bay Area and Los Angeles. The state provides transit funding through State Transit Assistance[19], bond measures such as Prop 1B[20], and more recently, through the California Climate Investments Fund (cap and trade proceeds).

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[19] http://www.sco.ca.gov/Files-ARD-Payments/Transit/statetransitassistanceestimate_1617_january16.pdf
[20] http://www.dot.ca.gov/hq/transprog/ibond.htm

Estimating statewide reductions in VMT resulting from improvements in transit service requires an estimate of the increase in transit service over a specified period of time (see Table 6, Step 2). This increase depends on what policies the state adopts, how transit agencies respond to these policies, and the investments that transit agencies choose to make with their own funds – all very difficult to predict with precision. One approach to estimating the percent increase in transit service is to estimate the funding available for service improvement for the specified period of time, then convert this amount to hours or miles of service using data on the per mile costs of such service. Another approach would be to compile proposed transit investments in the Regional Transportation Plans for the Metropolitan Planning Organizations in the state and assume this level or a proportionately higher level (to reflect new state policy) of investment in transit service.

State Policy Considerations for Transit Investments

The available evidence shows a strong connection between the extent of transit service and transit ridership. Although projecting the VMT impacts of new investments in transit service involves a number of critical assumptions, given limitations in the available evidence, this strategy shows strong potential for reducing VMT.

Service expansions are likely to have more impact when combined with other strategies such as improved access to bus stops and rail stations, coordinated schedules and transfers between systems, real-time information about arrivals and departures, and electronic farecards. The impacts of transit investments on VMT are likely to be higher in cases where the investments target "choice" riders, higher-income riders, off-peak and non-commute trips, and small cities and suburban areas. The State can increase the VMT-reduction impact of state actions to increase transit ridership by considering these conditions when, for example, developing guidelines for funding allocations, along with other considerations that achieve other policy goals, e.g. prioritizing investments in disadvantaged and low-income communities.

Although the bulk of transit funding comes from federal and local sources, the State does provide transit funding to regional and local transit agencies through a number of different programs. The state could ensure larger reductions in VMT by targeting this funding to areas and investments that are likely to have larger impacts. The State could also consider programs that directly encourage transit use, including tax breaks for employer-provided transit passes modeled on federal policy.[21] State policies that promote infill development around transit stations can also help to increase transit use (see section on Infill Development). Efforts to coordinate services among regional and local agencies could prove valuable as well.

While evidence suggests that state intervention to improve transit service is highly likely to yield reductions in VMT, estimating a more precise degree of impact from state actions – for

[21] http://www.nctr.usf.edu/programs/clearinghouse/commutebenefits/

the purposes of modeling by ARB and others to quantify anticipated VMT reductions from specific strategies – would require further analysis. Table 6 presents an outline of suggested steps for gaining more precision and clarity in this estimation.

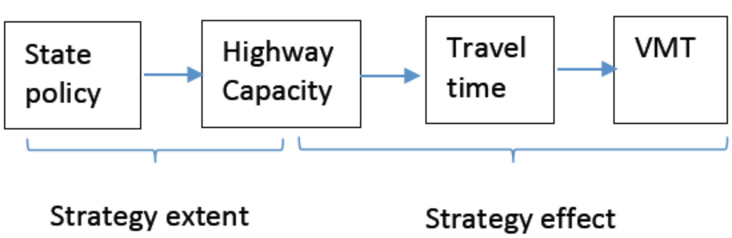
Table 6. Suggested Steps for Calculating VMT Impacts of Transit Investments

Step	**Assumptions or Data Needed**	**Validity of Assumption (Scale: 1 = poor, 5 = excellent)**	**Future research tasks to strengthen assumptions and data**
1. Measure current transit service in metro areas	Most common measures is service hours or miles.	Validity = 3 (fair) Measure does not account for quality of service or connectivity of the transit network.	Extract statewide data on transit service from National Transit Map and add data as needed. Develop measures of network connectivity.
2. Measure *increases in transit service* as percentage of current service by metro area	Compile planned increases in transit service from RTPs and assume proportionate increase based on proportionate increase in funding	Validity = 4 (good) Costs of expansion vary by service type and context.	Develop a GIS database of funded transit service increases
3. Use an elasticity of ridership with respect to transit service to calculate *percentage increases in transit ridership* by metro area	Use transit ridership elasticity from ARB transit brief	Validity = 3 (fair) Transit ridership elasticities may vary by type of improvement and context.	Conduct studies of the impacts of transit improvements of different types and in different contexts.
4. Apply predicted percentage change in transit ridership to a base-year measure of annual transit trips by metro area to estimate *increase in total annual transit trips* by metro area	Use estimate of transit trips by region	Validity = 5 (excellent) Transit agencies report annual ridership.	

Table 6. Suggested Steps for Calculating VMT Impacts of Transit Investments (Continued)

Step	Assumptions or Data Needed	Validity of Assumption (Scale: 1 = poor, 5 = excellent)	Future research tasks to strengthen assumptions and data
5. Adjust increase in total annual transit trips to reflect switching from modes other than driving to estimate *reduction in annual driving trips* by metro area	Apply driving mode share by metro area.	Validity = 2 (weak) Propensity to shift to transit may vary by current mode and by context.	Conduct studies of the impacts of transit improvements that measure shifts between modes.
6. Convert change in total annual driving trips to *change in total annual VMT* by metro area	Use estimate of average trip distance for transit riders by metro area.	Validity = 3 (fair) The CHTS has data on average distance for transit trips by metro area. Driving trips eliminated by new transit trips may be longer or shorter than current transit trip distances.	Conduct studies of the impacts of transit improvements that measure trip distance for new transit trips.

3.3 Highway Capacity



Strategy Effect: Impact of Highway Capacity on Aggregate VMT

Increased highway capacity is sometimes proposed as a strategy for reducing GHG emissions, following the logic that increased capacity will reduce congestion, smooth traffic flow, and thereby reduce GHG emissions through improved efficiency of vehicle operation. A strong body of evidence, however, supports the conclusion that increases in highway capacity do not measurably reduce congestion in the long-run. This phenomenon is referred to as "induced travel" or "induced traffic": the increase in capacity in effect reduces the (time) price of driving, and when the price goes down, consumption goes up.

The most recent and arguably most rigorous study shows an elasticity of around 1 after 10 years (Duranton and Turner, 2011). In other words, a 1% increase in highway lane miles leads to a 1% increase in VMT. Conversely, studies show that reductions in highway capacity, in the few places they have occurred, have not resulted in an increase in congestion, suggesting that VMT either disperses widely or decreases overall, though these effects have not been quantified. Estimating increases in VMT resulting from increases in highway capacity would be relatively straightforward (Table 7).

It is important to note that transportation systems management (TSM) strategies, such as eco-driving programs, incidence-clearance programs, roundabouts, and various other systems operations approaches[22] also have the potential to increase the effective capacity of the highway system. To the degree that they reduce travel times, they may induce additional vehicle travel that could offset whatever improvements in fuel efficiency or reductions in GHG emissions they produce. The VMT-inducing potential of these strategies has not been rigorously assessed.

Strategy Extent: Impact of State Policy on Highway Capacity

Over nearly a century, the State has built a highway system that now totals nearly 25,000 lane-miles of Interstates, freeways, and expressways.[23] In 2014 alone, the California Transportation Commission programmed $2.2 billion in projects for the State's highway system for a two-year period.[24] The Regional Transportation Plans adopted by the MPOs together with the State Transportation Plan outline continued expansions to the highway system, drawing on federal, state, and local funding sources, despite a growing share of the available funding going towards maintenance of the existing system. The projects listed in these plans could be compiled to project the percentage increase in highway capacity over a specified period. An important caveat is that proposed projects are often delayed, sometimes by decades, as priorities change or because of legal challenges to such projects, usually as a part of the environmental review process.

State Policy Considerations for Highway Capacity

As the owner-operator of the highway system, the State has direct control over projects that expand or reduce its capacity. Although county sales tax measures now account for a significant share of highway spending in the State, Caltrans and the California Transportation

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[22] See the ARB Research Briefs on EcoDriving, Traffic Incidence Clearance, Roundabouts, and Traffic Operations, available at: https://arb.ca.gov/cc/sb375/policies/policies.htm

[23] Highway Statistics 2014. Table hm60. Available: https://www.fhwa.dot.gov/policyinformation/statistics/2014/

[24] http://www.catc.ca.gov/programs/STIP/2016_STIP/Rev_Fund_Estimate_Jan_16.pdf

Commission must approve these projects. Under current practices, the VMT-inducing potential of these projects is not generally accounted for in the decision-making process. Such analyses could very well show that state investments in highway capacity are at odds with state goals for reducing GHG emissions.

The State could use the California Transportation Plan, or another platform, to establish new policies that limit capacity expansion, e.g. through performance criteria for state funding that take VMT increases into account. The current plan continues to focus on capacity expansion as important for addressing congestion, though it acknowledges that such investments alone will not solve the congestion problem.[25] A state-level "fix-it-first" policy would ensure that maintenance needs are met before funding is approved for projects that expand capacity. New guidelines on analyzing the environmental impacts of proposed highway projects could ensure that potential VMT increases are adequately assessed.[26]

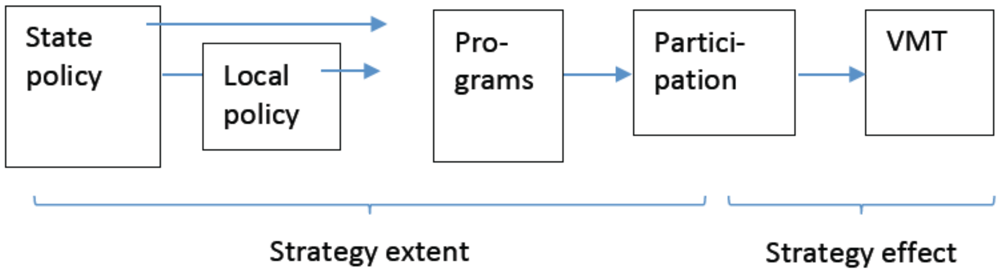
While evidence suggests that state intervention to increase highway capacity is highly likely to yield increases in VMT, estimating a more precise degree of impact from state actions – for the purposes of modeling by ARB and others to quantify anticipated VMT reductions from specific strategies – would require further analysis. Table 7 presents an outline of suggested steps for gaining more precision and clarity in this estimation

[25] http://www.dot.ca.gov/hq/tpp/californiatransportationplan2040/index.shtml
[26] http://www.dot.ca.gov/ser/cumulative_guidance/ceqa_guidelines.htm

Table 7. Suggested Steps for Calculating VMT Impacts of Highway Capacity Expansion

Step	Assumptions or Data Needed	Validity of Assumption (Scale: 1 = poor, 5 = excellent)	Future research tasks to strengthen assumptions and data
1. Measure current highway lane miles statewide	Caltrans data	Validity = 5 (excellent)	
2. Measure *increases highway capacity* as percentage of current capacity statewide	Compile planned highway capacity expansion from state and MPO plans	Validity = 4 (good) Timing of future highway projects beyond those currently programmed in a Transportation Improvement Program is uncertain. Proposed projects can be added or dropped when plans are updated.	Develop GIS database of existing highways, funded highway expansion projects, and proposed but unfunded highway expansion projects
3. Use an elasticity of VMT with respect to highway capacity to calculate *percentage increase in VMT*	Use capacity elasticity from ARB capacity brief	Validity = 4 (good) Evidence is consistent	
4. Apply predicted percentage increase in VMT to a base-year measure of annual statewide VMT to estimate *increase in total annual VMT*	Use VMT measure from Caltrans	Validity = 5 (excellent)	

4. Transportation Demand Management Programs



Transportation demand management programs encompass a variety of strategies, including employer-based trip reduction (EBTR) programs, telecommuting programs, and voluntary travel behavior change programs. Car-sharing services might also play a role in managing demand. While the literature provides strong evidence on the effects of participation in these programs on travel behavior, it provides limited insights into factors affecting the extent to which individuals choose to participate in these programs.

4.1 Employer-Based Trip Reduction Programs

Strategy Effect: Impact of EBTR Programs on Individual or Household VMT

Employer-based trip reduction programs, also known as commute-trip reduction programs, use various approaches to reduce single-occupant car travel to work. Employers may provide services that promote carpooling, such as carpool matching services, preferential parking for carpoolers, subsidized vanpools, or guaranteed rides home for carpoolers. Some programs include financial incentives for participants. Employers sometimes provide worksite facilities for employees who commute by active travel modes. Telecommuting programs and alternative work schedules are often offered as well.

Available studies, as summarized in the ARB research brief, suggest that commute VMT declines by 4% to 6% on average for employees at worksites participating in EBTR programs, including employees who switch from drive-alone to other modes and those who don't. Reductions are likely to be higher when programs offer a broad array of assistance and incentives and at sites with high levels of transit access.

Strategy Extent: Impact of State Policies on EBTR Programs

EBTR programs are implemented voluntarily or as a requirement of local, regional, or state policy. For example, Southern California's Regulation XV, implemented in 1988, required employers with work sites of more than 100 employees to develop employee trip reduction plans. In 1995, State legislation prohibited air districts or other public agencies from mandating employer trip reduction programs unless such mandates are required by federal law. But the State allowed the San Joaquin Valley Air District to adopt a commute-trip reduction program in 2009, and the Bay Area Air Quality Management District adopted a program in 2013. Several Silicon Valley cities have capped single-occupancy auto trips as part of entitlements for new tech company campus expansions.

The extent to which EBTR programs are implemented in the future depends on requirements for such programs as established by state or local policy. Projecting the state-wide VMT reduction potential of such programs requires an assumption about these requirements, for example, that they would apply to all worksites with 100 or more employees. The strategy effect would apply only to commute VMT for employees at the worksites with EBTR programs rather than to all commute VMT. Statewide reductions in VMT could be projected as outlined in Table 8.

Policy Considerations for EBTR Programs

The available evidence shows a strong connection between employer-based trip reduction programs and reductions in commute VMT. The statewide impact on VMT of state policies that require or encourage the adoption of EBTR programs depends on the total number of employees at worksites that adopt such programs. This strategy shows strong potential for reducing VMT depending on the aggressiveness of the state policy.

California could adopt an EBTR program requirement modeled on Washington State's, which requires employers with 100 or more employees in 9 of 39 counties to adopt trip-reduction programs. Such programs are traditionally implemented in metro areas with high levels of congestion, but programs like vanpooling and telecommuting could work in rural areas with long commute distances.

While evidence suggests that state intervention to increase employer-based trip reduction programs is highly likely to yield reductions in VMT, estimating a more precise degree of impact from state actions – for the purposes of modeling by ARB and others to quantify anticipated VMT reductions from specific strategies – would require further analysis. Table 8 presents an outline of suggested steps for gaining more precision and clarity in this estimation.

Table 8. Suggested Steps for Projecting VMT Impacts of Employer-Based Trip Reduction Programs

Step	Assumptions or Data Needed	Validity of Assumption (Scale: 1 = poor, 5 = excellent)	Future research tasks to strengthen assumptions and data
1. Use effect size for work sites to estimate *percentage decrease in commute VMT for participating worksites*	Use effect size from ARB EBTR brief	Validity = 3 (fair) Elasticities will vary by program and context	Conduct studies of the impacts of EBTR programs of different types and contexts.
2. Estimate *the number of employees at worksites of the size specified in the EBTR policy* by metro area	Data is collected by CA Franchise Tax Board	Validity = 5 (excellent)	
3. Use the average commute distance by metro area to estimate *the annual commute VMT for employees at worksites required to adopt EBTR programs* by metro area	Use commute VMT estimates from MPOs and/or Caltrans	Validity = 4 (good) American Community Survey and CHTS provide data on commute VMT	
4. Apply predicted percentage decrease in commute VMT to estimated annual commute VMT for EBTR worksites to estimate *decrease in total annual commute VMT* by metro area	Calculation		

4.2 Telecommuting Programs

Strategy Effect: Impact of Telecommuting Programs on Individual VMT

Telecommuting is the practice of working from home by employees who have a regular work place. Telecommuting may be encouraged as a part of an employer-based trip reduction program (see Section 4.1) or as a stand-alone program. The available research shows strong evidence that telecommuting reduces VMT. As summarized in the ARB Telecommuting research brief, reductions in commute VMT may be as high as 90% on telecommuting days, and personal VMT may decline by roughly 55 to 75% on telecommuting days. Annual VMT reductions for telecommuters depend on how frequently these workers telecommute. Available studies show that telecommuters average 1.2 to 2.5 days per week.

It is important to note that most of the research on the VMT impacts of telecommuting was conducted in the 1990s. With the advent of the Internet, wireless services, and smart phones, today's patterns of telecommuting may be quite different than in the past, and the impacts on driving may be more or less than previously. Anecdotally, it appears that work is increasingly done in places other than the office or home, the VMT implications of which are uncertain.

Strategy Extent: Impact of State Policy on Telecommuting Programs

State and local requirements for employer-based trip reduction programs may encourage the adoption of telecommuting programs. The State might also encourage employers to adopt telecommuting programs through tax incentives and other policies.

Projections from the 1990s as to the share of workers who would be telecommuting by now have not panned out, though telecommuting levels are not insignificant. Measuring the extent of telecommuting is challenging, given increasing flexibility in work sites and work hours. Statewide reductions in VMT could be projected as outlined in Table 9.

Policy Considerations for Telecommuting Programs

The available evidence shows a strong connection between telecommuting programs and reductions in VMT. The statewide impact on VMT of state policies that require or encourage the adoption of telecommuting programs depends on the total number of employees who choose to telecommute and how frequently they telecommute. This strategy shows strong potential for reducing VMT depending on employee demand for telecommuting.

California could encourage telecommuting by adopting a requirement for employer-based trip reduction programs that include a telecommuting program (see Section 4.1). Such programs are traditionally implemented in metro areas with high levels of congestion, but telecommuting programs could work in rural areas with long commute distances.

While evidence suggests that state intervention to increase telecommuting programs is highly likely to yield reductions in VMT, estimating a more precise degree of impact from state actions – for the purposes of modeling by ARB and others to quantify anticipated VMT reductions from specific strategies – would require further analysis. Table 9 presents an outline of suggested steps for gaining more precision and clarity in this estimation.

Table 9. Suggested Steps for Projecting VMT Impacts of Employer-Based Trip Reduction Programs

Step	**Assumptions or Data Needed**	**Validity of Assumption (Scale: 1 = poor, 5 = excellent)**	**Future research tasks to strengthen assumptions and data**
1. Use effect size to estimate *percentage decrease in personal VMT on telecommuting days*	Use effect size from ARB Telecommuting brief	Validity = 3 (fair) Available research is dated, and effect size may now be different	Conduct new studies of telecommuting patterns and impacts
2. Estimate the average number of telecommuting days per week	Use average telecommuting days from ARB Telecommuting brief	Validity = 3 (fair) Available research is dated, and telecommuting frequency may now be different	Conduct new studies of telecommuting patterns and impacts
3. Use the average daily VMT for workers by metro area to estimate *the annual commute VMT for employees who telecommute* by metro area	Use VMT estimates from MPOs and/or Caltrans	Validity = 4 (fair) American Community Survey and CHTS provide data on commute VMT. Telecommuters may have longer commuters than the regional average	Conduct new studies of telecommuting patterns and impacts
4. Apply predicted percentage decrease in daily VMT and average number of telecommuting days to estimate *decrease in total annual VMT for average telecommuter* by metro area	Calculation		
5. Multiply estimated decrease in total annual VMT for telecommuters by estimated number of telecommuters by metro area to get *decrease in total annual VMT* by metro area	Use telecommuter estimates from MPOs and/or Caltrans	Validity = 4 (fair) American Community Survey and CHTS provide data on share of workers telecommuting usually or on any given day, respectively	Develop improved survey questions to measure extent of telecommuting in travel surveys

Conclusions

The available evidence shows that the strategies considered in this paper are likely to reduce VMT if promoted by state policy. The connection between state policy and VMT reduction is more direct for some strategies than others (see Table 10), but the available evidence in all cases points to VMT reductions, even if projections of the magnitude of the statewide effects depend on a number of assumptions. The framework we have outlined for generating statewide projections of VMT reductions for these strategies helps to illuminate the sequence of causal events that would produce VMT reductions and highlights important gaps in knowledge that increase the uncertainty of the projections. Despite uncertainties, the evidence justifies state action on these strategies.

Most of the strategies discussed here are complementary: VMT reductions are likely to be greater if strategies are adopted in combination. For example, infill development coupled with investments in transit service and bicycle and pedestrian infrastructure will have more of an impact than infill development or transportation investments on their own. Pricing strategies will have more impact on VMT (with less impact on household budgets) if good alternatives to driving are available. The one exception to this complementarity rule is highway capacity: new highway capacity (whether from construction of additional lanes or implementation of transportation systems management strategies) is likely to increase VMT through the "induced travel" effect and will at least partly offset reductions in VMT achieved through other strategies.

The timeframe of the strategies is another important consideration. Some pricing strategies can be implemented quickly, if the State has the political will to do so, with direct impacts on the travel choices of Californians. Transportation investments may be a longer term proposition, requiring a series of investments over many years before transit or bicycle networks are extensive enough to attract substantial numbers of drivers. Infill development is also a longer term proposition, as new development represents a small increment of all development in any one year. But these longer term strategies are essential for providing and improving alternatives to driving that enable more painless VMT reductions; they also produce many other benefits for communities as discussed in the ARB research briefs (see also Sallis, et al. 2015).

We have also outlined the need for improved data and additional studies to reduce the uncertainty in projections of the statewide reductions in VMT that state policy might produce. Investments in data and research are well justified by the significance of the policies under consideration and the seriousness of the problem they would address. However, the State does not need to wait for new data or research to act. In fact, the State is already acting through numerous policies that directly and indirectly influence VMT whether that was their purpose or not. The existing evidence is strong enough to point the State in the right direction to achieve the needed reductions in VMT starting now and over the decades to come.

Table 10. Summary of State Policy Options

Strategy Category	State Policy to VMT Link	Effect on Individual VMT	Potential for Statewide Implementation and Adoption – Strategy Extent
Pricing	Most direct	Strong effect Solid evidence	Can be applied state-wide (fuel taxes, VMT fees) and in targeted areas (link pricing, cordon pricing, parking pricing). Most effective where individuals have good alternatives to driving. Strategies have equity implications. Generates revenues that can be invested in transportation system.
Infill Development	Direct and indirect	Moderate effect Solid evidence	Most applicable in metro areas. Will affect populations living and working in infill areas. May depend on changes in local land use policy. May require financial incentives. Land use changes and VMT effects accrue over the long term.
Transportation Investments			
Bike/Ped	Direct and indirect	Small effect Moderate evidence	Most applicable in metro areas. Will affect populations living and working where investments are made. May depend on changes in local investments. May require financial incentives. May require package of strategies. Many co-benefits.
Transit	Direct and indirect	Small effect Moderate evidence	Most applicable in metro areas. Will affect populations living and working where investments are made. May depend on changes in transit agency action. May require financial incentives. May require package of strategies. Many co-benefits.
Highways	Direct	Strong *induced VMT* effect Solid evidence	New capacity that reduces travel times leads to VMT growth. Effect is greatest in congested areas. Operational improvements that reduce travel times can also induce VMT.
Transportation Demand Management	More indirect	Moderate effect Solid evidence	Most applicable in metro areas. Generally implemented by large employers in response to state or local requirements or financial incentives. Some applications appropriate for rural areas.

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Appendix: Linking Scenario Planning Models of Infill Development to Fine-Grained Data on the Effect of Infill Strategies

Table A1 shows an example calculation of the effect size of moving from the third to fourth quintile of regional job access or from the fourth to fifth quintile of regional job access in the Los Angeles region, as shown in Figure 1 in the text. The data in Table 2 show mid-points of the gravity variable quintile from the ranges that are reported in Boarnet et al. (2011).

Following across columns in Table 2, moves from the mid-point of the third quintile of job access to the fourth quintile increase the gravity job access variable by 38.72 percent, based on the values reported in Boarnet et al. (2010). Using an elasticity range of -0.13 to -0.25 from the ARB briefs, the resulting change in household VMT is 38.72 percent multiplied by -0.13 or -0.25, or a reduction of from 5.03 to 9.68 percent in household vehicle travel. Similarly, moving from the fourth quintile of job access (e.g. in Lakewood, per Table XX) to the top quintile (e.g. near downtown) is a 102.65 percent increase in the job access measure, which when multiplied by the low and high values for the elasticity imply a reduction in household VMT ranging from 13.34 to 25.66 percent. These estimates bound the 18 percent VMT reduction that we obtained in the body of the report from distance measures rather than gravity measures, suggesting that using distance to the metropolitan area downtown can be a good approximation for more complex measures of job access.

Table A1: Example Calculation of Effect of Moves Across Job Access Quintiles on Daily Household VMT

						from ARB regional accessibility brief	
			elasticity from ARB brief			**% change VMT**	
Access quintile (from Boarnet et al. 2010)	mid-point of gravity variable range	% change mid-point access across adjacent quintiles	Low estimate	High estimate	HH VMT miles/day (from Boarnet et al. 2010)	Low estimate	High estimate
5th	524.75	102.65	-0.13	-0.25	47.81	-13.34%	-25.66%
4th	258.94	38.72	-0.13	-0.25	47.81	-5.03%	-9.68%
3rd	186.67		-0.13	-0.25	47.81		

Sources: Calculated from data in Boarnet et al. (2011) and ARB regional accessibility policy brief (https://arb.ca.gov/cc/sb375/policies/regaccess/regional_accessibility_brief120313.pdf.)

Exhibit 2

Caltrans Greenhouse Gas Emissions and Mitigation Report

Final Report

August 2020

Caltrans Greenhouse Gas Emissions and Mitigation Report

Final Report

August 2020

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Preface

This report was developed by a consultant team based on interviews with approximately 50 Caltrans staff and a review of a wide range of documents. The report is the final product of a consultant project with the following purpose: "document current Caltrans activities that reduce greenhouse gas (GHG) emissions and to identify future opportunities for further reducing GHG emissions." This document is intended for informational purposes only. The assertions and recommendations contained in this report were developed by the consultant team and do not necessary reflect the views of all Caltrans staff involved in the development of this report.

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Executive Summary

Motor vehicles are a major contributor to the greenhouse gas (GHG) emissions that are causing global climate change, with potentially catastrophic effects on California and the planet. California is already feeling the effects of climate change. Evidence is mounting that climate change has contributed to a variety of recent problems plaguing the state including drought, wildfires, pest invasions, heat waves, heavy rains, and mudslides. Projections show these effects will continue and worsen in the coming years, with major implications for our economy, environment, and quality of life.[1]

In response, the State of California and many local governments have adopted policies to reduce GHG emissions. Given the large contribution of the transportation sector to California's GHG emissions, Caltrans and other state transportation agencies have an important role to play in fostering solutions. Caltrans has influence over a large share of the state's GHG emissions – particularly emissions from persons and vehicles utilizing the State Highway System. As shown in Table 1, vehicles traveling on the State Highway System are responsible for roughly 89 million metric tons (MMT) of GHG emissions annually, equivalent to 21 percent of all California GHG emissions.

Caltrans also has influence over the materials and equipment used by its contractors. The activities associated with the materials and equipment used for Caltrans highway construction and maintenance projects account for roughly 2.5 MMT of GHG emissions per year, or 0.6 percent of statewide emissions.

The emissions from Caltrans internal operations include those produced by Caltrans vehicles and equipment, buildings, highway lighting, and other Caltrans facilities. These emission sources under Caltrans direct control produce roughly 120,000 metric tons of GHG emissions per year – not a trivial amount, but only 0.03 percent of California's total statewide inventory. GHG emissions under Caltrans direct control have declined 45 percent since 2010 due to a variety of factors including improved energy efficiency of buildings and roadway lighting, introduction of more fuel-efficient vehicles, and reductions in the carbon intensity of California's grid electricity and transportation fuels.

Table 1. Caltrans and California GHG Emissions

Source Category	MMT of CO_2-equivalent emissions per year
All California emissions (CARB 2017 inventory) [a]	424
Vehicle travel on the State Highway System (2017) [b]	89
Embodied emissions from Caltrans project materials (2017) [c]	2.5
Caltrans GHG Inventory (2017) [d]	0.12

Sources: a) CARB 2017 GHG inventory. b) On-road vehicle total from CARB 2017 GHG inventory; split of SHS vs. non-SHS travel based on VMT totals as described in Section 2. c) Material usage data from Caltrans 2017 Contract Cost Data; emission factors from literature as described in Section 2. d) Caltrans data submitted to The Climate Registry.

[1] California Air Resources Board, *California's 2017 Climate Change Scoping Plan*, November 2017.

Reducing Emissions from State Highway System Users

It is essential to address the emissions produced by vehicles traveling on the State Highway System if the state is to meet the GHG reduction goal established under AB 32, SB 32, and Executive Order S-3-05. The state's climate change policies recognize that most of the needed transportation sector GHG emission reductions will come from improved vehicle technologies and low carbon fuels, but also that vehicle miles of travel (VMT) reductions are necessary to achieve the targets. The State's Climate Change Scoping Plan identified that some of the necessary VMT reductions would result from the MPO-level GHG reduction actions to meet regional targets established under SB 375, but also that "there is a gap between what SB 375 can provide and what is needed to meet the State's 2030 and 2050 goals."[2] Moreover, recent data shows that statewide VMT and VMT per capita are growing, and that SB 375 is not producing the desired GHG reductions, as made clear in a recent California Air Resources Board (CARB) assessment.[3]

Historically, Caltrans focused its investments towards expanding the highway system to meet the demands of a growing population and economy and increased vehicle ownership and use. Today, expansion of the highway system has slowed, and the focus has shifted to managing the system effectively. This paradigm calls for evaluating new highway projects in terms of their ability to move people rather than vehicles, and to support a multimodal system that offers travel choices and better reliability. The shift in focus away from maximizing vehicle throughput is also reflected in the passage of SB 743, which calls for replacing vehicle delay and level of service as the mechanism for evaluating transportation impacts under the California Environmental Quality Act (CEQA).

Because it plans, builds, and operates most of the state's highway system, Caltrans has some unique opportunities to influence on-road vehicle travel in the state. These opportunities include the provision of multimodal transportation systems that provide viable alternatives to vehicle travel, roadway pricing and other approaches to manage demand, and avoiding new highway capacity additions that result in substantial induced vehicle travel, leading to higher VMT and GHG emissions. The phenomenon of induced vehicle travel is widely accepted and well documented[4,5], and it can often lead to an increase in VMT and GHG emissions when highway capacity is expanded, including through the addition of HOV and express lanes.

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[2] *California's 2017 Climate Change Scoping Plan*, California Air Resources Board, November 2017.

[3] California Air Resources Board, *2018 Progress Report: California's Sustainable Communities and Climate Protection Act*, November 2018.

[4] Handy, Susan and Boarnet, Marlon, G., "Impact of Highway Capacity and Induced Travel on Passenger Vehicle Use and Greenhouse Gas Emissions," prepared for the California Air Resources Board, 2014. https://ww2.arb.ca.gov/sites/default/files/2020-06/Impact_of_Highway_Capacity_and_Induced_Travel_on_Passenger_Vehicle_Use_and_Greenhouse_Gas_Emissions_Policy_Brief.pdf

[5] Caltrans, Draft Transportation Analysis Framework: Induced Travel Analysis, March 2020. https://dot.ca.gov/-/media/dot-media/programs/transportation-planning/documents/sb-743/2020-04-13-taf-a11y.pdf

Reducing Emissions from Caltrans Internal Operations

In terms of the emissions from Caltrans internal operations, the Department has long been a leader in resource conservation and energy efficiency, and in recent years has implemented numerous strategies to further reduce GHG emissions from its internal operations. These actions include:

- Installation of more than 70 solar power photovoltaic (PV) energy systems at Caltrans buildings
- Purchase and use of more than 250 plug-in electric and fuel cell vehicles
- Reducing water consumption by more than 65 percent compared to 2013 baseline levels
- Converting more than 80 percent of overhead “cobra head” highway lights to light-emitting diode (LED) lights

Pavement strategies appear to offer the most promising opportunities for additional GHG reductions related to internal operations. Use of alternative materials and modifications to construction and maintenance practices can reduce emissions associated with asphalt and concrete pavements as well as structures. Because of the large volume of pavement and structural materials used by Caltrans and its contractors, even small changes in policy can result in significant GHG reductions for the state. However, decisions to promote specific pavement materials and methods in the name of GHG reduction must be supported by careful analysis that considers not only the materials, transport, and construction phases, but also any effects on vehicle fuel economy (pavement smoothness) and durability and lifetime of the pavement.

Some of the other promising opportunities for further reducing Caltrans internal operations emissions include:

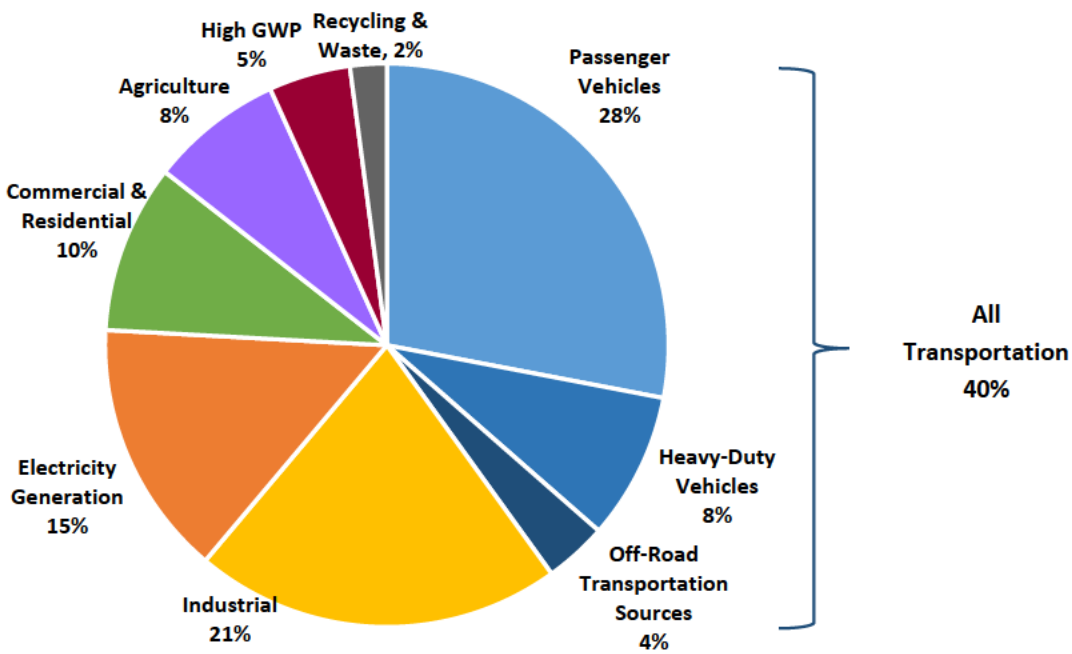
- Increasing renewable energy generation by installing solar power projects in the highway right-of-way
- Purchasing fuels with lower carbon intensities for Caltrans fleet, such as renewable natural gas
- Providing additional programs and incentives to increase transit use, ridesharing, and bicycling for Caltrans employee commuting

Changes to Caltrans’ internal operations strategies will not reduce GHG impacts much compared to reducing highway system user emissions. However, they are important because they set an example for other agencies and can help to advance emerging technologies and practices.

1 Introduction

Transportation is a major contributor to greenhouse gas (GHG) emissions in California. In 2017, the transportation sector accounted for 40 percent of the state's total GHG emissions, as shown in Figure 1. On-road vehicles alone accounted for 36 percent of the state total. This reflects just the tailpipe emissions resulting from vehicle fuel combustion. The next largest contributors to the state's GHG emissions were the industrial sector (21 percent) and electricity generation (15 percent). Some emissions associated with transportation, such as refining and processing of fuels and production of asphalt and concrete, are included in these non-transportation sectors.

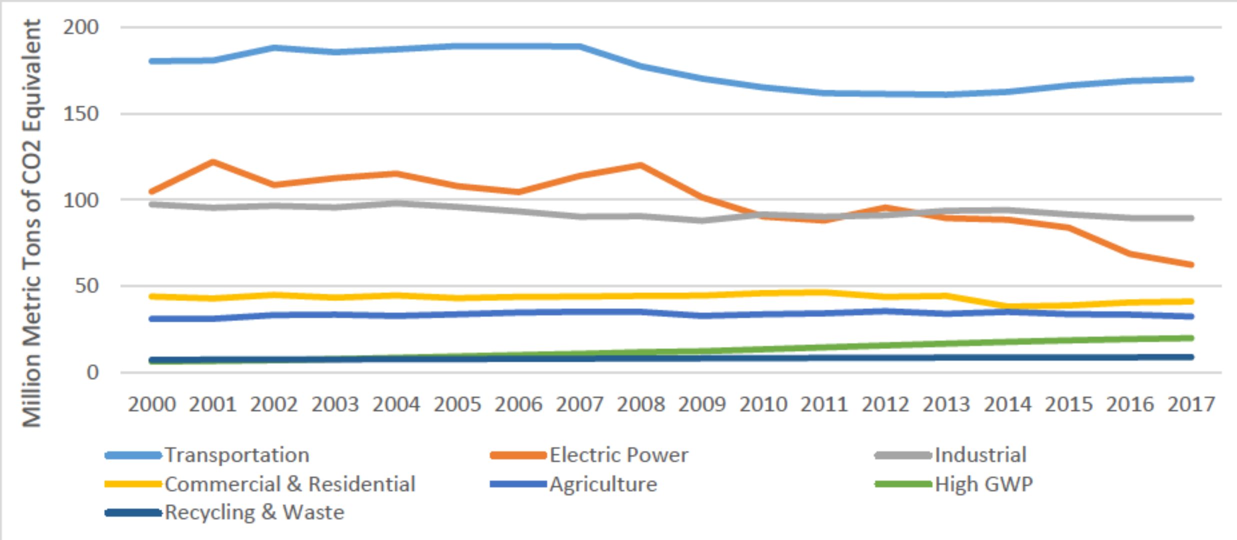
Figure 1. California GHG Emissions by Sector, 2017



Source: California Air Resource Board, California Greenhouse Gas Emission Inventory - 2019 Edition, Available at https://www.arb.ca.gov/cc/inventory/data/data.htm

Moreover, after declining over the period 2007-2013, transportation GHG emissions are increasing again, as shown in Figure 2. Transportation emissions increased 5.6 percent during the period 2013 – 2017. With the exception of high global warming potential (GWP) gases and recycling & waste, all other major economic sectors saw a decline in GHG emissions during this period.

Figure 2. California GHG Emissions by Sector, 2000-2017



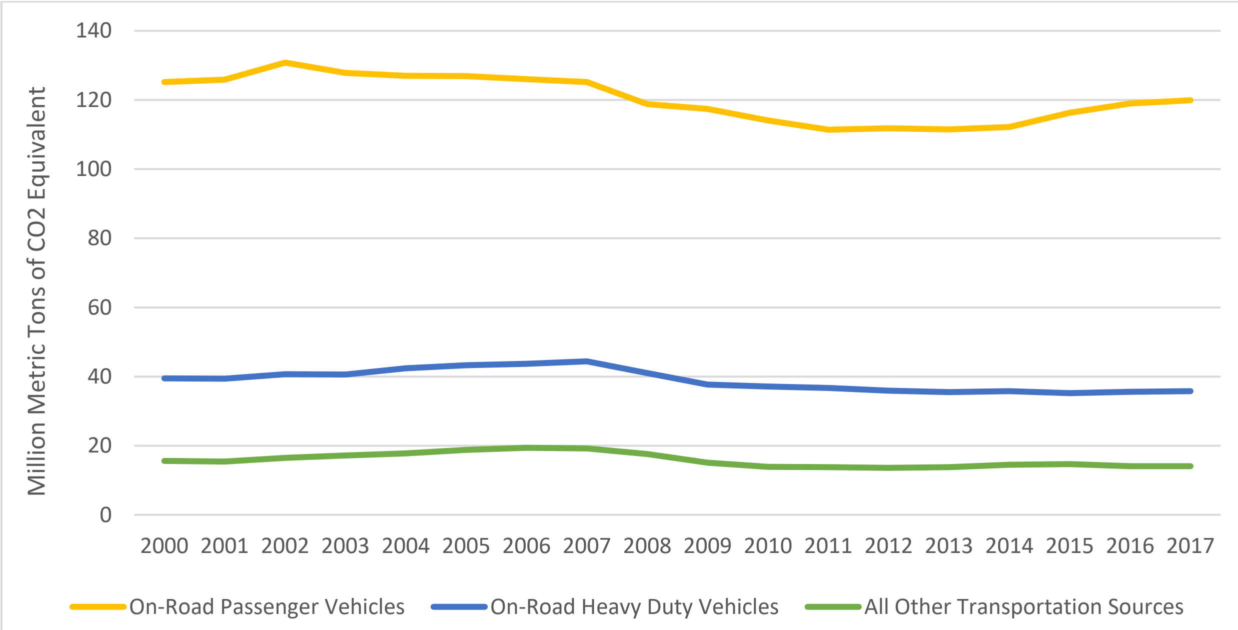
Source: California Air Resource Board, California Greenhouse Gas Emission Inventory - 2019 Edition, Available at https://www.arb.ca.gov/cc/inventory/data/data.htm

Within the transportation sector, about 70 percent of GHG emissions come from on-road passenger vehicles (i.e., light-duty vehicles). Another 21 percent comes from on-road heavy-duty vehicles (i.e., freight trucks and buses). The other sources of transportations emissions each account for a relatively small fraction of the state's GHG emission inventory. Note, however, that the state's GHG emission inventory includes only in-state movement of aircraft and marine vessels; ships and planes engaged in international transport of people and goods are not counted in the inventory.

The figure below shows that the recent growth in transportation GHG emissions has primarily occurred with passenger vehicles. Between 2013 and 2017, passenger vehicle GHG emissions increased nearly 8 percent, while GHG emissions from heavy-duty vehicles were essentially flat. These trends are the result of a number of different factors. Passenger vehicle travel has been increasing due to population growth and the state's robust economic activity. Between 2013 and 2017, this VMT growth outpaced the improvements in fuel efficiency of the vehicle fleet, leading to a rise in emissions. With heavy-duty vehicles, the percent of biodiesel and renewable diesel in the total diesel blend has grown rapidly in recent years, due in part to the implementation of the Low Carbon Fuel Standard. The increasing market penetration of biodiesel and renewable diesel was able to offset the increase in on-road heavy-duty truck activity and diesel use.[6]

[6] California Air Resources Board, California Greenhouse Gas Emissions for 2000 to 2016: Trends of Emissions and Other Indicators, Available at: www.arb.ca.gov/cc/inventory/pubs/reports/2000_2016/ghg_inventory_trends_00-16.pdf

Figure 3. California Transportation GHG Emissions, 2000-2017



Source: California Air Resource Board, California Greenhouse Gas Emission Inventory - 2019 Edition, Available at https://www.arb.ca.gov/cc/inventory/data/data.htm

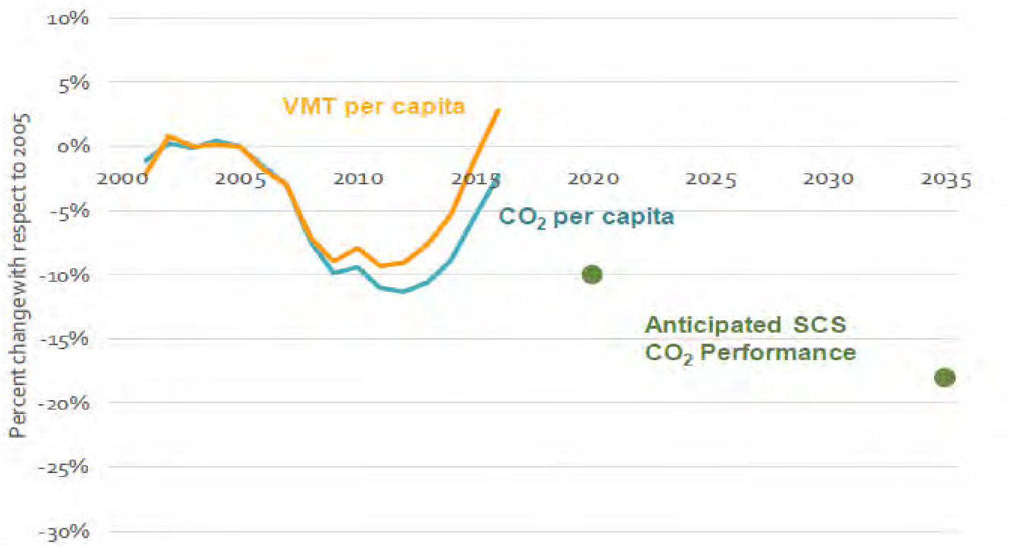
Looking ahead, it is expected that the state will continue to make considerable progress to curb transportation GHG emissions through improvements in fleet-average fuel economy and support for electric vehicle and other alternative fuels. But other developments related to transportation GHG emissions are potentially troubling. Although numerous models of electric vehicles (EVs) are now available, a variety of factors will likely limit their market penetration for some time. Trucks are a large contributor to GHG emissions, and the growth of e-commerce and trade is contributing to increasing heavy-duty vehicle VMT. Many promising technologies to reduce truck emissions are in development, but it may be years before these technologies are cost effective. In addition, while new and emerging technologies related to vehicles, fuels, and system management offer significant potential for reducing GHG emissions from transportation, some other new technologies and services could work against this trend. For instance, recent studies suggest that at least 40 percent of trips by transportation network companies (TNCs) are replacing transit, bicycle, and walk trips, thus generating additional VMT.[7] And autonomous vehicles are widely expected to create additional new vehicle trips and extend the length of trips.

The State's 2017 Climate Change Scoping Plan charts a course for meeting California's 2030 GHG reduction targets. The Scoping Plan recognizes that most of the GHG reductions in the transportation sector will come from vehicle technologies and low carbon fuels, but notes that VMT reductions also are

[7] Rodier, Caroline, "The Effects of Ride Hailing Services on Travel and Associated Greenhouse Gas Emissions," A White Paper from the National Center for Sustainable Transportation, April 2018. https://ncst.ucdavis.edu/wp-content/uploads/2016/07/NCST-TO-028-Rodier_Shared-Use-Mobility-White-Paper_APRIL-2018.pdf

necessary to achieve the 2030 target. Much of this VMT reduction was expected to occur as a result of the transportation and land use planning changes required by SB 375, the Sustainable Communities and Climate Protection Act of 2008. Yet a recent California Air Resources Board (CARB) assessment makes clear that the state "is not on track to meet greenhouse gas reductions expected under SB 375," as illustrated in the figure below.[8]

Figure 4. Statewide CO_2 and VMT Per Capita Trend with Respect to Anticipated Performance of Current SB 375 Sustainable Communities Strategies



Source: California Air Resources Board, 2018 Progress Report: California's Sustainable Communities and Climate Protection Act, November 2018.

Given the large contribution of the transportation sector to California's GHG emissions and the emerging opportunities and challenges associated with GHG emissions from motor vehicles, Caltrans has an important role to play in fostering solutions. Because it plans, builds, and operates most of the state's highway system, Caltrans has some unique opportunities to influence on-road vehicle travel in the state. These opportunities include the provision of multimodal transportation systems that provide viable alternatives to vehicle travel, roadway pricing and other approaches to manage demand, and minimizing highway capacity expansion projects that result in substantial induced vehicle travel and lead to higher VMT and GHG emissions. These efforts align well with broader Caltrans goals of safety, health, sustainability, and system performance.

In addition to influencing the users of the transportation system, Caltrans has numerous opportunities to reduce GHG emissions through its own internal operations and contractors' operations. The maintenance and operation of the State Highway System requires extensive resources such as paving materials, electricity for lighting, water for landscaping, and a large fleet of vehicles. There are proven options for making these resources more energy efficient and less carbon-intensive, many of which

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[8] California Air Resources Board, *2018 Progress Report: California's Sustainable Communities and Climate Protection Act*, November 2018.

Caltrans has adopted. Changes to the materials used for roadway construction and maintenance appear to offer the most opportunity for internal operations GHG reduction.

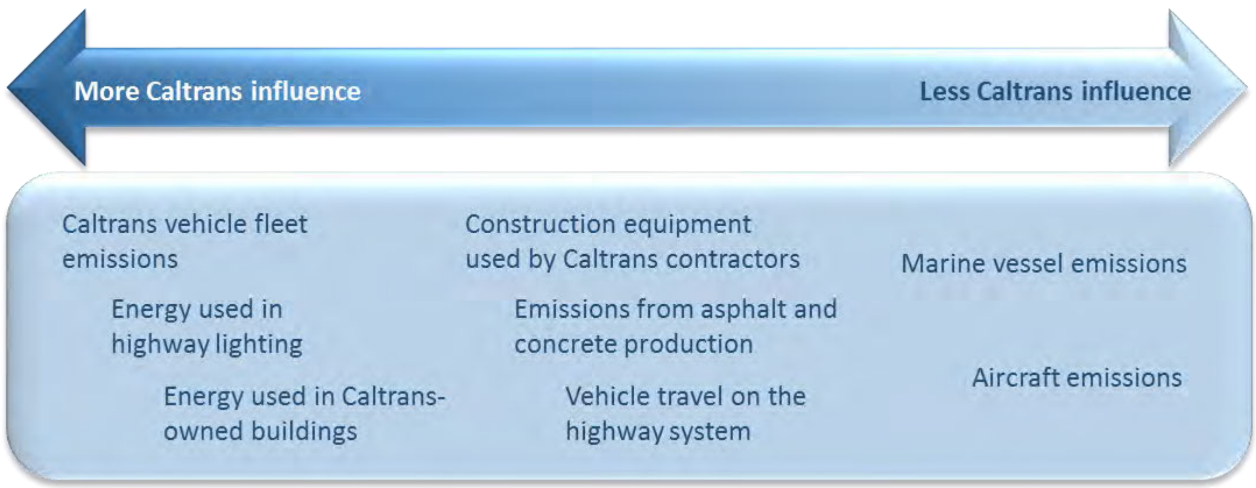
This report describes recent Caltrans actions that reduce GHG emissions, quantifies the magnitude of reductions where possible, and identifies opportunities for the Department to achieve greater emission reductions. Section 2 reviews the sources of emissions that Caltrans can control or influence. Section 3 focuses on reducing emissions from vehicles on the SHS. Section 4 focuses on reducing emissions from Caltrans internal operations. GHG reduction activities are described for the major functional units at Caltrans, which generally align with steps in transportation project delivery – planning, programming, environmental review, design, construction, maintenance, and operations. The identification of recent actions was done primarily through interviews with Caltrans staff and a review of Caltrans publications. Twelve group interviews were conducted at Caltrans Headquarters involving approximately 50 Caltrans staff, along with follow-up telephone interviews and email correspondence. GHG reductions were estimated by gathering data on Caltrans activities and applying standard quantification methods and emission factors.

The assessment of GHG reduction actions provides the foundation for an evaluation of the ways that Caltrans can better support State climate change goals. This report focuses on the GHG reduction strategies that would be most impactful, recognizing that a variety of barriers may currently prevent the implementation of these strategies, such as cost, technology readiness, lack of data for monitoring, staff familiarity, regulatory or policy prohibitions, and potential conflict with other Caltrans goals. The report discusses these barriers and ways to overcome them. The report provides a roadmap for Caltrans as it seeks to align its policies, procedures, plans, and investments so as to maximize the Department's contribution to State GHG reduction efforts.

2 Overview of GHG Emission Sources Influenced by Caltrans

To identify the best opportunities for Caltrans to contribute to California's GHG emission reduction goals and help to mitigate the impacts of climate change, it is important to understand the range of influence Caltrans has on sources of GHG emissions and the magnitude of those emissions sources. As illustrated in the figure below, Caltrans' influence over sources of GHG emissions reflects a continuum. Caltrans has strong influence over the fuel use and emissions from its vehicle fleet and its buildings, although these sources account for only a small fraction of total GHG emissions in California. Caltrans has varying degrees of influence, but less direct control, over a variety of other emission sources, some of which are quite large. These include the emissions from vehicles traveling on the State Highway System and the materials and equipment used by Caltrans contractors. Caltrans has little to no influence over some other sources of transportation emissions, such as marine vessels and aircraft.

Figure 5. Illustration of Range of Influence Caltrans Has on Sources of GHG Emissions



The rest of this section discusses the major sources of emissions that Caltrans can influence.

2.1 Roadway System User Emissions

Because of its role in planning, designing, and operating the State Highway System, Caltrans can influence emissions from vehicles driving on the state's roadways – one of the largest sources of GHG emissions in the state. Fundamentally, travel occurs because of the desire of individuals to reach destinations – for employment, schooling, shopping, recreation, etc. The choice of where, when, and how to travel is based on numerous factors that vary for each individual. When the choice involves traveling by motor vehicle using gasoline or diesel fuel, the result is GHG emissions from fuel combustion. Similarly, businesses make decisions to use the transportation system for the movement of supplies and finished products, which results in GHG emissions.

CARB's statewide GHG inventory shows that on-road vehicles produced 156 million metric tons of CO_2-equivalent emissions in 2017, 37 percent of the state's total emissions. Some of these emissions occur on the State Highway System (SHS) that is owned and operated by Caltrans, and some emissions occur on other roadways.

According to Caltrans, travel on the State Highway System resulted in 195 billion VMT in 2016.[9] For the same period, FHWA estimates 340 billion VMT on the state's entire roadway network.[10] Thus, State Highway System VMT represents about 57 percent of all VMT in California. As a rough order-of-magnitude estimate, applying this ratio to the statewide on-road transportation GHG inventory suggests that State Highway System travel results in 89 million metric tons of directly emitted CO_2-equivalent emissions.

Caltrans influences travel on the SHS through its activities related to planning, programming, design, and highway operations. For example, projects that change the capacity of highways can affect near-term decisions about travel mode as well as longer term land development decisions that can generate or redistribute automobile and truck trips. Investments in bicycle or transit system improvements can encourage travel by non-automobile modes. Activities that change traffic operations can affect roadway congestion levels and the associated vehicle emission rates, as well as decisions about the mode and time-of-day of travel. Section 3 discuses opportunities for Caltrans and partner agencies to reduce highway system user emissions.

Caltrans activities also influence travel on facilities beyond the SHS. Although Caltrans does not own or operate local roadways, personal and business travel decisions are based on the performance of and accessibility offered by the entire transportation system, of which the SHS is a major component. For example, in a built-out urbanized area, projects that improve highway system performance will affect travel on local roadways that are used to access the highway system. On the perimeter of an urbanized area, construction of a new SHS interchange could improve access to the surrounding land, which can spur new development and influence travel to and from the development, even if the travelers do not use the SHS. In addition, Caltrans Local Development-Intergovernmental Review (LD-IGR) program advises other agencies regarding land use and infrastructure plans and projects that may impact the SHS.

2.2 Lifecycle GHG Emissions from Materials and Fuels

In addition to travel by roadway system users, Caltrans can influence emissions associated with the materials and fuels used in highway construction, maintenance, and operation. To describe these emissions requires understanding the concept of a life-cycle assessment (LCA). LCA is an environmental assessment used to determine impacts throughout a product or process's entire lifetime. This holistic approach is often referred to as assessing materials use from "cradle" (e.g., raw materials extraction and

[9] Caltrans. 2018. Historical Monthly Vehicle Miles of Travel.
[10] U.S. Department of Transportation, FHWA. Highway Statistics 2016, 2018. www.fhwa.dot.gov/policyinformation/statistics/2016/

refining) to "grave" (i.e., recycling, reuse, or disposal). Traditionally, an environmental assessment would only incorporate impacts directly related to a product or process's use-phase, such as fuel combusted in operations. LCA ensures that researchers can capture all relevant impacts in associated supply chains both upstream and downstream of use.[11]

LCA is a valuable method for identifying sources of GHG emissions throughout Caltrans asset design and material procurement activities. The large volumes of materials used in construction and maintenance activities can have significant climate change impacts in production, supply, and disposal. Some of the materials used most extensively on highway projects include concrete, asphalt, aggregates, and steel. These materials all have unique supply chain characteristics, but have similar general steps in production and supply. Table 2 summarizes the general life-cycle stages and how each stage relates to common transportation infrastructure materials. When applying LCA, researchers can quantify the associated GHG emissions from energy or material requirements at each life-cycle stage to generate a complete picture of how emissions accumulate throughout a material's lifetime.

Table 2. Typical life-cycle assessment stages for highway materials

	Raw Materials Extraction	Production and Manufacturing	Construction and maintenance	Highway Use	End-of-Life
Concrete	Limestone quarrying	Cement, aggregates, pyroprocessing, batching	Highway construction, maintenance	Vehicle operations by highway users [a]	Material disposal, recycling
Steel	Ore mining	Secondary/primary steel production			
Asphalt	Bitumen extraction and refining	Bitumen feedstock production			
Aggregates	Limestone quarrying	Crushing, sorting			

Note a: Materials influence the fuel economy of vehicles traveling on the highway system. For example, pavement smoothness affects rolling resistance and therefore fuel combustion.

Large volumes of materials are used on Caltrans projects in any given year, offering potential for significant GHG reduction. For example, in 2017 Caltrans projects used more than 1 million cubic yards of concrete, which involved approximately 325,000 tons of Portland cement, a highly GHG-intensive material. Similarly, Caltrans projects used more than 4 million tons of hot mix asphalt and 1 million cubic yard of aggregate in 2017.

[11] U.S. EPA. 2006. Life Cycle Assessment: Principles and Practice. Available at: https://nepis.epa.gov/Exe/ZyPDF.cgi/P1000L86.PDF?Dockey=P1000L86.PDF

Developing a LCA-based estimate of the GHG emissions associated with all materials used in Caltrans projects would require an extensive effort and has not been conducted to date. However, a rough order-of-magnitude estimate can focus on the four materials that likely make up the vast majority of roadway construction materials: asphalt, concrete, aggregate, and steel. The amount of these materials used on Caltrans projects can be obtained from the annual Caltrans *Contract Cost Data* report. Recent literature provides lifecycle GHG factors for these materials for the raw materials extraction, materials processing, material transport, and construction phases.[12] This approach suggests that Caltrans highway projects are responsible for roughly 2.5 million metric tons per year of GHG emissions during these extraction, processing, transport, and construction phases – sometimes termed the "embodied" emissions in these materials.

Like the materials used in highway projects as described above, motor vehicle fuels also involve lifecycle impacts beyond the emissions released from the vehicle tailpipe during the use phase. For example, gasoline and diesel fuel require the extraction and transport of petroleum, refining processes, and distribution to retail fuel stations – all of which contribute to GHG emissions. Biofuels create emissions due to the harvesting of feedstocks (e.g., corn or soy), processing, and fuel distribution. Battery electric vehicles produce no tailpipe emissions but require generation of electricity, which typically produces GHG emissions. Estimating the GHG impacts of using alternative fuels requires a life-cycle perspective that considers both tailpipe and "upstream" emissions.

Based on carbon intensity values used by CARB for the Low Carbon Fuel Standard (LCFS) program, the upstream emissions from gasoline and diesel fuel used in California account for about 27 percent of the total lifecycle emissions associated with these fuels. Thus, vehicles operating on the SHS are associated with roughly 32 million metric tons of upstream GHG emissions in addition to the 89 million metric tons of directly emitted tailpipe emissions. These upstream emissions are generally captured under the "Industrial" sector for the purpose of developing a GHG inventory. Note that some of these fuel upstream emissions occur outside California and therefore are outside the boundaries of CARB's statewide GHG inventory summarized in Figures 1 and 2.

2.3 Emissions from Caltrans Internal Operations

The emissions associated with Caltrans internal operations are included in the annual emission inventory that Caltrans prepares and submits to The Climate Registry. In doing so, Caltrans follows standard conventions for defining the organizational and operational boundaries that establish the framework the GHG emission inventory. These conventions recognize the following three types of emissions:

- **Scope 1** emissions include direct emissions from operations, facilities, and sources under Caltrans' operational control. Scope 1 emissions result from activities such as on-site combustion of fossil fuels to generate electricity or heat, use of fleet vehicles, and fugitive GHG emissions from Caltrans-owned refrigeration and air-conditioning equipment.

[12] Lawrence Berkeley National Laboratory, *Life-Cycle Assessment and Co-Benefits of Cool Pavements*, Prepared for the California Air Resources Board and the California Environmental Protection Agency, April 2017.

- **Scope 2** includes indirect emissions from purchased electricity, steam, and chilled water that are consumed within the organizational boundaries of Caltrans. Caltrans can directly control the purchase of electricity but not the process used to generate electricity that results in GHG emissions.
- **Scope 3** includes all indirect emissions that are not included in Scope 2. Similar to Scope 2, Scope 3 emissions are indirect emissions that are a consequence of the Caltrans activities, but the actual emissions are generated by sources not controlled by Caltrans. There are many Scope 3 emission sources. Scope 3 emission sources are typically more difficult to estimate and may be more challenging to reduce due to the lack of direct control over the emission source, but they are often significantly larger than Scope 1 or 2 emission sources and thus provide greater emission reduction potential. Examples of Scope 3 emission sources could include employee commute activity, employee business travel, materials and equipment used by Caltrans contractors, and vehicle travel on the State Highway System.

Like most DOTs and other government organizations, Caltrans includes only Scope 1 and Scope 2 emissions in its submission to The Climate Registry. Also, like most organizations, Caltrans elects to omit small sources of emissions because it is too costly or resource-intensive to gather the necessary data. Some GHG guidance documents, such as the World Resources Institute's *GHG Protocol: Corporate Accounting and Reporting Standard*, define a *de minimis* threshold that allows organizations to exclude small emission sources that together account for no more than 5 percent of their total operational emissions.[13]

Table 3 shows Caltrans' reported GHG inventory for three recent years and 2010. Emissions from all source categories have dropped substantially, with total emissions declining 45 percent since 2010. These reductions are due to a variety of factors including improved energy efficiency of buildings and roadway lighting, introduction of more fuel efficient vehicles, and reductions in the carbon intensity of California's grid electricity and transportation fuels. Caltrans use of renewable diesel in particular has contributed to a decline in vehicle emissions.

Table 3. Caltrans GHG Emission Inventory, metric tons CO_2e

Source Type	2010	2015	2016	2017	Change, 2010-17
Natural Gas	7,585	5,003	5,140	5,000	-34%
Vehicles	118,042	110,998	82,474	76,725	-35%
Purchased Electricity	89,356	48,172	40,829	36,957	-59%
Total Emissions	**214,983**	**164,173**	**128,443**	**118,682**	**-45%**

Source: The Climate Registry

Table 3 excludes some Scope 3 emissions sources that are sometimes included in an organization's emission inventory, such as business travel, employee commuting, contracted solid waste, and

[13] Available at: https://ghgprotocol.org/corporate-standard

contracted wastewater treatment. Some of these sources can be as large as or larger than the Scope 1 and Scope 2 emissions included in Caltrans GHG inventory. For example, commuting by Caltrans employees produces roughly 50,000 metric tons of GHG emissions per year, more than purchased electricity emissions (see below for emissions estimates and sources). Including employee commute emissions in future Caltrans GHG inventories would help to focus attention on opportunities to reduce this source of emissions.

2.4 Summary of Emissions Sources and Caltrans' Influence

Table 4 lists major sources of emissions that Caltrans can influence, and a rough order-of-magnitude estimate of the size of these emission sources. Emission sources under Caltrans direct control or strong influence total roughly 120,000 metric tons of GHG emissions per year – not a trivial amount, but only about 0.03 percent of California's total statewide GHG emission inventory. Caltrans has some influence over much larger sources of emissions – particularly direct emissions from travel on the State Highway System (89 million metric tons[MMT]) and local roads (67 MMT), upstream emissions from State Highway System travel (32 MMT), and embodied emissions in materials used in highway construction and maintenance (2.5 MMT).

Table 4. Summary of Emissions Sources and Caltrans' Influence

Emissions Source Category	Emissions Source	Caltrans Influence			Rough order of magnitude annual GHG emissions (thousand metric tons CO2e)	Source	
		More		Less			
Direct emissions from California transportation sources	On-road vehicles in Caltrans fleet	●			64	a	
	On-road vehicles used in Caltrans projects		●		N/A		
	On-road vehicles for Caltrans employee commuting		●		53	b	
	Off-road equipment in Caltrans fleet	●			13	a	
	Off-road equipment used in Caltrans projects		●		N/A		
	All on-road vehicles operating on SHS		●		89,000	c	CARB Total Transportation Sector GHG Inventory
	All on-road vehicles operating on local roads		●		67,000	c	CARB Total Transportation Sector GHG Inventory
	All off-road equipment operating in CA			●	2,700	d	CARB Total Transportation Sector GHG Inventory
	Rail locomotives operating in CA			●	1,800	d	CARB Total Transportation Sector GHG Inventory
	Marine vessels operating in CA			●	3,300	d	CARB Total Transportation Sector GHG Inventory
	Aircraft operating in CA			●	4,700	d	CARB Total Transportation Sector GHG Inventory
	Unspecified transportation sources			●	1,500	d	CARB Total Transportation Sector GHG Inventory
Upstream emissions from on-road vehicle fuels used on SHS	Mining/extraction of feedstocks		●		32,000	e	
	Processing/refining of fuels		●				
	Electricity generation (for EVs)		●				
	Distribution of fuels		●				
Caltrans building energy emissions	Electricity used in Caltrans buildings	●			20	f	
	Natural gas used in Caltrans buildings	●			5	f	
	Electricity for pumping water to Caltrans buildings	●			<1	g	
CA highway operations energy emissions	Electricity for roadway lighting	●			17	f	
	Electricity for pumping irrigation water	●			10	h	
Embodied emissions from materials used in Caltrans projects	Mining and extraction		●		2,500	i	
	Production processes		●				
	Transport of materials		●				

Sources for GHG emissions estimates:

a. Vehicle total from Caltrans data submitted to The Climate Registry. Split of on-road vs. off-road calculated by ICF based on Caltrans fleet 2016 annual mileage and fuel use data.

b. ICF estimate using assumptions for average commute length and vehicle fuel economy. Number of Caltrans employees commuting by non-auto modes based on data provided by Districts.

c. On-road vehicle total from CARB 2017 GHG inventory. Split of SHS vs. non-SHS travel based on VMT totals as described in text.

d. CARB 2017 GHG inventory.

e. ICF estimate. On-road vehicle tank-to-wheel (TTW) total for SHS based on CARB 2017 GHG inventory, with split of SHS vs. non-SHS travel based on VMT totals as described in text. Well-to-wheel carbon intensities from CARB Low Carbon Fuel Standard values: CARBOB tailpipe 73.94 g/MJ, CARBOB WTW 100.58 g/MJ, Diesel tailpipe 74.86 g/MJ, Diesel WTW 102.82 g/MJ.

f. Caltrans data submitted to The Climate Registry. Caltrans Fact Booklet, June 2017.

g. ICF estimate based on data originally collected for *Caltrans Activities to Address Climate Change*, 2013, with updates.

h. ICF estimate using annual water consumption provided by Caltrans. Assumes energy intensity of water as an average of 5.4 kWh/1000 gal (Northern California) and 13.0 kWh/1000 gal (Southern California).

i. Annual material usage data for steel, concrete, asphalt, and aggregate from Caltrans, 2017 Contract Cost Data: A Summary of Cost by Items for Highway Construction Projects. Lifecycle GHG emission factors from CARB, Life-Cycle Assessment and Co-Benefits of Cool Pavements, Prepared by Lawrence Berkeley National Laboratory, Contract # 12-314, April 2017.

3 Reducing Emissions from California Highway System Users

Caltrans can influence the emissions from highway system users through its involvement in planning, programming, environmental analysis, design, and operation of the highway system. As discussed in Chapter 2, use of the State Highway System is by far the largest source of emissions that Caltrans can influence. On-road vehicles in California emit approximately 156 million metric tons of GHG emissions annually, and roughly 57 percent of those emissions occur on the State Highway System owned and operated by Caltrans. These emissions dwarf the emissions that result directly from Caltrans internal operations. Given the sheer magnitude of highway system user GHG emissions, it is critical that Caltrans carefully assess all of its opportunities to reduce this emissions source while enabling the movement of people and goods, and prioritize the implementation of strategies that are most effective.

There are three general approaches for Caltrans to reduce GHG emissions on the State Highway System:

- Limit demand for travel by single-occupant vehicles (SOVs), primarily by minimizing induced vehicle travel and through the use of pricing
- Improve facilities that provide alternatives to travel by carbon-intensive modes, particularly SOVs
- Maximize the operating efficiency of vehicles traveling on the State Highway System

Section 3.1 discusses the best opportunities for Caltrans to reduce highway system user emissions. Section 3.2 describes the numerous related on-going activities at Caltrans that support highway user GHG reductions but are unlikely to have major GHG impacts.

3.1 Best Opportunities for Reducing Highway System User Emissions

Caltrans' best opportunities to reduce highway system user emissions would be to focus on revising current planning, programming, and project development procedures to minimize induced vehicle travel, promote greater use of roadway pricing, and facilitate the multimodal system improvements that shift travelers away from automobiles.

Minimize Induced Vehicle Travel

Caltrans, in partnership with local governments and transportation agencies, has a strong influence on the performance of the highway network, which in turn can influence the demand for SOV travel. As a general rule, SOV drivers will shift to an alternative mode only if the alternative is equal to or better than SOV travel in terms of factors such as convenience, travel time, reliability, perceived safety, and cost. Every individual makes travel choices based on these and other decision factors, with variation in the relative importance of each factor. However, even if multimodal options such as transit, rideshare, bicycling, and walking are developed and improved, they are unlikely to attract significant use so long as SOV travel remains faster and cheaper. This explains why more than three quarters of all trips in California are still taken by motorized vehicles.

Highway Capacity Expansion and Induced Vehicle Travel

As population and VMT grow, the roadway network becomes more congested, particularly in urban areas. Projects that expand highway capacity where conditions are congested will induce additional vehicle travel. Capacity additions effectively reduce the "price" of driving, which leads to more driving than would otherwise occur as individuals and businesses become aware of changed conditions. Induced vehicle travel is closely related to the concept of "latent demand," which refers to the travel that would occur if the price were lower (i.e., travel times were faster), or in other words, the travel that does not occur because price is high (i.e., travel times are slow).

The phenomenon of induced vehicle travel is widely accepted and well documented.[14] In the short term, expansion of highway capacity can cause new vehicle trips that would otherwise would not be made, longer vehicle trips to more distant destinations, shifts from off-peak to peak travel hours, and shifts from other modes to driving. Longer term changes can include an increase in more dispersed, low density development patterns that are dependent on automobile travel. As far back as the 1960s, researchers have identified this phenomenon, sometimes dubbed the "Fundamental Law of Road Congestion," which asserts that the amount of vehicle travel will increase in exact proportion to the highway capacity expansion, so that traffic speeds will revert to their pre-expansion levels.[15]

Researchers typically seek to identify induced vehicle travel effects in terms of an "elasticity", which is the ratio of the percentage change in one variable associated with the percentage change in another variable. For example, an elasticity value of 0.5 suggests that a 1 percent increase in roadway capacity is associated with a 0.5 percent increase in VMT, or a doubling (100 percent increase) in roadway capacity is associated with a 50 percent increase in VMT. Table 5 summarizes the results of research on induced vehicle travel, with the elasticity values in the rightmost column. While some of the most well-known studies in this field are 20 years old, more recent research has produced similar findings.

The research has found elasticity values ranging from 0.1 to 0.6 in the short term (typically defined as one year or less) and 0.4 to 1.06 in the long term (5 to 10 years or more). The most recent and comprehensive research (Hymel, 2019) suggests that long-run elasticity is close to 1.0, which means that a 10 percent expansion of highway capacity will lead to a 10 percent increase in VMT. This VMT increase can negate any near-term congestion relief and potentially lead to an increase in GHG emissions, particularly in urbanized areas.

Quantifying induced vehicle travel elasticity is challenging, in part because researchers must account for all the other factors that affect vehicle travel and isolate the effects of capacity expansion. The range of results shown in Table 5 is indicative of different methods and data sources used to study this phenomenon. Induced vehicle travel effects will also vary from region to region and corridor to corridor,

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[14] Handy, Susan and Boarnet, Marlon, G., "Impact of Highway Capacity and Induced Travel on Passenger Vehicle Use and Greenhouse Gas Emissions," prepared for the California Air Resources Board, 2014. https://ww2.arb.ca.gov/sites/default/files/2020-06/Impact_of_Highway_Capacity_and_Induced_Travel_on_Passenger_Vehicle_Use_and_Greenhouse_Gas_Emissions_Policy_Brief.pdf

[15] Downs, Anthony, "The law of peak-hour expressway congestion," *Traffic Quarterly*, Vol 16, No. 3, 1962.

because of differences in land uses and socioeconomic conditions, the availability of transit and other alternatives to driving, growth rates, and other factors.

Table 5. Research on the Impact of Capacity Expansion on Induced Vehicle Travel

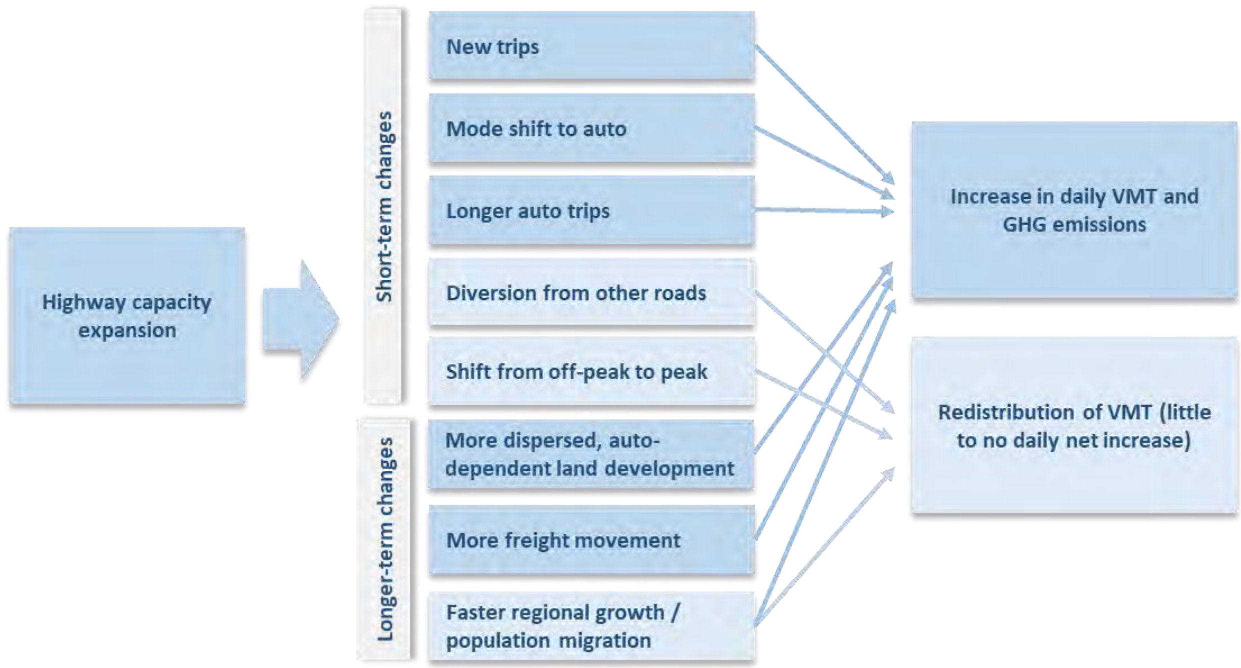
Study	Study Location (and Type)	Study Years	Time Period	Elasticity (change in VMT / Change in Lane- Miles)
Hymel (2019)	U.S (States)	1981-2015	long-term	0.89 to 1.06
Duranton and Turner (2011)	U.S. (MSAs – Interstates)	1983-2003	10 years	0.93 to 1.03 [a]
Cervero (2003)	California (Freeway Corridors)	1980-1994	short-term long-term	0.10 0.39
Cervero and Hansen (2002)	California	1976-1997	short-term intermediate term	0.59 0.79
Noland (2001)	U.S. (States – all roadway types)	1984-1996	short-term long-term	0.30 to 0.60 0.70 to 1.00
Noland and Cowart (2000)	U.S. (Metro Areas – Freeways and arterials)	1982-1996	short-term long-term	0.28 0.90
Hansen and Huang (1997)	California	1973-1990	short-term long-term	0.20 0.60 to 0.90

Source: Handy, Susan and Boarnet, Marlon, G., "Impact of Highway Capacity and Induced Travel on Passenger Vehicle Use and Greenhouse Gas Emissions," prepared for the California Air Resources Board, 2014; Duranton, G., & Turner, M. A., "The Fundamental Law of Road Congestion: Evidence from US Cities," *American Economic Review*, 101 (6), 2011; Hymel, Kent, "If You Build It, They Will Drive: Measuring induced demand for vehicle travel in urban areas," *Transport Policy*. Volume 76, pp. 57-66, 2019.

Note a: Duranton and Turner developed several models and elasticities but report 1.03 as the "most defensible estimate." This total elasticity includes contributions from traffic diversion, which the authors estimate to account for 0 – 10 percent of the total. Because diverted traffic does not generally reflect a net increase in induced vehicle travel, the range shown in Table 5 reflects only the induced vehicle travel that is not diverted traffic.

It is important to recognize that the induced vehicle travel observed on a single highway following capacity expansion is not necessarily equal to a net system-wide increase in VMT and corresponding increase in GHG emissions, as discussed in several of the papers listed above. In the short term, effects such as new trips, mode shift to automobile travel, and longer automobile trips all contribute to a net increase in VMT, while diversion from other roads and shifts from off-peak to peak-period travel primarily redistribute VMT rather than cause a net increase in VMT. In the longer term, effects such as more dispersed, auto-dependent development patterns and freight logistics process reorganization contribute to a net increase in VMT; population migration can at least partially redistribute VMT, potentially from other states, although it can also cause a net increase. The figure below illustrates the short-term and longer-term changes that can result from highway capacity expansion and their relationship to a net increase in VMT and GHG emissions.

Figure 6. Changes Resulting from Highway Capacity Expansion



Recent induced travel research has attempted to distinguish between these different impacts and isolate the net increase in VMT. The research suggests diverted traffic effects are likely small. One of the most comprehensive studies, Duranton and Turner (2011), concludes: "Increasing lane kilometers for one type of road diverts little traffic from other types of road."[16] And a review of literature commissioned by CARB concludes: "Capacity expansion leads to a net increase in VMT, not simply a shifting of VMT from one road to another."[17] The research listed in Table 5 generally seeks to quantify the net increase in VMT.

Proponents of highway capacity expansion often claim that the project will reduce emissions because of a reduction in congestion and an increase in vehicle speeds. Vehicle GHG emission rates are lowest between 35 and 55 miles per hour, as show in the figure below. If there is no change in VMT, then a project that increases average vehicle speeds from less than 35 mph to the 35-55 mph range will reduce emissions. However, most highway capacity expansion projects in urban areas will cause an increase in VMT, and the induced vehicle travel can offset some or all emission reduction benefits of congestion reduction. Moreover, any congestion reduction benefits that improve traffic flow and reduce *per vehicle* emission rates are likely to be short-lived, because induced vehicle travel will lead to a return of congested conditions.

This is not to imply that all highway capacity expansion projects will increase GHG emissions. In some circumstances, the emissions benefits of smother traffic flow may be greater than the emissions

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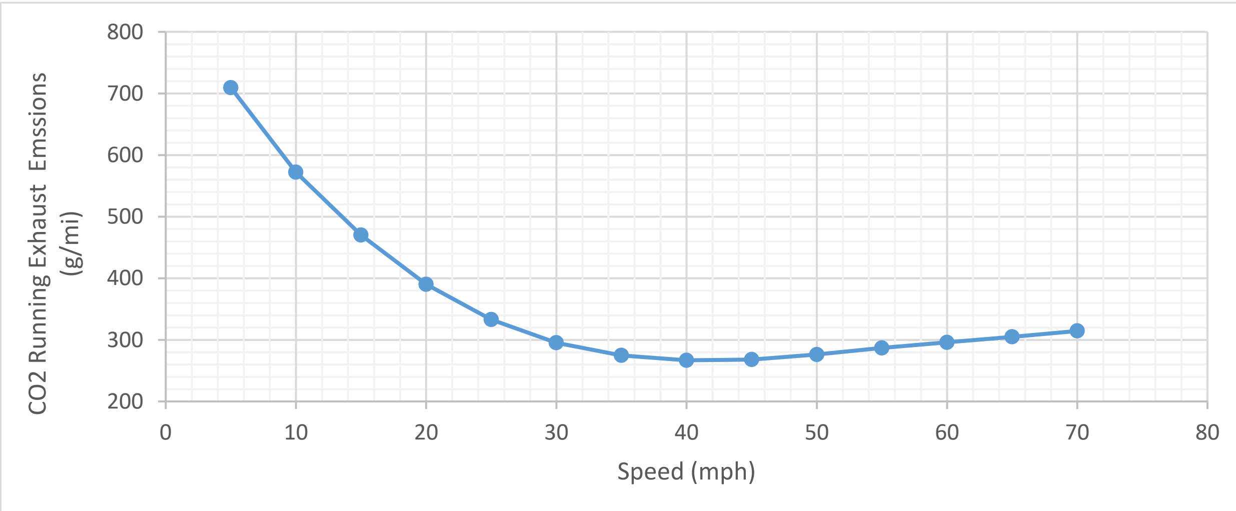
[16] Duranton, G., & Turner, M. A., "The Fundamental Law of Road Congestion: Evidence from US Cities," *American Economic Review*, 101 (6), 2011.
[17] Handy, Susan and Boarnet, Marlon, G., "Impact of Highway Capacity and Induced Travel on Passenger Vehicle Use and Greenhouse Gas Emissions," prepared for the California Air Resources Board, 2014.

increase from induced vehicle travel, at least in the short term. The relative magnitude of these two factors will vary by project and vary over time. However, the evidence is clear that induced vehicle travel effects can be substantial, and ignoring induced vehicle travel will produce misleading conclusions about emissions impacts.

Figure 7. California Average Light Duty Vehicle CO_2 Emission Factors by Speed, 2018



Source: EMFAC 2017

Rather than add new highway lanes in name of congestion reduction, operational improvements can sometimes deliver system performance (congestion reduction) benefits at far less cost. These can include ramp metering, reconfigurations to highway ramps to reduce weaving and merge impacts, incident management, and traveler information systems. The GHG impacts of these types of operational strategies are highly context-specific and not well understood, in part because nearly all the research does not consider induced vehicle travel. Traffic operations strategies are discussed in Section 3.2.

Caltrans and its local partners have an opportunity to limit VMT growth and the associated GHG emissions by avoiding highway capacity expansion projects that are likely to result in substantial induced vehicle travel. This approach is consistent with State, regional, and local efforts to mitigate VMT and GHG impacts, and with the Caltrans Strategic Management Plan, which established a goal of reducing statewide per capita VMT by 15 percent relative to 2010 levels.

To limit VMT growth and GHG emissions, consideration of induced vehicle travel is applicable throughout the decision-making process. The development of a highway project begins with identification of the need for the project, which is often framed as a structural or operating deficiency of the existing transportation system. Project needs are identified through Caltrans management systems, master plans, system and regional plans, and prioritizing processes, or by other sponsoring agencies.[18] The project need is documented in a Project Initiation Document (PID). Based on a review of PIDs by the research team, "congestion" is often identified in a PID as a system deficiency, and the identified need for a highway capacity expansion project is to "reduce congestion." Some capacity expansion projects

[18] Caltrans, "How Caltrans Builds Projects," August 2011.

also identify "reduce emissions" as an objective. In some cases, this practice ignores the evidence on induced vehicle travel, since statements in the PID assume that highway capacity expansion will reduce congestion, while the evidence suggests that in urbanized areas, the project may result in little or no congestion relief. The ultimate impact on GHG emissions will depend on the relative speed impacts and induced vehicle travel impacts, as noted above.

Transportation projects must be analyzed for their impacts under the California Environmental Quality Act (CEQA). Despite the evidence documented in literature, the planning and environmental analysis processes have often failed to adequately account for induced vehicle travel.[19] The Governor's Office of Planning and Research provides guidance on the general steps for this analysis.[20] Caltrans has developed the "Transportation Analysis Framework" is to assist Caltrans Districts in identifying the best approach for analyzing VMT (induced travel) under CEQA in various settings and for projects on the SHS.[21] This document identifies two general approaches for assessing induced vehicle travel for SHS projects:

- Use the Induced Travel Calculator developed by the National Center for Sustainable Transportation (NCST) at UC Davis, which applies elasticities from empirical studies discussed above.
- Use a travel demand model, potentially supplemented with off-model post-processing or other adjustments as necessary.

The Caltrans Transportation Analysis Framework discusses in which circumstances these approaches are most appropriate.

HOV Lanes and Express Lanes

Induced vehicle travel and GHG impacts are also important considerations in decisions regarding high-occupancy vehicle (HOV) lanes and express lanes. Caltrans maintains a network of nearly 1,400 miles of HOV lanes, primarily in the Los Angeles and San Francisco Bay Area metropolitan areas. California law states that the purpose of HOV lanes is "to stimulate and encourage the development of ways and means of relieving traffic congestion on California highways and, at the same time, to encourage individual citizens to pool their vehicular resources and thereby conserve fuel and lessen emission of air pollutants." In theory, HOV lanes can potentially reduce emissions in two ways: (1) by enabling smoother traffic flow that results in a lower rate of fuel use and emissions per vehicle, and (2) by encouraging SOV travelers to shift to carpools, thereby reducing VMT. In reality, however, there is little evidence that expanding highway capacity by adding HOV lanes will reduce GHG emissions, and some research, as discussed below, suggests that HOV lane additions will increase GHG emissions.

In recent years, some HOV lanes have been modified or newly constructed to allow SOVs to use the facility by paying a toll. These facilities were initially termed high occupancy toll (HOT) lanes and are now

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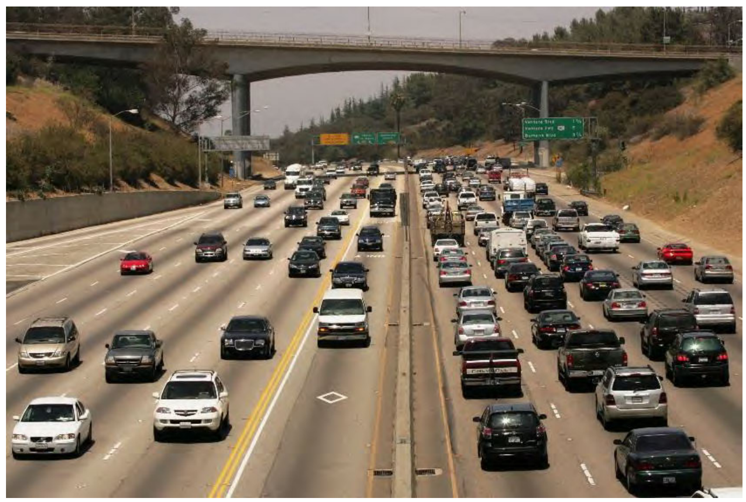
[19] Volker, Jamey M. B., Amy E. Lee, and Susan Handy, "Induced Vehicle Travel in the Environmental Review Process," *Transportation Research Record*, Vol. 2674(7), 468–479, 2020.

[20] Office of Planning and Research, Technical Advisory on Evaluating Transportation Impacts in CEQA, December 2018. http://opr.ca.gov/ceqa/updates/sb-743/

[21] Caltrans, Draft Transportation Analysis Framework: Induced Travel Analysis, March 2020.

frequently referred to as “express lanes”. California currently has 214 miles of express lanes, with many more facilities in development or planning phases. Express lanes can be a way to introduce the concept of roadway pricing, and pricing can be an effective mechanism for limiting SOV travel demand in some circumstances, as discussed in the following sub-section. Express lanes can also be used by transit vehicles to increase travel time reliability, especially when coupled with dynamic pricing.

Studies have shown that vehicles traveling in HOV lanes emit fewer pollutants than vehicles in mixed-flow lanes, because of smoother traffic flow.[22] However, most of this research simply compares HOV lanes with mixed-flow lanes at a single point in time, rather than looking at travel changes that were caused by the addition of the HOV or express lane. Virtually all the HOV lanes in California have been constructed as new highway capacity, rather than conversion of existing mixed-flow lanes to HOV. Thus, by adding capacity, HOV and express lanes induce new vehicle travel in urbanized areas as described above. The additional VMT will at least partially offset any emissions benefits resulting from smoother traffic flow, and in many cases will completely offset the emissions benefits from traffic flow improvements. These conclusions are supported by regional simulation modeling studies.[23] [24] They are also supported by project-level analyses of emissions impacts of HOV and express lane additions reported in recent project environmental documents.[25] [26]



The impact of HOV lane additions on carpool formation and average vehicle occupancy is uncertain. Surveys of HOV lane carpoolers and vanpoolers conducted in the 1980s and 1990s found that 40 to 50 percent reported previously driving alone.[27] Observations of Southern California freeways that added HOV lanes in the 1990s found that average vehicle occupancy across the entire facility generally increased following the HOV lane opening, although some of the carpools may have simply diverted

[22] “Modeling the Effectiveness of High Occupancy Vehicle (HOV) Lanes at Improving Air Quality,” Prepared by Bourns College of Engineering, Center for Environmental Research and Technology, University of California, Riverside, Prepared for Caltrans, 2006.
[23] Johnston, Robert A and Raju Ceerla, “The Effects of New High-Occupancy Vehicle Lanes on Travel and Emissions,” Transportation Research Part A, Volume 30, No. 1. 1996.
[24] Dowling, Richard et al, 2005. NCHRP Report 535, Predicting Air Quality Effects of Traffic-Flow Improvements: Final Report and User’s Guide. Transportation Research Board. www.trb.org/Publications/Blurbs/155398.aspx
[25] Air Quality Study Report, SR 65 Capacity and Operational Improvements Project, State Route 65, Cities of Roseville, Rocklin, and Lincoln, Placer County, 03-PLA-65-PM R6.2 to R12.8, EA 03-1F170, September 2016.
[26] Sac 50 Phase 2 High Occupancy Vehicle Lanes Project, Draft Initial Study [with Proposed Mitigated Negative Declaration]/ Environmental Assessment with Finding of No Significant Impact. September 2016.
[27] Turnbull, K. H. Levinson and R. Pratt. HOV Facilities – Traveler Response to Transportation System Changes. Transportation Cooperative Research Program Report 95, Chapter 2. 2006.

from other facilities.[28] But other studies have found that an individual's decision to drive as an HOV rather than a SOV is not very sensitive to travel time savings, casting doubt on the impacts of HOV lane additions on vehicle occupancy. Forming a new carpool can require additional travel or waiting time, and for most drivers, the time savings afforded by HOV lane travel are not significant enough to overcome the extra burden of forming a new carpool. A 2007 study of California's HOV lanes concluded: "Travel time savings do not provide a statistically significant carpooling incentive."[29]

Other research has shown that most carpool vehicles consist of family members riding together. For example, a study using 2001 data found that 83 percent of carpools for home-based work trips contained only members of the same household.[30] This suggests that carpool formation for work trips depends almost entirely on the work locations of members of the same household.[31]

Observed trends also suggest that HOV lanes have limited influence on carpool formation, or that their influenced is countered by other trends, such as the increased spatial dispersion of workplaces. As shown in the figure below, the number of workers commuting by carpool in California has declined from a peak of 2.1 million in 1990 to around 1.85 million today, a 10 percent reduction, while the number of HOV lane miles in the state has greatly increased. During the same period, the number of SOV commuters in California has increased 36 percent, to 13.5 million. Note, however, that a variety of factors have contributed to the decline in ridesharing, such as the elimination of some mandates for employee trip reductions by larger employers and continued low gasoline prices, so the influence of HOV lanes on broader ridesharing trends is unclear.

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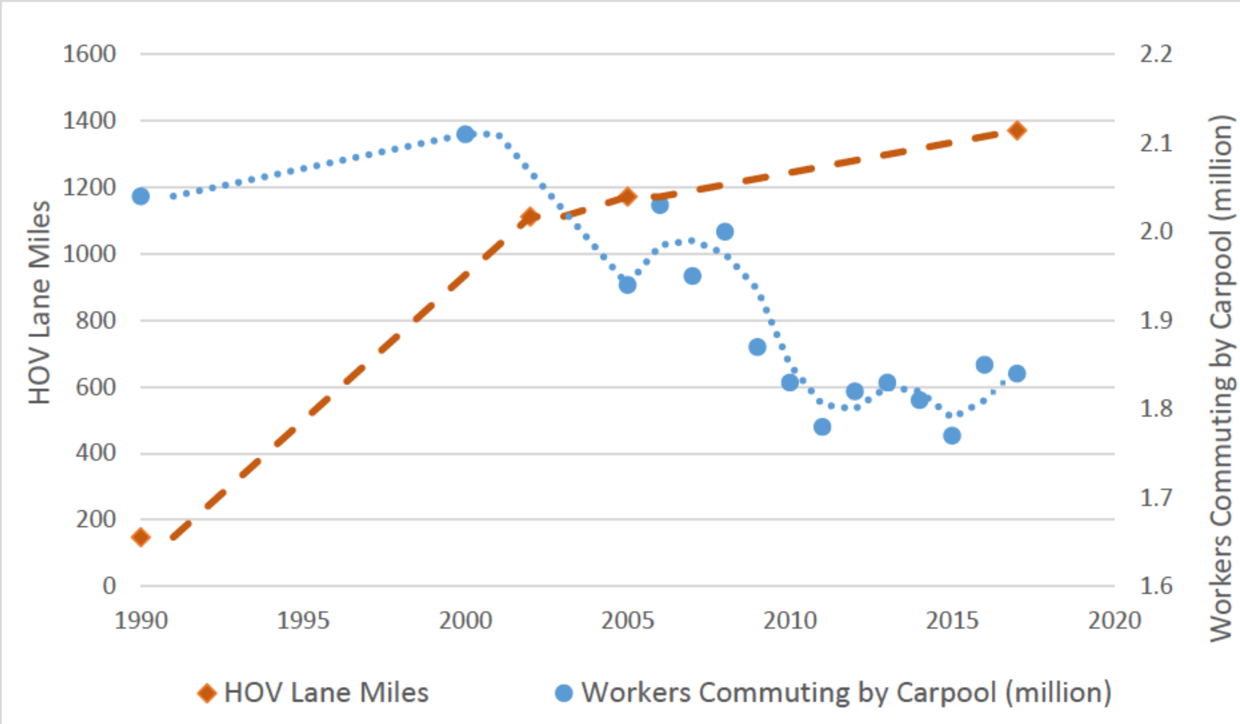
[28] Turnbull, 2006.
[29] Varaiya, Pravin, "Effectiveness of California's High Occupancy Vehicle (HOV) System," UCB-ITS-PRR-2007-5, California PATH Research Report, May 2007.
[30] McGuckin, N. and N. Srinivasan. "The Journey-to-Work in the Context of Daily Travel," Paper prepared for the Census Data for Transportation Planning Conference.
http://onlinepubs.trb.org/onlinepubs/archive/conferences/2005/censusdata/resource-journey-to-work.pdf
[31] Variaya, 2007.

Figure 8. Change in California HOV Lane Miles and Workers Commuting by Carpool, 1990 – 2017



Source: Commute data from US Census Bureau, Decennial Census & American Community Survey; HOV lane mile data from Caltrans, *High Occupancy Vehicle Guidelines* (various years) and May, Adolf D., Lannon Leiman, and John Billheimer, "Determining the Effectiveness of HOV Lanes," California PATH Research Report, UCB-ITS-PRR-2007-17, November 2007.

The impacts on carpooling of converting HOV lanes to express lanes appears to vary widely. One recent study concluded that HOV to HOT lane conversion generally reduces the prevalence of carpooling.[32] However, previous research came to different conclusions. In San Diego, for example, the number of HOVs increased significantly in the seven years after the I-15 HOV lanes were modified to allow SOV buy-in.[33]

For HOV lanes to effectively encourage carpooling, they must offer a significant travel time savings and better reliability as compared to general purpose lanes. Yet the free-flow conditions on the state's HOV lane system has been declining. More than half of HOV lanes in the state exhibit "degraded" performance, defined as having average traffic speed during the morning or evening weekday peak commute hour is less than 45 miles per hour for more than 10 percent of the time.[34] Improving HOV lane performance though better enforcement and potentially higher occupancy requirements (e.g., 3+

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[32] Burris, Mark, "The impact of HOT lanes on carpools," *Research in Transportation Economics*, Volume 44, June 2014.

[33] Turnbull, K. H. Levinson and R. Pratt. HOV Facilities – Traveler Response to Transportation System Changes. Transportation Cooperative Research Program Report 95, Chapter 2. 2006. www.trb.org/Publications/Blurbs/158237.aspx

[34] Caltrans, "2016 California High-Occupancy Vehicle Lane Degradation Determination Report," October 2017.

occupants) can help to maximize their potential to boost ridesharing. Use of dynamic pricing can also significantly improve travel time reliability on express lanes, making them more attractive to carpoolers.

HOV lanes are most effective when they carry large numbers of transit buses and vanpools. In these cases, the passenger throughput of the HOV lane can be significantly higher than general purpose lanes. For example, the I-395 HOV lanes in the Northern Virginia and Washington DC area carry large numbers of buses and vanpools. The observed average vehicle occupancy on this facility in the AM peak was 3.1, and HOV lane peak-hour person throughput was approximately 5,600, compared to 2,000 for the general purpose lanes.[35] Buses that use properly functioning HOV lanes can see reduced travel times and better schedule adherence, which can help to attract new bus riders and enhance transit cost effectiveness.

It should be noted that HOV lanes have played a role in encouraging adoption of low emission vehicles in California. Since 2000, the State has issued decals that allow HOV lane access by certain low- or zero-emission vehicles. There is evidence that, for some vehicle owners, this HOV lane access has been a motivating factor in the choice of purchasing a low- or zero-emission vehicle.[36]

Because most California highway capacity projects today involve HOV or express lanes, and because the GHG impacts of building these facilities are uncertain, it is important to carefully study the likely impacts of proposed projects and avoid premature assumptions about VMT or emission reductions. This acknowledgement should begin during planning and programming when projects are first proposed for congestion reduction purposes. Based on interviews conducted for this report, many Caltrans and local partner staff continue to believe that all HOV lane projects reduce emissions. For example, a recent Caltrans website for a proposed project to add HOV lanes in a major metro area stated: “This project will also benefit transit ridership/ ridesharing by providing less delay and a more reliable traveling option and air quality is expected to improve due to decrease in delay and vehicle miles traveled (VMT).” These types of assertions, made before careful traffic and emissions studies have been performed, can contradict the findings of research on induced vehicle travel effects and the simulation modeling performed for recent Caltrans projects. Without properly recognizing the uncertainty and potential for induced vehicle travel and GHG emissions increases, projects may be advanced that are inconsistent with State and local GHG reduction targets and do little to alleviate congestion.

Roadway Pricing

As an alternative to capacity expansion, roadway pricing provides a mechanism for reducing the demand for SOV travel and improving network performance. Roadway pricing in the form of tolls has been in place for many years. Examples include the tolled bridges in the Bay Area and tolled highways in California and other states. Road pricing is being introduced widely as part of the development of

[35] Turnbull, K. H. Levinson and R. Pratt. HOV Facilities – Traveler Response to Transportation System Changes. Transportation Cooperative Research Program Report 95, Chapter 2. 2006.
[36] Tal, Gil and Michael A. Nicholas, “Evaluating the Impact of High Occupancy Vehicle (HOV) Lane Access on Plug-In Vehicles (PEVs) Purchasing and Usage in California,” Institute of Transportation Studies, University of California, Davis, Working Paper UCD-ITS-WP-14-01, 2014.

express/HOT lanes, as discussed above. Tolls or pricing in these examples have been implemented in part to raise revenue for facility construction and/or maintenance.

Roadway pricing can be applied explicitly for the purpose of reducing congestion in urban areas and for mitigating associated adverse environmental impacts. For example, London, Stockholm, and Singapore impose a charge for vehicles entering the city center. In all these cities, vehicle travel and congestion dropped significantly following the implementation of the pricing scheme. For example, the central London congestion charging scheme, coupled with transit service improvements, resulted in a 20 percent reduction in vehicle traffic and a 30 percent reduction in peak-period congestion delay, while transit ridership increased.[37] These cities have robust public transit systems, and the introduction of roadway pricing was typically coupled with transit service improvements. Also, the price level necessary to significantly deter vehicle travel must be relatively high, as compared to the lower price level of tolling as typically applied for the purposes of funding roadway construction and maintenance.

Increasingly, roadway pricing is being considered as an alternative to roadway capacity expansion and a mechanism to curb congestion and reduce VMT. For example, the investment strategy for the Metropolitan Transportation Commission's *Plan Bay Area 2040* includes a new cordon pricing zone in downtown San Francisco. A study by the Southern California Association of Governments found that implementing a cordon pricing scheme for the Los Angeles Westside area ("Mobility Go Zone") would reduce daily VMT by 8 percent, increasing transit and non-motorized travel, and yield a benefit-cost ratio of 3:1.[38] Other metropolitan areas that are actively considering urban area roadway pricing include New York City, Seattle, Portland, Oregon, and Vancouver, British Columbia.

Caltrans has identified expanding the use toll lanes or development of other pricing strategies as one type of project alternative that can potentially minimize, or avoid altogether, the additional VMT from capacity-increasing projects.[39]

By increasing the cost of SOV travel, roadway pricing will encourage travelers to consider other modes, most of which are less carbon intensive such as walking, bicycling, transit, and ridesharing. Thus, road pricing works best when paired with improvements to non-SOV travel options, discussed in the next section. Like many forms of behavior change, the most effective approaches to changing travel choices involve both "carrots" (more attractive alternative modes) and "sticks" (SOV price increases).

Impacts on VMT

The potential for road pricing to reduce VMT depends on the magnitude of the charges, among other factors. As the price of driving increases, VMT will decrease as divers shift to other modes, shorten trips, or forego discretionary trips altogether. Research on fuel price elasticity can provide a starting point for

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[37] Litman, Todd, "London Congestion Pricing: Implications for Other Cities," Victoria Transport Policy Institute. November 24, 2011. www.vtpi.org/london.pdf

[38] Southern California Association of Governments, *Mobility Go Zone & Pricing Feasibility Study: Final Report*, March 2019.

[39] Caltrans, Draft Transportation Impacts Analysis under CEQA for Projects on the State Highway System, March 1, 2020.

estimating VMT effects. A report published by the Federal Highway Administration (FHWA) synthesized several prominent studies on travel demand relative to fuel cost, finding a wide range in elasticities, ranging from -0.1 to -0.63.[40] These values imply that doubling the cost of driving would reduce VMT by 10 to 63 percent. However, motorists' response to roadway pricing may differ from the response to a change in fuel price. On one hand, roadway pricing could result in a larger VMT reduction because the impacts are more immediate and closely tied to the vehicle trip as compared to fuel prices. On the other hand, in some situations, some drivers may be able to avoid highway charges by using surface streets, limiting impacts of roadway pricing on VMT. Actual impacts are likely to vary widely depending on the context.

A study of increased peak period tolls on the San Francisco-Oakland Bay Bridge in 2010 estimated a traffic elasticity of -0.23, meaning that doubling toll rates would reduce traffic by 23 percent. The study notes that this relatively low elasticity value is "an indication that peak period motorists were fairly insensitive to pricing and a reflection of the nondiscretionary nature of many peak hour journeys." The study also showed a high reduction in carpool vehicles once carpools change from free to tolled, even at a discounted rate.[41]

In the absence of real-world examples of comprehensive roadway pricing schemes in the United States, modeling studies provide the best estimates of impacts. As one example, the City of Seattle commissioned in 2009 a study of various regional tolling options. The study estimated a drop in per capita VMT from 24.1 (2009) to 22.7 (2030), a 6 percent reduction, with the variable priced tolling on all freeways in the Seattle metropolitan area. Such a tolling scheme would collect $1.9 billion in revenue annually.[42]

Where possible, the application of roadway pricing to existing travel lanes can be an effective strategy for Caltrans and partner agencies to manage congestion and reduce VMT, rather than highway capacity expansion that will include new vehicle travel. At present, however, Caltrans and its partner agencies have only limited ability to implement road pricing. Federal law prohibits tolling of Interstate highway general purpose lanes, with the exception of a small number of pilot programs. Federal law does allow charging of tolls for SOV use of HOV lanes.

Equity Concerns

Objections to roadway pricing are often centered around equity concerns. Pricing road travel could make it too expensive for low-skilled workers to get to their jobs. Tolls or other forms of road user charges would consume a larger share of income for poor drivers as compared to wealthy drivers. The actual social equity impacts of any specific roadway pricing scheme are complex and depend on many

[40] Dong, J., Davidson, D., Southworth, F., Reuscher, T. 2012. *Analysis of Automobile Travel Demand Elasticities with Respect to Travel Cost.* FHWA. www.fhwa.dot.gov/policyinformation/pubs/hpl-15-014/TCElasticities.pdf
[41] Cervero, Robert, "Traffic Impacts of Variable Pricing on the San Francisco-Oakland Bay Bridge, California," *Transportation Research Record*, No. 2278, 2012.
[42] Seattle Department of Transportation, *Seattle Variable Tolling Study,* 2009. www.seattle.gov/Documents/Departments/SDOT/About/DocumentLibrary/Reports/FINALTollingStudyreportrevised6.25.10.pdf

factors. While equity concerns should in no way be dismissed, it is worth noting that much of the literature on the subject finds that road pricing is not as inequitable as commonly believed.

Observations of existing priced highway lanes in urban areas finds that a large portion of users of these facilities are low- and middle-income drivers. When examining HOT lanes, researchers have found that, even if they don't use the facility regularly, lower income drivers value the option to bypass congestion because they may have less flexibility in their schedules and pay a greater penalty for arriving late. This is borne out in public opinion surveys, which consistently find that support for road pricing does not vary substantially by income group.[43]

When pricing is used to generate revenue for roadway improvements, it must be compared against alternative revenue generation approaches. In California, sales taxes are often used to fund highway improvements, and research finds that a transportation sales tax "disproportionately favors the more affluent at the expense of the lower-income."[44]

Roadway pricing equity concerns can potentially be addressed in several ways. "Lifeline" programs could be used to provide discounted access to toll roads, similar to utility programs available to low-income households. The distribution of road pricing revenue can also be used to fund services that benefit low-income travelers. If equity is a prominent factor in the design and implementation of a roadway pricing program, the results can benefit disadvantaged communities through improved public transit, safer pedestrian and bicycle routes, and reduced environmental burdens.[45]

Improve Alternatives to SOV Travel

Caltrans plans, designs, constructs, and operates facilities that provide alternatives to SOV travel. Caltrans decisions can support these alternatives even when Caltrans does not directly control the facilities. As shown in the table below, SOVs typically produce the highest emissions per passenger mile among major modes surface of transportation, although the results depend on vehicle fuel type, vehicle occupancy, and other variables. The emission factors shown below were developed using fuel-based carbon intensity values from CARB's LCFS program, which account for the emissions resulting from the production and distribution of the various fuel types and all associated tailpipe exhaust emissions.[46]

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[43] FHWA, "Income-Based Equity Impacts of Congestion Pricing: A Primer," 2008. https://ops.fhwa.dot.gov/publications/fhwahop08040/cp_prim5_00.htm

[44] Schweitzer, Lisa, and Brian D. Taylor, "Just Pricing: The Distributional Effects of Congestion Pricing and Sales Taxes," *Transportation*, Vol 35, No. 6, 2008.

[45] TransForm, *Pricing Roads, Advancing Equity*, January 2019. www.transformca.org/transform-report/pricing-roads-advancing-equity

[46] California Air Resources Board. 2018. California Climate Investments Quantification Methodology Emission Factor Database. Available at: www.arb.ca.gov/cc/capandtrade/auctionproceeds/cci_emissionfactordatabase.xlsx

Table 6. GHG Emissions by Surface Transportation Mode

Transportation Mode	Fuel Type	Grams CO_2e per vehicle mile	Assumed Vehicle Occupancy	Grams CO_2e per passenger mile [a]
Single-occupancy vehicle	Gasoline	492 [b]	1	492
	Electric	123 [c]	1	123
Carpool	Gasoline	492 [b]	3	164
	Electric	123 [c]	3	41
Vanpool	Gasoline	1,292 [b]	8	161
Transit Bus *(80% occupied)*	Diesel	2,512 [b]	36	66
	Electric	893 [d]	36	25
Transit Bus *(20% occupied)*	Diesel	2,512 [b]	9	263
	Electric	893 [d]	9	99
Passenger Rail	Diesel	24,954 [e]	203	123
	Renewable Diesel	8,696 [e]	203	43
Light Rail	Electric	7,795 [e]	121	65
Streetcar	Electric	8,297 [e]	29	285

Notes:

[a] Grams per passenger mile calculated by dividing the grams per vehicle mile by the assumed vehicle occupancy for each mode.

[b] GHG emission factors developed by multiplying vehicle fuel consumption rates from CARB's EMFAC2017 model by CARB's LCFS fuel-based carbon intensity values. The following vehicle types were assumed to represent the transportation modes: light-duty automobile (LDA)/light-duty truck (LDT)/medium-duty vehicle (MDV) = SOV and carpool; light-heavy duty vehicle (LHD1) = vanpool; and urban bus (UBUS) = transit bus. The EMFAC modeling was performed at the statewide level for calendar year 2016.

[c] Assumes an electricity consumption rate of 0.326 kilowatt-hours per vehicle mile, based on the average efficiency for top selling U.S. electric vehicle brands in 2015 (U.S. Department of Energy 2016). This rate was multiplied by CARB's LCFS carbon intensity for grid electricity (CARB 2018).

[d] Assumes an electricity consumption rate of 2.36 kilowatt-hours per vehicle mile, based on the average efficiency of King County Metro 40-foot battery electric buses (Federal Transit Administration 2018). This rate was multiplied by CARB's LCFS carbon intensity for grid electricity (CARB 2018).

[e] GHG emission factors were obtained directly from CARB (2018).

VMT Reduction Strategies

A variety of programs and services are available to encourage alternatives to SOV travel, reduce reliance on the private automobile, and thereby reduce VMT and GHG emissions. Examples are listed in the table below. Many of these strategies are categorized as transportation demand management (TDM). In some cases, Caltrans can lead the implementation of these strategies, while in other cases, Caltrans would play a supporting role to MPOs, local governments, large employers, or other organizations.

Table 7. Examples of VMT Reduction Strategies

Strategy Category	Strategies for which Caltrans has a Support Role	Strategies for which Caltrans has a Lead or Support Role
Bicycle, Pedestrian, and Urban Design Strategies	Bikeshare	Bikeway network expansion Bike lane/path development Pedestrian facility network expansion Pedestrian facility development Street connectivity
Transit Strategies	Transit system expansion Transit frequency improvements Transit travel time improvements Transit reliability improvements Transit fare reduction	
Land Use and Parking Strategies	Land use mixing Higher density development Transit oriented development Destination accessibility Parking management and pricing	
Transportation Demand Management Strategies	Employer alternative commute option programs Rideshare Carsharing programs Telework Community-based travel marketing	Park and ride lots

California's 18 MPOs lead the planning for VMT reduction measures at the regional scale. Most MPOs have been pursing these types of strategies for decades due to air quality planning requirements, often working with regional air quality management districts. The passage of SB 375 added the requirement that MPOs demonstrate that their long-range transportation plan will achieve light-duty vehicle per-capita GHG emission reduction targets set by CARB. In some cases, the GHG reduction targets can be achieved through future land use plans that result in VMT reduction. However, most MPOs have also analyzed and adopted additional TDM strategies for VMT and GHG reduction. For example, MTC's Plan Bay Area 2040, adopted in 2017, includes the following strategies to reduce VMT[47]:

- Commuter Benefits Ordinance
- Car Sharing
- Vanpools and Employer Shuttles
- Smart Driving Program
- Targeted Transportation Alternatives (i.e., community-based travel marketing)

[47] Metropolitan Transportation Commission. 2017. Plan Bay Area 2040: Final Travel Modeling Report. http://2040.planbayarea.org/sites/default/files/2017-07/Travel_Modeling_PBA2040_Supplemental%20Report_7-2017_0.pdf

- Trip Caps
- Bike Share
- Bicycle Infrastructure

The MTC plan also includes three strategies to promote accelerated deployment and use of clean vehicles: a Regional Electric Vehicle Charger Network, a Vehicle Buyback and EV Incentive Program, and a Clean Vehicles Feebate Program.

Bicycle System Improvements

Walking and cycling are forms of active transportation that do not generate any GHG emissions. Caltrans can support active transportation by expanding bike and pedestrian infrastructure and improving the safety of existing facilities. New bicycle lanes can reduce GHG emissions by encouraging the replacement of auto trips with bicycle trips, which reduces VMT.[48,49] The amount of emission reductions achieved by new bicycle facilities depends on many variables, including regional connectivity, length of the facility, average daily traffic (ADT) on the parallel roadway, proximity to activity centers, and the extent to which cycling trips are replacing auto trips. Bicycle facilities are most effective at reducing VMT and GHG emissions when they improve the connectivity of a regional bicycle network, improve access to popular destinations, and are perceived as safe and convenient by cyclists.

The table below presents an illustrative example of potential GHG and VMT reductions that may be achieved by three hypothetical Class 2/Class 4 bike lane projects. The research team assumed the three facilities have different characteristics, as described below, in order to identify a range of low, medium, and high GHG reductions. GHG and VMT reductions for each facility were quantified by the research team using CARB's Active Transportation Program GHG Emission Reduction Calculator.

- Facility 1: less than 1-mile bike lane parallel to a roadway with less than 12,000 ADT located in a town with less than 250,000 people. The new facility would be within 0.5 mile of three activity centers.
- Facility 2: 1- to 2-mile bike lane parallel to a roadway with 12,000 to 24,000 ADT located in a university town with less than 250,000 people. The new facility would be within 0.5 mile of three to seven activity centers.
- Facility 3: longer than 2-mile bike lane parallel to a roadway with 24,000 to 30,000 ADT located in a town with more than 250,000 people. The new facility would be within 0.25 mile of more than seven activity centers.

[48] Matute, Juan, Herbie Huff, Jamie Lederman, Diego de la Peza, and Kevin Johnson (2016). Toward Accurate and Valid Estimates of Greenhouse Gas Reductions from Bikeway Projects. California Department of Transportation, Report CA 17-2919. www.lewis.ucla.edu/wp-content/uploads/sites/2/2016/08/UCCONNECT-Matute-Final-Report-with-Appendices.pdf

[49] Handy, S., Tal, G., and Boarnet, M. (2014). Impacts of Bicycling Strategies on Passenger Vehicle Use and Greenhouse Gas Emissions - Policy Brief. California Air Resources Board. www.arb.ca.gov/cc/sb375/policies/bicycling/bicycling_brief.pdf

Table 8. Potential VMT and GHG Reductions from New Bicycle Lanes

Facility	Auto VMT Reduction (miles per year)	GHG Reduction (metric tons CO_2e per year)
Facility 1	8,100	4
Facility 2	64,260	30
Facility 3	127,980	59

Notes: The calculator uses CARB's "Methods to Find the Cost-Effectiveness of Funding Air Quality Projects for Evaluating Motor Vehicle Registration Fee Projects and Congestion Mitigation and Air Quality Improvement Projects" to quantify VMT and GHG reductions. The GHG reductions account for emissions resulting from the production and distribution of the displaced fuel, as well as all associated tailpipe exhaust reductions.

While new bicycle facilities can reduce auto VMT and associated emissions, the GHG reduction potential is relatively low, in part because any resulting mode shift tends to replace only short automobile trips. Based on the analysis presented above, more than 15,000 bicycle lanes with characteristics like "Facility 3" would need to be constructed to reduce 1 percent of annual GHG emissions on the State Highway System (89 million metric tons, as shown in Table 1).

Transit System Improvements

System improvements that make transit more reliable and attractive as an alternative to SOV travel can increase transit ridership and reduce automobile VMT and GHG emissions.[50] There are a variety of mechanisms for improving transit service, including:

- Increasing the frequency of transit service, which reduces wait times for riders
- Improving transit travel speed and reliability through treatments such as transit signal priority, bus-only signal phases, queue jumps, curb extensions to speed passenger loading, and dedicated bus lanes.
- Expanding transit service by developing new routes, which can improve transit access to residents and businesses
- Reducing transit fares to make transit travel more competitive with auto travel

Caltrans does not operate public transit service so would rely on local partners to lead transit service improvements. However, Caltrans can support public transit in several ways. Caltrans administers a number of transit programs, including the Transit and Intercity Rail Capital Program (TIRCP), created in 2014 to provide grants from the state's Greenhouse Gas Reduction Fund to fund transit capital improvements that will reduce GHG emissions. Caltrans can also influence transit operations that occur on the State Highway System. For example, Caltrans can permit buses to operate on freeway shoulders to increase transit speeds and reliability, particularly during peak-hours or heavy congestion. Buses are

[50] Handy, S., Lovejoy, J., Boarnet, M., and Spears, S. (2013). Impacts of Transit Service Strategies on Passenger Vehicle Use and Greenhouse Emissions – Policy Brief. California Air Resources Board. www.arb.ca.gov/cc/sb375/policies/transitservice/transit_brief.pdf

currently permitted to operate on the shoulders of I-805 in San Diego County. In some situations, Caltrans may also be able to improve transit efficiency by creating dedicated bus-only lanes on the State Highway System.

The table below presents an illustrative example of potential GHG reductions that may be achieved by three hypothetical transit improvement projects under various ridership assumptions. The inputs were developed by the research team, and the GHG reductions were quantified using CARB's Transit and Intercity Rail Capital Program calculator. These examples assume that because transit-only and transit-priority lanes would likely be implemented in areas with existing transit service, they are not likely to significantly increase bus VMT. Accordingly, the analysis presented below does not assume any expansion to transit operations. There are many other ways to improve transit service, as noted above; some transit improvement options would increase bus VMT which would at least partially offset the GHG benefits of mode shift from autos.

Table 9. Potential GHG Reductions from Improved Transit Service

Project [a]	Additional Annual Ridership to Existing Transit Service [b]	GHG Reduction (metric tons CO_2e per year)
Transit Service 1	103,323 (Low)	407
Transit Service 2	206,646 (Medium)	814
Transit Service 3	516,614 (High)	2,035

Notes:

[a] All transit projects were analyzed as long-distance bus service in Sacramento County during calendar year 2020. Analysts also assumed all transit vehicles were model year 2015 and an average transit trip length of 10.23 miles (CARB 2017). No changes in transit VMT are assumed.

[b] For illustrative purposes, the low, medium, and high ridership levels represent a 1, 2, and 5 percent increase, respectively, in Sacramento Regional Transit's 2017 annual ridership (SacRT 2017).

Compared to new bicycle facilities, improved and productive transit service has a higher potential to reduce automobile VMT and associated GHG emissions (e.g., mode shift from SOVs to transit), although the illustrative reductions presented above are still relatively low compared to annual GHG emissions on the State Highway System.

Bicycle and Transit Project Impacts in Relation to Induced Vehicle Travel Impacts

Overall, Caltrans investments in projects that improve facilities for transit, bicycles, pedestrians, and other SOV alternatives are important components of the state's GHG reduction efforts. The co-benefits of these projects can be substantial, including public health improvements from more physical activity and safety improvements for the most vulnerable travelers (e.g., pedestrians and bicyclists). However, it is important to consider the magnitude of the GHG reductions from these projects in relation to the emissions impacts of induced vehicle travel. Typically, GHG emissions increases from induced vehicle travel will far outweigh any reductions from improvements to non-SOV facilities. Thus, based on this analysis, the inclusion of multi-modal improvements to a highway project will not “offset” the vehicle emissions impacts.

3.2 On-Going and Recent Actions

A variety of recent and on-going activities at Caltrans support reductions in highway system user GHG emissions. These actions, described below, are primarily led by the Division of Transportation Planning, the Division of Environmental Analysis, and Division of Traffic Operations. These actions can complement and support the high impact approaches discussed in the previous section, but are not likely to result in major GHG reductions by themselves.

Statewide Policy and Planning

Transportation planning at Caltrans articulates a long-term vision for California’s transportation system and implements statewide transportation policy through partnerships with state, regional, and local agencies. Transportation planning at Caltrans also includes the first phases of the project delivery process, including the development of project initiation documents (PIDs), which are prepared by the Division of Transportation Planning. The products and services of transportation planning support and guide transportation investment decisions. Programming is the commitment of transportation funds to be available over a period of several years to particular projects. Caltrans supports the preparation of several programming documents as required under State and Federal law, including the State Transportation Improvement Program (STIP) and the State Highway Operation and Protection Program (SHOPP). Nearly all these plans and programming documents can affect VMT in the state and therefore can influence GHG emissions.

Strategic Management Plan

Caltrans adopted a Strategic Management Plan in 2015 in order to provide clear direction for meeting statewide objectives, create and deepen strategic partnerships, and provide performance measures to monitor success. The Strategic Management Plan provides a definition of sustainability by identifying the following objectives for Caltrans Goal #3:

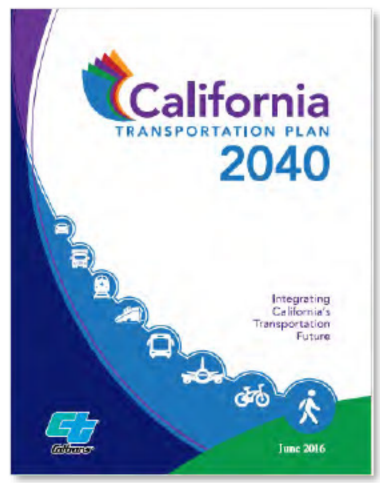
- PEOPLE—Improve the quality of life for all Californians by providing mobility choice, increasing accessibility to all modes of transportation and creating transportation corridors not only for conveyance of people, goods, and services, but also as livable public spaces.
- PLANET—Reduce environmental impacts from the transportation system with emphasis on supporting a statewide reduction of greenhouse gas emissions to achieve 80 percent below 1990 levels by 2050.
- PROSPERITY—Improve economic prosperity of the State and local communities through a resilient and integrated transportation system.

The Strategic Management Plan contains a number of sustainability performance measures and targets, several of which directly or indirectly relate to GHG reduction. These performance measures are shown in the table below.

Table 10. Sustainability Performance Measures in Strategic Management Plan

Performance Measure	Targets
Per capita vehicle miles traveled (Reported statewide by District)	By 2020, achieve 15% reduction (3% per year) of statewide per capita VMT relative to 2010 levels reported by District.
Percent reduction of transportation system-related air pollution for GHG emissions	15% reduction (from 2010 levels) of GHG to achieve 1990 levels by 2020.
Percent reduction of GHG emissions from Caltrans design, construction, operation, and maintenance of transportation infrastructure and building	By 2020, reduce Caltrans' internal operational pollutants by District from 2010 levels (from planning, project delivery, construction, operations, maintenance, equipment, and buildings) including: • 15% reduction by 2015 and 20% reduction by 2020 of Caltrans' GHG emissions per EO-B-18-12.

California Transportation Plan



Senate Bill 391 (2009) requires Caltrans to develop a statewide long-range transportation plan every five years that aligns with and supports California's GHG reduction targets as specified by AB 32. California Transportation Plan 2040 (CTP 2040), released in 2016, was the first CTP developed under this mandate. As a statewide transportation plan, CTP 2040 provides a framework for meeting the State's mobility and GHG goals and considers all transportation modes. Caltrans incorporated information from the statewide modal plans (described in subsequent sections) and regional transportation plans.

CTP 2040 is California's first statewide transportation plan that included modeling scenarios to measure potential GHG reductions. In the first scenario, Caltrans used the regional transportation plans for the state's four largest metropolitan planning organizations (MPOs), the State modal plans, and California Air Resources Board's Advanced Clean Cars program to model the GHG reductions from key existing plans and policies. The second scenario starts with the first scenario and adds in efficiency strategies (e.g., increased car and rideshare, improved multimodal options, driving pricing, and improved operations) that help reduce transportation-related GHG emissions. The third scenario assumes fuel and vehicle technology improvements (e.g., increased biofuel availability, zero emission vehicle deployment, and rail and aviation efficiencies) on top of the second scenario to help meet the transportation sector's share of the State's GHG reduction target of 80 percent emission below 1990 levels by 2050.

Caltrans has now started the development of the next statewide long-range transportation plan, CTP 2050. This effort will include development of a range of tangible future transportation scenarios, and then modeling of those scenarios to determine their potential impact on GHG emissions and other CTP performance objectives in compliance with adopted CTP Guidelines.

Caltrans Modal Plans

Caltrans develops statewide plans for individual transportation modes. These plans vary in structure and level of detail, but generally describe a vision for improving the performance of modal-specific transportation systems. When successful, improvements to non-highway travel modes can help to reduce travel by on-road vehicles (autos and/or trucks) and associated GHG emissions. Recent modal plans developed by Caltrans include the following:

- Toward an Active California: State Bicycle + Pedestrian Plan
- California State Rail Plan: Connecting California
- California Statewide Transit Strategic Plan
- California Freight Mobility Plan

A description of each of these plans is included in Appendix A.

Sustainable Freight

Caltrans created a Sustainable Freight Branch in 2016, primarily to implement the state's Sustainable Freight Action Plan. The Sustainable Freight Action Plan was produced by a partnership of state agencies in response to Executive Order B-32. The Plan includes 9 major actions and 73 sub-actions; Caltrans is the assigned lead for 25 of the sub-actions. Other key implementation partners are the California Air Resources Board, the California Energy Commission, and the Governor's Office of Business and Economic Development. Several of the actions led by Caltrans can reduce GHG emissions. These include:

- **Truck Parking Availability**. Because of a shortage of truck parking spaces and need for drivers to comply with federal hours of service limits, truckers can spend circling to search for an overnight parking space. This contributes to unnecessary truck VMT and possibly excessive idling. Increasing the availability of truck parking in key locations would improve system efficiency and reduce emissions.

- **Electric Charging Infrastructure for Parked Trucks**. Long-haul freight trucks often need to idle their diesel engines during overnight stops in order to provide truck cab comfort and amenities. With appropriate electrical service at truck parking facilities, trucks can minimize fuel consumption and GHG emissions. In addition, refrigerated trucks can potentially use electrical service instead of diesel engines to operate cooling units. Caltrans is leading coordination and feasibility assessments to encourage investment in electric charging infrastructure for public truck parking facilities along the freight network. A first step is to identify where these type of parking facilities can be located, if possible. Longer term, this infrastructure could also help to shift vehicles to zero emission technologies. District 11 recently worked with a private vendor to provide electric infrastructure at a truck parking facility along SR 76.

- **Truck Platooning**. Several research teams have demonstrated the operation of Class 8 line-haul trucks using semi-automated platooning. UC Berkeley, in partnership with Caltrans, has demonstrated two linked vehicles. Other prominent demonstrations have occurred in Virginia.[51] Using vehicle-to-vehicle communication, radar, and active braking, two or more trucks can operate at high speeds in close proximity, which reduces aerodynamic drag. Recent tests by the National Renewable Energy Laboratory using two trucks in platoon showed fuel savings of up to 5.3% for the lead truck, up to 9.7% for the trailing truck, and a net savings of up to 6.4% for the platooned pair. Caltrans DRISI is supporting pilot projects in California to further explore this strategy.
- **Marine Highway 580**. Caltrans is supporting an assessment of the use of waterways to move freight between the Port of Oakland and Central Valley locations such as the Port of Stockton. Currently many shipping containers imported through the Port of Oakland are transported inland via truck on I-580. If tugs and barges were to transport these containers using the Sacramento River Delta, it could potentially reduce fuel consumption and emissions, while also mitigating highway congestion. The feasibility of this service depends on private sector interest, as barge travel adds significantly to the travel time. Caltrans will be sponsoring a network optimization study for the corridor to assess feasibility. Ultimately, achieving emission reductions through the use of a “Marine Highway 580” may also necessitate efficiency and emission control improvements to the tugs that propel the barges.
- **Supportive Local Development Decisions**. Caltrans is considering how to support sustainable freight movement through the Local Development-Intergovernmental Review (LD-IGR) process, discussed below. Caltrans is also considering how its guidance for complete streets projects can accommodate freight. With the growth of e-commerce and urban package delivery, there may be more conflicts between complete streets features and the parking needs of delivery trucks. Without parking options, double-parked delivery trucks can hinder transit service and contribute to excessive delay and idling among all vehicles using the street.

Smart Mobility and Active Transportation

Complete Streets Program

Caltrans Complete Streets Program promotes roadways that provide safe mobility for all users, including bicyclists, pedestrians, transit vehicles, truckers, and motorists, appropriate to the function and context of the facility. The program responds to Deputy Directive 64-R2, first signed in October 2008 and renewed in October of 2014, which directs Caltrans to implement complete streets:

[51] Loftus, Jeff, “Truck Platooning: The State of the Industry and Future Research Topics,” presentation at the 2018 Transportation Research Board 97th Annual Meeting. https://www.fmcsa.dot.gov/sites/fmcsa.dot.gov/files/docs/safety/395146/loftus-tershak-truck-platooning-final-508c.pdf

> "The Department provides for the needs of travelers of all ages and abilities in all planning, programming, design, construction, operations, and maintenance activities and products on the State Highway System."

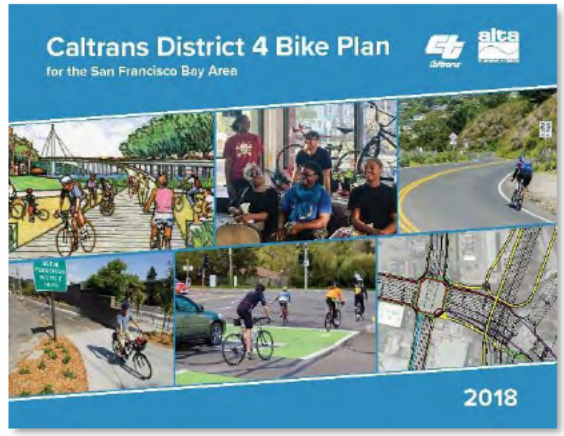
Caltrans efforts that increase use of bicycle, pedestrian, and transit modes will typically result in a reduction in VMT and associated GHG emissions.

One outcome of this program has been the development of the Complete Streets Elements Toolbox. The Toolbox provides detailed information about specific roadway elements that can be designed and constructed to provide multi-modal mobility and access. Approximately 40 elements are included in the Toolbox, focusing on bicycle, pedestrian, and transit travel. For each of these elements, the Toolbox provides definitions and benefits, links to design guidance, and project examples. In addition, the Toolbox describes how Caltrans staff can quantify each Complete Streets element for entry into the SHOPP Tool. This is a critical step for securing funding for bicycle, pedestrian, and transit improvements as part of SHOPP projects. Project Initiation Documents (PIDs) developed for the 2018 and 2020 SHOPP cycles are required to consider complete streets elements.

Other Caltrans achievements related to Complete Streets include:

- Incorporation of active transportation projects into the Cal-B/C model. The Cal-B/C model is used by Caltrans staff to perform a life-cycle benefit/cost analysis for proposed state highway and public transit projects. The spreadsheet model was enhanced to include bicycle and pedestrian projects. The tool calculates benefit of these projects in terms of journey quality, travel time, safety auto accident and emissions, and public health. The project benefits are monetized (translated into dollar terms), which can then be compared to project costs as part of a benefit-cost analysis.
- Development of a Complete Streets brochure. The full-color brochure describes Complete Streets at a high level and includes examples and photos of Complete Streets projects on Caltrans facilities.
- Complete Streets overview training course. Caltrans contracted with UC Berkeley Tech Transfer to develop and deliver a Complete Streets overview training course specifically for Caltrans employees in all functional units. The course was delivered 12 times in 2014 – 2016.

District-Level Active Transportation Planning



Following on the publication of the statewide bicycle and pedestrian plan, Caltrans Districts are developing plans and leading related active transportation efforts. The first of these plans was released by District 4 in April 2018 – a Bike Plan for the San Francisco Bay Area. In addition to the plan, District 4 created a separate on-line mapping tool that offers a comprehensive interactive map of the projects in the plan.[52] Clicking on specific projects brings up details of those projects. Other District-level plans are under development.

Smart Mobility Framework

The Smart Mobility Framework (SMF) was introduced in 2010 is an important part of Caltrans efforts to achieve goals such as reduced vehicle travel and GHG emissions, better multimodal accessibility and safety, improved public health, and efficient use of resources. One of the core principles of Smart Mobility is location efficiency, which refers to the integration of transportation and land use at both the neighborhood scale and the regional/statewide scale. When these two dimensions of location efficiency are both strong, communities can achieve the full extent of smart mobility benefits in terms of higher levels of non-motorized travel, reduced vehicle trip making, and shorter vehicle trips. The Smart Mobility 2010 document provides high-level tools for applying the Framework. One is a set of Place Types and corresponding recommendations for planning activities, transportation projects and programs, and land development projects and programs. The second tool is a set of 17 Smart Mobility performance measures, intended for use in decision making at both the planning and project level to evaluate progress toward implementing the Smart Mobility principles and attaining Smart Mobility benefits. More recently, Caltrans developed a Smart Mobility Framework Guide, which provides more detailed instruction to Caltrans staff who are interested in implementing Smart Mobility strategies.

Local Development Intergovernmental Review (LD-IGR) Program

Caltrans coordinates and consults with local jurisdictions and Tribal Governments when proposed local land use planning and development may impact the State Highway System. Through the LD-IGR process, Caltrans advises Lead Agencies on what these impacts might be and ways to avoid, minimize, and/or mitigate adverse impacts. Caltrans also identifies land use and design strategies that may enhance connectivity and access to destinations.[53] Caltrans issued LD-IGR Interim Guidance in September 2016 to respond to recent legislation such as SB 743 and recent planning guidance such as the Smart Mobility Framework and the California Transportation Plan 2040. In the past, LD-IGR practices primarily used vehicle Level of Service to identify impacts to the State Highway System, and often limited

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[52] Available at:
https://caltrans.maps.arcgis.com/apps/webappviewer/index.html?id=91f1bb4eb7ff418092977b762b459d01
[53] Caltrans, Local Development Intergovernmental Review Program Interim Guidance, Approved – September 2, 2016

recommended mitigation to traditional road improvements. The 2016 Interim LD-IGR Guidance document is intended to ensure that all Caltrans comments on growth plans, development projects, and infrastructure investments align with state policies through the use of efficient development patterns, innovative demand reduction mitigation strategies, and necessary multimodal roadway improvements. Specifically, the Interim Guidance calls for Caltrans reviewers to include the following elements in their reviews:

- Reviewers should comment on vehicle miles traveled resulting from the land use project
- Provide recommendations that strive to reduce VMT generation; improve pedestrian, bike, and transit service and infrastructure; and which don't induce additional VMT.
- Reviewers should use the terms "transportation impact study" rather than "traffic impact study" and note that the study should analyze all modes.
- Comments related to impacts to the State Highway System (SHS) will be focused on VMT impacts not delay or effects on road capacity.

The Interim Guidance includes a flow chart and associated guidance to determine whether to comment on site-specific projects and what types of comments to make based on the type of project and its location. This guidance references the Smart Mobility Framework place types to help reviewers determine which comment guidance is most relevant for a given project.

Climate Change Program

The Climate Change Branch in Caltrans' Division of Transportation Planning is responsible for overseeing the development, coordination, and implementation of the Department's climate change policies. The Branch also serves as a Caltrans-wide resource for technical assistance, training, information exchange, and partnership-building. The Branch is focused on both GHG reduction efforts and climate change impacts and adaptation efforts. In 2013, the Branch published the report *Caltrans Activities to Address Climate Change: Reducing Greenhouse Gas Emissions and Adapting to Impacts*. The Branch also develops Caltrans annual GHG inventory for reporting to the Climate Registry and California EPA.

Project Planning

A transportation need is identified through Caltrans or partner agency planning processes or asset management programs. A transportation need can be a structural or operating deficiency of the existing transportation system or a response to planned land use changes. Caltrans and local agencies use a Project Initiation Document (PID) for determining the type and scope of project that will be developed to address the transportation need. The PID is a record of the purpose and need for the project, and the approach that will be taken to meet or reduce transportation deficiencies. The most important function of the PID is to establish a project as a viable candidate for Federal, State, regional, and local funds. A Project Study Report (PSR) is the most common type of PID.

For projects recommended for inclusion in the SHOPP, Caltrans requires an estimation of GHG emissions where possible. This requirement stems from Executive Order B-30-15, which states:

> *7. State agencies' planning and investment shall be guided by the following principles:*
>
> > *-Priority should be given to actions that both build climate preparedness and reduce greenhouse gas emissions;*

Caltrans has issued guidance for including GHG emissions calculations in SHOPP PIDs.[54] The guidance includes the following direction:

> "Under the new requirements of Executive Order B-30-15, Caltrans will need to define project-level performance in the Project Initiation Document (PID) work plan and SHOPP Tool, and PIDs must demonstrate project-level performance to be eligible for programming into the 2018 SHOPP. Project level performance needs to include a definition of condition improvement, complete streets components, climate change mitigation/adaptation elements, system performance, operational improvements, safety improvements or other tangible project level benefits." Kome Ajise, Chief Deputy Director-January 22, 2016

The guidance calls for use of the FHWA Infrastructure Carbon Estimator (ICE) Tool to perform the GHG estimation. The ICE Tool is specifically designed for estimation of GHG emissions at the planning stage, when all that may be known about a project is the type of work, the length of the project, and the number of lanes. The types of infrastructure that can be analyzed using the ICE Tool are:

- Roadway projects, including new facility, lane additions, lane widening, shoulder improvements, pavement rehabilitation and resurfacing.
- Parking facilities
- Bridges
- Rail line construction
- BRT construction
- Bicycle facilities
- Pedestrian facilities

The ICE Tool evaluation is typically performed by a District level project engineer (PE), who must sign off on the PID. The Caltrans guidance strongly encourages the PE to use the mitigation feature of the ICE Tool and document mitigation measures that can be employed in the project. Mitigation measures in the tool include concrete and asphalt pavement alternatives, alternative fuels and vehicle hybridization, and vegetation management. If the PID includes GHG mitigation, then the project with mitigation elements should be advanced to the California Transportation Commission for inclusion in the SHOPP, which increases the likelihood that the mitigation will be carried forward to design and construction.

[54] Caltrans, District Guidance for Including Greenhouse Gas (GHG) Emissions Calculations For 2018 & Future State Highway Operations and Protection (SHOPP) Project Initiation Documents (PIDs), November 2017- Version 4.

Sometimes at the environmental stage, a more detailed GHG analysis tool is used because there is more project detail by that stage (See Section 3.2 for more information). If so, then that GHG analysis will supersede the ICE analysis.

One of the benefits of GHG quantification and use of the ICE Tool at the SHOPP PID stage is the increased awareness on the part of Project Engineers. Project Engineers may not fully understand the GHG benefits of strategies like alternative concrete mixes, warm mix asphalt, etc. Caltrans has seen a difference in this GHG mitigation awareness in the two years they have been requiring use of the ICE Tool. And once a project is programmed in the SHOPP, these same engineers often do the project design, and they can continue to incorporate GHG mitigation at that stage. One challenge is that Caltrans project engineers often cannot specify a particular asphalt or concrete mix; they can only specify pavement performance characteristics and compliance with Caltrans standard specifications. Thus, there is currently a gap between the knowledge of pavement GHG reduction strategies (discussed in Section 4.2) and the ability of Caltrans to promote those strategies.

Planning Grants

In addition to developing policies and plans, Caltrans provides grants to support local planning for GHG reductions and other sustainability goals. Two current grant programs, Sustainable Communities Grants and Adaptation Planning Grants, were funded through Senate Bill 1 (SB 1, 2017), which allocated funding for transportation improvements. The Strategic Partnership Grant program is funded by FHWA and administered by Caltrans. Descriptions of these grant programs is included in Appendix A.

Environmental Analysis

Caltrans Division of Environmental Analysis administers Caltrans' responsibilities under federal and state environmental law. These laws include the National Environmental Policy Act (NEPA), the California Environmental Quality Act (CEQA), and a variety of other environmental laws and regulations. The Division of Environmental Analysis develops and maintains Caltrans environmental standards, policies, procedures, and practices that are implemented by the 12 District Environmental Branches. Program staff work with the districts to identify and assess the effects of Caltrans projects on California's natural and cultural environments and on the climate, and identify ways to avoid or mitigate those effects.

Caltrans has developed Environmental Document Annotated Outlines in order to provide a consistent document format for the presentation of required content in NEPA and CEQA documents. The actions of the Division of Environmental Analysis do not by themselves reduce GHG emissions. However, the environmental documentation produced by the Division can help to Caltrans staff make more informed decisions about project design in ways that can lead to GHG reductions.

Implementation of SB 743 places a new emphasis on reducing VMT and highlights the nexus between VMT reduction and the State's climate change goals. Governor Jerry Brown signed SB 743 on September 27, 2013, which mandated a change in the way that public agencies evaluate transportation impacts of projects under CEQA, focusing on VMT rather than level of service (LOS) and other delay-based metrics. SB 743 states that new methodologies under CEQA are needed for evaluating transportation impacts that are better able to promote the state's goals of reducing GHG emissions and traffic-related air pollution, promoting the development of a multimodal transportation system, and providing clean, efficient access to destinations. Amendments to the CEQA Guidelines shifting the focus of the transportation impact analysis from automobile delay to VMT were adopted in January 2019.

While the 2019 CEQA Guideline Amendments do not change the GHG impact analysis considerations, they bring CEQA transportation analyses into closer alignment with statewide policies on GHG emissions and smart growth. To facilitate implementation of the 2019 CEQA Guideline Amendments, the Governor's Office of Planning and Research (OPR) published the *Technical Advisory on Evaluating Transportation Impacts in CEQA* (Technical Advisory), which includes recommended VMT thresholds for various types of land use projects. These thresholds connect the level of VMT reduction to the State's emissions goals. The Technical Advisory does not currently provide a numeric VMT threshold for transportation projects, but notes that "a transportation project which leads to additional vehicle travel on the roadway network… would need to quantify the amount of additional vehicle travel in order to assess air quality impacts [and] greenhouse gas emissions impacts".[55]

Caltrans has prepared guidance documents addressing the Department's transportation analysis and CEQA procedures consistent with SB 743. These include:

- **Transportation Analysis Framework** (TAF): This document provides guidance for CEQA transportation/traffic analysis for projects on the SHS, including direction to Caltrans Districts related to selecting methods for VMT analysis (including induced travel demand) in project-level environmental documents reflecting both project type and context (urban vs. rural).
- **Transportation Analysis under CEQA for Projects on the State Highway System** (TAC): The TAC provides methodologies for CEQA practitioners to evaluate the transportation impacts of projects on the SHS, including how to determine significance of those impacts, and identifies potential mitigation measures.

Project-level GHG Analysis for Operational Emissions

For projects that provide congestion relief or otherwise increase roadway capacity (including operational improvement projects that are expected to address future demand volumes), Caltrans guidance calls for developing a quantitative analysis of GHG emissions using either the CT-EMFAC2014 or CT-EMFAC2017 model. The Annotated Outlines provide instructions for this analysis, as follows:

> *[C] conduct separate model runs for existing/baseline conditions (existing conditions at the time of the Notice of Preparation [NOP] or existing conditions at the time the environmental analysis began), and the design-year for both the build and no-build alternatives. It is also helpful to include an intermediate year such as the open-to-traffic year. Summarize this information in a table that includes the VMT projections used for the CT-EMFAC model run and the resulting annual metric tons of CO_2e. A sample table format is provided for your convenience. Please modify it to fit the proposed project.*

[55] Governor's Office of Planning and Research. *Technical Advisory on Evaluating Transportation Impacts in CEQA*. December 2018. http://opr.ca.gov/docs/20190122-743_Technical_Advisory.pdf

Table ##: Modeled Annual CO_2 Emissions and Vehicle Miles Traveled, by Alternative

Alternative	***CO_2 Emissions (Metric Tons/Year)***	***Annual Vehicle Miles Traveled***
Existing/Baseline 20XX	*XX*	*XX*
Open to Traffic 20XX		
No Build	*XX*	*XX*
Build Alternative 1	*XX*	*XX*
Build Alternative 2	*XX*	*XX*
20-Year Horizon/Design-Year 20XX		
No Build	*XX*	*XX*
Build Alternative 1	*XX*	*XX*
Build Alternative 2	*XX*	*XX*

Project analyses should also identify applicable policies from the local RTP/SCS and analyze whether the project is consistent with regional goals to reduce VMT, congestion and delay, and vehicle-related GHG emissions. The analysis should discuss how modal choice was considered in the early planning phases of the project and explain how transit-only or multi-modal alternatives were assessed and/or eliminated. Existing transit infrastructure and how it connects with the project should also be discussed.

For non-capacity-increasing projects, Caltrans guidance recommends performing a qualitative analysis that describes why an increase in operational GHG emissions is unlikely. Examples of projects that are likely to have minimal or no increase in operational GHG emissions are listed below. OPR's Technical Advisory includes additional example project types for reference. The Technical Advisory also notes that transit and active transportation projects, including all passenger rail projects, bus and bus rapid transit projects, and bicycle and pedestrian infrastructure projects, generally reduce VMT.[56]

- Pavement rehabilitation
- Shoulder widening
- Culvert/drainage/storm water work
- Landscaping
- Closed-circuit television (CCTV)
- Maintenance vehicle pullouts
- Minor curve corrections

Caltrans' Annotated Outlines further identify ramp metering and signalization projects as potentially eligible for a qualitative assessment of operational GHG emissions. The analysis should discuss traffic-soothing effects and the extent to which the signal or meter provides for smoother traffic flow. However, if the ramp or signal creates lengthy traffic queues, a quantitative emissions analysis should be conducted using CT-EMFAC.

[56] Governor's Office of Planning and Research. *Technical Advisory on Evaluating Transportation Impacts in CEQA*. December 2018. http://opr.ca.gov/docs/20190122-743_Technical_Advisory.pdf.

Project-level GHG Analysis for Construction Emissions

Construction GHG emissions must be calculated for all projects per the requirements of EO B-30-15. The Annotated Outlines call for using the Sacramento Metropolitan Air Quality Management District's Road Construction Emissions Model or the Caltrans Construction Emissions Tool (CAL-CET) to quantify the expected construction-related GHG emissions related to a proposed project.

The Road Construction Emissions Model requires users to enter information about the project, including:

- Project type (new road construction, road widening, bridge/overpass construction, or other linear project type)
- Project length and area
- Volume of soil and asphalt brought to or from the construction site
- Use of water trucks (for dust control)

Using these inputs and emission factors from EMFAC, the model calculates emissions resulting from the movement of construction equipment.

GHG Reduction Strategies in Environmental Documents

When environmental analyses determine that a project or program will result in significant GHG impacts, the impacts must be mitigated. Strategies to reduce GHG emissions generated during construction and operation of a transportation project must be specific and enforceable. The environmental analysis must describe, either quantitatively or qualitatively, the expected GHG reduction benefits of each measure. Due to the global nature of GHG emissions, mitigation to reduce an individual project's GHG impacts may be implemented on the project site or at an offsite location. Successfully reducing project-generated GHG emissions requires early consideration of relevant reduction measures and strategies, preferably during the initial project planning and design.

Caltrans Division of Environmental Analysis has developed lists of strategies that could be used for mitigating potentially significant GHG impacts from construction and operation of transportation projects.[57] Individual projects should carefully evaluate the feasibility of any reduction strategy before it is required as project-specific mitigation. In addition to project-specific reduction measures, Caltrans guidance also recommends discussing all applicable Standard Specifications, Standard Special Provisions, Nonstandard Special Provisions, and measures from other resource topics (e.g., air quality) that will reduce GHG emissions.

GHG Analysis Tools

Because of its responsibility to quantify GHG emissions as part of environmental documents, the Division of Environmental Analysis maintains the most comprehensive understanding of GHG emissions analysis tools and methods within Caltrans. Staff from the Division of Environmental Analysis actively

[57] Caltrans, GHG Reduction Measures Toolbox for Internal Use in Caltrans Project Development, January 2020.

monitor improvements to existing tools and development of new tools. The Division has compiled a list, summarized below, of GHG analysis tools current used by Caltrans in some form.

Table 11. GHG Emissions Analysis Tools Used by Caltrans

Tool Name	Developer	Description
Cal-B/C Tool	Developed by Caltrans Transportation Economics Branch and consultants	A PC-based spreadsheet model. Can be used to analyze many types of highway construction and operational improvement projects, some Intelligent Transportation System (ITS) and transit projects, bike and pedestrian projects, park-and-ride lots, and intermodal freight projects.
SB-1 Emissions Tools	Developed by Caltrans Transportation Economics Branch and consultants using similar methodology developed by the CARB for California Freight Investment Program	Excel-based tool that estimates emissions from changes in VMT, service-miles, ton-miles, and speeds. Users enter the input data and model will calculate emission reduction results. Tool should only be used to analyze projects that do not fall under any project category types in Cal-B/C tool.
SMAQMD Roadway Construction Emissions Model (RCEM)	Developed by Sacramento Air Quality Management District (SMAQMD)	Excel-based tool to estimate construction equipment emissions for roadway projects. Requires detailed project design and construction inputs to estimate construction equipment usage and the resulting emissions. The required information is mostly only available at the PA&ED or later phases of the project development process. Recommended for use on Caltrans projects for environmental analysis during PA&ED.
FHWA Carbon Infrastructure Estimator (ICE) tool	Developed by U.S FHWA	Excel-based tool that estimates the lifecycle energy and GHG emissions from the construction and maintenance of transportation facilities. Requires limited data inputs and is designed to inform planning and pre-engineering analysis. Allows users to create "ballpark" estimates of energy and GHG emissions using limited data inputs. Tool is current being updated and expanded as part of a pooled fund study. Caltrans uses ICE to calculate GHG Emission for 2018 and future SHOPP PIDS.
EMission FACtors (EMFAC)	Developed by CARB	The mobile source emission tool that CARB developed to assess emissions from on-road vehicles in California. EMFAC provides emission rates to calculate project emissions. EMFAC is required for air quality analyses in compliance with transportation conformity, NEPA, and CEQA as a part of the Environmental Document (PA&ED).

Tool Name	Developer	Description
CT-EMFAC	Developed by Caltrans Headquarter, Division of Environmental Analysis (HQ DEA), Air Quality Program	Caltrans DEA created the CT-EFMAC to expedite and streamline the efforts required to complete project-level emission analyses.
GHG Emissions Calculator	Developed by Caltrans HQ DEA, Air Quality Program	Excel-based tool to estimate GHG emissions from on-road vehicles in California. Because EMFAC2014 includes only CO_2 and CH_4 emission rates, the GHG Emission Calculator expand on EMFAC2014 data to include N2O, black carbon, and hydrofluorocarbons (HFCs).
Caltrans Construction Emissions Tool (CAL-CET)	Developed by Caltrans HQ DEA, Air Quality Program	Excel-based tool to estimate construction equipment emissions on Caltrans highway projects. The tool utilizes engineering economic principles based on construction Forced Account calculations to estimate equipment usages and the resulting emissions. CAL-CET was created based on data collected from Caltrans construction projects.
Climate Registry Information System (CRIS)	The Climate Registry	Online emissions calculator that converts energy, material, and fuel consumption into GHG emissions (CO_2e) using the latest international reporting protocols and emissions factors (IPCCC's Fifth Assessment Report). The tool includes all seven recognized GHG pollutants in their calculation of CO_2e. This is the required tool for Caltrans' annual GHG report to CalEPA – the "State Agency Greenhouse Gas Reduction Report Card".

Promoting Alternative Fuel Use on the State Highway System

In response to the Governor's ZEV Action Plan, Caltrans is installing EV charging for public use along the State Highway System. One part of this program is focusing on installation of DC fast charge stations at Department-owned, publicly accessible locations. Caltrans is developing 11 DC fast charging projects at 37 locations consisting of 49 individual charging units. The projects are located throughout the state at 28 safety roadside rest areas, 5 maintenance stations, 2 District offices, and 2 park-and-ride lots. The proposed DC fast charging locations will address gaps in the state's EV charging infrastructure, since the vast majority of fast charging stations are currently located in urbanized areas and do not serve long-distance travelers. Caltrans estimates that most of the units will be operational by summer or fall of 2020. Operational status will be dependent upon the ability of electric utilities to provide the needed electrical service upgrades.

Traffic Operations

Caltrans Traffic Operations Program performs a variety of activities intended to maximize the mobility and safety of travelers on the State Highway System. While these programs do not reduce VMT, when they result in smoother traffic flow and reduced delay, they can reduce GHG emissions. As discussed in Section 3.1 and illustrated in Figure 6, motor vehicles exhibit their lowest CO_2 emission rates around 40 mph. Vehicles in congested traffic, with queuing and stop-and-go conditions, produce much higher emissions per mile of travel, so systems operations improvements that reduce or eliminate these conditions can reduce GHG emissions. However, emission rates start to increase as speed increases above 40 mph, so not all delay reduction necessarily equates to GHG reduction.

The emissions impacts of traffic operations strategies are complex and not well understood. One reason for this is that evaluating the impacts of traffic operations strategies using controlled field experiments is difficult and costly. Thus, most studies use simulation models, which inherently raises questions about how well these models reflect actual conditions. In addition, when traffic operations strategies succeed in reducing delay, they can also induce new vehicle travel, which can potentially offset the emissions benefits of speed improvements.

The available research is insufficient to make definitive statements about the conditions under which traffic operations strategies will reduce emissions and by how much. Nearly all of the published research does not consider induced vehicle traffic effects, so reports of GHG emissions benefits are generally overstated.[58] The remainder of this section discusses some specific traffic operations programs at Caltrans and the available research on their GHG impacts.

Traffic Signal Management

Caltrans works to refine signal synchronization to improve traffic flow and reduce idling time. Caltrans Headquarters works with Districts to coordinate their signals. As individual signals are synchronized, they are connected to a central signal control system. Centralized signal control increases efficiency, as a decentralized system requires that GPS units maintain the timing on each individual signal. Using a remote traffic signal management surveillance system, Caltrans aims to control roughly 5,000 of its traffic signals remotely, which reduces the need for staff to physically go to a signal to monitor and improve signal timing, conduct maintenance, or fix failed signals.

The impact of traffic signal coordination on GHG emissions is highly context-specific and has not received extensive research attention. A meta-analysis conducted for CARB identified four studies that estimated GHG impacts of signal coordination, three of them outside the U.S.[59] The estimated GHG

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[58] Rodier, Caroline, Susan Handy, and Marlon Boarnet, "Impacts of Traffic Operations Strategies on Passenger Vehicle Use and Greenhouse Gas Emissions, Technical Background Document, Prepared for the California Air Resources Board, 2014. https://ww2.arb.ca.gov/sites/default/files/2020-06/Impacts_of_Traffic_Operations_Strategies_on_Passenger_Vehicle_Use_and_Greenhouse_Gas_Emissions_Technical_Background_Document.pdf

[59] Rodier, Caroline, Susan Handy, and Marlon Boarnet, "Impacts of Traffic Operations Strategies on Passenger Vehicle Use and Greenhouse Gas Emissions – Policy Brief," 2014. https://ww3.arb.ca.gov/cc/sb375/policies/tsm/tos_brief.pdf

reductions ranged from 1 to 10 percent. Note that none of these studies considered the potential for induced vehicle travel.

Ramp Metering

Caltrans uses ramp metering to improve freeway traffic flow in many congested corridors. Caltrans is currently seeking to increase use of adaptive ramp metering, whereby ramp meters are adjusted dynamically in response to traffic conditions, as opposed to pre-timed or fixed time rates. This feature allows system managers to actively control the rate of vehicles entering the freeway and prevent back-up queues from spilling onto local roads.

The effects of ramp metering on fuel consumption and GHG emissions are complex and not well understood. When ramp metering improves highway traffic flow by eliminating bottlenecks around entrance ramps, the result will be a reduction in GHG emission rates for vehicles on the highway. However, ramp metering can cause an increase in stop-and-go traffic at the ramps, increasing emissions and fuel consumption. Furthermore, by improving highway travel speeds, ramp metering has the potential to induce new vehicle traffic (discussed in Section 3.1), which could offset GHG emissions benefits of traffic flow smoothing. The net GHG emissions impact resulting from these different effects will vary from project to project, making it difficult to generalize about the GHG impacts of ramp metering.

Bay Area Ramp Meter (source: MTC)

Very few research studies have reported on the system-wide GHG emissions impacts of ramp metering. One of the only such studies used simulation modeling to estimate the CO_2 emissions effects of ramp metering on a South Korean highway, finding a 7.3 percent emission reduction.[60] However, this study

[60] Bae S., T. Heo, and B. Ryu. “An Evaluation of the Ramp Metering Effectiveness in Reducing Carbon Dioxide Emissions,” Society for Modeling and Simulation International, Korea, 2012.

did not consider induced vehicle travel. A meta-analysis conducted for CARB identified no other relevant research and noted that any reported impacts could not be generalized beyond the particular region or time period of the study.[61]

Traffic Incident Management

Caltrans works with the California Highway Patrol and local and regional transportation agency and public safety partners to implement traffic incident management programs in the state's large metropolitan areas. Traffic incident management programs are intended to quickly respond to vehicle crashes and other highway incidents. Clearing a freeway following an incident will reduce the associated congestion and vehicle emissions. FWHA estimates that about half of all congestion is non-recurrent congestion attributable to temporary disruptions, and one-quarter is caused by traffic incidents in particular.[62]

Like other traffic operations strategies, the GHG emissions impacts of traffic incident management programs are not well understood. Research typically relies on traffic simulation models to estimate the impact of incidents on traffic speeds, and the corresponding benefits of more rapid incident clearance. A meta-analysis conducted for CARB identified three studies that estimated GHG impacts of incident management programs, with fuel use or GHG benefits ranging from 0.07 percent to 4 percent.[63] The most relevant of these studies examined clearance of lane blockages on a highway corridor in Montgomery County, Maryland, during the AM peak, finding a 4 percent reduction in CO_2 emissions.[64] MTC claims its freeway service patrol program reduces "auto carbon emissions by approximately 67,000 tons annually".[65] The existing research on incident management program impacts does not consider induced vehicle travel, and therefore likely overstates GHG benefits.

Roundabouts

Caltrans' Intersection Control Evaluation policy encourages consideration of roundabouts. Historically, if an uncontrolled intersection experienced a history of collisions, the default approach was to install a traffic signal. Now, Caltrans considers the intersection needs more holistically, which could involve a variety of options. One result is the more frequent use of roundabouts. Roundabouts can offer several benefits over signalized intersections in some circumstances. They can reduce the number and severity of crashes, eliminating head-on or broadside collisions.[66] Roundabouts can also reduce maintenance costs because they do not require periodic retiming or electrician visits in the event of a signal outage.

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[61] Rodier, C., Handy, S., and Boarnet, M., Impacts of Traffic Operations Strategies on Passenger Vehicle Use and Greenhouse Gas Emissions – Policy Brief, 2014. https://ww3.arb.ca.gov/cc/sb375/policies/tsm/tos_brief.pdf
[62] FHWA, https://ops.fhwa.dot.gov/program_areas/reduce-non-cong.htm
[63] Rodier, C., Handy, S., and Boarnet, M., Impacts of Traffic Operations Strategies on Passenger Vehicle Use and Greenhouse Gas Emissions – Policy Brief, 2014. https://ww3.arb.ca.gov/cc/sb375/policies/tsm/tos_brief.pdf
[64] Avetisyan, H. G., Miller-Hooks, E., Melanta, S., & Qi, B. (2014). Effects of vehicle technologies, traffic volume changes, incidents and work zones on greenhouse gas emissions production. Transportation Research Part D: Transport and Environment, 26, 10-19.
[65] MTC, Bay Area Freeway Service Patrol, www.fsp-bayarea.org/About-us
[66] FHWA, Office of Safety, "Roundabouts" https://safety.fhwa.dot.gov/intersection/innovative/roundabouts/

Roundabout on Route 138 in Palmdale

The GHG emissions impacts of roundabouts depends on how the devices affect traffic flow, particularly traffic speeds, acceleration, and deceleration. The emissions impacts also depend on what a roundabout is compared against: an uncontrolled intersection, stop signs, or traffic signals. Because they create less vehicle delay and idling, roundabouts have the potential to lower fuel use and emissions in some cases. Available research suggests that roundabouts can reduce emissions in some circumstances but increase emissions in others. A study in Sweden found that replacement of a signalized intersection with a roundabout reduced fuel consumption by 28 percent, but a study in Maryland found a 5 percent fuel increase and a 1 percent CO_2 increase from a similar replacement. A meta-analysis conducted for CARB concludes: "Given the wide range of estimated impacts, it is not possible to conclude that roundabouts will reduce fuel consumption and GHG emissions in all cases."[67]

Other Traffic Operations Strategies

Caltrans has a variety of other strategies to improve traffic flow, including:

- Reversible lanes, which Caltrans is testing along the Coronado Bridge on I-15 in San Diego.
- Work zone strategies to reduce traffic delay.
- Working with a private vendor, Pre-Pass, Caltrans allows heavy vehicles that are preregistered to bypass open weigh stations legally. Doing so reduces truck delay at these stations and the associated emissions.
- Integrated corridor management (ICM), which uses advanced technology to monitor and actively manage traffic through an entire highway corridor. Key features of ICM can include adaptive ramp metering, incident management, enhanced traffic signal control, transit signal priority, and system integration
- Traveler information systems, which enable drivers to select routes and travel times to avoid unnecessary delay. The Caltrans QuickMap is a web page and mobile app that presents several types of real-time traffic information layered on a Google Map, including traffic speed, lane and

[67] Handy, Susan and Marlon Boarnet, "Impacts of Roundabouts on Passenger Vehicle Use and Greenhouse Gas Emissions: Policy Brief," Prepared for the California Air Resources Board, 2014. https://ww3.arb.ca.gov/cc/sb375/policies/rndabt/roundabout_brief.pdf

road closures due to construction and maintenance activities, incident reports, changeable message sign content, camera snapshots, and active chain control requirements.

There is little to no information on the GHG impacts of these types of traffic operations strategies.

4 Reducing Emissions from Caltrans Internal Operations

Caltrans has the vast responsibility of planning, designing, building, operating, and maintaining the State Highway System – a network of more than 50,000 lane miles and more than 12,000 bridges. To carry out these activities, Caltrans employs more than 19,000 workers, many located in the Caltrans Sacramento Headquarters or in one of the 12 District offices. Other staff work from the approximately 250 Caltrans maintenance stations, equipment shops, and transportation management centers. Caltrans operates a fleet of more than 7,000 automobiles and light trucks and more than 1,000 heavy-duty vehicles. Caltrans also operates 86 Safety Roadside Rest Areas across the State. These activities and facilities offer numerous opportunities to reduce GHG emissions resulting from Caltrans own internal operations.

Caltrans has been working to conserve energy and natural resources for more than three decades. The Department has already taken a variety of actions that reduce GHG emissions from its internal operations, including deploying electric vehicles and other alternative fuels in its fleet, installing energy efficient lighting along roadways and in buildings, generating renewable energy with solar power, conserving water, and using recycled materials.

Actions that can achieve additional GHG emission reductions primarily involve expansion of or modification to existing efforts, including:

- Increasing renewable energy generation, focusing on solar power in the highway right-of-way
- Using the latest pavement lifecycle assessment research to modify highway construction and maintenance practices to maximize GHG reduction
- Reducing emissions associated with employee commuting by offering more attractive programs and incentives to encourage travel by less carbon-intensive modes

The remainder of this section describes actions to reduce Caltrans internal operations emissions – both on-going activities and opportunities for additional reductions. The descriptions are organized according to major Caltrans functional areas:

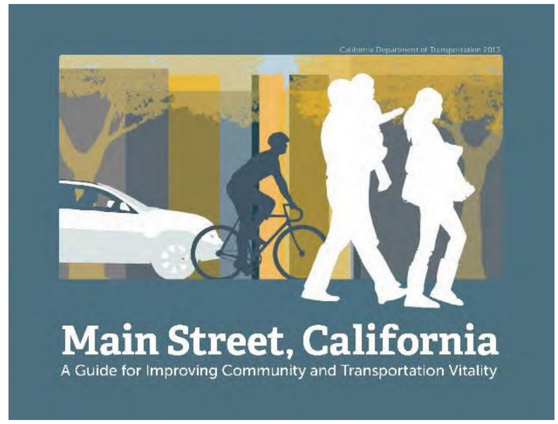
- Design and Construction
- Pavements
- Maintenance
- Vehicle Fleet and Equipment
- Facilities and Administration

Where possible, the report provides estimates of the magnitude of GHG emission reductions associated with recent and on-going activities.

4.1 Design and Construction

Caltrans oversees the design and construction of projects on the State Highway System. The Division of Design develops standards and guidance for highway system improvements, often working closely with other Caltrans divisions. The Division of Construction administers roughly $8 billion worth of construction contracts. A variety of design and construction efforts reduce GHG emissions by supporting multi-modal travel that can reduce VMT, promoting the use of construction materials with lower carbon intensity, and encouraging more energy efficient construction techniques.

Design to Encourage Complete Streets



Caltrans Highway Design Manual (HDM) has been has been updated several times in recent years to facilitate the design of complete streets. The Division of Design also led the creation and update of *Main Street, California: A Guide for Improving Community and Transportation Vitality*. The Main Street guide promotes flexible design of state highways that serve as local main streets. The guide describes planning and design strategies to improve community livability through the creation of a high-quality public realm that supports economic vitality, ecological quality, and community quality of life. *Main Street, California* highlights design options that are compatible with established traffic engineering and design practices, policies, and standards.

Caltrans endorsed the *National Association of City Transportation Officials (NACTO) Urban Street Design Guide* in 2014.[68] In the endorsement, Caltrans stated that the "endorsement of the NACTO guidelines is part of an ongoing effort to integrate a multimodal and flexible approach to transportation planning and design."

Caltrans has recently made some changes to its design exceptions process to more overtly encourage flexible design. For example, recent changes to the HDM included replacing the nomenclature for "mandatory" and "advisory" standards with boldface and underlined standards, respectively. The HDM update also replaced the Design Exception Fact Sheet with a Design Standard Decision Document.

Contracting Methods to Encourage Use of Clean Equipment

Caltrans' Office of Innovative Design and Delivery develops and tests alternative contracting techniques. For instance, contracts could be awarded based on contractors' ability to meet sustainability criteria such as GHG emission reduction.

As one example of this approach, Caltrans initiated a pilot program to promote Tier 4 low emission construction equipment. Tier 4 is the most stringent U.S. EPA emission standard off-road diesel equipment. The standards took full effect in 2015 and require significant reductions in NOx and PM emissions from new off-road equipment engines. However, most construction equipment in use today

[68] Caltrans (April 11, 2014). "Caltrans Backs Innovative Street Design Guides to Promote Biking and Walking."

was manufactured before 2015 and therefore does not meet the Tier 4 standard. Caltrans' pilot program was intended to accelerate deployment and use of Tier 4 equipment.

Under the pilot program, project RFPs were released that asked contractors to respond with one bid that includes Tier 4 equipment and one that does not. This was intended to enable Caltrans to quantify the incremental cost of using Tier 4 equipment. Two projects under this pilot have already been initiated, one in District 6 and one in District 8. The contractors agree to exclusively use Tier 4 equipment on the project, or otherwise pay a penalty of $2,000 per day per piece of non-compliant equipment operated.

Since the Tier 4 emission standard focuses on NOx and PM emissions and does not affect GHG emissions, this current pilot program does not achieve significant GHG reductions. However, the pilot serves as a model that, in theory, could be replicated for GHG reductions. For example, Caltrans could issue construction project RFPs that specify use of alternative fuels (e.g., renewable diesel) or battery electric or hybrid-electric equipment (if available).

Construction Methods and Specifications

Caltrans has advanced several construction methods that improve efficiency and thereby reduce fuel consumption and GHG emissions.

Automated Machine Guidance

Caltrans established requirements for contractors to create three-dimensional models of large construction projects. The contractors then use these models to plan how their equipment will be operated and to program the construction equipment. Using GPS, the construction equipment can execute the project, following the 3-D models, with little human intervention. This approach is called Automated Machine Guidance (AMG). AMG results in faster construction of projects and reduced equipment idling time, which reduces GHG emissions. Prior to using AMG, equipment would idle while survey crews were putting stakes in the ground; this is no longer necessary. The model also enables contractors to more efficiently plan for material movement, rather than stockpiling materials in one spot then moving them out to different locations.

Grader equipped with AMG

Intelligent Compaction

When paving roads, Caltrans has historically had an operator running a compactor for pre-specified number of passes. Caltrans has approved a new procedure called Intelligent Compaction that utilizes a GPS system and temperature sensors attached to the compactor rollers, which can determine precisely how many passes are needed to adequately compact the pavement. The result is more efficient use of the compactor equipment compared to the traditional static rollers. This reduces the time associated with compaction, and also reduces fuel consumption and associated GHG emissions. Another benefit of this strategy that it achieves optimum pavement density to ensure long lasting roadway performance.

In 2014, Caltrans developed two new specifications to allow use of intelligent compaction for construction of hot mix asphalt (HMA) and Cold In Place Recycling (CIR). Since then, dozens of Caltrans projects have used this technique, and it is expected to become standard practice in the near future.

Intelligent Compaction Retrofit Equipment Evaluation- El Dorado Hills, CA 2014

Field Engineer Tablet Pilot Study

Caltrans conducted a pilot project to evaluate the use of mobile devices (tablets) in the construction administration process. Use of tablet computers provides a substitute for hardcopy engineering drawings kept in the project field office, allowing the engineers to spend more time in the field and less time traveling back to an office to retrieve plans, which reduces VMT. For the pilot, tablets were deployed on eight contracts. The goal of the pilot was to evaluate the potential for tablets to improve staff performance, increase transparency, and incorporate sustainability into current construction practices. A report on the pilot estimates that, if tablets were used on all Caltrans construction contracts, the annual GHG savings would total 1,450 tons.[69]

Accelerated Bridge Construction

Accelerated bridge construction (ABC) uses innovative planning, design, materials, and construction methods to reduce the onsite construction time to build new bridges or rehabilitate existing bridges.[70] The benefits of ABC include: reduced mobility impacts to motorists; enhanced safety to motorists and construction personnel; reduced environmental impacts; reduced construction impacts to local communities; and potential improvement to construction quality. ABC can involve a range of methods that can be categorized as follows:

- Prefabricated Bridge Elements and Systems (PBES), which are bridge structural components that are fabricated offsite, or near-site of a bridge, and include features that reduce the onsite construction time and mobility impact time compared to conventional construction methods.[71]
- Geosynthetic Reinforced Soil-Integrated Bridge System (GRS-IBS), which comprises components such as reinforced soil foundation, abutment, and integrated approach, and involves use of alternating layers of compacted granular fill and geosynthetic reinforcement to enable bridge loads that are significantly higher than designed with predictable and reliable performance.[72]
- Structural placement methods, such as self-propelled modular transporters (SPMT) and slide-in bridge construction, to facilitate rapid placement and positioning of the bridge.[73]
- Ultra-High Performance Concrete (UHPC) Connections for PBES. UHPC is defined as steel fiber-reinforced, portland cement-based concrete – an advanced composite material that delivers enhanced performance compared to conventional concrete mixtures. Benefits of using field-cast

[69] Caltrans Division of Construction, "Report on Mobile Device Pilot Project," April 2017.
[70] FHWA. Accelerated Bridge Construction. www.fhwa.dot.gov/bridge/abc/.
[71] FHWA. Prefabricated Bridge Elements and Systems. www.fhwa.dot.gov/bridge/prefab/.
[72] FHWA. Geosynthetic Reinforced Soil-Integrated Bridge System. www.fhwa.dot.gov/innovation/everydaycounts/edc-3/grs-ibs.cfm.
[73] FHWA. Structural Placement Methods. www.fhwa.dot.gov/bridge/abc/structural.cfm.

UHPC to create connections between prefabricated concrete components includes improved speed and simplicity of construction.[74]

Since most of the ABC technologies involve partial or complete fabrication of bridge components off-site in a fabrication facility staging area near the site, they eliminate the need for temporary bridges and additional right of way, as well as deep/pile foundations that are abrasive to the environment and could result in increased GHG emissions due to equipment usage. FHWA estimates indicate that since October 2010, more than 800 bridges have been designed or constructed using PBES, and over 80 bridges using GRS-IBS (eight on the National Highway System and 75 off the National Highway System). In addition, several states have successfully completed bridge installations using slide-in bridge construction.[75]

Caltrans has successfully implemented ABC technologies on several projects. Examples include use of SPMTs on the 2014 Highgrove project in San Bernardino County and use of longitudinal launch to facilitate the emergency replacement of the Pfeiffer Canyon Bridge on Highway 1 in Big Sur (pictured below).

Pfeiffer Canyon Bridge Launch
(Source: Monterey Herald)

Precast Concrete Pavement System

Like PBES, Precast Concrete Pavement System (PCPS) technology involves an off-site fabrication approach that allows for construction of lighter, thinner, or more durable pavement sections through more stringent quality control and the use of design details not feasible for in-place construction. The applications of PCPS include isolated intermittent repairs, intersection and ramp rehabilitation, pavement replacement under overpasses, and construction of longer mainline pavement segments. PCPS technology can aid in faster construction while maintaining pavement quality, and help minimize

[74] FHWA. Ultra-High Performance Concrete Connections for PBES. www.fhwa.dot.gov/innovation/everydaycounts/edc_4/uhpc.cfm.
[75] FHWA. www.fhwa.dot.gov/innovation/everydaycounts/edc-2/pdfs/edc_abc.pdf.

lane closures and traffic disruption, in turn reducing GHG emissions. The advantages of PCPS over traditional cast-in-place methods include: shorter installation time; improved concrete curing conditions; reduced weather restrictions on placement; reduced delay before opening to traffic; elimination of construction-related early-age failures; and longer-life performance compared to traditional cast-in-place methods.[76]

Precast Concrete Pavement Installation
(Source: Kirsten Stahl, Caltrans)

PCPS has been effectively implemented across 25 states, including California; however, the technique is still not widely used. To date Caltrans has developed standard plans and specifications for intermittent repairs, jointed precast pavements (PCP), and prestressed PCP. The Department has implemented PCPS across in several Districts, such as the use of a series of 36-ft prestressed panels placed on a rapid-set lean concrete base and posttensioned to replace long sections of I-680 in District 4, and installation of over 2,300 California Rapid Roadway system panels along Highway 101 in District 7 through downtown Los Angeles.[77]

The GHG benefits of PCPS result primarily from the reduction traffic disruption and delay, and therefore are highly context-specific. There is little research available on the GHG impacts of this strategy.

[76] FHWA. Precast Concrete Pavement Systems. www.fhwa.dot.gov/goshrp2/Solutions/Renewal/R05/Precast_Concrete_Pavement

[77] Tayabji, S., and Brink, W. *Precast Concrete Pavement Implementation by US Highway Agencies*. Report No. FHWA-HIF-16-007). FHWA, Washington DC. 2015.

4.2 Pavements Strategies

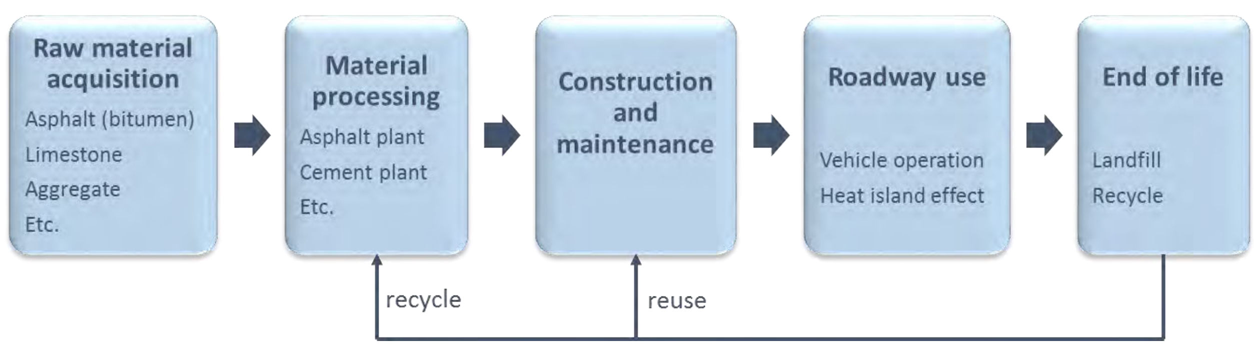
Millions of tons of asphalt and concrete are used in Caltrans roadway and bridge projects every year. As noted in Section 2, the materials used in Caltrans highway construction and maintenance projects account for roughly 2.5 million metric tons of emissions annually, considering raw materials extraction, materials processing, material transport, and construction activities. There are numerous opportunities to reduce the GHG emissions associated with pavements by using alternative materials and modifying construction and maintenance practices. Because of the large volume of pavement materials used by Caltrans, even small changes can result in significant GHG reductions for the state. By virtue of its leadership role in highway design and maintenance, Caltrans also influences the pavement decisions of local transportation agencies, which can lead to additional GHG reductions. This section describes GHG reduction opportunities associated with pavements. Note that some of these opportunities (e.g., alternative concrete mixes) can apply to structures in addition to roadway pavements.

Overview of Pavement GHG Reduction Strategies

A life cycle assessment (LCA) approach is needed to understand the full GHG impacts of pavements. As discussed in Section 2, a LCA for GHG emissions (sometimes called a "carbon footprint") accounts for all materials, activities, and GHG emissions that result from a pavement decision. The activities can be grouped into the following five phases, illustrated in the figure below:[78]

- **Raw material acquisition** – includes mining or extraction of bitumen, aggregate, and limestone.
- **Material processing** – includes the production of cement, asphalt, steel, and other materials
- **Construction and maintenance** – includes equipment used at the site and transport of material to the site
- **Roadway use** – includes the emissions from vehicles operating on the roadway, which are affected by pavement smoothness
- **End of life** – includes the disposal of pavement at the end of its life, including recycling and reuse

Figure 9. Phases in Pavement LCA



[78] Harvey, John, Alissa Kendall, and Arash Saboori, "The Role of Life Cycle Assessment in Reducing Greenhouse Gas Emissions from Road Construction and Maintenance," National Center for Sustainable Transportation, July 2015. https://ncst.ucdavis.edu/white-paper/ucd-dot-wp1-2/

Pavement LCA is a complex and active field of research. Until recently, decisions regarding sustainable pavements often focused only on the raw material acquisition, material processing, and construction phases. But the roadway use phase can have major implications for the total GHG impacts, particularly for high-volume roadways. For this reason, a more holistic LCA approach is needed. The UC Davis Pavement Research Center supports Caltrans efforts to better understand pavement sustainability issues and improve pavement decisions.

Federal, state, and local transportation agencies spend millions of dollars annually to reduce or eliminate highway pavement distresses (both functional and structural), and have maintenance strategies and programs in place to ensure highway pavement networks operate at higher smoothness levels. Smoother pavements not only ensure safer highway networks, they also help reduce pavement-vehicle tire friction, and thereby reduce overall fuel consumption and resulting GHG emissions. Effective pavement maintenance and rehabilitation strategies (e.g., overlay, recycling, grinding, sealing) and timely interventions can enable Caltrans to achieve desired pavement smoothness thresholds.

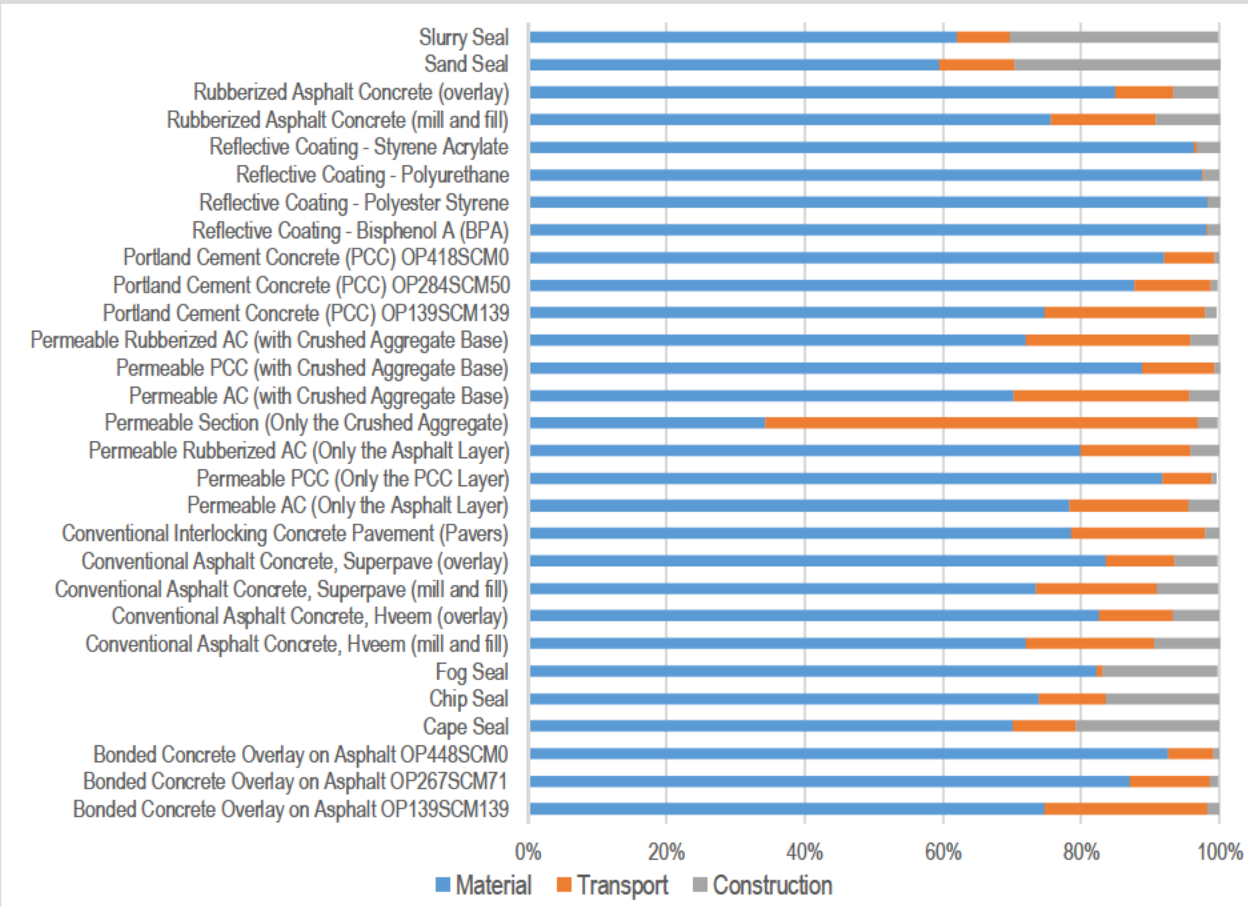
The GHG benefits of pavement smoothness can be substantial. One research study, funded by Caltrans, suggests that Caltrans could achieve an annual GHG reduction of 0.57 to 0.82 million metric tons across the entire State Highway System simply through the strategic application of maintenance and rehabilitation treatments that minimize roughness. This study used a life-cycle analysis approach that considered material acquisition, processing, and construction phases, as well as vehicle use.[79]

Alternative pavement materials and techniques have been shown to yield substantial energy and GHG reduction. The most promising additional GHG reduction opportunity for Caltrans for asphalt pavements appears to be greater use of reclaimed asphalt pavement (RAP). For concrete pavements, the greatest additional GHG reduction opportunities appear to be greater use of supplemental cementitious materials (SCMs). However, the net effect of different pavement options is complex and often dependent on the project context. For example, RAP may not be advantageous if the recycled material is not locally sourced.

Pavement options differ substantially in terms of the contribution of the different lifecycle phases to the total GHG impact, as illustrated in the figure below. Considering just the materials acquisition and processing, materials transport, and construction phases, this figure shows, for a variety of pavement treatments, the portion of lifecycle GHG emissions resulting from each of these three phases. For example, more than 90 percent of GHG emissions for Portland cement concrete comes from the materials phase, while for treatments like chip or slurry seal, only 60 to 70 percent of emissions are associated with materials.

[79] Wang, T., Harvey, J. and Kendall, A., "Reducing greenhouse gas emissions through strategic management of highway pavement roughness," Environmental Research Letters, 9(3), p.034007. 2014. https://iopscience.iop.org/article/10.1088/1748-9326/9/3/034007/pdf

Figure 10. Relative Contribution to Global Warming Potential of Pavement Materials, Transport, and Construction Phases



Source: Levinson, R., Gilbert, H., Ling J., Mandel, B., Millstein, D., Rosado, P., Harvey, J., Kendall, A., Li, H., Saboori, A., Lea, J., Ban-Weiss, G., Mohegh, A., and Santero, N. "Life-Cycle Assessment and Co-Benefits of Cool Pavements," Prepared for the California Air Resources Board and the California Environmental Protection Agency. Contract # 12-314. 2017.

Asphalt Pavements

Asphalt is the most common paving material in the state. Laying asphalt requires a binder—typically bitumen, a petroleum product. It also generally requires heating the asphalt, which requires energy and results in GHG emissions. A variety of alternative asphalt pavement techniques can result in lower GHG emissions.

Warm-Mix Asphalt

Warm Mix Asphalt (WMA) is a group of asphalt concrete mixture technologies that allow for retention of properties and performance of traditional hot mix asphalt (HMA) at reduced production, placement, and compaction temperatures. While production temperatures of traditional HMA range from 280 ˚F to 320 ˚F, production temperatures of WMA are typically between 212 ˚F and 280 ˚F. WMA technologies could comprise organic additives/waxes, chemical additives/surfactants, and foaming processes that use water. Reduction in production temperatures using WMA technologies allows for benefits such as energy savings, reduced fuel consumption, reduced GHG emissions, reduced worker exposure, enhanced compactability and durability, improved temperature uniformity, longer hauling distances, and cold weather paving ability. Introduced in Europe in the late 1990s, WMA has since found extensive use across U.S. and Europe, primarily with an intent to reduce energy and provide workers with a safer work environment.[80]

Asphalt Mixtures by Temperature Range

(Source: Fleming, M.H., Introduction to Warm-Mix Asphalt, PennDOT)

Per FHWA estimates, WMA is currently used in more than 40 states.[81] In California, WMA technologies are used for various applications that include field test sections, accelerated pavement testing, and associated laboratory testing. Generally, however, the volume of WMA on Caltrans projects is very small compared to the volume of HMA (less than 5 percent). Caltrans approved WMA technologies include additive and water injection/foamed technologies, which can be used for Type A HMA, RHMA-G (rubberized hot mix asphalt), and OGFC (open graded friction course). Caltrans' inspection process requires that WMA surface temperatures and roller passes be documented and reported to ensure that compaction operations conform to method specification requirements.

As mentioned, one of the significant benefits associated with use of WMA is GHG emissions reduction. Estimates indicate that WMA production results in 25 to 50 percent energy savings, and that 20 to 35 percent energy savings in WMA production translates to a reduction of 4.1-5.5 kg of CO_2 equivalent per

[80] Bonaquist, R.F. *Mix Design Practices for Warm Mix Asphalt*. NCHRP Report 691. Transportation Research Board, 2011. www.trb.org/Publications/Blurbs/165013.aspx

[81] Williams, B.A., Copeland, A., and Ross, C.T. Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage: 2017, Informational Series 138 (8th edition). FHWA, 2017.

ton of WMA.[82] [83] [84] A reduction of HMA production temperature by 68˚F (i.e., production temperature of WMA) could potentially reduce combined CO_2 emissions resulting from fuel and asphalt binder use by about 44 percent.[85]

Reclaimed Asphalt Pavement

Reclaimed asphalt pavement (RAP) refers to recycled or reprocessed pavement material components (asphalt binder and aggregates) that are used to partially replace virgin materials within asphalt concrete mixtures. FHWA estimates indicate that in 2017, more than 76 million tons of RAP was used in asphalt mixtures, which translates to over 3.8 million tons (21.5 million barrels) of asphalt binder conserved, and more than 72 million tons of virgin aggregate replaced.[86] Aggregative savings through use of RAP provides benefits such as conservation of natural resources, lower material and transportation costs, reduced waste disposal, reduced haul distances, reduced energy consumption, and reduced GHG emissions.

In 2009, Caltrans started to allow up to 15 percent RAP in HMA (by aggregate weight), which was increased to 25 percent by aggregate weight in 2013, along with a maximum binder replacement of 25 percent for the surface course (upper 0.2 foot of HMA, exclusive of the open-graded friction course) and 40 percent for lower courses. Caltrans currently allows for use of up to 100 percent RAP in pavement base layers (asphalt treated bases), and is evaluating options to allow 30-40 percent RAP usage to replace HMA in pavement surface layers.

Estimates indicate that use of 15 percent or higher RAP in traditional HMA reduces asphalt binder requirement by about 12 percent and virgin aggregate by about 15 percent, thus resulting in GHG emission reduction at a rate of 5 pounds GHG per ton of RAP used in HMA.[87] Use of RAP, particularly in WMA (since WMA allows for increased use of RAP compared to traditional HMA), is found to yield significant GHG emission reduction benefits. Adding 15 percent RAP for a 2-inch surface course of WMA and 25 percent RAP for a 4-inch base course layer of WMA can result in significant energy savings related to reduced fuel usage (approximately a quarter gallon of diesel fuel per square meter of pavement), which translates to a GHG reduction of 2.4 kg CO_2 per square meter of pavement.[88] [89] It is

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[82] European Asphalt Pavement Association (EAPA) (2010) EAPA Position Paper on the Use of Warm Mix Asphalt. www.eapa.org/usr_img/position_paper/the_use_of_warm_mix_asphalt_january_2010.pdf

[83] Croteau, J.-M. and Tessier, B. (2008) Warm Mix Asphalt Paving Technologies: A Road Builder's Perspective. www.colascanada.ca/uploads/colascanada/File/expertise/WarmMixAsphaltPavingTechnologies.pdf

[84] Tutu, K.A. and Tuffour, Y.A. Warm-mix asphalt and pavement sustainability: a review. *Open Journal of Civil Engineering*, *6*(02), p.84. 2016.

[85] Keches, C. and LeBlanc, A., Reducing Greenhouse Gas Emissions from Asphalt Materials. BSc. Thesis, Worcester Polytechnic Institute, Worcester, 2007.

[86] Williams, B.A., Copeland, A., and Ross, C.T. Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage: 2017, Informational Series 138 (8th edition). FHWA, 2017.

[87] Pavement Management Report 2015. County of Riverside Transportation Department

[88] Croteau, J.-M. and Tessier, B. (2008) Warm Mix Asphalt Paving Technologies: A Road Builder's Perspective. http://www.colascanada.ca/uploads/colascanada/File/expertise/WarmMixAsphaltPavingTechnologies.pdf

[89] Tutu, K.A. and Tuffour, Y.A. Warm-mix asphalt and pavement sustainability: a review. *Open Journal of Civil Engineering*, *6*(02), p.84. 2016.

estimated that a use of 25 percent RAP in WMA could result in lifecycle GHG emissions reduction of around 15-20 percent.[90]

Rubberized Asphalt Pavement

Terminal Blending Process for Rubberized Asphalt

Since 1960s, recycled tire rubber has been used in asphalt paving. Rubberized asphalt pavement includes use of recycled tire rubber as a modifier for asphalt binders and as an additive for asphalt concrete mixtures. The rubberized asphalt production process is carried out at higher mixing temperatures, but use of WMA technology along with rubberized asphalt can help reduce mixing temperatures and improving mixture compaction and workability, resulting in approximately 20–25 percent of fuel savings. In addition, energy consumption for rubberized asphalt is typically lower than the traditional HMA during maintenance phase. Benefits of using rubberized asphalt pavement include reduced pavement noise levels, cold temperature paving, safer worker environment, reduced waste disposal, energy savings, and reduced GHG emissions. GHG emissions from the production and construction of rubberized asphalt mixtures are akin to HMA.[91] [92] According to staff in the Caltrans pavement program and UC Davis researchers, the net lifecycle GHG impact of using rubberized asphalt in Caltrans projects is unclear and requires further research.

Caltrans has been using rubberized hot mix asphalt (RHMA) to resurface roadways since the 1970s, and state policy has turned best practices into requirements. AB 338 requires Caltrans to use at least 15 percent crumb rubber in 35 percent of asphalt pavements, as illustrated in the figure below. Caltrans works to implement AB 338 in partnership with CalRecycle, which works to keep tires out of the waste stream.[93] Per Public Resource Code section 42703(a)(3) requirements, Caltrans is required, on average, to annually use no less than 11.58 pounds of crumb rubber modifier (CRM) per metric ton of the total amount of asphalt paving materials used.[94]

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[90] National Asphalt Paving Association (NAPA) (2009) Black and Green: Sustainable Asphalt, Now and Tomorrow. Special Report Number 200. National Asphalt Paving Association, Lanham. http://www.hotmix.org/images/stories/sustainability_report_2009.pdf

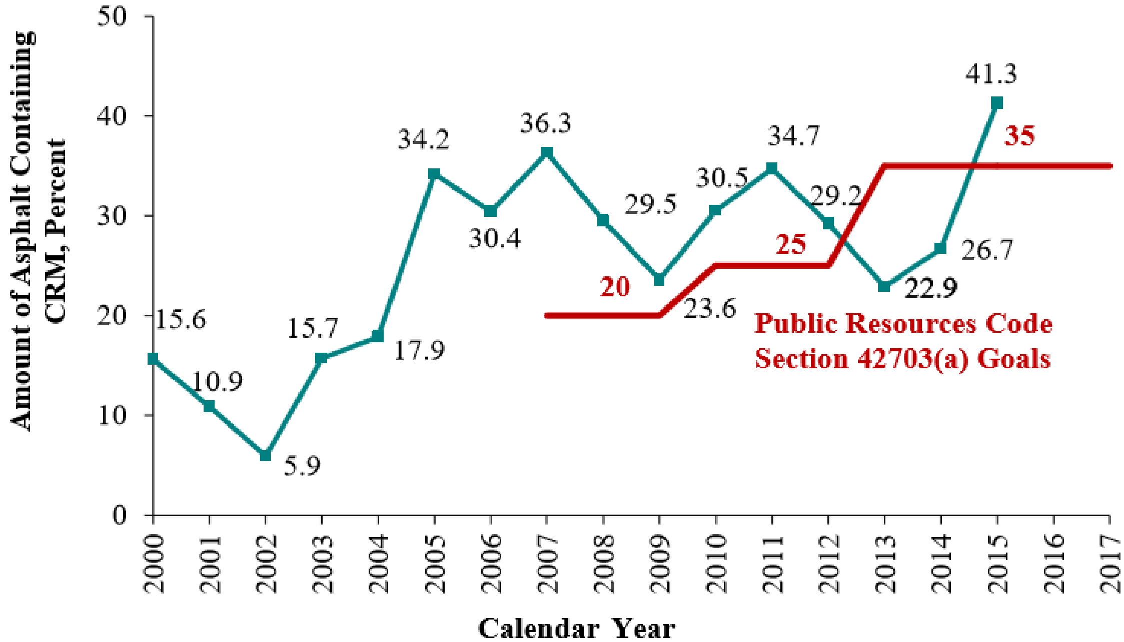
[91] FHWA. The Use of Recycled Tire Rubber to Modify Asphalt Binder and Mixtures. Technical Brief. FHWA-HIF-14-015. FHWA, Washington DC. 2014.

[92] Wang, T., Xiao, F., Zhu, X., Huang, B., Wang, J. and Amirkhanian, S. Energy consumption and environmental impact of rubberized asphalt pavement. Journal of Cleaner Production, 180, pp.139-158. 2018.

[93] California Legislative Information, AB 338 – Recycling: crumb rubber. http://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=200320040AB338

[94] 2015 Crumb Rubber Report. Public Resources Code Section 42703. California Department of Transportation.

Figure 11. Caltrans Annual Use of Asphalt Containing Crumb Rubber Modifier

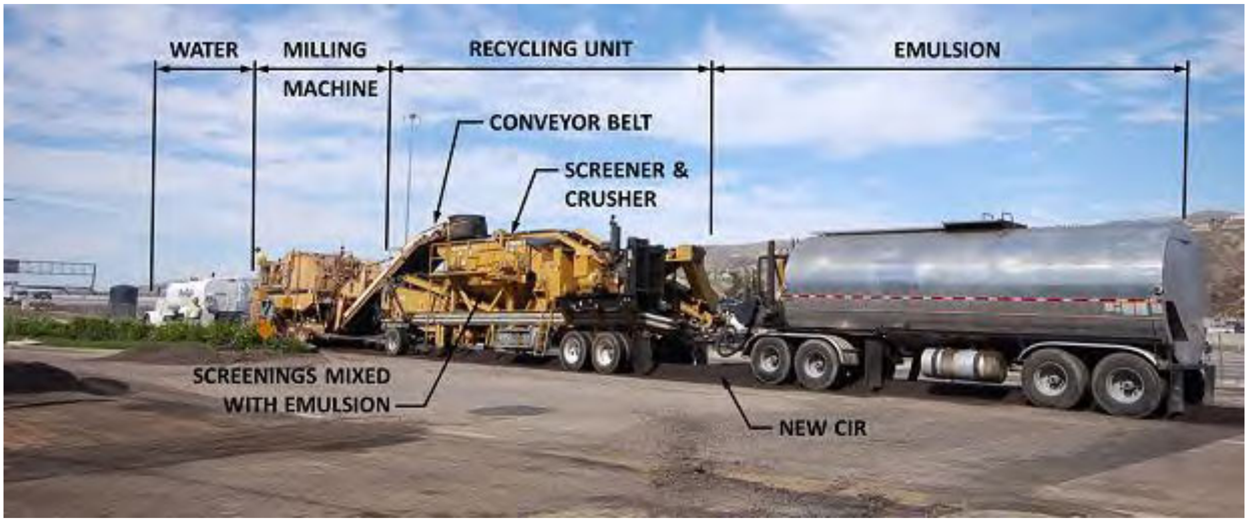


Cold In-Place Recycling

Cold in-place recycling (CIR) involves partial depth removal of pavement surface, including pulverization of a portion of the asphalt pavement layers, mixing with a recycling agent (e.g., foamed asphalt emulsion), and compacting and in-place repaving. CIR utilizes 100 percent of the RAP generated during the process, and involves typical treatment depths of around 3 to 4 inches. Typically suited for low to moderate volume roadways, CIR involves recycling of existing pavement, resulting in material and energy savings, and reduction in GHG emissions.

Estimates indicate that CIR process emits an equivalent of 5 to 20 kg of CO_2 per ton of material laid, as compared to 45 to 50 kg of CO_2 with traditional HMA (even when recycled asphalt is utilized).[95] Using the UC Berkeley PaLATE model, CIR was found to reduce CO_2 emissions by 52 percent compared to a traditional rehabilitation procedure with 6 inches of HMA laid across a 1 km of pavement section at a width of 7.5 meters.[96]

[95] Dorchies, P. T. The Environmental Road of the Future: Analysis of Energy Consumption and Greenhouse Gas Emissions. The 2008 Annual Conference of the Transportation Association of Canada. Toronto, Ontario. 2008.
[96] Alkins, A., Lane, B. and Kazmierowski, T. Sustainable pavements: environmental, economic, and social benefits of in situ pavement recycling. *Transportation Research Record: Journal of the Transportation Research Board*, (2084), pp.100-103. 2008.



CIR Process

(Source: Los Angeles Public Works Department)

Concrete Pavements

Concrete is commonly used as pavement for Caltrans roadways, particularly in urban areas where highways experience high traffic volumes. Concrete is typically composed of four materials: aggregates such as sand or gravel, cement to bind the aggregate together, water, and admixtures that help give the concrete specific properties. The most common cement is Portland cement, produced by heating crushed limestone to high temperatures in a kiln. Producing Portland cement is highly GHG intensive, so alternative mixes that reduce the use of Portland cement yield GHG reductions. Other approaches to reducing GHG emissions from concrete pavements involve reduction in virgin aggregate or other materials.

Supplementary Cementitious Materials

Supplementary cementitious materials (SCMs) are inorganic materials or mineral admixtures that enhance concrete mixture properties and reduce the use of Portland cement. Examples of SCMs include fly ash, slag cement (ground, granulated blast-furnace slag), silica fume, rice husk ash, and natural pozzolans (e.g., calcined clay/shale, volcanic ash). Use of SCMs typically improve concrete performance through improved mixture workability, durability, and strength. As SCMs aid in reduced consumption of Portland cement per unit volume of concrete, they help with reduced material consumption and waste disposal, along with energy savings and GHG emission reduction.[97]

Increased use of SCM or ground limestone is estimated to reduce 0.918 tons of CO_2 emitted on average per ton of AASHTO M 85 Portland cement manufactured.[98] Ground granulated blast furnace slag

[97] FHWA. Supplementary Cementitious Materials Best Practices for Concrete Pavements. Technical Brief. FHWA-HIF-16-001, 2016.
[98] Dam, V.T., "Supplementary cementitious materials and blended cements to improve sustainability of concrete pavements. Tech Brief," National Concrete Pavement Technology Center, Iowa State University Institute for Transportation, 2016.

(GGBFS), an SCM, could reduce approximately 0.5 tons of CO_2 at a 50 percent replacement rate per ton of Portland cement.[99] By another estimate, at a worldwide level, a 15 percent replacement of Portland cement in concrete by SCMs could potentially reduce CO_2 emissions by 250 million tons annually, while a 50 percent replacement could reduce CO_2 emissions by 800 million tons.[100] [101]

Amendments to Caltrans Standard Specifications in 2010 removed a requirement that at least 75 percent of the cement used in concrete be Portland cement. The change in specifications also offered contractors more options for alternatives to Portland cement by removing limits on the amount of fly ash and allowing up to three materials to be used in cement mixes. Caltrans now requires use of at least 25 percent SCMs, and allows up to 50 percent. Based on a review of pavement mix design samples, it appears that concrete producers for Caltrans projects are typically using only minimum 25 percent fly ash. In line with ASTM C977 standards, Caltrans also allows up to 5 percent limestone (high calcium quicklime or dolomite quicklime) in Portland cement concrete, although Caltrans estimates that 3 percent limestone is typical for Caltrans projects. Thus, there are opportunities to substantially increase SCM use on Caltrans projects and achieve larger GHG reductions.

Subgrade Enhancement (Subgrade Stabilization)

Subgrade, per Caltrans Standard Specifications, refers to the "roadbed portion on which pavement, surfacing, base, subbase, or a layer of any other material is placed". For increased foundation support and strength, subgrade soils can be stabilized by improving the subgrade properties either mechanically, chemically, or both. Subgrade stabilizations can serve as alternatives to thicker pavements, which can yield material (aggregate) cost savings, increased pavement strength, extended pavement service life, energy savings, and reduced GHG emissions. The stabilization methods include: [102]

- Mechanical stabilization, which is achieved by interlocking of soil particles using compaction, blending, and/or geosynthetics (geogrids/geotextiles).
- Cementitious stabilization, which involves treating subgrade soils using cementitious stabilizers such as soil cement, lime, fly ash, cement kiln dust, lime kiln dust, or ground-granulated blast furnace slag.
- Asphalt stabilization, using asphalt emulsion, foamed asphalt, cutback/liquid asphalt, and coal tar.
- Additive stabilization, using materials such as petroleum resins or sulfonated oils.

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[99] Owaid, H.M., Hamid, R.B., and Taha, M.R. A review of sustainable supplementary cementitious materials as an alternative to all-Portland cement mortar and concrete. *Australian Journal of Basic and Applied Sciences*, *6*(9), pp.287-303. 2012.
[100] Malhotra, V.M. 2004. Role of supplementary cementing materials and superplasticizers in reducing greenhouse gas emissions. In Fiber composites, high-performance concrete, and smart materials; Proc. ICFRC intern. conf., Chennai, India, January 2004: 489 - 499.
[101] Naik, T.R. and Moriconi, G. Environmental-friendly durable concrete made with recycled materials for sustainable concrete construction. In *International Symposium on Sustainable Development of Cement, Concrete and Concrete Structures, Toronto, Ontario, October* (pp. 5-7). 2005.
[102] Jones, D., Rahim, A., Saadeh, S., and Harvey, J.T. Guidelines for the stabilization of subgrade soils in California. No. UCPRC-GL-2010-01. California Department of Transportation. 2010.

Similar to Portland cement concrete, Caltrans allows up to 5 percent limestone (high calcium quicklime or dolomite quicklime) for soil stabilization purposes, in line with ASTM C977 standards. Caltrans estimates that 3 percent limestone is typical for Caltrans projects. It is unclear why contractors are not going to 5 percent limestone; possible reasons include limited supply of limestone and increased costs of transporting limestone from manufacturing plants to project locations.

Recycled Concrete Aggregate

Recycled concrete aggregate (RCA) is the granular aggregate material generated through recycling of used concrete. FHWA estimates indicate that over 140 million tons of concrete is annually recycled within the U.S., and 44 states use RCA for various applications, including on concrete pavement mixtures, pavement base and subbase layers, and embankments and shoulders. Like RAP, RCA helps offset the need for quarry virgin aggregates, thus leading to reduced material and hauling/transportation costs, landfill, energy consumption, waste disposal, and GHG emissions.[103]

Concrete Recycling Process

(Source: Van Dam et al., Towards Sustainable Pavement Systems: A Reference Document, FHWA, 2015)

[103] FHWA. Accelerated Implementation and Deployment of Pavement Technologies. Annual Report. 2016-2017.

Aggregate production involves several processes such as quarrying, hauling, crushing, and screening, with its GHG emissions ranging from 2.5 to 10 kg of CO_2 per ton of aggregate.[104] Because recycling allows for reduced use of virgin aggregates, thus lowering aggregate production levels, GHG emissions can be considerably reduced. In addition, on-site recycling can help reduce hauling and material transportation activity, thus further lowering GHG emission levels. One project that documented the environmental impacts of RCA is the Beltline Highway project in Madison, Wisconsin, where a life-cycle assessment indicated 13 percent reduction in CO_2 emissions and 9 percent reduction in hazardous waste materials.[105] [106]

Returned Plastic Concrete

Returned plastic concrete (RPC) refers to underutilized or excess concrete, which is in unhardened/plastic state and suitable for recycling and reuse. Since RPC reduces the need for production of new batches of fresh concrete, its potential benefits include reduction in energy consumption, landfill areas and disposal costs, depletion of coarse and fine aggregates, construction, hauling, and transportation costs, and GHG emissions.

Caltrans' Revised Standard Specifications Section 90-9, "Returned Plastic Concrete," allows for the addition of up to 15 percent returned plastic concrete to fresh concrete, with RPC not to exceed 100 ˚F at any time. Typically, RPC is used for minor jobs and not roadway pavement, so the overall GHG benefits of RPC are limited compared to other pavement strategies.

Applying Pavement Research to Reduce GHG Emissions

The research and examples described above make clear that there are numerous opportunities to reduce GHG emissions through pavement strategies. And as described in Section 2, the large volume of material used on Caltrans roadway projects means that implementation of these strategies can yield significant benefits statewide. Caltrans projects in 2017 used more than 1 million cubic yards of concrete, which involved approximately 325,000 tons of Portland cement, more than 4 million tons of hot mix asphalt, and 1 million cubic yard of aggregate.

The main challenge is that decisions to promote specific pavement materials and methods in the name of GHG reduction must be supported by careful analysis that considers not only the materials, transport, and construction phases, but also any effects on vehicle fuel economy (use phase) and durability and lifetime of the pavement. This challenge can be address by working closely with the UC Davis Pavement Research Center and other experts to improve understanding of pavement lifecycle GHG impacts, and then incorporating the research and understanding into Caltrans pavement decision support tools.

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[104] Chehovits, J. and Galehouse, L. Energy usage and greenhouse gas emissions of pavement preservation processes for asphalt concrete pavements. In *Proceedings on the 1st International Conference of Pavement Preservation* (pp. 27-42). 2010.

[105] Snyder, M.B., Cavalline, T.L., Fick, G., Taylor, P., and Gross, J. Recycling Concrete Pavement Materials: A Practitioner's Reference Guide. FHWA, 2018.

[106] Bloom, E. F., G. J. Horstmeier, A. P. Ahlman, T. B. Edil, and G. Whited. 2016a. Assessing the Life-Cycle Benefits of Recycled Material in Road Construction. Paper presented at Geo-Chicago 2016: Sustainability, Energy, and the Geoenvironment, August 14–18, Chicago, IL.

Because of the complexity of pavement LCA research, some degree of uncertainty about the magnitude of these impacts is likely to remain for some time. However, the urgency to reduce GHG emissions calls for taking steps quickly to put into practice more pavement strategies for which at least the directionality of GHG benefit is clear.

Caltrans also needs better procedures to track the use of GHG-reducing pavement strategies. Currently Caltrans has data only for the annual use of standard materials such as hot-mix asphalt and concrete. Caltrans also tracks use of rubberized HMA because this is a state requirement. However, no centralized records exist to monitor the use of other alternative asphalt or concrete mixes that can reduce GHG emissions. As a result, Caltrans does not have good estimates of the current use of pavement strategies such as WMA, CIR, and SCMs, nor does Caltrans have reliable information to indicate trends in use of these strategies.

4.3 Maintenance

In addition to pavement repair and resurfacing, described above, Caltrans performs a wide variety of other activities to maintain the State Highway System including vegetation management and maintenance of roadside lighting and signage. These activities offer numerous opportunities to reduce GHG emissions through use of alternative materials and more efficient practices.

Material Recycling and Re-use

AB 74 and SB 1016 require that state agencies track how much waste they generate, and establish a target for recycling or diverting waste. Use of recycled materials typically reduces GHG emissions by minimizing the production of new materials, which can be GHG-intensive. Caltrans employs a variety of approaches to recycle and reduce the use of materials during the construction and maintenance of highway facilities.

- In landscape architecture and highway maintenance, Caltrans uses urban green waste as a compost. This not only diverts waste, but also enhances soil structure and increases water conservation.
- Caltrans recently created a standard that allows the use of recycled mats to control weeds that grow under and obscure guard rails and posts. Historically, Caltrans paved the ground under guard rails and around posts with concrete.
- Caltrans requires the use of recycled paint to abate graffiti. Specifically, unused paint is mixed together to create a grey or brown color, which is painted over graffiti.
- Caltrans uses recycled motor oil and lubricants, recapped tires, and recycled solvents. Steel posts and metal guard rail used along highways are also recycled.
- A pilot project is recycling lead acid batteries (discussed in Section 4.4).

Standard specifications require that contractors submit data on their waste stream each year. Generally, Caltrans has recycled roughly 50 percent of construction materials, and 75 percent if pursuing LEED certification.[107] While contracts do not typically require this, construction material recycling is a CalGreen and a LEED requirement, and is only slightly more costly for the contractor.

Lighting Energy Efficiency

Caltrans has undertaken energy efficiency improvements for a variety of lighting used in the highway system and associated maintenance facilities.

Signal Lighting

Historically, traffic signals were one of the largest uses of electricity for Caltrans. Incandescent lights were originally used for the roughly 76,000 traffic signals along the State Highway System. Starting in 1999, Caltrans began converting traffic signals from incandescent lights, which use 85-155 watts of electricity, to light-emitting diode (LED) lights, which use only 22 watts on average. Caltrans has now converted nearly all signal lighting, and requires LEDs in all new traffic signals. Caltrans' early adoption of the technology helped lead to the nationwide standardization of LEDs for traffic signals.

Highway Lighting

In addition to reducing highway lighting to points of conflict (e.g., ramps, lane merges), Caltrans has been improving the energy efficiency of the lighting by retrofitting roughly 80 percent of its overhead "cobra head" highway lights with LEDs. In an earlier pilot phase, District 11 found that LEDs for highway lighting consume up to 66 percent less energy than the traditional high-pressure sodium (HPS) lights. In addition to the improved energy efficiency, LEDs last 15 to 20 years, four to five times longer than HPS lights, thus reducing the need for maintenance.

Changeable Message Signs

Caltrans operates more than 700 changeable message signs (CMS) along the State Highway System to inform travelers about road conditions and provide other information. Initially, Caltrans replaced the traditional incandescent light bulbs in these signs with xenon bulbs, which consume 72 percent less energy than incandescent bulbs. However, updated Caltrans' specifications require that all new signs use LEDs, which use 71 percent less energy than xenon fixtures (and 92 percent less than incandescent). Caltrans has now converted approximately 90 percent of its CMS to LEDs. However, Caltrans has also increased its inventory of CMS, so the energy savings from LEDs may be partially offset by the increased number of signs.

[107] U.S. Green Building Council, Construction and demolition waste management, https://www.usgbc.org/credits/reqmrc21r1-0; https://www.usgbc.org/credits/reqmrc22r1-3?view=language

Roadway Signage Lighting

Caltrans has more than 600,000 signs for the highways it manages, many of which require lighting for nighttime visibility. In 2003, Caltrans implemented energy savings guidelines that required the use of more energy efficient magnetic induction light fixtures for highway signs in place of more conventional mercury vapor (MV) fixtures to reduce the energy demand of sign lighting. Subsequently, Caltrans has been replacing 85-watt induction lamps with 60-watt LED lamps.

Retroreflective Sheeting on Signs

In addition to replacing fixtures for highway signs with more energy efficient lighting, Caltrans has been eliminating the need for lighting altogether by replacing lit roadway signs with retroreflective signs. Retroreflective sheeting materials feature a prismatic background that makes them highly visible under vehicle headlights. In addition to saving energy, these signs improve safety for Caltrans staff engaged in sign maintenance, and they decrease vandalism and copper-wire theft because they do not require maintenance catwalks. Caltrans specifications now require that all new green-background (directional) and yellow-background (warning) signs have this retroreflective sheeting, and existing signs are being replaced. Eventually, Caltrans plans to eliminate 70 to 85 percent of sign lighting, although the ultimate number depends on engineering requirements. For instance, lighting may be required in areas that are very foggy or where road curvature reduces sign reflectivity. In the future, Caltrans could reduce the amount of time that the signs are lit, or only turn the sign lighting on when fog is present or when traffic volumes are high.

Yard Lighting

Lighting has accounted for 70 percent of energy consumed at Caltrans maintenance yards, which require lighting for regular maintenance work that occurs at night. The maintenance yards and buildings previously used high-pressure sodium (HPS) and fluorescent lights. Caltrans is targeting to change these lighting systems to LED by the end of 2018. In addition to improved energy efficiency, LEDs do not need to warm up as compared to HPS lights, enabling a more refined control system to turn off lights when they are not in use, which can help reduce lighting energy consumption.

Summary of Roadway Lighting GHG Reductions

The table below shows a 2017 inventory of Caltrans highway system lighting by type. The vast majority of lights have been converted to LED.

Table 12. Caltrans Highway Lighting by Type, 2017

Lighting Type	Number
Traffic light fixture LED - Intersections	72,799
Traffic light fixture LED - Ramp Meters	5,147
Flasher LED	2,207
Ped Signal LED	37,736
Changeable Message Sign Xenon	183
Changeable Message Sign LED	545
Roadway LED	63,846
Roadway HPS	8,144
Roadway MV	1,419
Induction Sign Lighting (85W)	~15,000

Source: Caltrans

The table below shows the estimated GHG reductions that result from Caltrans lighting energy efficiency efforts.

Table 13. Annual CO_2 Emission Reductions Associated with Lighting Efficiency Strategies, 2017

Lighting Type	Fixtures Replaced	GHG Reduced (tons CO_2 per year)
Roadway		
Signals	117,889	12,065
Highway	63,846	13,246
CMS	728	2,745
Signage	~15,000	~2,000
Facilities		
Office	12,356	595
Yard and maintenance bay	13,778	1,536
Total (approximate)	**224,000**	**32,000**

Source: ICF calculations using lighting inventory provided by Caltrans.

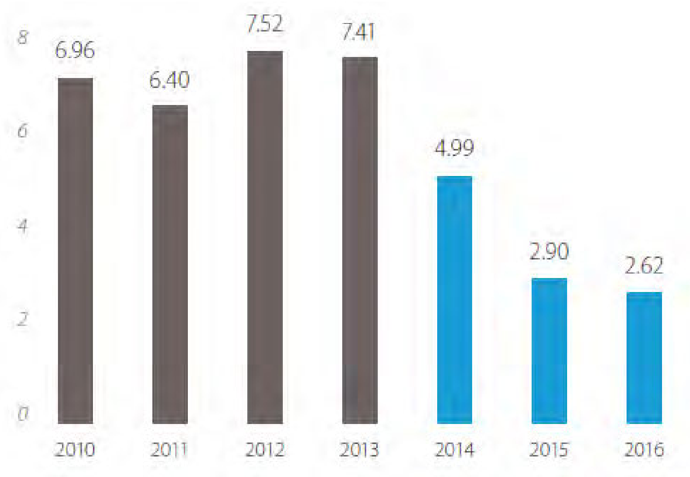
Water Conservation

Caltrans conserves water in roadside irrigation, at rest areas, and elsewhere. A reduction in the use of water means less energy devoted to pumping and treating water, which contributes to a reduction in GHG emissions.

Water Conservation in Irrigation

In response to the severe 2011-2015 drought, Caltrans adopted a goal of a 50 percent reduction in water use based on a 2013 baseline. Because Caltrans is responsible for 33,000 acres of landscaping, targeting this irrigation for reduction makes a substantial contribution to overall statewide water conservation efforts. Caltrans exceeded its water conservation goal; water use in 2016 was 65 percent below 2013 levels.

Figure 12. Caltrans Statewide Water Use (billions of gallons)



Source: Caltrans, MileMarker, September 2017

Water use reductions have been achieved through several strategies. Caltrans has invested in increased installation of "smart controllers" for roadside irrigation systems around the State. These smart controllers sense soil moisture levels and adjust water irrigation accordingly; they also receive weather reports via satellite. If the irrigation system is broken or faulty, the smart controllers quickly notify Caltrans maintenance staff, and shut off water flow if a line breaks.

Caltrans has also increased its use of recycled water for activities like cleaning vehicles and irrigation. Between 2014 and June 2017, Caltrans increased recycled water use statewide from 14 to 23 percent by converting 48 irrigation water sources to recycled water. Deputy Directive 013 requires that Caltrans irrigate landscapes exclusively with recycled water by 2036.

Caltrans has also taken steps to limit water use in its buildings. Several Caltrans district offices have installed low-flow water fixtures to reduce water use. Some districts have modified the watering of landscaping around their offices and have committed to washing vehicles only when they become too dirty to operate. District 8, as an example, cut water usage by 58 percent over roughly four years by implementing such strategies.

Water Conservation at Rest Areas

Caltrans operates 86 Safety Roadside Rest Areas across the state, most of which are in rural areas that are not part of municipal water and wastewater systems. Irrigation accounts for the majority of water use at these locations, particularly during summer months. Some rest areas use recycled water to flush toilets, reducing their discharges, which are regulated and must be treated. For example, Dunnigan rest area, located on Interstate 5 in Yolo County, recycles toilet water for non-potable uses. Caltrans is also exploring treatment options that can handle the volume and quality of the remaining rest area wastewater. At the Sunbeam Rest Area, located in Imperial County on Interstate 8, Caltrans has installed a system that treats wastewater from toilets and sinks. The treated water is suitable for use in the drip irrigation lines used for grass lawns at the rest area. At the Ereca rest area on Interstate 5 near Fresno, Caltrans is building a water recycling system to recycle toilet water.

Sunbeam Rest Area on Interstate 8

4.4 Vehicle Fleet and Equipment

Caltrans reduces GHG emissions from its vehicle fleet through alternative fuels, advanced technologies, and efficient vehicle operation.

Alternative Fuels for Caltrans Light-duty Vehicles

Caltrans supports State initiatives to reduce GHG emissions by expanding use of alternative fuels in the light-duty vehicle (LDV) fleet, which includes automobiles and pickup trucks. The focus of its alternative fuel efforts is on replacing gasoline and diesel LDVs with zero emission vehicles (ZEVs), which consist of electric vehicles (EVs) and fuel cell vehicles (FCVs). Executive Order B-16-12 created a target of 1.5 million ZEVs in California by 2025, and required that the State vehicle fleet increase its number of ZEVs so that at least 10 percent of LDV purchases are ZEV by 2015, and at least 25 percent of fleet LDV purchases are ZEV by 2020. The State adopted a ZEV Plan in 2016, which outlines a path for achieving this goal. Executive Order B-48-18 created a target of 5 million ZEVs in California by 2030, and 250,000 electric vehicle charging stations and 200 hydrogen fueling stations in California by 2025. The DGS Management Memo “Zero-Emission Vehicle Purchasing and Electric Vehicle Service Equipment Infrastructure Requirements” directs agencies to purchase ZEV charging equipment to further Executive Order B-16-12.

Caltrans has implemented a ZEV Action Plan, which created a generalized schedule for light-duty vehicle ZEV purchases as a part of overall fleet replacement. Each year’s actual ZEV purchasing is based on vehicle condition and scheduled turnover; therefore, if none of the LDVs in the fleet require replacement, no ZEVs will be purchased that year.

Caltrans has exceeded the EO B-16-12 ZEV fleet requirement, as ZEVs accounted for approximately 20 percent of LDV purchasing in FY 2017-18. Because some state departments can accommodate ZEVs more easily than others, compliance with EO B-16-12 will eventually be on a State basis rather than a Departmental basis, and Caltrans may be required to increase their ZEV LDV fleet beyond the executive order requirements to help the statewide goal. However, one challenge that Caltrans faces is that nearly half of its LDV fleet is composed of pickup trucks, and currently there are no ZEV pickups available from original equipment manufacturers.

Electric Vehicles

There are two main categories of electric vehicles. Battery electric vehicles (BEVs) have no internal combustion engine and run on electricity supplied by the onboard battery alone; current BEVs typically have a range of approximately 60 to 250 miles, with most models limited to less than 150 miles. Plug-in hybrid electric vehicles (PHEVs) have both an internal combustion engine and a battery that can be charged via plug; PHEVs run on the battery's electricity for the first 10 to 50 miles and then switch to using the gasoline-powered engine after the battery is depleted, allowing PHEVs to travel distances comparable to conventional gasoline-fueled cars.

To date, Caltrans has largely met and exceeded its ZEV fleet requirements by replacing conventional and hybrid LDVs with battery electric and plug-in hybrid electric vehicles. In 2017, the Department operated 80 BEVs and 136 PHEVs.

Electric Vehicle Charging Equipment

In addition to purchasing electric vehicles, Caltrans has been actively installing EV charging equipment. State agencies are mandated to provide EV charging at five percent of their workplace parking spaces, with the intent that State employees will use the EV charging for their commute vehicles during the day, and the agency's fleet will use the EV charging at night. Caltrans is in the process of meeting this goal. Currently, Caltrans has 142 electric vehicle charges, 128 of which are dual-port. Fifteen of these are solar electric charging stations.

Solar powered EV charging station at Caltrans Headquarters

Caltrans will contribute funding to DGS for the installation of EV charging infrastructure. Significant funding will be required. While EV charging equipment is relatively inexpensive, preparing and installing equipment at charging locations can be much more expensive, as it can require trenching, installing conduit and wiring, upgrading electrical panels, and acquiring a fire marshal's permit.

Fuel Cell Vehicles

While Caltrans has largely replaced its older LDV fleet with EVs, the Department is also interested in procuring hydrogen fuel cell vehicles, as they hold a number of advantages over electric vehicles. Hydrogen FCVs have a longer range than typical EVs and can be fueled more quickly. Furthermore, hydrogen fueling is more resilient in a disaster as it does not depend on the electrical grid and backup generators can be used to produce additional hydrogen fuel if necessary. To date, Caltrans has purchased 50 Toyota Mirai FCVs. Because Caltrans does not yet have its own hydrogen fueling infrastructure, these vehicles refuel at public fueling stations located in Districts 3, 4, and 7.

Toyota Mirai Fuel Cell Vehicles at Caltrans District 7

The GHG benefits of the fuel cell vehicles can vary widely depending on the production and transportation processes of the hydrogen used to fuel the FCVs. Larger GHG reductions can be achieved if the hydrogen is liquefied for transport of the fuel; GHG reductions can be ten times larger if the hydrogen is produced locally using a renewable energy source such as solar or wind.

Summary of Light Duty Vehicle Emissions Benefits

The table below shows the number of Caltrans hybrid, electric, and fuel cell vehicles in operation in 2017, the total mileage of these vehicles, and the resulting annual GHG reductions. In total, Caltrans alternative fuel light duty vehicles generated approximately 200 tons of GHG reduction in 2017. This reduction has subsequently increased as Caltrans has added more of these vehicles to its fleet.

Table 14. Number of Hybrid, Electric, and Fuel Cell Vehicles and Total Mileage, 2017

Vehicle Type	GHG Reduction per Vehicle	Number of Fleet Vehicles (2017)	Total Mileage (2017)	Total Annual Fleet GHG Emission Benefits (tons)
Hybrid Electric Vehicle	18%	91	831,467	56
Plug-In Hybrid Electric Vehicle	38%	136	500,116	73
Battery Electric Vehicle	67%	80	197,385	50
Fuel Cell Vehicle	38%	37	181,953	26
Total		**344**	**1,710,920**	**204**

Source: ICF calculation using vehicle mileage data from Caltrans. All vehicles compared to a conventional gasoline vehicle, assumed to be a Chevrolet Cruze. PHEVs assumed to operate 40% in electric mode (EMFAC). Fuel cell vehicles assumed to use compressed gaseous hydrogen from central reforming of fossil natural gas.

Additional Light Duty Vehicle GHG Mitigation Opportunities

Caltrans has aggressively added EVs and FCVs to its light duty vehicle fleet, as described above, and will continue to integrate more as part of regular fleet turnover. Opportunities to use EVs and FCVs for Caltrans' light truck (e.g., pickup) fleet vehicle fleet are currently limited by commercial availability. If viable battery electric or fuel cell options become available for light-duty trucks, Caltrans expects to consider adding these vehicles to its fleet. Otherwise, there are limited opportunities for Caltrans to further reduce fleet GHG emissions through vehicle electrification beyond the planned vehicle replacements.

Alternative Fuels for Caltrans Heavy-duty Vehicles and Off-road Equipment

State agencies have also started to explore opportunities to use alternative fuels in heavy-duty vehicles, which include construction, maintenance, and utility trucks. Caltrans has used alternative fuels for many decades, but applications were limited because of the operational and power requirements for these large vehicles. However, alternative fuels and newer technologies are increasingly available for heavy-duty applications. Options that reduce GHG emissions include:

- Biodiesel fuel
- Renewable diesel
- Compressed natural gas (conventional and renewable)
- Hybrid electric and full electric vehicles
- Hydrogen fuel cell vehicles

Through 2015, Caltrans was widely using biodiesel blended with conventional diesel in nearly all HDVs. As a fuel made from animal and vegetable fats, biodiesel has a lower GHG emission rate on a life-cycle basis compared to conventional diesel. However, to meet the petroleum reduction goals set by Executive Order B-30-15, the Department of General Services (DGS) released Management Memo 15-07

"Diesel, Biodiesel, and Renewable Hydrocarbon Diesel Bulk Fuel Purchases," which instructs state agencies to purchase renewable diesel in lieu of bulk conventional diesel and biodiesel. Renewable diesel is a product of fats or vegetable oils refined by a hydro treating process, which results in a fuel that meets the same standards as conventional diesel and thus, unlike biodiesel, does not need to be blended with conventional diesel. Renewable diesel can therefore be a "drop-in" fuel that generates 50 to 60 percent less GHG emissions than conventional diesel. The adoption of renewable diesel has become a more feasible alternative to other forms of diesel in recent years because of the improved cost competitiveness that have resulted from credits generated under the federal Renewable Fuel Standard and state Low Carbon Fuel Standard (LCFS).

Caltrans also employs compressed natural gas (CNG) engines for some heavy-duty vehicles, such as sweepers and refuse trucks. Because CNG also has significantly lower ozone precursor emissions than diesel, many of these vehicles are deployed in the South Coast Air Basin (Districts 7, 8, and 12) where ozone pollution is most severe. The GHG emissions associated with natural gas vehicles partly depend on the source of the gas; natural gas can be produced from renewable sources, which have lower life-cycle GHG emissions than conventional natural gas from fossil fuel sources. For example, natural gas from landfills has a carbon intensity that is roughly half that of natural gas from conventional fossil sources.

CNG Fueling Infrastructure at Caltrans Foothill Maintenance Station, District 7

Assembly Bill 739 (2018) requires that, by 2025, at least 15 percent of newly purchased vehicles with a gross vehicle weight rating (GVWR) of 19,000 lbs. or more be zero emission vehicles (ZEVs), and that by 2030, at least 30 percent of these vehicles be ZEVs. However, because available electric trucks have limited ranges and long charge times, electric trucks cannot currently meet Caltrans' operational requirements for most construction and maintenance activities, particularly emergency maintenance response.

While electric vehicle options to replace Caltrans heavy-duty vehicle are limited, fuel cell vehicles offer the range and rapid fueling that match conventional diesel powered counterparts. As a result, Caltrans is examining fuel cell vehicle options for various heavy-duty applications. Fuel cells have been used in forklifts and heavy-duty trucks at ports, where the range requirement is lower. In 2018, Caltrans funded the development and deployment of the world's first fuel cell freeway sweeper in District 7 as a demonstration project. Caltrans is also purchasing a gasoline-electric hybrid and a diesel-electric hybrid sweeper. These vehicles use an average of 45 percent less fuel than a conventional diesel sweeper. The University of California, Riverside is currently evaluating the performance of these advanced technology sweepers and will assess the feasibility of expanding the use of these vehicles. If the vehicles perform adequately, Caltrans intends to place hydrogen sweepers in the South Coast Air Basin and other locations where hydrogen fueling infrastructure exists, and place the hybrid-electric sweepers elsewhere.

Caltrans fuel cell sweeper

The table below shows the use of heavy-duty vehicle alternative fuels by Caltrans in 2017 and the resulting GHG reductions, as compared to conventional diesel fuel. Renewable diesel can come from different sources (pathways) which vary in their carbon intensity. Because the source of Caltrans renewable diesel was not known at the time of this analysis, the GHG reduction calculation conservative assumes a relatively high carbon intensity pathway. Thus, the actual GHG reduction from renewable diesel could be greater than shown here.

Table 15. Heavy Duty Vehicle Alternative Fuel Use and GHG Reductions, 2017

	Annual fuel use, 2017 (gallons or dge)	Annual GHG reduction, 2017 (tons)
CNG	145,022	456
Renewable diesel	3,772,536	23,637
Total	**3,917,558**	**24,093**

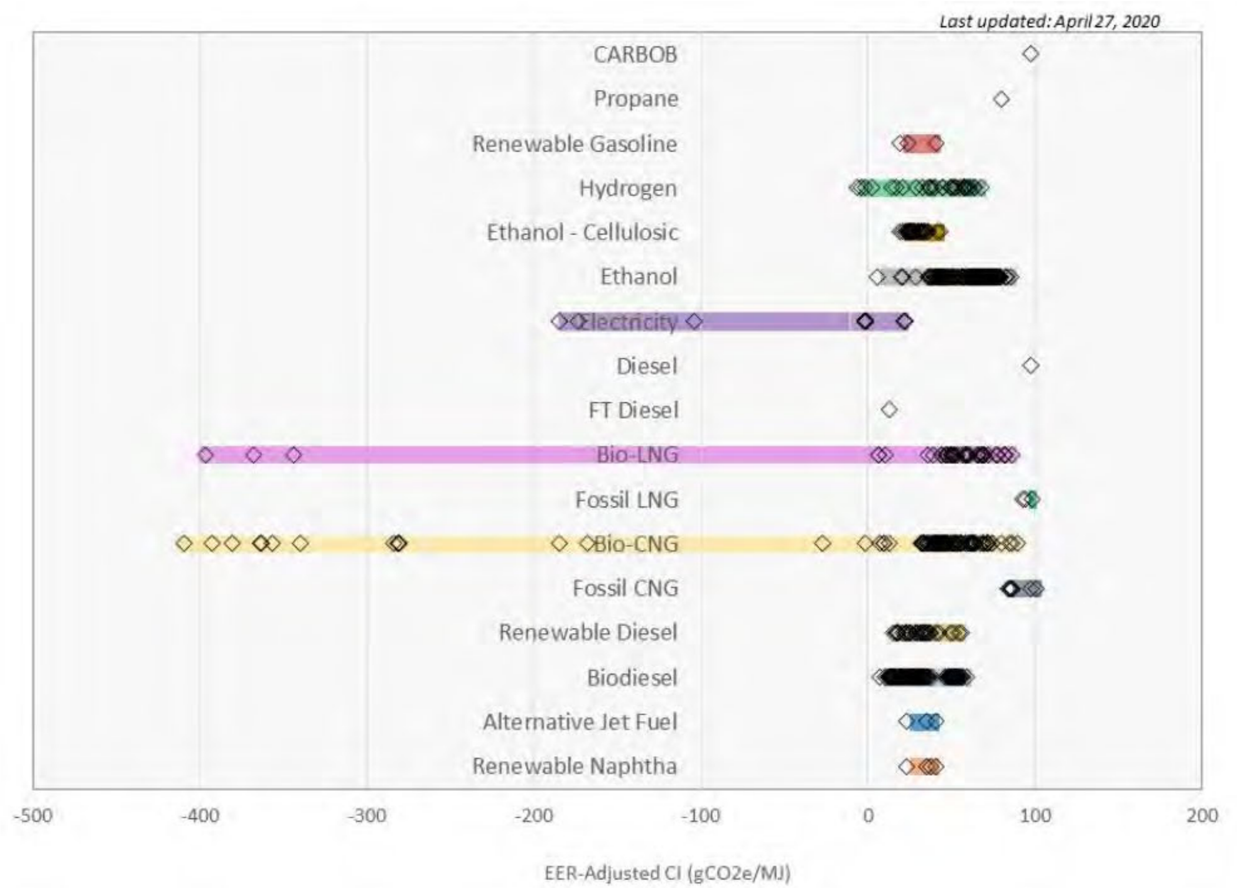
Source: ICF calculation using fuel use data from Caltrans. Emission factors from CARB LCFS pathways.

Additional Heavy-Duty Vehicle GHG Mitigation Opportunities

Similar to light duty trucks, the ability to reduce GHG emissions by using electric or fuel cell technology for heavy-duty vehicles is currently limited by the commercial availability these vehicles. In the future, when electric or fuel cell options become more widely available, Caltrans can likely achieve additional GHG reductions through these technologies.

Presently, low carbon fuels other than electricity offer more immediate potential for additional GHG reductions in Caltrans heavy duty fleet. California's LCFS mandates a 10 percent reduction in the carbon intensity of California's transportation fuels and is helping to drive the introduction of many low carbon fuel options. The figure below shows the carbon intensity (CI) for fuel pathways that have been certified under the LCFS program. Conventional gasoline (CARBOB) and diesel have carbon intensities of approximately 100 grams of CO_2-equivalent per megajoule (MJ). Renewable diesel, already used by Caltrans, is available with CI values of 20-55 g CO_2e/MJ, or 45 to 80 percent lower than conventional diesel. Even lower carbon intensities are available for some forms of renewable natural gas (Bio-CNG). Caltrans can achieve larger fleet GHG reduction by purchasing these low carbon fuels where they are available.

Figure 13. Carbon Intensity Values of Certified LCFS Pathways (2020)



Source: California Air Resources Board

Efficient Operation of Caltrans Vehicles

In addition to replacing gasoline and diesel with alternative fuels, Caltrans has implemented a wide range of strategies to reduce the consumption of fuels in general.

Idling consumes fuel for other purposes besides propulsion. Caltrans Deputy Directive 096 “Unnecessary Idling of the Department’s Fleet Vehicles and Equipment” supports efforts to reduce unnecessary energy consumption from vehicle idling. However, some idling can serve important functions that support Caltrans work. For example, drivers sometimes run their engines to keep their cabs heated. In four yard trucks purchased recently, Caltrans added heaters that draw a smaller amount of fuel than running the vehicle engine to keep the cab warm; however, Caltrans has found that drivers are not always using this heater in place of idling.

In some cases, Caltrans has deployed more energy efficient vehicles and equipment. Caltrans maintenance vehicles operate amber warning lights for driver and worker safety. While older vehicles must run the engine to shine warning lights, newer vehicles use LED warning lights which require very little power, reducing the load on the vehicle engine. To reduce vehicle air conditioning needs and evaporative emissions, DGS Management Memo 12-03 mandates that all State agency LDVs be white, silver metallic, or gold metallic, which are solar reflective colors that reduce the amount of vehicle cabin heating.

Caltrans also has improved vehicle and equipment efficiency by implementing GPS-based tools to assist the operators. Caltrans has added GPS to all vehicles but offload trailers. In addition to helping recover stolen vehicles, GPS devices track driving speeds; speeding reports are sent to administrative deputies and District discipline services, who follow up with drivers to encourage slower, more fuel efficient driving speeds. GPS also eliminates the need for drivers to manually log their vehicle data, thereby increasing organizational efficiency. Caltrans has also installed automated vehicle locators (AVLs) on their snow plows, which help operators improve overall efficiency by indicating when plows are down and tracking the amount of material (sand, salt, etc.) that has been deployed.

Recycled Vehicle Batteries

In California, 160,000 tons of lead acid batteries must be recycled per month. Currently, many of these batteries go to the Exide plant in the City of Industry, California. This creates a toxic hazard for the community, as lead has been found in the community's ground and water and in residents' blood tests. These batteries are also often sent abroad where the waste is managed poorly. Assembly Bill 2832 calls for creation of an advisory group to develop recommendations to ensure sustainable recycling of vehicle batteries.

To help reduce lead waste, Caltrans has engaged in a pilot partnership with a private company called AquaMetals. AquaMetals extracts lead from batteries to produce 99.9 percent pure lead ingots, which it can then resell. This lead is not only higher quality, but it is also lighter, stronger, and holds a charge for longer than using lead that is typically available.

4.5 Facilities and Administration

Caltrans reduces GHG emissions through its programs for purchasing supplies, procuring renewable energy and improving the efficiency of its workplace offices for employees, and supporting employee commute travel.

Purchasing and Contracting

Caltrans is currently pursuing several methods to purchase products and create projects that are less GHG-intensive. This includes analyzing the lifecycle emissions of purchases, and using sustainable purchasing, environmentally preferred purchasing, and environmental product declarations, and alternative contracting methods.

Sustainable Purchasing

Caltrans Division of Procurement and Contracts is currently establishing a Sustainable Purchasing Program. The Division will identify opportunities to incorporate sustainability, including both environmental and social components, into products carried in Caltrans supply warehouses, such as wood posts, sign posts, and related equipment. Notably, this does not include purchasing related to construction, facilities, or the vehicle fleet, which are handled by other divisions.

As part of the development of this program, Caltrans plans to conduct an economic input-output lifecycle analysis to quantify the GHG emissions embedded in all of Caltrans' purchases. This analysis will provide a baseline of GHG emissions and help identify areas where Caltrans could improve. For instance, the analysis will provide the zip codes of suppliers and purchasers, associated transportation emissions, and whether those emission could be reduced by using a local supplier or at least a supplier that is closer to the purchaser.

Environmentally Preferred Purchasing

Caltrans indirectly incorporates environmentally preferred purchasing (EPP) under Department of General Services (DGS) procurements. While Caltrans lacks the authority to incorporate EPP when selecting a contractor, Executive Order B-18-12 requires that state agencies conduct environmentally preferred purchasing, including DGS. Therefore, when Caltrans uses a DGS-developed procurement agreement, the agreement considers EPP. For instance, many state departments and entities use tires; DGS has contracted with numerous vendors to provide tires, and the contract tire specifications include EPP. As a result, when Caltrans purchases tires through this contract, they indirectly incorporate EPP into the tire purchase.

While Caltrans provides input into DGS specifications, the Department does not lead the development of the specifications.

Environmental Product Declarations

In 2016, Caltrans began pursuing the use of environmental product declarations (EPDs). An EPD is an internationally recognized environmental impact label, similar to a nutrition label on food. EPDs are developed in accordance with specific standardized methods for quantifying the environmental impacts of manufacturing a particular product on a lifecycle (cradle to grave) basis. Caltrans has contracted with the University of California, Davis Pavement Research Center helped to assemble a roadmap for Caltrans use of EPDs.

In 2017, the Buy Clean California Act (AB 262) was passed. AB 262 directs the Department of General Services (DGS) establish and publish standardized methods for calculating the lifecycle GHG emissions (called global warming potential) of four commonly purchased products: carbon steel rebar, flat glass, mineral wool board insulation, and structural steel. Potential suppliers of these materials to the state will then be required to report the global warming potential of their products using an EPD. DGS will also establish and publish in the State Contracting Manual a maximum acceptable global warming potential for each category of product. Caltrans purchases these products will results in lower GHG emissions once the program requirements take effect July 1, 2019.

Purchase of Recycled Material

Caltrans purchases a variety of products containing recycled content. Caltrans reports annually regarding progress toward the State Agency Buy Recycled Campaign (SABRC), which is a joint effort between CalRecycle and DGS to implement state law requiring state agencies to purchase recycled-content products and track those purchases. The table below shows Caltrans reporting for fiscal year

2016-17 in 11 categories of materials.[108] Caltrans generally meets the SABRC targets unless suppliers of suitable recycled-content products are not available.

Table 16. Caltrans Purchases of Recycled Content, 2016-17

Product Category	Total Purchases	SABRC Compliance Purchases	Percent Compliant	Minimum Post-Consumer Recycled Content
Antifreeze	$190,412	$101,661	53%	70%
Compost, Co-Compost, Mulch	$2,484,684	$2,484,684	100%	80%
Glass Products	$342,424	$342,089	100%	10%
Lubricating Oils	$1,086,722	$906,338	83%	70%
Paint	$1,918,341	$980,834	51%	50%
Paper Products	$237,847	$131,119	55%	30%
Plastic Products	$3,209,642	$824,044	26%	10%
Printing & Writing Paper	$490,816	$240,431	49%	30%
Metal Products	$42,758,715	$38,483,777	90%	10%
Tire-Derived Products	$21,008	$5,087	24%	50%
Tires	$4,050,226	$725,956	18%	Retread/Recapped

Source: Caltrans

One challenge in requiring the use of recycled or sustainable materials is that when using federal funds, Caltrans cannot necessarily create material restrictions as this can restrict trade with other states.

Renewable Energy

Electricity produced by renewable sources such as solar power displaces electricity used from the grid, which is comes from more GHG-intensive sources. To date, Caltrans' primarily renewable energy projects have been conducted under the Clean Renewable Energy Bonds solar program. As discussed below, Caltrans has opportunities for achieving additional GHG reductions by pursuing solar power projects in the highway right-of-way (ROW).

Clean Renewable Energy Bonds Solar Program

Caltrans has participated in the Clean Renewable Energy Bonds (CREBs) program to finance the installation of photovoltaic (PV) energy systems. The CREBs program was created by the Federal government in 1995 as a way to finance renewable energy projects. Caltrans initially received approval for CREBs projects in 2006. Caltrans was the only state agency to participate significantly in the CREBs program. Caltrans has completed installation of 70 PV projects financed through CREBs. The projects are located at a variety of Caltrans facilities, as summarized in the table below.

[108] Memorandum, To Angela Shell, Chief, Division of Procurement and Contracts, "State Agency Buy Recycle Annual Report Fiscal Year 2016-17," October 25, 2017.

Table 17. Caltrans CREBS Solar Projects by Facility Type

Facility Type	Number of Projects
Maintenance Facilities	46
Equipment Shops	9
Safety Roadside Rest Areas	3
Office Buildings	4
Materials Laboratories	2
Transportation Management Centers	2
Toll Bridge Facilities	2
Truck Inspection Facilities	2
Total	**70**

Source: Caltrans

In total, these projects generate 2.38 MW of renewable energy, enough to power 500 homes, which is more than the 2.1 MW used by Caltrans' 344 maintenance stations. Caltrans has noted that in some cases, energy production performance of PV installations could be improved. In some locations, the PV panels and inverters have needed repair; others do not receive frequent cleaning, which can degrade their performance.

To improve tracking of performance and issues in real-time, Caltrans uses telematics (remote tracking) to monitor most of the CREBs installations (61 out of 70). The remaining 9 locations lack internet capabilities or have equipment incompatibility issues, but Caltrans is identifying potential tools to track energy production and display information on a user-friendly dashboard for all 70 sites.

Other Solar Projects at Caltrans Facilities

In addition to the CREBs projects, Caltrans has been developing several other solar projects. In District 8, Caltrans installed a 1 MW solar facility – Caltrans' largest solar installation – at its Southern Regional Lab and traffic management center in Fontana. Other projects include:

- District 3 – A solar canopy in the Marysville office parking lot (in progress)
- District 4 – Solar facilities at the San Francisco-Oakland Bay Bridge Maintenance, Warehouse, and Training Complex
- District 5 – Mobile EV chargers with solar panels at three locations
- District 6 – Solar panels at the northbound and southbound Philip Raine Rest Areas on SR99
- District 7 – A solar pavement pilot project at a district office building, working with a company from the Netherlands on the technology
- District 12 – Mobile EV chargers with solar panels (installed); and solar canopies/EV charging stations at Park and Ride lots

Solar panels at the Caltrans Traffic Management Center in Fontana, District 8

Summary of GHG Reductions from Renewable Energy

The table below shows the estimated GHG reductions in 2017 that result from Caltrans renewable energy efforts.

Table 18. Annual CO_2 Emission Reductions Associated with Solar Projects, 2017

Solar Project Type	Estimated Electricity Produced (kWh)	GHG Reduced (tons CO_2 per year)
Clean Renewable Energy Bonds (CREBs)	3,617,400	955
Other projects	3,282,000	866
Total	**6,899,400**	**1,821**

Source: ICF calculation using electricity production data provided by Caltrans

Although nearly all of Caltrans' solar projects were previously developed through the CREBs program, other projects are now estimated to produce nearly as much electricity as the CREBs solar installations. Actual electricity production – and associated GHG reductions – at each site may vary considerably, depending on system design, weather, and other factors that impact solar generation.

Solar PV Arrays in Highway ROW

While Caltrans has achieved energy savings and reduction in GHG emissions using through successful installation of PV energy systems on various Caltrans facilities (e.g., maintenance facilities, equipment shops, etc.), the Department can further reduce GHG emissions by targeting other types of underutilized spaces for renewable energy technologies such as solar PV. Many transportation agencies have been exploring installation options for decentralized renewable energy technologies on spaces that are not conventionally considered for energy generation, including use of the highway ROW.[109] The highway ROW and other land areas used by transportation agencies are often in proximity to electrical infrastructure, which can make these locations ideal for renewable energy applications.[110] California's aggressive renewable portfolio standard, expanded in 2015 as part of SB 350, requires all utilities in the state to source half of their electricity sales from renewable sources by 2030, so the demand for renewable energy is growing rapidly.

Renewable energy generation in the ROW can come from solar, wind, and other technologies. Solar PV is the most promising immediate option for the highway ROW. California has some of the best conditions for solar power in the U.S. PV arrays are formed by modules of connected individual PV cells that typically produce 1 to 2 watts (W) of solar power. They can utilize two types of PV systems: traditional flat-plate PV systems (which use conventional solar cells) or concentrating photovoltaic systems (in which solar power is captured in more expensive high-efficiency solar cells, using lenses/mirrors, which reduces required cell area and increases the cell efficiency).

Countries such as Canada, Austria, France, Germany, the Netherlands, Switzerland, and the United Kingdom have implemented solar cell applications (including PV noise barriers) along highways and railways within existing ROW. State DOTs in the U.S. are increasingly exploring solar-related initiatives and technologies for highway ROW. Oregon DOT piloted the first highway ROW solar PV installation in 2008 at the interchange of I-5 and I-205 near Portland. Recent examples are shown in the figure and table below.[111]

Caltrans is currently researching the potential of using highway ROW for solar energy, with a goal of developing a ROW pilot solar project in 2019 and the potential to expand to other Caltrans sites after that.

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[109] FHWA, Renewable Energy in Highway Right-of-Way, www.fhwa.dot.gov/real_estate/right-of-way/corridor_management/alternative_uses.cfm

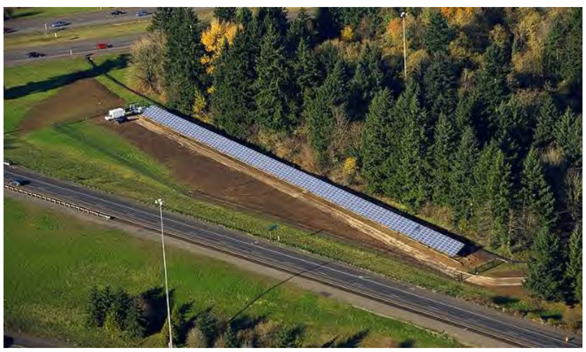
[110] Poe, C. and Filosa, G., 2012. Alternative uses of highway rights-of-way: accommodating renewable energy technologies. *Transportation Research Record: Journal of the Transportation Research Board*, (2270), pp.23-30.

[111] FHWA. Renewable Energy Generation in the Highway Right-of-Way Briefing. FHWA-HEP-16-052. January 2018. www.fhwa.dot.gov/environment/sustainability/energy/publications/row/fhwahep16052.pdf

Figure 14. Examples of Solar PV in Highway ROW or other State DOT Property

MassDOT-installed solar panels in the ROW at Exit 13 North on I-90 in Framingham, MA

Oregon DOT-installed 1.75 MW solar array at the French Prairie Rest Area on I-5



Oregon DOT-installed solar array at the interchange of I-5 and I-205 near Portland

Solar panels along Northwest Parkway near Denver, Colorado

Sources: Oregon DOT; Massachusetts DOT; Northwest Parkway LLC, www.northwestparkway.org/road-info.html#Sustainability

Table 19. Use of ROW by State DOTs to Accommodate Solar Energy Technologies

Project	Purpose	Size
Arizona: I-10, Riverpoint Solar Research Park (in progress)	Generate energy through compression air storage underground	
Colorado: Northwest Parkway Solar (I-25/U.S. 36/State Highway 128) (2008)	Electric power from PV arrays (20-year ROW lease)	26 PV arrays
Oregon: I-5/I-205 Interchange Solar Demonstration Project (2008)	Illuminate adjacent interchange	594 panels, 104 kW, 0.2-acre footprint
Ohio: I-280 Veterans Glass City Skyway Bridge (2010)	Test flexible and rigid solar panels' abilities to offset demand and operating costs of LED bridge structure.	115.6 kW
Oregon: Baldock Safety Rest Area (2012)	Generate/retain Renewable Energy Certificates	6,994 panels, 1.75 MW, 7-acre footprint
Massachusetts: State Route 44 (2012)	Power nearby water treatment facility	99 kW, 1.26-acre footprint
Massachusetts: Solar PV Program	Purchase electricity generated through low, 20-year rate schedule	Minimum 6 MW (from multiple locations)
Various States (e.g., FL, HI, MI, MO, NY, WY)	Solar at rest areas and other highway facilities	

Source: FHWA. Renewable Energy Generation in the Highway Right-of-Way Briefing. FHWA-HEP-16-052. January 2018. www.fhwa.dot.gov/environment/sustainability/energy/publications/row/fhwahep16052.pdf

Green Buildings

Caltrans is pursuing various green building initiatives, including LEED certification, Zero Net Energy buildings, energy efficient lighting, and others.

LEED Certification

Three district offices and a Caltrans Transportation Management Center are certified to Leadership in Energy and Environmental Design (LEED) Gold standards, and two other district offices are LEED Silver. In compliance with Executive Order B-18-12, Caltrans is pursuing LEED-EB (Leadership in Energy and

Environmental Design for Existing Buildings) certification for its office buildings that exceed 10,000 square feet. Seven of Caltrans' buildings meet this criterion, including:

- Three buildings that have submitted their application to the U.S. Green Building Council
- Two buildings that are in the application process
- One building that is working to improve its Energy Star rating before applying
- One building that is in the process of installing submetering to qualify before applying

District 3 Headquarters, Marysville, CA

Additionally, Caltrans requires that buildings at rest areas be LEED certified. Recently, the Phillip Raine Safety Roadside Rest Area along SR99 near Tipton was built and certified as LEED Platinum.

Zero Net Energy Buildings

Executive Order B-18-12 also requires new or existing State buildings to achieve zero net energy, offsetting any energy consumed with renewable energy production. Buildings can achieve zero net energy both by implementing energy efficiency measures and by installing renewable energy sources. The order requires that half of all new facilities beginning after 2020 be zero net energy, and that all new State buildings and major renovations beginning after 2025 be zero net energy. Additionally, half of State agencies' building square footage must be zero net energy by 2025.

In response, Caltrans has begun assessing their buildings to determine how to achieve these goals. Caltrans plans to assess which buildings can most feasibly become zero net energy. It may not be possible to convert some buildings to zero net energy due to limitations. For instance, District 4 facilities in Oakland lacks enough physical space for solar panels; therefore, they may look into installing panels elsewhere.

To meet the energy performance targets, Caltrans has made a concerted effort to replace office lighting in all administrative buildings with more energy efficient options. In 2015, the Department upgraded 9,000 bulbs in the headquarters building, replacing T12 fluorescent lights with T8 lights, which use 20 percent less energy. For each District's office buildings, Caltrans purchased LED light fixtures, which use significantly less energy than traditional fluorescent lights. Some Districts have completed the replacements while others are still working to finish replacing their fixtures; one District has been unable to replace the bulbs because the LEDs were not compatible with the light fixtures.

Employee EV Charging

Executive Order B-18-12 requires state agencies to identify and pursue opportunities to provide electric vehicle charging stations at employee parking facilities in new and existing buildings. The state's 2016

ZEV Action Plan calls on each state agency to develop a workplace charging plan that will result in EV charging availability at a minimum of 5% of workplace parking spaces at state-owned facilities. In response, Caltrans is developing a new Policy regarding the provision of EV charging infrastructure for use by Caltrans employees. Caltrans currently has 413 EV charging ports for employee vehicles, with a goal of 1,000 EV charging ports within three years.

Employee Commute Options

Commute travel by Caltrans employees generates approximately 50,000 tons of GHG emissions annually. While this figure is small in relation to the emissions from all roadway system users, Caltrans recognizes its role as the state's leader in transportation to reduce the GHG emissions from employee commuting to set an example for other state agencies and the traveling public. While Caltrans has a number of programs in place to encourage less carbon intensive commuting, there are opportunities to increase the effectiveness of these efforts.

Caltrans offers or supports a number of programs to encourage Caltrans employees to utilize alternative transportation modes and reduce the amount of solo driving trips to and from work. To improve employee alternative transportation options, Caltrans provides bicycle parking and lockers for some Caltrans buildings, subsidizes transit passes, and supports vanpool programs.

With more than 4,000 employees in the Sacramento area, which offers a number of transportation options, Caltrans Headquarters has a distinct opportunity to influence travel and GHG emissions from employee commuters. Data was collected from Caltrans administration and self-reported information submitted through the Commuter Club portal of the Sacramento Transportation Management Association. More than 1,300 employees at Headquarters take a transit subsidy or payroll deduction to pay for transit. Another 50 Headquarters employees receive reimbursements for participating in the vanpool program. Additionally, 141 employees report biking to work.

Headquarters and each District administered a survey of employees about their commute patterns. The Districts that collected and shared data showed a large variance in the share of employees commuting by different modes. The adoption of alternative modes is largely a reflection of the mode options available and the land use patterns around each office.

Caltrans District 9 Employees Celebrate Bike to Work Month

The table below shows the estimated GHG reductions that result from employee commute programs administered or supported by Caltrans.

Table 20. Annual CO_2 Emission Reductions Associated with Employee Commute Programs, 2017

Mode	Number of Participants	GHG Reduced (tons CO_2)
Transit	2,570	3,754
Carpool	1,041	1,829
Vanpool	455	1,207
Bicycle	277	255
Total	**4,342**	**7,175**

Source: Calculations by ICF using employee commute data gathered from Districts. GHG reduction calculations follow the methods described in Caltrans Activities to Reduce GHG emissions, 2013, with updated emission factors.

Even though robust transit options for commuters are largely limited to large urban areas (i.e., Headquarters, District 4, and District 7), transit makes up the largest share of alternative commute trips and associated GHG reductions. The reductions associated with carpool and vanpool are roughly half that of transit. A small portion of employees bike to work, with about half of the reported bicyclists commuting to Headquarters. Note that District 11 did not report commute data, which could represent significant additional reductions given the variety of transportation options in the San Diego area and the proximity of the District 11 office to a light rail stop.

Additional programs and incentives could further increase transit use, ridesharing, and bicycling among Caltrans employees. For example, in some Districts, the Department could consider offering subsidized or free bikeshare memberships to encourage bicycling. The District of Columbia Department of Transportation and some federal agencies in Washington D.C. offer this benefit to employees.[112]

Guaranteed Ride Home programs encourage non-vehicle commute by providing a safety net for employees who may be concerned about getting home quickly in case of an emergency, late at night, or when transit may not be running. While some Caltrans offices offer this service through partnerships with transportation management associations (TMAs), such programs could be expanded Department-wide. The Washington State DOT administers a Guaranteed Ride Home program for WSDOT employees, offering up to eight taxi rides for employees from work to home per year. WSDOT contracts with taxi companies and manages a hotline to coordinate rides.[113]

Location Efficiency

Location efficiency refers a combination of land use and transportation system characteristics that provide efficient access to destinations via a multimodal transportation system. Areas with high location efficiency typically are adjacent to bicycle and pedestrian infrastructure and are accessible by frequent transit service. In addition, neighborhood characteristics, such as density, mixed land uses, and equitable access among income groups are also important features that encourage non-vehicle travel.

Caltrans can help to GHG emissions associated with employee commuting by ensuring that any new office facilities are located in areas with high location efficiency. In 2016, the California Strategic Growth Council adopted the *Resolution on Location Efficiency in Strategic Growth Council Agency Leased Facilities*.[114] Under this resolution, the Council set a goal to increase the average location efficiency score of new leased facilities for infill-compatible uses among Strategic Growth Council agencies. Location efficiency scores come from the US General Services Administration's Smart Location Calculator, which uses a scale of 0-100 based on a number of accessibility factors.[115] Factors include accessibility via transit, walking and bicycling, land use mix, regional mode share, retail, residential, and office density, intersection density and street design, and vehicle ownership, among others. Locations with high location efficiency scores are likely to exhibit less vehicle travel and emissions. Each score is relative to its own metro region. This means that high scoring locations in metropolitan areas with lower overall accessibility may generate more VMT than lower scoring locations in metropolitan areas with higher overall accessibility.

For example, the Caltrans District 4 office has a location efficiency score of 81. This office has a relatively high numbers of transit and bicycle commutes, likely in part due to transit access and bicycle infrastructure, and also a high number of carpoolers. District 1 has fewer transit options but has a

[112] DC Government Department of Human Resources website. https://dchr.dc.gov/page/capital-bikeshare-membership-discount
[113] Washington State Agencies Commute Trip Reduction website. www.ctr.wa.gov/employees/saferide.htm

[114] State of California Green Buildings website. Retrieved from: https://green.ca.gov/buildings/resources/les/
[115] Smart Location Calculator. Retrieved from: https://www.slc.gsa.gov/slc/#

location efficiency score of 89, higher than District 4, because the score compares characteristics of the office location to other locations in the Eureka metropolitan area. Again, these scores cannot be compared across regions; they represent the location efficiency relative to their own metropolitan region. The table below shows the location efficiency score of each Caltrans District headquarters office.

Table 21. Location Efficiency Score of Caltrans District Offices

District	Address	Location Efficiency Score
HQ	1120 N Street, Sacramento CA	98
1	1656 Union Street, Eureka CA	89
2	1657 Riverside Drive, Redding CA	75
3	703 B Street, Marysville CA	79
4	111 Grand Avenue, Oakland CA	81
5	50 Higuera Street , San Luis Obispo CA	75
6	1352 W. Olive Avenue, Fresno CA	81
6	2015 E Shields, Fresno CA	89
6	855 M Street, Fresno CA	94
7	100 S. Main Street, Los Angeles CA	88
8	464 West 4th Street, San Bernardino CA	73
9	500 South Main Street, Bishop CA	89
10	1976 Dr. M.L.K. Jr Blvd, Stockton, CA	65
11	4050 Taylor Street, San Diego CA	64
12 (former location)	3347 Michelson Drive, Irvine CA	57
12	1750 E 4th St, Santa Ana, CA	69

Source: ICF calculation using US General Services Administration's Smart Location Calculator

While Caltrans has not leased any new properties since the time the directive was issued through the Strategic Growth Council's initial reporting period, Caltrans can encourage employee travel by modes with low carbon intensity by ensuring that any new facilities (owned or leased) be located in areas with high location efficiency.

5 Summary

This report documents the numerous ways that Caltrans is helping to reduce GHG emissions through its planning, programming, design, construction, maintenance, traffic operations, and administrative activities, and also identifies opportunities for Caltrans to further contribute to GHG reduction efforts.

By far the greatest opportunities for Caltrans to reduce GHG emissions relate to influencing vehicle travel on the State Highway System. Vehicle travel on the State Highway System produces roughly 89 million metric tons of GHG emissions annually, or 21 percent of California's total GHG inventory. The primary opportunities for Caltrans to reduce these emissions are:

- **Limit demand for travel by SOVs.** Caltrans can limit the demand for SOV travel that accounts for the bulk of transportation GHG emission in the state by avoiding highway capacity expansion projects that induce new vehicle travel. Adding highway capacity in urbanized areas, including HOV and express lanes, often will induce new vehicle travel, limiting long-term congestion reduction benefits and leading to increased VMT and potentially higher GHG emissions. As an alternative to capacity expansion, roadway pricing provides a mechanism for reducing the demand for SOV travel and improving network performance, although Federal law currently prohibits Caltrans from imposing tolls on Interstate highway general purpose lanes.
- **Support transportation system improvements that to provide alternatives to SOV travel.** Caltrans can lead the development of new facilities for bicyclists, pedestrians, and carpoolers. For example, Caltrans develops bicycle lanes on state highways and constructs park-and-ride lots that encourage ridesharing. Caltrans can also support demand management strategies that are implemented by other organizations. For example, Caltrans supports public transit service by enabling bus operations on the highway shoulder where possible and facilitates exceptions to highway design standards that support local complete streets efforts. By promoting mode shift, these activities have been demonstrated to reduce GHG emissions, although the magnitude of GHG impacts is typically small as compared to those from vehicles on the highway system.

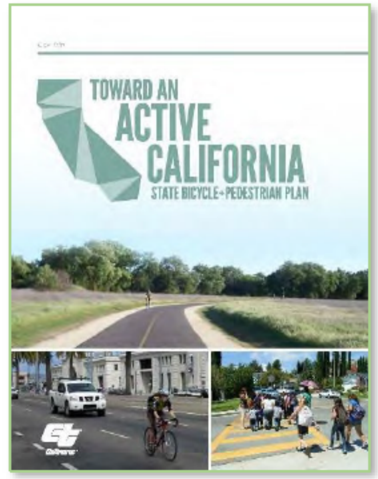
Caltrans highway construction and maintenance projects result in substantial GHG emissions, particularly when considering the emissions associated with the extraction, processing, and transport of materials such as concrete, asphalt, and aggregates. A variety of strategies are available to reduce emissions from paving and other highway construction and maintenance projects, including use of reclaimed asphalt pavement and use of supplemental cementious materials (such as fly ash) in concrete. Because of the large volume of roadway construction materials used on Caltrans projects, and Caltrans influence among partner agencies and the pavement and road construction industry, the Department can achieve significant GHG reductions through its design and construction process specifications. However, the impact of pavement choices on GHG emissions is complex, and any decisions to promote pavement or other materials strategies for GHG reduction should be informed by experts in the field of LCA research.

Caltrans is directly responsible for approximately 120,000 tons of CO_2-equivalent emissions per year due to its own internal operations, which is about 0.03 percent of California's total statewide GHG emission inventory. Sources of these emissions include the fuel used to power Caltrans vehicle fleet, energy used for lighting on the State Highway System, and energy used in Caltrans buildings. The internal operations emissions under direct Caltrans control have declined 45 percent since 2010, and are expected to continue to decline as more energy efficiency measures are implemented, low carbon vehicle fuels gain market share, and California's grid electricity becomes cleaner. Opportunities to further reduce Caltrans internal operations emissions include increasing renewable energy generation by installing solar power projects in the highway right-of-way, purchasing fuels with lower carbon intensities for Caltrans fleet such as renewable natural gas, and expanding programs and incentives to increase transit use, ridesharing, and bicycling for Caltrans employee commuting.

Appendix A

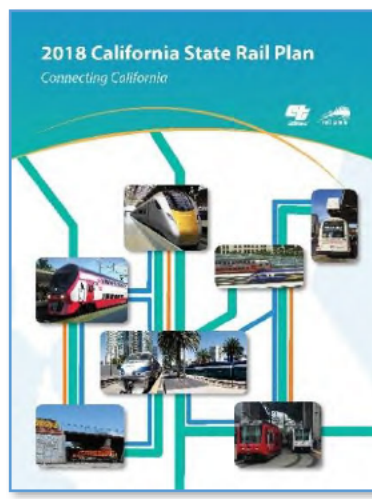
Caltrans Modal Plans

Toward an Active California: State Bicycle + Pedestrian Plan



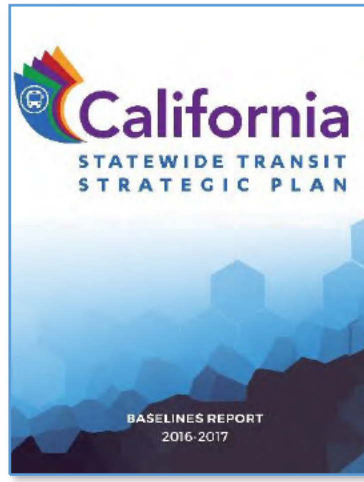
In 2017 Caltrans released *Toward and Active California: State Bicycle + Pedestrian Plan*, which describes Caltrans' overall approach for non-motorized transportation facilities. The plan describes statewide transportation system goals that can be supported by the development of bicycle and pedestrian facilities, such as improved mobility and social equity, and strategies for achieving those goals. To the extent they shift travel from motorized modes, measures that encourage bicycling and walking have clear GHG benefits, as these modes have no direct GHG emissions. An appendix to the plan provides an estimate the environmental benefits, including CO_2 emissions reduced, of achieving the active transportation mode share targets established in the Strategic Management Plan. The study estimates 2.2 million more bicycling trips and 11.4 million more walk trips; some factor of these would replace motorized trips, resulting in a reduction of 1.2 million tons of CO_2 per year. This equates to roughly 1 percent of the state's current annual CO_2 emissions from passenger vehicles.

California State Rail Plan: Connecting California



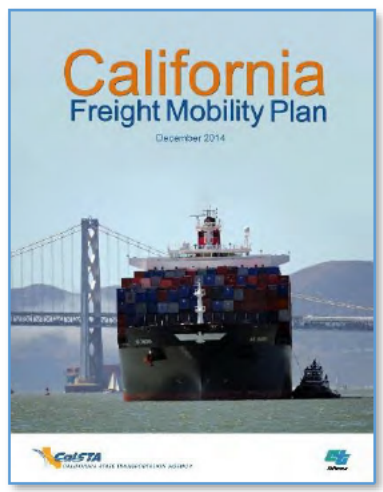
The *California State Rail Plan* was released in September 2018. The plan includes an expansive overview of rail system in California, including the State's goals for the rail system, policies driving rail service, and funding and financing. Rail investments can impact both passengers and freight movement. The plan envisions faster service and improved connectivity across the entire transportation network as a result of the rail plan elements. Improvements in rail can result in GHG emission reductions by shifting both passenger travel and freight shipping from on-road vehicles and from improvements in rail locomotives, including the electrification of rail lines. According to the plan documentation, there are currently 115,000 intercity rail passenger trips per day; in 2040, the plan forecasts 151,000 daily trips without the projects outlined in the plan to improve capacity and operations and over 1.3 million daily passenger trips if the 2040 plan is fully implemented as envisioned. While improvements in freight rail and grade crossings can encourage shifting of freight shipments from on-road trucks to rail and reduce congestion for all vehicles on shared roadways, the plan does not include these potential shifts in its emission benefit estimates. The emissions analysis instead focuses on the shift from personal vehicles to passenger rail. If the elements of the rail plan are not implemented, the plan estimates that on-road vehicles and locomotives will emit over 416,000 tons of CO_2 per day in 2040; with the plan fully implemented, CO_2 emissions will be reduced by 12,778 tons per day.

California Statewide Transit Strategic Plan



The *Statewide Transit Strategic Plan* consists of three separate reports from 2012: an assessment of baseline transit conditions and trends; a summary of outcomes from stakeholder engagement activities; and recommendations for Caltrans Division of Mass Transportation. Caltrans is in the process of updating the transit plan, with new baseline and stakeholder engagement reports released in 2017 and a new set of recommendations scheduled to be released in 2018. Unlike newer modal plans (and the new recommendations report not yet released) which discuss efforts and strategies for all relevant state and local government agencies, the 2012 transit plan focuses narrowly on efforts that Caltrans Division of Mass Transportation could implement. These recommendations include: sponsoring vanpools; supporting station vans to provide last-mile trips; supporting bus-only lanes; allowing buses on shoulders of controlled access highways; and supporting local efforts to implement congestion pricing mechanisms. Statewide strategies and investments in public transportation systems have the potential to reduce VMT by encouraging travelers to replace private vehicle trips with transit trips, especially when considering transit systems have a key role in network connectivity which can improve travel across the broader multimodal transportation system. The 2012 transit plan does not include estimates of VMT or GHG emission reductions related to its recommendations.

California Freight Mobility Plan



The 2014 *California Freight Mobility Plan* describes the state's long-range plan for a sustainable freight transportation system. The plan recognizes the threat that GHG emissions impose and includes objectives for environmental stewardship and congestion relief and describes general strategies to achieve those goals. The plan describes the many local (port) and state programs that are in action to reduce emissions related to maritime, rail, on-road trucking, and air freight movement, and the associated reductions in criteria pollutant emissions. The plan describes the many local (port) and state programs that are in action to reduce emissions related to maritime, rail, on-road trucking, and air freight movement, and the associated reductions in criteria pollutant emissions. The Freight Mobility Plan does not include an estimate of the GHG impacts of the plan. However, the plan includes a list of potential projects, both financially constrained and unconstrained, in an appendix.

Planning Grants

Sustainable Communities Grants

Sustainable Communities Grants are intended to help local and regional agencies achieve or improve GHG reductions through their multimodal transportation and land use planning efforts. SB1 provides $250 over ten years, or $25 million per year, for this grant program, with half being allocated to competitive grants and the other half through formula grants. For fiscal year 2017-2018, Caltrans received 127 applications requesting a total of $34.1 million in the for competitive grant program. Caltrans awarded 43 grants, totaling $12.4 million, and work has started on those projects. Under the formula program, 13 MPOs were awarded a share of the grant funding as they met minimum program requirements, which include having a Regional Transportation Plan Sustainable Communities Strategy (RTP-SCS) in place and meeting environmental justice standards. As of May 2018, Caltrans had awarded $12.8 million for 47 competitive grants and $12.5 million for 17 MPOs.

Adaptation Planning Grants

Adaptation Planning Grants are awarded to agencies to support local and regional planning to prepare for and reduce the impacts associated with climate change. This is a competitive grant program that is funded for $20 million split over three years (FY 2017/2018 through FY 2019/2020). Grant projects should identify climate risks to multimodal transportation infrastructure, vulnerabilities, and actions to mitigate vulnerabilities, in addition to developing potential designs, cost estimates, and cost analyses. Furthermore, these grant projects must involve partnerships across sectors and jurisdictions and identify co-benefits associated with adaptation efforts (e.g., air quality, public health, natural environment, economic, and equity improvements). Caltrans awarded 21 grants worth $7 million in fiscal year 2017-2018 and 22 grants for $7 million in fiscal year 2018-2019.

Strategic Partnerships Grants

Strategic Partnerships Grants are awarded to MPOs and Regional Transportation Planning Agencies (RTPAs) to encourage engagement of local and regional planning agencies with Caltrans to ultimately improve the State Highway System. Projects have included studies of corridors and multimodal or intermodal facilities; state-level research and modeling; and sustainable freight planning. The grant funding is provided by FHWA (FHWA State Planning and Research, Part I) and administered by Caltrans. In fiscal year 2017-2018, $1.5 million was available for the program; $4.3 million is available for fiscal year 2018-2019, with awards ranging from $100,000 to $500,000. Also in FY 2018/2019, the program newly directs funding for transit planning projects to address multimodal transportation gaps.

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Decarbonizing US passenger vehicle transport under electrification and automation uncertainty has a travel budget

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LETTER

Decarbonizing US passenger vehicle transport under electrification and automation uncertainty has a travel budget

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Abstract

The transportation sector is at the beginning of a transition represented by electrification, shared mobility, and automation, which could lead to either increases or decreases in total travel and energy use. Understanding the factors enabling deep decarbonization of the passenger vehicle sector is essential for planning the required infrastructure investments and technology adoption policies. We examine the requirements for meeting carbon reduction targets of 80% and higher for passenger vehicle transport in the United States (US) by midcentury under uncertainty. We model the changes needed in vehicle electrification, electricity carbon intensity, and travel demand. Since growth in fleet penetration of electric vehicles (EVs) is constrained by fleet stock turnover, we estimate the EV penetration rates needed to meet climate targets. We find for a base case level of passenger vehicle travel, midcentury deep decarbonization of US passenger transport is conditional on reducing the electricity generation carbon intensity to close to zero along with electrification of about 67% or 84% of vehicle travel to meet decarbonization targets of 80% or 90%, respectively. Higher electricity generation carbon intensity and degraded EV fuel economy due to automation would require higher levels of fleet electrification and/or further constrain the total vehicle travel allowable. Transportation deep decarbonization not only depends on electricity decarbonization, but also has a total travel budget, representing a maximum total vehicle travel threshold that still enables meeting a midcentury climate target. This makes encouraging ride sharing, reducing total vehicle travel, and increasing fuel economy in both human-driven and future automated vehicles increasingly important to deep decarbonization.

1. Introduction

Deep decarbonization of human activities is necessary to increase the likelihood of avoiding global temperature increases of greater than 1.5 or 2 °C in this century [1]. The Intergovernmental Panel on Climate Change (IPCC) examined emissions scenarios likely to maintain warming below 2 °C in the 21st century relative to pre-industrial levels. These scenarios are characterized by global anthropogenic greenhouse gas (GHG) emissions reductions of 40%–70% by midcentury compared to 2010 [2]. More recently, the IPCC concluded that reaching net zero CO_2 emissions globally around 2050 would likely be required for limiting global warming to 1.5 °C above pre-industrial levels [3]. Because of traditionally long infrastructure turnover timelines, the committed emissions from existing energy and transportation infrastructure across sectors would jeopardize meeting this 1.5 °C climate target, without accelerated policy efforts [4]. Deeply decarbonizing the transport sector is an essential element in any climate stabilization scenario, and requires a major a transition in energy use, vehicles, and enabling infrastructure [5]. While there is some progress in reducing emissions from electricity generation, emissions from transportation, representing 23% of global energy-related CO_2 emissions, continue to grow [2, 6]. The transportation sector is at the beginning of an age of 'advanced mobility' represented by electrification, advanced mobility, and automation [7]. Electric vehicle (EV) cost declines, IT-enabled vehicle ridesourcing, public and personal transport innovations, and partial and full personal vehicle automation systems will fundamentally change transportation. These technologies could improve efficiency, affordability, mobility, and accessibility, however the impacts of these technologies on total travel, energy use, and emissions remain uncertain [8–14]. Thus, any decline of transportation emissions is dependent on use, deployment, and importantly, electricity emissions. Still, transportation deep decarbonization by midcentury under the uncertainty that advanced mobility brings requires policy actions, and identifying robust pathways to achieving climate policy objectives.

The US transport sector represents about 33% of total US CO_2 emissions, approximately 1800 million metric tons [15]. Light-duty vehicles (LDV) comprised of passenger cars and light trucks are responsible for about 60% of these transport emissions [15]. The US Energy Information Administration (EIA) projects that due to increases in vehicle efficiency and about a 12% penetration of EVs, mostly Battery Electric Vehicles (BEVs), total US transportation sector CO_2 emissions in 2050 will be slightly less than current levels, despite a total passenger vehicle travel increase [16]. This is due to the improved fleet average fuel economy which EIA projects to increase by more than 60% by 2050, driven by the penetration of alternative fuel vehicles and overall technology advancement [16]. While these projections do not consider the impact of future policies and may underestimate technology advancement, achieving deep US GHG emissions reductions by midcentury will still require much larger changes in the transportation sector [17, 18].

As the LDV fleet represents the majority of transport demand, energy use, and emissions [16], potential modal shifts away from personal vehicles to public and active transport should be one of the strategies for transport GHG reduction. However, the growth of shared mobility through ridesourcing and vehicle automation may increase public transit use through providing last and first mile accessibility [19], or result in a modal shift from public transport to passenger vehicles [12], or a combination of these effects. Therefore, a robust strategy for deep decarbonization under technology and behavioral uncertainty must address LDVs as a primary component. While there are aggressive transition projections to achieve GHG reductions in the LDV sector [20–27], the incumbency of vehicle and refueling technologies as well as the time required for fleet compositional changes can constrain options and strategies. Potential alternative fuels include hydrogen made from low-carbon sources used in fuel cell vehicles, advanced low-impact biofuels, and carbon neutral hydrocarbons (CNHCs) that re-use CO_2 extracted from the atmosphere via biomass use or direct air capture and hydrogen from carbon-free sources to create to a useable fuel. All of these fuels are under development with known and unknown challenges to overcome that include cost, infrastructure, land use, and uncertainty in life cycle emissions [28–34]. What remains is electricity, which has the ability to use a variety of existing low-carbon technologies for generation and distribution such as wind, solar, hydro, and nuclear, providing a diverse portfolio of clean energy sources that could ensure a reliable and low cost transition to a near-zero emissions grid [35]. It is therefore, the independent pace and scale of both vehicle electrification and electricity decarbonization that will ultimately determine the energy and environmental outcomes of the transportation sector through 2050.

In 2018, the global EV stock exceeded 5.1 million, and close to 2 million new EVs were sold worldwide [36]. But EVs remain a small percentage of new sales (2.2%) and the total fleet of vehicles (0.43%) [36, 37]. China, the US, and Europe comprised over 90% of global EV stock [36]. Policy incentives can increase the pace of a transition to EVs. In 2017, China announced a policy to phase out production and sales of conventional fossil fuel-powered vehicles [38, 39]. This policy in the world's second largest economy and largest auto market has considerable implications for the global oil market, the automobile industry, and the rate of EV technology penetration and advancement. India and many European countries such as France, the United Kingdom, and others have discussed setting targets to phase out sales of gasoline and diesel vehicles [39].

Along with vehicle electrification, advanced mobility services represented by the emergence of individual and shared ridesourcing offered by Transportation Network Companies (TNCs) such as Uber and Lyft, as well as potential vehicle automation, could reshape passenger transport [7, 12]. TNC options could increase ride sharing, but also could increase total vehicle kilometers traveled (VKT) (or vehicle miles traveled (VMT)) or shift demand away from public transit [12, 40]. Partial and full vehicle automation could offer synergies with electrification, and could either increase or decrease fuel economy, vehicle travel, and energy use, depending on how these vehicles are deployed and used [10, 11, 41–43]. However, coupling an increase in shared ridesourcing with electrification and optimizing automation strategies to reduce vehicle travel and energy use could increase the likelihood of meeting climate mitigation targets [7]. LDV transport deep decarbonization under advanced mobility will depend in part on this total travel demand, which represents a mitigation frontier of what is possible in the next few decades.

It is critical to characterize and manage uncertainties across the multiple facets of the electricity and transport systems when analyzing decarbonization pathways [44, 45]. Here we assess the bounds of EV adoption, the pace of electricity decarbonization, and total travel demand for decarbonizing the US LDV sector to achieve GHG emissions reduction targets by 2050. For the base case, we use an 80% reduction by 2050 compared to emissions in the reference year of 2005—a common midcentury decarbonization benchmark target [17, 45]. We also examine a 90% reduction target to understand the sensitivity of decarbonization requirements to this policy goal. To enable comparisons with national projections, inventories, and other studies, we only include direct CO_2 emissions and exclude life cycle impacts [15, 16]. We include CO_2 emissions from electric power generation units for the EVs and fuel use for internal combustion engines, but not upstream impacts from producing fuels, vehicles, and batteries, which are assessed in other studies and introduce additional model and scenario uncertainties [46, 47], although we comment on the life cycle implications in the discussion section. Similar to a robust decision making approach [48], we assess the conditions that enable meeting a mitigation target (e.g. an 80% reduction in 2050) for the passenger vehicle transportation sector by understanding the factors affecting deep decarbonization. This enables public and private stakeholders to make choices on the required enabling infrastructure, investments, policies, and technologies.

2. Method and data

We considered the 1134 million metric tons of CO_2 from 2005 US LDV travel as a reference value [15]. Reducing the 2005 value by 80% results an emissions target of 227 million metric tons in 2050 [15], and we use 250 million metric tons to simplify the analysis and visualization. For a more aggressive target of 90% reduction, the target would be 113 million metric tons, and we use 120 million metric tons as an approximate target. Our results can also assess reaching a 100% reduction target, which requires a zero GHG electricity sector and full vehicle electrification. However, it is important to stakeholders to understand the implications of the 80% and 90% reduction targets to enable policy planning under uncertainty.

In order to characterize the requirements to reduce US LDV CO_2 to 250 and 120 million metric tons in 2050, we model: the share of LDV travel from EVs, the carbon intensity of electricity, the fuel economy of EVs and ICEVs, and the total travel from LDVs using equation (1). Using this equation with EIA reference case projections resulted in comparable CO_2 emissions to EIA's (See Supporting Information (SI) tables S1–S7 and calculations). Ranges of possible values for these variables are used to find combinations that meet the target emissions in 2050. The US electricity carbon intensity (CI) has decreased by about 30% since 2001 and is expected to further decrease with a continued shift from coal to natural gas and increased renewables [49, 50]. The EIA's projected vehicle travel in 2050 is about 3.3 trillion miles (or 5.28 trillion km) [16]. In this paper, we use VMT instead of VKT in order to be consistent with US regulatory agency reporting. All the metrics and their associated units in the analysis are shown in the SI table S1, as well as the calculation of the targets and the current and historical levels of annual LDV CO_2 (table S2) and parameters used (table S3).

Hybrid electric, diesel, and ethanol powered vehicles were modeled as part of the ICEV fleet in addition to conventional gasolines, and their weighted average fuel economy was estimated using EIA's projected 2050 composition of the ICEV fleet [16]. We refer exclusively to BEVs as EVs since they are projected to be the major electric vehicle technology in 2050 (more than 80% of the EV fleet) with the remaining 20% from Plug-in Hybrid Electric Vehicles (PHEVs), hence we provide a conservative estimate of the required travel electrification [16]. We considered ranges for EV adoption represented as the EV share of LDV travel ranging from 0% to 100%. We also considered the charging, transmission and distribution losses in the CO_2 emissions estimation. We assumed an 88% charging efficiency to account for the plug-to-wheels losses [51, 52], and approximately 4.5% for the losses in the power transmission and distribution system [53].

$$Total\,LDV\,CO_2\,(kg) = \frac{\alpha \times (1+\mathrm{L}) \times total\,VKT \times EV\_CI\left(\frac{kg}{kWh}\right)}{EV\_FE\left(\frac{km}{kWh}\right)} + \frac{(1-\alpha) \times total\,VKT \times ICEV\_CI\left(\frac{kg}{l}\right)}{ICEV\_FE\left(\frac{km}{l}\right)} \tag{1}$$

where α represents the fraction of the LDV travel by EVs, and (1-α) represents the fraction that is traveled by ICEVs. Total VKT represents the total km traveled by the LDVs in the US for one year. The loss factor (L) used was calculated as ($\mathrm{L} = 0.12 + 0.045$) to include the charging and grid inefficiencies.

The EIA projects a 2050 US net generated electricity carbon intensity of 329 g CO_2 kWh^{-1}, and the 2018 level was 428 g CO_2 kWh^{-1} [16, 50].

This AEO-projected electricity carbon intensity is incompatible with the climate targets under consideration. We focus on lower levels of electricity net generation carbon intensity representing the US national average electricity generation mix, which would be associated with charging EVs in 2050. Urbanization and driving patterns vary by region, as do electricity emissions which also vary by season and time of day. Yet here we model the entire US to illustrate the scale of emissions reductions and fleet technology change required at the national level. EV charging initially represents new demand served by marginal generators. Yet electrifying the vast majority of LDV travel for deep decarbonization will require both the average and the marginal emissions of the generation fleet to be deeply decarbonized. If states such as California continue to make progress on vehicle electrification and electricity decarbonization ahead of other states, this provides some room for other states to increase efforts somewhat more slowly. However, what matters for climate policy is the total amount of CO_2 from the transportation sector, and an 80% or 90% or greater emissions reduction will require a substantial fleet and electricity grid transition across all regions.

The EV and ICEV fuel economy (FE) values represent the weighted average fuel economy of the technology fleet in a given year. The assumed fuel economy value for ICEVs is based on the base case projections of its technology mix (i.e. by blended gasoline, diesel, ethanol, and hybrid) of vehicles in the fleet from the Argonne National Laboratory VISION 2018 Model which uses the EIA's Annual Energy Outlook, as shown in SI table S4 [16, 54]. These fuel economy values are expressed in miles per gallon of gasoline equivalent (mpgge) (and converted to km/l) and represent the weighted average value of the vehicle measured fuel economy based on standardized test cycles. However, these laboratory-measured fuel economy values are generally higher than fuel economy observed in actual vehicle operations. Hence we used a road degradation factor for each technology to better capture real on-road fuel consumption [54]. We use a 2050 EV FE base case level of 6 miles kWh^{-1} (9.67 km kWh^{-1}) given the ongoing and future technology improvement. We test the sensitivity of the results to this assumption by considering EV FE levels of 3 and 9 miles kWh^{-1} (4.8 and 14.5 km kWh^{-1}, respectively) as shown in tables S8–S10.

The ICEV CI term is the weighted average combustion carbon intensity (emission factors) of the fuels burned by the ICEVs vehicles in the fleet. The emission factors for the liquid fuels such as gasoline and diesel were taken from the Environmental Protection Agency (EPA) and used to calculate the weighted average CI for ICEVs [55]. We assumed about 12% ethanol content by volume in the 2050 blended gasoline used by conventional cars and light trucks [54]. The EV carbon intensity here is the direct CO_2 emissions of combustion of fuels for electricity generation.

The LDV survival curves for cars and light trucks from the Transportation Energy Data Book were used to estimate the lifetime of EVs and ICEVs entering the fleet [56]. Overall, our data source for this analysis was the EIA 2018 Annual Energy Outlook (AEO) [16]. The base case values for the projected LDV travel demand (VMT) and future annual sales were all taken from the AEO. Also, the projected base case EV sales and fleet stock from AEO and VISION were used in modeling the fleet turnover [16, 54].

3. Results and discussion

3.1. Meeting a climate mitigation target in transportation

We show in figure 1 a range of possible total US LDV CO_2 emissions in 2050 ranging from zero to 300 million metric tons to illustrate the sensitivity of the results to different decarbonization policy targets. Figure 1 shows the required electricity net generation carbon intensity and EV travel share of the total US LDV miles to meet a given total CO_2 emissions target in 2050. The targets of 80% and 90% reduction from 2005 levels are indicated by the two vertical dashed lines. We find that reducing LDV CO_2 emissions to 250 million metric tons is attainable if the electricity carbon intensity is reduced to zero and about 67% of LDV travel is electrified. For the 90% reduction target, about 84% travel electrification would be needed. These targets could also be met with somewhat higher electricity carbon intensity but would require more electrification of LDV miles. The feasibility space for this trade off shrinks as the climate target becomes more stringent. Ultimately, meeting the IPCC target of net zero CO_2 emissions [3] for LDVs implies zero carbon electricity and full electrification, hence reducing the feasibility space to a single point. Therefore, decarbonizing electricity is the major constraint and opportunity for meeting climate targets through transportation electrification. The 2050 EV fleet average fuel economy assumed in figure 1 is 6 miles kWh^{-1} given potential future improvements in efficiency, battery specific energy, lighter vehicle weight, and other improvements. However, with the potential additional energy required for vehicle automation (e.g. computing, sensing, additional weight) [43], the EV fleet average FE could be lower. Figure S1 shows how figure 1 would change if the 2050 EV fleet average FE is reduced to 3 miles/kWh.

3.2. The travel budget frontier

Next, we examine the effect of the travel budget frontier, which is the maximum total miles that can be traveled without exceeding the targeted maximum emissions, for a given EV share and electricity carbon intensity. Figure 2 shows the space of the possible combinations of the electricity carbon intensity and

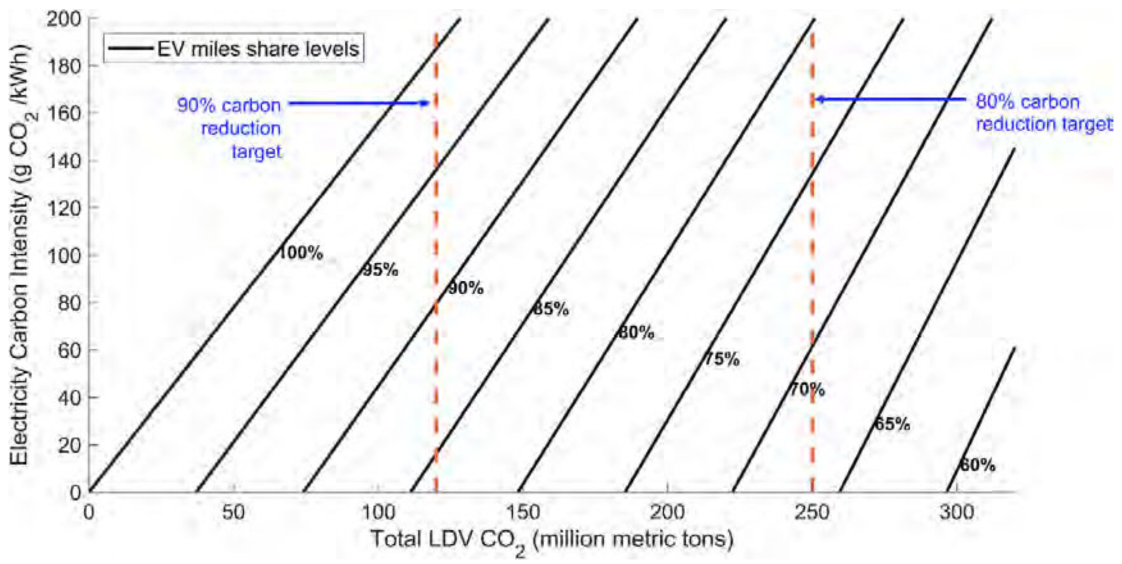

Figure 1. Levels of EV miles share and electricity net generation carbon intensity required for a given 2050 total US Light Duty Vehicle (LDV) CO_2 target and 3.3 trillion miles of LDV travel. The two vertical dashed lines at 250 and 120 million metric tons represent an 80% and 90% reduction in LDV CO_2 from 2005 levels, respectively. The triangle formed by the *x*-axis, a given CO_2 intensity level and the share of EV miles represent the feasible space which shrinks as decarbonization targets become more stringent. The feasibility space approaches a single point (the point of origin) as the decarbonization target approaches zero emissions.

travel electrification that meet the 80% target for different levels of LDV total VMT. Figure S2 shows that the more aggressive 90% target results in increasing the required electricity decarbonization and travel electrification. We emphasize that for a given EV miles share, reducing the electricity carbon intensity stretches the travel budget and increases the maximum total VMT that can be traveled while meeting the target. Behavioral changes can lead to travel demand reductions, but given historical trends and current projections [16, 57] it is prudent to consider cases where total demand does not fall. Assuming no travel demand reduction, there is only a narrow region of EV miles and electricity carbon intensity combinations that can meet the climate target. Further decarbonization of the electric power sector could increases the travel budget or reduce the travel electrification requirement. These findings highlight the window of feasible conditions to meet LDV decarbonization targets, when constrained by the total travel demand. For example, if automation or other factors increase total LDV travel to 4 trillion miles, the minimum EV miles share would increase by about one fifth.

We further examined the effect of an upper limit of 9 miles kWh^{-1} for EV FE, reflecting a scenario when potential operational effects of connected automated vehicles (e.g. eco-driving, platooning, and intersection connectivity) coupled with improved batteries enhance the average fuel economy of EVs [43]. As tables S8-S10 show, improved FE of EVs, and more importantly limiting any total travel increase (through means of modal shift and shared mobility), hedge against any shortfall from electricity not being able to achieve zero GHGs by 2050. While the impact of EV FE on the required travel electrification and total emissions becomes irrelevant with zero carbon electricity, improved ICEV FE (50 mpg) can considerably reduce the minimum required EV miles share as shown in SI figures S3 and S4.

There are opportunities to reduce total VMT and associated emissions while maintaining mobility and passenger miles traveled (PMT). These opportunities include shared traditional or automated ridesourcing, carpooling, and lower impact modes such as transit, bicycles, scooters and walking [8, 11–13, 60]. If VMT is reduced through mode shifting and advanced mobility approaches, the possibility frontier of meeting the carbon reduction target expands, and fewer EV miles are required. However, the opposite would occur if advanced mobility technologies result in increased total VMT. For example, reducing VMT to 2 trillion miles in 2050 would require a minimum of 45% EV travel, while increasing VMT to 4 trillion miles results in minimum of 73% EV travel to meet the 80% target as shown in figure 2.

Because transportation CO_2 emissions are directly coupled to total distance traveled, figure 2 addresses the feasibility space for meeting the climate target through decreased VMT, whether through demand reduction (less travel), a shift to transit or other modes, or increased ride sharing (i.e. increased PMT). The long-term historical trends in the US could continue and traditional privately-owned LDV travel could dominate passenger travel while public transit remains a small portion of passenger travel. Previous work also expects a limited contribution to emission reductions from activity reduction and

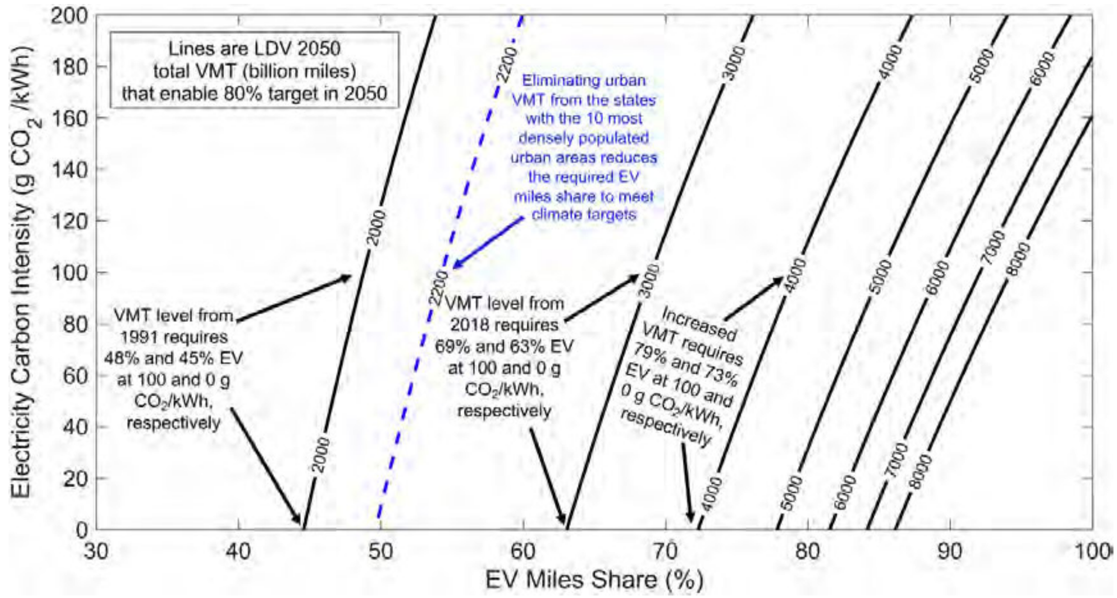

Figure 2. The combinations of the travel demand, electricity generation CO_2 intensity, and EV miles share to meet a 2050 LDV CO_2 target of 250 million metric tons (an 80% reduction from 2005 levels). The impact from the reduced or increased travel is illustrated with the contour lines. The dashed 2.2 trillion miles line represents the impact of eliminating all of the 1.1 trillion LDV the urban miles from the US states with the 10 most densely populated metropolitan areas [58, 59]. Urban LDV miles traveled in all US states comprise about 70% of total current US LDV travel.

modal shifting compared to fuel switching and further enhancements in energy efficiency [61, 62].

However, there is an opportunity to reduce and shift US urban LDV VMT, which comprises about 70% of total LDV VMT [58]. Further, urban VMT in the 13 states that have the top ten metropolitan areas in terms of population density, comprise almost one trillion VMT, or one-third of current US LDV VMT (See SI table S11–S13). In figure 2 we illustrate the impact of eliminating this urban VMT on the miles budget (further cases in figure S5), which can help bound the large improvements possible through VMT reduction. Synergy between public transport and shared, automated and connected vehicles, as well as bicycle, scooter, and pedestrian modes could provide mobility that enables PMT while reducing VMT. Shared EVs could be responsible for the last mile delivery of passengers to and from destinations and public transit stops. This means public transit and advanced mobility could serve some of the PMT demand and help meet a climate target under a total travel budget. Shifted miles from LDVs to public transit would still emit CO_2 emissions, whether shifted to rail, conventional buses, or electric buses (with electricity greater than 0 g GHG kWh^{-1}). The additional emissions from these shifted miles, when coupled with LDV emissions, will need to remain below the climate target to prevent emissions leakage from the LDV sector to the transit sector. This highlights the importance of a deeply decarbonized electricity system and electrification of transit modes in addition to electric LDVs. Yet, others did find that achieving large efficiency improvements and fuel switching makes it possible to meet CO_2 emission reduction targets without large shifts to public and non-motorized transport [63].

Ride sharing impacts can be quantified through an increase in the load factor (LF) of trips, computed as person miles of travel per vehicle mile [64]. The load factor of the US LDV sector was estimated as the VMT weighted average of the load factors for cars and light trucks from the 2017 National Household Travel Survey (NHTS) [64]. The estimated average load factor is about 1.60 based on the recent NHTS, slightly lower than the 2009 level of 1.63 passengers averaged across VMT that was used in previous studies [11] (see SI table S14 for historical values of the load factor) [57, 64]. We note that the NHTS is a survey, and actual load factors may be different both spatially and temporally. To examine the effect of the load factor on meeting the emissions target level, we varied the load factor in our model from 1 to 2.5 as shown in figure 3. Using the EIA projected total VMT for 2050 and the current load factor of 1.60, the projected 2050 PMT would be about 5.3 trillion miles, while the current PMT is about 4.6 trillion miles [16, 57, 64]. We show three cases of high travel electrification and low electricity CI in figure 3. Other combinations including lower EV miles share (50%) and higher electricity CI (100 and 150 g CO_2 kWh^{-1}) are shown in SI figures S6 and S7. In all cases, as load factor increases, total VMT declines while PMT demand is met. Figure 3 shows increase ride sharing enabled by advanced mobility effectively reduces the minimum electricity decarbonization and fleet electrification requirements to meet a climate target. While ride sharing could increase load factors, increased miles traveled by ridesourcing vehicles cruising between pickups or potentially automated vehicles traveling without a driver could decrease load factors and policies would he needed to reduce cruising and reduce the impact of decreased load factors [8].

3.3. The impact of fleet turnover timelines

The share of EVs in the LDV stock is affected by vehicle turnover, which is constrained by the penetration rate of the new vehicle technology as well as the rates and ages when vehicles exit the fleet (see table S16). New ICEVs that enter the stock will effectively delay a transition to a predominately electrified fleet unless the ICEVs exit early [65]. Stock turnover limitations and the timing of the new vehicle technology deployment will affect total emissions and fuel economy [65, 66]. Additionally, more automated features could likely reduce crashes [67, 68], and also extend vehicle lifetimes and stock turnover time as fewer vehicles retire due to crashes. Based on current LDV survival curves, it takes about three decades for all of the current LDV stock to retire [56]. We show the effect of EV penetration rate and stock turnover on meeting the climate target in figure 4. Using current projected rates of total vehicle sales and retirements, getting to a 100% EV fleet in 2050 requires all LDV sales to be only EVs starting in 2020. To find the year when all LDV sales need to be EVs to reach a specific stock share in 2050, we conservatively examine if the sales of EVs follow the EIA reference case trajectory and vary the starting year of 'only EV' sales until the target level is met. Since about 67% EVs is the minimum EV share that can meet the 80% climate target with decarbonized electricity without reducing projected baseline VMT (See figure 2), the lower bound case shows that 2040 is the latest possible year to start EV only sales and reach 67% EVs by 2050. For the 90% target, 2037 would be the starting year for selling only EVs to reach about 80% EVs in the fleet by 2050. We include additional hypothetical cases for the starting years that would be required to meet the Bloomberg New Energy Finance (BNEF) 2019 Electric Vehicle Outlook projection of 42% EVs in the US in 2040 [69]. These results also highlight the effect of the long tail of the vehicle survival curve, as it takes more time to retire the last 10% of the replaced technology [56] and the likely need for policies to induce the early retirement of petroleum-powered vehicles. Considering that new vehicles are on average driven more than older ones, the targeted travel share could be reached earlier than the physical stock share of vehicles. We used a typical annual miles by age distribution [54] for passenger cars and light trucks to calculate the difference between the miles share and stock share. As shown in figure S8, the miles share always exceeds the stock share and the annual difference can be up to 7%, depending on the number of years since starting to sell only EVs. This indicates the benefit of early introduction of EVs at large market shares along with targeting higher utilization of EVs and designing policies to decrease the average annual miles driven by ICEVs.

Further, the high EV travel share required to meet the decarbonization target can be met with an even lower stock share through increasing the utilization of those vehicles beyond the annual miles of typical new vehicles. For example, a vehicle stock that has 50% EVs could have considerably greater than 50% of annual travel by EVs, if these EVs are highly utilized (i.e. driven more over the year than the annual LDV average). Figure S9 shows the impact of decoupling the EV travel share from the EV fleet share. High utilization of the EV fleet could effectively offset some of the fleet electrification requirement for meeting transport carbon reduction targets. Thus, vehicles with high utilization rates such as taxis, ridesourcing vehicles, and service fleets could be the early adopters of EVs during the transition and can accelerate the climate benefits, but this would require carefully designed policies such as additional subsidies for highly utilized EVs, EV-only access zones in urban areas, or other incentives for EV ride sharing or fees for single occupancy vehicles in urban zones.

The potential of high EV utilization through ride sharing despite low EV fleet share could also be constrained by the spatial and temporal distribution of passenger demand. It will likely require higher capacity EV shuttles in dense urban areas. In the suburbs, exurbs, and rural areas, the density of the demand is much lower, and trips are usually longer, thus reducing the opportunities for ride sharing and increasing the need for focused policies. Despite these challenges, given the increased urbanization and advancements in vehicle automation, and ride sharing optimization by TNCs, the urban areas might be able to partially offset limited ride sharing in other areas. Urban areas currently comprise about 70% of total miles of road transport in the US, which is dominated by LDVs [58, 73]. Therefore, urban areas need to achieve higher levels of electrification and ride sharing, to offset a potentially more limited transition in rural areas to reach the targeted load factor, EV travel share levels, and emissions reductions.

4. Pathways for passenger transport decarbonization

We presented the required changes to passenger vehicle travel demand, electricity generation carbon intensity, and vehicle travel electrification to meet 80% and 90% decarbonization targets for the US light-duty vehicle transport sector. Among these changes, deep decarbonization of electricity generation to near zero is required, unless a severe reduction in vehicle travel occurs. These actions need to be concurrent with achieving a considerably high EV

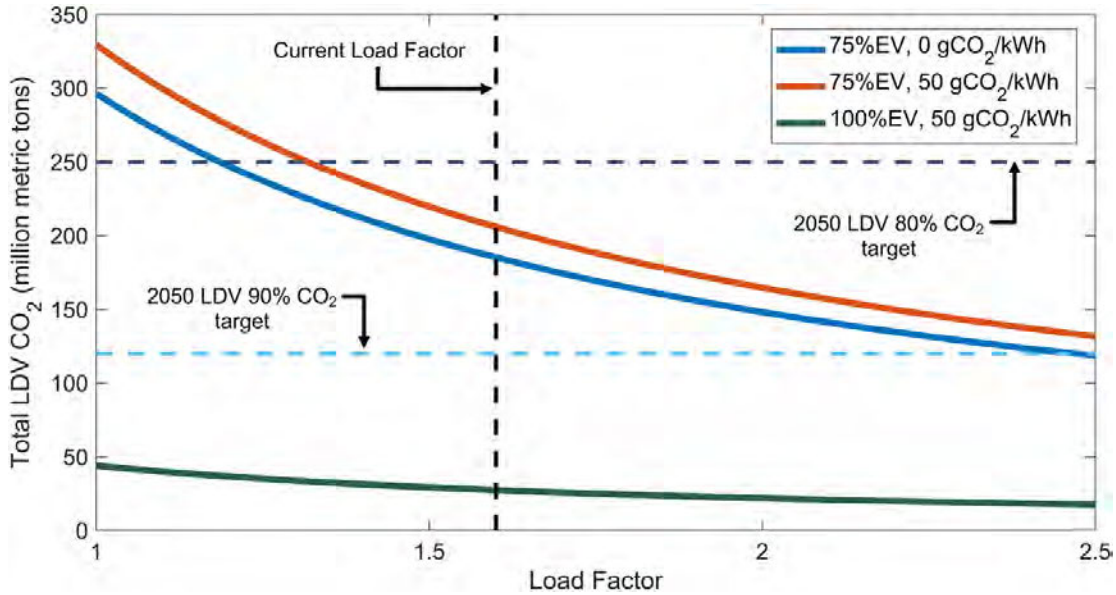

Figure 3. 2050 US LDV total CO_2 emissions as a function of the load factor for different levels of travel electrification and electricity generation carbon intensity (75% EV and 0 g CO_2 kWh^{-1}, 75% EV and 50 g CO_2 kWh^{-1}, 100% EV and 50 g CO_2 kWh^{-1}). The vertical line indicates the current load factor of 1.6 [57, 64]. The two horizontal dashed lines indicate the 80% and 90% midcentury decarbonization targets.

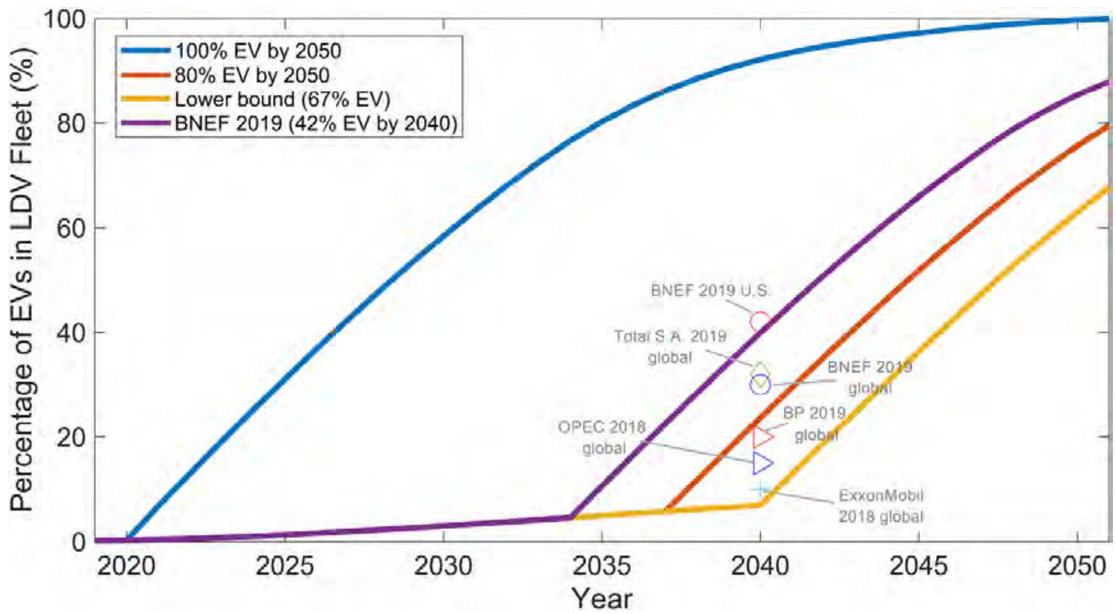

Figure 4. Projections of EV fleet share up to 2050 under different forecasts for the US and global LDV fleets. The lines represent the main cases considered in this analysis that are 100%, 80%, 67%, and the case matching the BNEF 2019 forecast of 42% EVs in US LDV by 2040 [69]. Points with US and global projections by others are shown for comparison [69–72].

travel share by 2050. With the current projected travel demand, the EV share of LDV travel cannot be lower than about 67% with a zero-carbon electricity grid to meet an 80% climate target in 2050. Therefore, deep decarbonization of the passenger transport sector during the transition to electrification and automation has a travel budget frontier, and the rates of electricity decarbonization, vehicle travel demand reductions, and travel electrification will determine success.

There are interconnected policy options that can increase the likelihood of a decarbonized passenger transportation sector, but require large scale implementation across several sectors. These policies can be a combination of subsidies to pull technologies to the market, research, development, demonstration, and deployment (RDD&D) to advance technology maturity, regulatory actions, and strategic infrastructure investments. First, rapidly transitioning the power sector to near zero emissions is the foundation of any transportation decarbonization plan. There are myriad options and pathways to low-carbon electricity, but a national power sector carbon portfolio standard, coupled with carbon pricing, technology subsidies, energy efficiency efforts, and advanced technology RDD&D would speed up the transition.

Similarly for the passenger vehicle fleet, EV subsidies for purchases as well as RDD&D to enable technology breakthroughs in batteries, EV driving ranges, efficiencies, costs, and charging times could increase the market penetration of EVs. But this is unlikely to be sufficient under a time constraint. We show that turnover rate is a barrier to the vehicle fleet transitioning to EVs, due to the long tail of the age distribution of vehicles [56, 65]. The transition of highly utilized public and private fleets enables a higher EV travel share, and helps alleviate a slower fleet penetration rate that is constrained by time and market forces. But the vast majority of the more than 250 million passenger cars and SUVs in the US are owned by individuals, and a rapid transition will require accelerated policies encouraging older gasoline-powered vehicles to exit the fleet. Yet if conventional vehicles were scrapped before the end of their useful lives, there is an asset value for these vehicles and incentives would be needed. For example, a policy inspired by the former Car Allowance Rebate System ('Cash for Clunkers') program, potentially could convince ICEV owners to retire their older vehicles and purchase new EVs [26, 27], but would have a high cost. Over 700 000 relatively more fuel-efficient vehicles were sold under the CARS program [74] which resulted in rebate applications of \$2.88 billion submitted, under the \$3 billion budget provided by Congress to administer the program [75]. If new car sales were restricted to EVs starting in 2021, more than half the fleet would be electrified by 2030. But between 110 and 125 million ICEVs would still be on the road. Using the Cash for Clunkers average tax credit of about \$4200 [76] in 2010 and converting it to 2018 real dollars, the resulting estimated cost of scrapping these ICEVs in 2030 would be approximately \$550–600 billion. In addition, while the potential for existing partially-automated crash avoidance technologies to substantially reduce crashes is very important for safety [68], the average age of the vehicle fleet may continue to increase, further extending the time for existing cars to exit the fleet. EVs could have shorter service lives and/or be driven less as they age relative to similarly-aged ICEVs due to battery degradation. However, electrification could potentially extend the vehicle lifetime since many of the ICEV powertrain parts are no longer needed and primarily a battery replacement would be required to keep an EV in good operating condition. Improvements in the fuel economy of ICEVs as well as lightweight material bodies for all vehicles will help accelerate transport decarbonization, improved vehicle fuel economy, electrification, and automation could lead to a rebound effect of increased travel due to lower fuel cost and increased convenience [11, 41, 77, 78]. Another potential impact on fuel economy could be the energy required to power the vehicle automation computing and sensing hardware as well as the additional weight [43]. The range of automated EVs could decline under automation and either enhanced battery capacity, increased vehicle efficiency, or an auxiliary energy source will be needed. However, when potential operational effects of connected automated vehicles are included (e.g. eco-driving, platooning, and intersection connectivity), fuel economy and emissions can be improved [43]. Further investigation of the interplay between these effects is a critical area of future work.

We note that we did not consider the life cycle impacts of producing fuels, batteries, vehicles, and infrastructure, which would result in GHG emissions from the industrial sector. Although estimates vary depending on assumptions, the production of an electric vehicle and its battery can generate about 7 to 10 metric tons of CO_2-eq, the production and distribution of gasoline generates an additional 2.66 kg CO_2-eq/gallon, and deploying even very low-carbon electricity infrastructure generates some GHGs [79]. Without both deeply decarbonizing the electricity and industrial sectors in the countries of the supply chains, the CO_2 impacts from producing the millions of EVs required for a large EV fleet would erode some of the climate benefits of an EV transition—requiring the US electrification and miles targets we outlined here to become more stringent. Even if vehicle and battery production GHGs dropped to 3 metric tons, every 10 million EVs sold would generate a GHG pulse of 30 million metric tons before they drove their first mile. This further highlights the need for cross-sectoral deep decarbonization efforts during a transition to EVs.

Finally, to increase the likelihood of achieving deep decarbonization of the passenger vehicle sector, the policies around the future of travel demand deserve more attention. Much of the structural space is determined locally with similar long-term timelines for change—land use and housing policy, walkability and community design, and the historical prioritization of parking. Federal policy can incentivize low-impact outcomes, as well as invest in expanded intercity and intracity electrified transit options, encourage congestion and road pricing, cycling, walking, and other methods to shift and reduce travel demand. Vehicle automation brings another layer of new challenges and opportunities to transportation decarbonization. Prioritizing electric, shared, and low-impact automation that leverages public transit enables the potential for maintaining or enhancing existing passenger mobility while reducing total vehicle miles traveled. Using prices, subsidies, or regulations, to encourage higher levels of ride sharing and mode shifting to electrified public transit or other alternatives could extend the travel budget under decarbonization, and acts as a hedge in case LDV travel electrification and electric power decarbonization take longer than expected. However, a future where vehicle automation increases total travel and is not primarily electrified creates an environment where deep decarbonization becomes a lot more difficult. Electrification and automation will also change the spatial and temporal aspects of air pollutant emissions from vehicles and power plants, including across urban and rural areas. Continued research and focused policies are needed to ensure equity and environmental justice is improved during a low-carbon transportation transition.

While deep decarbonization of transport remains challenging, we have illustrated that possible pathways exist. A mix of targeted policy interventions to encourage the concomitant objectives of EV adoption, ride sharing and travel demand reduction, low-impact automation, and grid decarbonization increases the likelihood of meeting a deep decarbonization target for US passenger vehicle transport.

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Exhibit 4

Cutting Greenhouse Gas Emissions Is Only the Beginning: A Literature Review of the Co-Benefits of Reducing Vehicle Miles Traveled

March 2017

A White Paper from the National Center for Sustainable Transportation

Kevin Fang, University of California, Davis

Jamey Volker, University of California, Davis

National Center for Sustainable Transportation

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NCST

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Introduction

Traditional evaluation of the transportation system focuses on automobile traffic flow and congestion reduction. However, this paradigm is shifting. In an effort to combat global warming and reduce greenhouse gas (GHG) emissions, a number of cities, regions, and states across the United States have begun to deemphasize vehicle delay metrics such as automobile Level of Service (LOS). In their place, policymakers are considering alternative transportation impact metrics that more closely approximate the true environmental impacts of driving. One metric increasingly coming into use is the total amount of driving or Vehicle Miles Traveled (VMT).

Since passing the seminal Global Warming Solutions Act (AB 32) in 2006, California has enacted two major laws over the past decade that are spurring efforts to reduce VMT: Senate Bill 375 (2008) and SB 743 (2013). SB 375 addresses regional GHG emissions reductions from passenger travel. For each region in the State with a metropolitan planning organization (MPO), the law requires the California Air Resources Board (ARB) to set and regularly update per capita GHG emissions reduction targets for 2020 and 2035. To achieve those targets, SB 375 requires each MPO to adopt a "sustainable communities strategy" (SCS) as part of its regional transportation plan. VMT reductions are a key strategy in SCSs.

Senate Bill 743 (2013) directs the Governor's Office of Planning and Research (OPR) to revise the guidelines for determining the significance of transportation impacts during analyses conducted under the California Environmental Quality Act (CEQA). SB 743 requires a replacement metric that will "promote the reduction of greenhouse gas emissions, the development of multimodal transportation networks, and a diversity of land uses." It mandates that "automobile delay, as described solely by [LOS] shall not be considered a significant impact on the environment" under CEQA, except in "locations specifically identified in the guidelines, if any." VMT is OPR's currently recommended replacement metric (OPR, 2016).

While state goals for reducing GHG emissions have been one motivation for the shift to VMT measures, reductions in VMT produce many other potential benefits, referred to as "co benefits," such as reductions in other air pollutant emissions, water pollution, wildlife mortality, and traffic congestion, as well as improvements in safety and health, and savings in public and private costs. Such benefits may provide additional justification for reducing VMT. In this paper, we review the literature to explore the presence and magnitude of potential co benefits of reducing VMT, providing California specific examples where available.

Figure 1 shows the conceptual framework guiding our literature review. Items shaded in green indicate characteristics that can influence VMT. Items shaded in red indicate co benefits potentially sensitive to VMT.

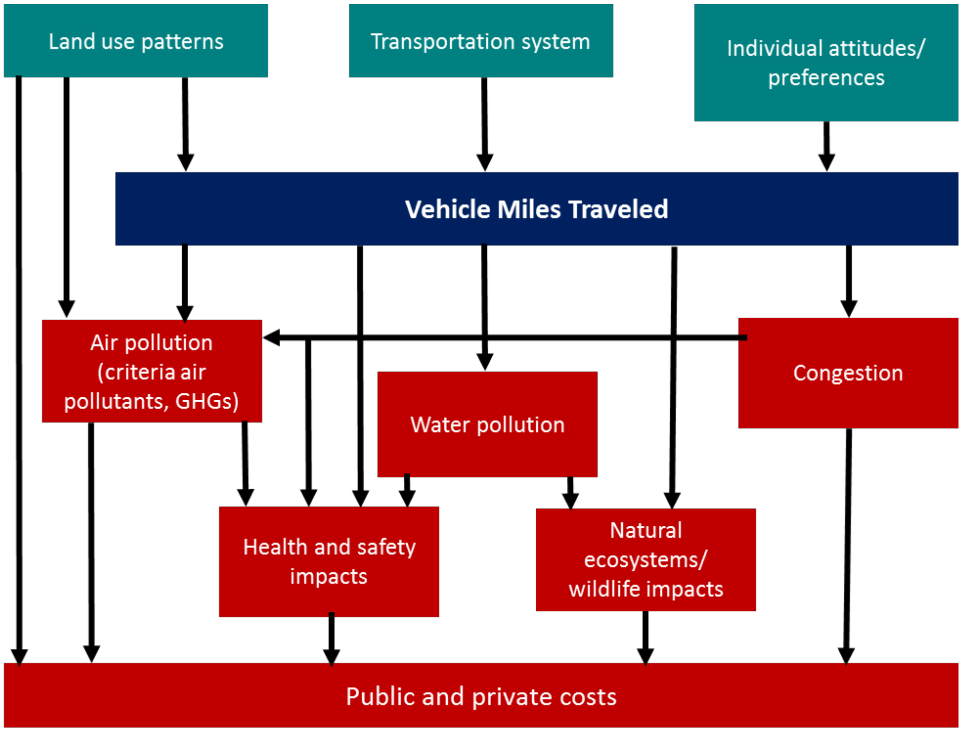

Figure 1. Conceptual Framework

Air Pollutant Emissions

GHG and Criteria Air Pollutant Emissions from Vehicular Operation

Motor vehicles emit pollutants into the atmosphere as by products of combustion (tailpipe emissions) and through other mechanisms such as fuel evaporation, tire and brake wear, and creation of road dust from the wearing of pavement. Emissions of major concern include greenhouse gases and criteria air pollutants, each of which is a major policy concern in California. Reducing the State's GHG emissions has been state priority for over a decade, as reflected by the aforementioned AB 32, SB 375 and SB 743. Criteria air pollutants are substances for which national and state standards have been set on the basis of human health. California has long standing air quality problems, with large areas of the state unable to attain national ambient air quality standards (NAAQS) for criteria pollutants. Of 52 counties, 39 are in non attainment for at least one pollutant. Four counties are in non attainment for five pollutants, and nine counties are in non attainment for four pollutants.

Transportation is a major source of emissions. Table 1 shows emissions of criteria air pollutants and GHGs from the operation of on road vehicles in California (not including life cycle emissions). For criteria air pollutants, operation of on road vehicles are the source for a majority of carbon monoxide (CO), a near majority of nitrogen oxides (NOx), and a double digit percent share of particulate matter (PM) 2.5. For greenhouse gases, approximately 33 percent of carbon dioxide equivalent (CO_2e) emissions comes from the operation of on road vehicles.

Estimates of vehicles nationwide project that the average passenger vehicle emits approximately 5.5 metric tons of CO_2e per year (US Environmental Protection Agency, 2005). This equates to approximately 1.01 pounds of CO_2e per mile.

Table 1. Criteria air pollutant/greenhouse gas emissions from on-road transportation operations in California and potential emissions reduction[1]

	Emissions (Tons/yr)							
	ROG	CO	NOx	SOx	PM	PM 10	PM 2.5	CO_2e
Total	634,596	2,690,886	768,555	38,354	928,560	532,849	152,574	486,670,304
From on-road transportation*	147,278	1,437,220	373,585	1,964	15,764	28,309	15,721	159,559,517
Share of emissions from road transportation*	23.2%	53.4%	48.6%	5.1%	1.7%	5.3%	10.3%	32.8%
If on-road transportation emissions decreased by…	**Emissions (tons/yr) would decrease by…**							
	ROG	**CO**	**NOx**	**Sox**	**PM**	**PM 10**	**PM 2.5**	**CO_2e**
1%	1,473	14,372	3,736	20	158	283	157	1,595,595
5%	7,364	71,861	18,679	98	788	1,415	786	7,977,976
10%	14,728	143,722	37,358	196	1,576	2,831	1,572	15,955,952
15%	22,092	215,583	56,038	295	2,365	4,246	2,358	23,933,927
If on-road transportation emissions decreased by…	**Total statewide emissions would drop by…**							
	ROG	**CO**	**Nox**	**Sox**	**PM**	**PM 10**	**PM 2.5**	**CO_2e**
1%	0.2%	0.5%	0.5%	0.1%	0.0%	0.1%	0.1%	0.3%
5%	1.2%	2.7%	2.4%	0.3%	0.1%	0.3%	0.5%	1.6%
10%	2.3%	5.3%	4.9%	0.5%	0.2%	0.5%	1.0%	3.3%
15%	3.5%	8.0%	7.3%	0.8%	0.3%	0.8%	1.5%	4.9%

*Includes tailpipe and other operational emissions (e.g. evaporation, brake dust, tire wear) from mobile transportation sources. Does not include other transportation-related lifecycle emissions (e.g. vehicle manufacturing, fuel refining)

Table 1 also shows potential mass reductions of pollutants if on road transportation emissions decreased by modest percentages. There could be reductions of up to millions of tons of reduced CO_2e emissions and up to hundreds of thousands of tons of criteria air pollutant emissions.

State targets for some emissions (e.g. CO_2) require a steep reduction over the coming years and decades. In order to reach those targets, improvements in vehicle efficiency, fuels, and VMT will each need to contribute substantially. If per capita VMT does not decline, VMT increases (through population growth) would likely preclude achieving GHG reduction goals by outweighing improvements in vehicle efficiency and fuel carbon content (California Air Resources Board, 2016). Thus, while improvements in vehicle efficiency and fuel pollutant content will mean each reduced mile of vehicle travel eliminates less pollution in an absolute

[1] Criteria air pollutant emissions from California Air Resources Board (2013) – California Almanac of Emissions and Air Quality [2012 data]
CO_2e emissions from California Air Resources Board (2016) – California Greenhouse Gas Inventory [2014 data]

sense, steeply reducing targets mean that, for the foreseeable future, VMT reduction will continue to provide a substantial share of the needed emissions reduction to hit targets. Vehicles which have no tailpipe emissions (e.g. plug in hybrid and fully electric vehicles) still lead to some air pollutant emissions, through the electricity generation required for charging. Emissions can be substantially less depending on the carbon content of the energy grid (McLaren, et al. 2016). California has a relatively high proportion of energy generated from renewables; however, a substantial (though shrinking) share of electricity used in California is generated from sources that emit GHGs or criteria air pollutants (California Energy Commission, 2016). Thus, reducing even the VMT driven by zero tailpipe emissions vehicles would reduce GHG and local air pollutant emissions.

A potential confounding factor when discussing potential emissions benefits of reduced VMT is travel speed, as emissions of several criteria air pollutants and GHGs are sensitive to travel speed (Transportation Research Board, 1995; Barth and Boriboonsomsin, 2009). In conventional vehicles, powered by internal combustion engines (ICEs), greater per mile emissions tend to take place at higher speeds (e.g. 60 mph or greater) where more energy is required to move a vehicle, as well as at lower speeds (e.g. less than 30 mph average travel speeds), where the stop and go conditions of congestion cause extra acceleration cycles, energy lost to braking, longer vehicle operation time.

The effect of speed is different on hybrid and battery electric vehicles. Nikowitz, et al. (2016) show that unlike ICEs, which have greatest energy use (and in turn emissions) at low and high speeds, hybrid and battery electric vehicles have greatest energy use under high speed and aggressive driving scenarios (see Table 2). Emerging advanced vehicle technologies such as regenerative braking recovers some of the energy lost in stop and go conditions. Electric motors in battery electric and hybrid vehicles shut off when the vehicle is stopped. Similar “start stop” technology is increasingly common in ICE powered vehicles. Increased deployment of technology points to a decreased sensitivity of emissions reductions to the speed of VMT in the future.

Table 2. Relative energy consumption for internal combustion, hybrid, and battery electric vehicles under different drive cycle scenarios[2]

		Scenario		
		City driving	Highway driving	Aggressive driving
Test cycle		UDDS	HWFET	US06
Test cycle parameters		19.59 mph average speed, frequent stops and starts	48.3 mph average speed, one start/stop	48.4 mph average speed, some stops, rapid acceleration
Make	**Vehicle type**	**Energy consumption relative to lowest energy consumption**		
2012 Ford Focus	Internal Combustion Engine	32% greater	Lowest	37% greater
2010 Toyota Prius	Hybrid	Lowest	4% greater	60% greater
2012 Nissan Leaf	Battery electric	Lowest	19% greater	72% greater

Life Cycle Emissions

Beyond reducing tailpipe emissions, VMT reduction also reduces life cycle emissions, such as those from fuel refining, vehicle manufacture, roadway construction, and roadway maintenance (Chester and Horvath, 2009; Chester and Madanat, 2010, Chehovitz and Galehouse, 2010; Hendriks, et al., 2004). These additional sources increase estimates of GHG emissions from road vehicles by approximately 63 percent over tailpipe emissions alone, and increase estimates of criteria air pollutant emissions from 1.1 to 800 times greater. To the extent that VMT reductions (1) reduce fuel purchases, (2) cause or are the result of decisions of would be drivers to sell their vehicles or forego purchasing an additional vehicle, or (3) reduce roadway repair burdens, they reduce life cycle emissions.

Emissions from Building-Related Energy Use

Compact development is a key VMT reduction strategy, as it leads to both shorter trip distances and greater use of alternative modes (Ewing and Cervero, 2010, Transportation Research Board 2009). Stone et al. (2007) estimate that building compact development to reduce VMT would also reduce criteria air pollutant and carbon dioxide emissions at a regional level between five and six percent over a conventional growth scenario, even when accounting for changes in travel speeds.

Compact development can also promote air pollutant and GHG emissions reductions through decreased building energy use. More compact housing units have a smaller volume of air to heat and cool. Additionally, attached housing units have less exposed surface area through which energy is lost. Overall, Ewing and Rong (2008), estimate households living in compact counties use approximately 20 percent energy than households living in sprawling counties, even while taking into account other factors such as income, and the urban heat island effect.

[2] Drive cycles – US Environmental Protection Agency (2016)
Energy consumption – Adapted from Nikowitz, et al. (2016)

Water Pollution

Motor vehicle travel can cause deposition of pollutants onto roadways, which can then be carried by stormwater runoff into waterways. Fuel, oil, and other liquids used in motor vehicles can leak from vehicles onto the ground (Delucchi, 2000). Brake dust and tire wear can further cause particles to be deposited onto the ground (Thorpe and Harrison, 2008). Brake pads and tire compounds are made out of compounds that include metal. One study estimates that approximately half of all copper in San Francisco Bay could have originated from brake pads (Nixon and Saphores, 2003). In California as a whole, up to 232,000 pounds of copper, 13,280 pounds of lead, and 92,800 pounds of zinc in stormwater are attributable to brake pad dust (Nixon and Saphores, 2003).

Motor vehicles require roadways for travel. Paved roadways are generally impervious surfaces which prevent infiltration of storm water in the ground. Impervious surfaces can increase the rate, volume, speed, and temperature of stormwater runoff (US Environmental Protection Agency, 2003), and can transport pollutants via that runoff into waterways. Wearing down of roadways can further cause particles to be deposited onto the ground (Thorpe and Harrison, 2008).

Most motor vehicles also consume liquid fuel, the storage and handling of which can result in fuel tank leaks and spills (Delucchi, 2000). California has had at least 38,000 confirmed cases of leaks from underground storage tanks (Nixon and Saphores, 2003). Reducing VMT cuts consumption of fuel and could reduce fuel spillage risks. These reductions would be additional to reductions gained through greater vehicle efficiency and adoption of alternative fuel vehicles.

The Victoria Transportation Policy Institute (2015) estimates that motor vehicle related water pollution from roadway runoff, oil spills, and road salting cost approximately 42 billion dollars per year or 1.4 cents per mile.

Health and Safety

Vehicle Collisions and Fatalities

A plurality of “unintentional injury deaths” (deaths not caused by old age, disease, suicide and homicide) are transportation related (Savage, 2013). According to the National Highway Traffic Safety Administration’s Fatality Analysis Reporting System (FARS), 32,675 individuals were killed in motor vehicle crashes in 2014 (NHTSA, 2015). 3,074 of these fatalities occurred in California, 7.9 fatalities per every 100,000 people per year. These fatalities are not just borne by motor vehicle occupants, but by other users as well. In California, more than one quarter of those killed in motor vehicle collisions are pedestrians, bicyclists, or users of other non motorized modes.

Where there is more driving, there are more vehicle related fatalities. Comparing motor vehicle fatalities by state from FARS and VMT data from the Bureau of Transportation Statistics (2015) shows a strong positive correlation (r = 0.82) between VMT per capita and fatalities from motor vehicle crashes per capita (authors calculation, see Figure 3).

Data also indicates that each mile driven is also more dangerous in areas with high VMT. Again comparing data from FARS and the BTS, there is a moderately strong positive correlation (r = 0.50) between VMT per capita and deaths per mile traveled (authors calculation, see Figure 4). If the number of vehicle related fatalities were purely a matter of exposure, every mile traveled should have the same amount of risk regardless of where that mile was driven. There would thus be no correlation between VMT per capita and fatalities per mile. However, states with higher VMT tend to have more motor vehicle crash deaths per mile than lower VMT states. Since increasing VMT is associated with more vehicle related fatalities per capita and per mile, residents of states where they can fulfill their travel needs with fewer or shorter vehicle trips (and thus with lower VMT) enjoy reduced transportation safety risks.

Using public transit alternatives is associated with less risk than motor vehicle travel. Savage (2013) estimates that drivers or passengers of cars or light trucks experienced 7.28 fatalities per billion miles traveled from 2000 2009. Comparatively, riders of Amtrak, commuter rail, urban mass transit rail systems, buses, and commercial aviation experience 0.43 fatalities per billion miles traveled or fewer.

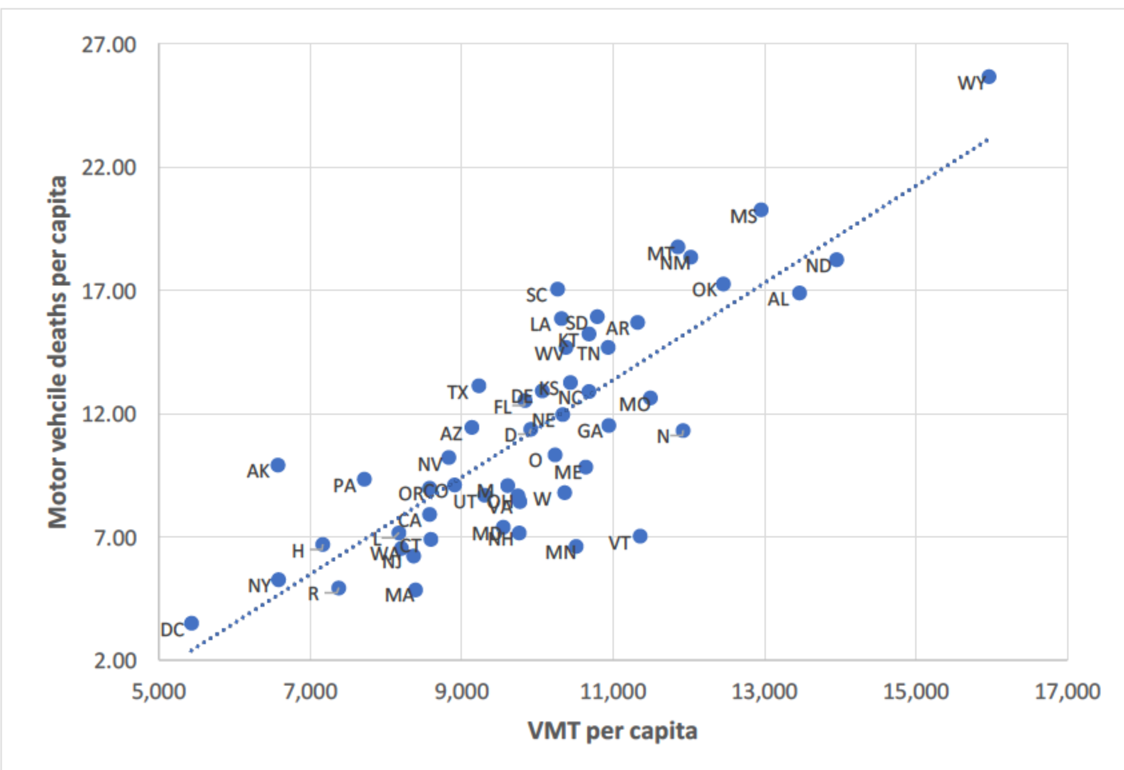

Figure 2. Motor-vehicle related deaths per capita increases as VMT per capita increases

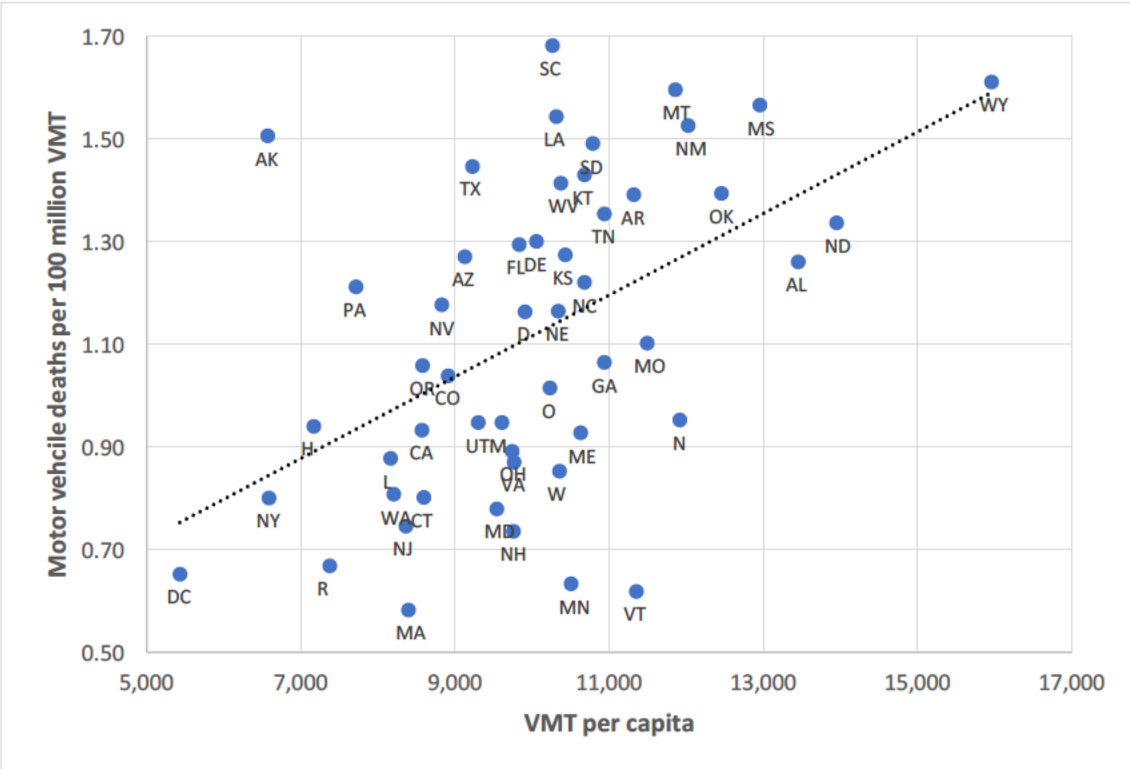

Figure 3. Motor-vehicle related deaths per mile increases as VMT per capita increases

Physical Health

Driving or riding in motor vehicles is a sedentary behavior. Several studies find associations between VMT and weight. For example, obesity and Body Mass Index (BMI) are positively associated with VMT per licensed driver (Jacobson and King, 2009; Behzad, King, and Jacobson, 2012). Geographic areas with high VMT per capita are also associated with poorer health outcomes resulting from reduced physical activity. Residents of counties in the United States with high VMT per capita are less likely to walk for leisure, more likely to be obese, have higher BMI levels, and have a greater prevalence of hypertension (Ewing, et al. 2003). Among California counties, those with the highest mean obesity also tend to have the highest mean VMT per capita (Lopez Zetina, Lee, and Friis, 2006). Potentially contributing to this pattern are more nights with insufficient sleep and higher smoking rates found with increased driving time (Ding, et al. 2014).

While transit users also ride in motorized vehicles, transit users are more likely to engage in significant physical activity, walking to and from transit stops. Besser and Dannenberg (2012) found that bus and rail users walk an average of 24 minutes per day to and from transit. More than a quarter of transit riders fulfill the US Surgeon General's recommendation of 30 minutes of physical activity per day just from walking to/from stops and stations. On the other hand, increased time driving is significantly associated with not meeting the physical activity recommendation (Ding, et al. 2014).

Users of non motorized modes by definition engage in physical activity while traveling. The Caltrans Strategic Management Plan (CSMP) sets a goal of doubling 2010 walking and transit levels, and tripling bicycling levels by 2020. An epidemiological analysis of that CSMP describe that achieving this goal would reduce chronic disease and "would constitute a major public health achievement on par with California's successful efforts at tobacco control." (Maizlish, 2016, p. 5).

Health Impacts of Air Pollution

As discussed previously, road transportation and VMT contribute to air pollutant emissions. Criteria air pollutants can lead to a variety of health effects. For example, nitrogen oxides and volatile organic compounds react with oxygen in the air to create ozone, which can have several negative health effects including chest pain, coughing, throat irritation, airway inflammation, reduced lung function, and aggravation of other respiratory conditions (US Environmental Protection Agency, 2016a). Particulate matter poses particularly acute health impacts as small particulates (less than 10 µm in diameter) can enter the lungs or bloodstream and cause or exacerbate heart and lung issues, and even lead to premature death (US Environmental Protection Agency, 2016b). California has especially poor air quality attainment for both ozone and particulate matter.

Table 3 shows per mile estimates of the cost of motor vehicle related air pollution by McCubbin and Delucchi (1999). Costs range from several cents per mile for most ozone, carbon monoxide, nitrogen oxides, and air toxics, to more than 12 dollars per mile for particulate matter. The higher estimate for particulate matter reflects the greater health effects, including mortality, that can be triggered by particulate matter.

Table 3. Gasoline-powered motor vehicle air pollution cost per mile[3]

	PM	O_3	CO	NO_2	Air Toxics
Cost (2015 $)	12.60	0.08	0.08	0.65	0.05

*Original data in 1991 dollars. Data above is average of low/high estimate from original study. Costs include emissions from tailpipe, upstream fuel and vehicle production, and road dust.

Mental Health

In addition to physical health, long driving commutes can also have a negative impact on mental health. Hennessy (2008) identifies several examples from studies associating long driving commutes with poor mental health outcomes and related consequences, including stress, negative mood, poor concentration, driver error and traffic collisions. Hennessy also

[3] Based off McCubbin and Delucchi (1999)

finds that as stress drivers experience while driving increases, workplace hostility and obstructionism rise among men. Other studies corroborate Hennessy's findings. Gee and Takeuchi (2004), for example, find that traffic stress correlates with depressive symptoms. Ding, et al. (2014) find the more total time a person spends driving per day, the more likely they are to report a poor/fair quality of life, high/very high physiological distress, being stressed for time, and that their health interferes with social activities.

In addition to negative mental health outcomes for drivers, VMT can also cause worse mental health for people in the neighborhoods where that driving occurs or originates. A review of literature by Pohanka and Fitzgerald (2004) notes that residents of dispersed, and thus generally auto dependent, suburban areas can face increased blood pressure, headaches, and social isolation, which is disadvantageous as the presence of social relationships is positively correlated with health. Additionally, the aforementioned depressive symptoms identified by Gee and Takeuchi are significantly worse in neighborhoods with a high "vehicular burden", which increases with motorized transport in an area. Built environments that reduce automobile dependence and promote walking can result in lower rates of dementia (Xia et al., 2013).

Wildlife Impacts

Many of the same roadway impacts that affect the health of people can also affect wildlife. Forman and Alexander (1998) outline several potential ecological impacts of roads. For instance, vehicles can directly harm wildlife in "roadkill" events, with an estimated one million vertebrates killed per day on US roads. Shilling and Waetjen (2016) discuss that in California, 5,950 wildlife related incidents were reported to the California Highway Patrol from a one year period between 2015 and 2016. Additionally, about 7,000 reports of animal carcasses are made annually to the volunteer California Roadkill Observation System. Overall, Shilling and Waetjen estimate that reported and unreported animal vehicle collisions cost California approximately $225 million per year. Due to varying avoidance of roadways, impacts differ by species types. Amphibians and reptiles are especially at risk on narrow, low traffic roads, larger mammals are at risk on narrow, high speed roads, and birds and small mammals at risk on wide, high speed roads, Forman and Alexander (1998).

Roadway avoidance is itself an impact, with lower populations of species adjacent to roadways Forman and Alexander (1998). Species can be affected and deterred by characteristics such as road noise, air pollution, altered or polluted water runoff, and nighttime lighting. Roadway avoidance tends to be higher adjacent to higher speed and higher traffic roads. Due to the impacts of roadkill and road avoidance, roadways also act as barriers for species movement. Roadways cutting through habitat can isolate populations of species into smaller groups. Isolated populations have a higher risk for extinction and can have negative impacts on genetic diversity (Coffin, 2007; Holderegger and DiGiulio, 2010).

More compact development patterns that are associated with lower VMT would consume less land and conceivably subject less territory to road avoidance and potential habitat fragmentation. A comparison of various development scenarios across the Sacramento and San Francisco Bay Areas predicted that the most compact growth scenario would save nearly 50 percent of agriculturally sensitive land acreage and steep sloped areas, and close to 100 percent of wetland areas (Landis, 1995).

Congestion and Accessibility

Broadly, congestion occurs when the free flow capacity of a roadway is either exceeded by demand (e.g. freeways entering central business districts during peak hour commutes) or impeded (e.g. when there are auto accidents, roadwork or other road closures). In either case, congestion increases as more vehicle travel is loaded onto the roadway (Falcocchio and Levinson, 2015; Downs, 2004). Conversely, reducing total VMT in a region can reduce congestion on the regional road network, albeit subject to temporal and spatial caveats.

From a temporal standpoint, unless there is an explicit cost imposed on using congested roadways (e.g. a congestion charge) or driving passenger vehicles in general, congestion reductions on those roadways will commonly increase the demand for using them and ultimately cause congestion to rebound to near preexisting levels in the long term. This is called the “Principle of Triple Convergence” – some trip makers in the region change their travel locations (routes), times and/or modes to take advantage of the reduced congestion on the roadways in question (Downs, 2004). This “triple convergence” is the reason why roadway expansions often do not reduce congestion in the long term (Handy and Boarnet, 2014), and why, according to Downs (2004, p. 22]), “building light rail systems or subways rarely reduces peak hour traffic congestion.”

However, recent research indicates that transit may cause a more sizeable and enduring reduction in peak hour congestion than previously thought. Anderson (2014) used a choice model, calibrated using data from the Los Angeles metro area, that unlike most previous studies accounted for the heterogeneity in congestion levels on roadways in the region, which increased the predicted congestion reducing effects of transit by six times. As Anderson (2014, p. 2764) explains, since “drivers on heavily congested roads have a much higher marginal impact on congestion than drivers on the average road,” and since transit riders are often those who would have to drive on “the most congested roads at the most congested times,” transit has a “large impact on reducing traffic congestion.”

Spatially, VMT reductions alleviate congestion in the specific locations where net vehicle travel is curtailed. And even where urban (or suburban) densification increases net localized vehicle travel and congestion despite reducing per capita (or even net regional) VMT, it generally increases local *accessibility* to jobs and other desired destinations, decreasing the time and cost of reaching those destinations. In a study of congestion and accessibility in the Los Angeles region, Mondschein et al. (2015, p. v) found that "high density areas in the region provide better access to jobs than those areas where traffic conditions are relatively less congested." Similarly, for Los Angeles firms, they found that "physical proximity to other firms, rather than area congestion levels, is the primary component of firms' ability to access other similar firms" (Mondschein et al., 2015, p. viii).

In sum, increasing regional VMT, all else equal, will increase regional congestion. And conversely, reducing regional VMT can reduce regional congestion, though congestion levels may rebound somewhat in the long term. Even where VMT reducing densification increases local congestion, it tends to improve local accessibility.

Fiscal Matters

Reducing VMT also has major fiscal impacts. It has both direct and indirect impacts on both household and public costs. VMT can also have major impacts on governmental revenues.

Household Costs – Direct Impacts

American households pay more for transportation than any other category of household expenditures except housing (Haas et al., 2013). According to Bureau of Labor Statistics data, households spent nearly 20 percent of their income on transportation on average in both 2000 (18%) and 2010 (16%) (Moeckel, 2017; Haas et al., 2013). A major reason for that is auto ownership and use are expensive – "the most expensive component of transportation cost is auto ownership" – and many U.S. households live in suburban and exurban areas with poor accessibility and transit connectivity (Haas et al., 2013, 20). Reducing household VMT (and car ownership) can thus reduce total household costs both directly and indirectly.

The direct cost reductions of driving less are well known, and include reduced fuel use and parking costs, lower maintenance costs averaged over time, and, for those households that reduce their VMT enough to sell one of their vehicles, license, registration, insurance, and additional maintenance cost savings (Levinson and Gillen, 1998; Cui and Levinson, 2016). The cost of alternatives to driving vary greatly by location, alternative, value of time, and other factors Active transportation options like walking and bicycling can be much cheaper for shorter trips than driving because they have lower capital and operating costs (e.g. the cost of walking shoes or a bicycle versus the cost of a vehicle and gasoline). And transit (e.g. buses and commuter rail) can be cheaper than driving for longer trips. Keeler et al. (1975), for example, estimated the comparative costs of a hypothetical commute in the San Francisco Bay Area by driving (1.5 passengers per auto), riding Bay Area Rapid Transit (BART), and riding a bus. They concluded that both bus and rail transit can be cheaper for the user on an average basis than driving at sufficiently high passenger densities. However, the potential for a given household to reduce its transportation costs by reducing VMT largely depends on availability of sufficient regional transit connectivity, accessibility to jobs and other amenities (Haas et al., 2013; Haas et al., 2008; Renne and Ewing, 2013).

Household Costs – Indirect Impacts

As is frequently discussed in both the academic literature and California policy circles, one way to reduce VMT – and achieve the associated household cost savings – is to increase residential and employment densities within existing urban areas, and especially near transit stations (Ewing and Cervero, 2010). For residences, a benefit of this type of "smart growth" is that it can substantially reduce household costs, particularly transportation costs. Haas et al. (2008), for example, developed a model for estimating average household transportation costs by Census block based on annual household VMT, household car ownership and annual household transit use. They tested their model in the Minneapolis St. Paul metropolitan region and found that reductions in average annual household transportation costs correlated with decreasing VMT, decreasing auto ownership, increasing transit trips and denser, more transit and job accessible areas. From that original model, the Center for Neighborhood Technology (CNT) developed the Housing + Transportation Index. CNT has since expanded and refined the model, but its results continue to show that residential density is the single largest predictor of auto ownership and use, and thus household transportation costs (Haas et al., 2013).

Households in denser and more accessible urban areas often also demand less energy and water because they have smaller units and lots (Litman, 2016; Busch et al., 2015). When all the cost savings of living in denser urban areas are combined, the available evidence shows that they "more than offset" the increased housing costs in those areas (Litman, 2016, p. 19; Ewing and Hamidi, 2014). In other words, when all costs are considered, rather than just housing costs, living in smart growth communities is generally less expensive than living elsewhere.

With specific respect to California, one recent study estimated that if 85 percent of new housing and jobs added in the state until 2030 were located within existing urban boundaries, it would reduce per capita VMT by about 12 percent below 2014 levels (Busch et al., 2015). That combination of reduced VMT and more compact development would, in turn, result in an estimated $250 billion in household cost savings cumulative to 2030 (with an average annual savings per household in 2030 of $2,000) (Busch et al., 2015). Household costs analyzed in the study include auto fuel, ownership and maintenance costs, as well as residential energy and water costs.

Public Costs – Indirect Impacts

In addition, denser development usually reduces the per capita costs of providing many types of public infrastructure and services. Denser development can, among other things, reduce road and utility line lengths, and in turn reduce travel distances needed to provide public services like police, garbage collection, emergency response and transporting school children (Litman, 2016; Busch et al., 2015; Burchell and Mukherji, 2003). Indeed, in his review of the literature, Litman (2016) found that "[n]o credible, peer reviewed studies demonstrate that comprehensive Smart Growth policies fail to significantly reduce public infrastructure and service costs."

With specific respect to California, the recent Busch et al. (2015) study estimated that if 85 percent of new housing and jobs added in the state through 2030 were located within existing urban boundaries, it would result in $8.2 billion in avoided public health costs and $18.5 billion in infrastructure cost savings cumulative to 2030 (Busch et al., 2015). Public health costs considered include those related to passenger vehicle air pollutant emissions, such as respiratory related ER visits, mortality, etc. Infrastructure costs estimated include "one time capital costs for building local roads, water and sewer infrastructure; and ongoing annual operations and maintenance costs" (Busch et al., 2015). All cost savings estimates are in 2015 dollars.

Government Revenues – Direct Impacts

VMT reduction can reduce public revenues from volumetric gas taxes or VMT fees, if those fees are held constant per gallon or mile. As VMT declines, so does the volume of gas consumed or miles tolled, and, correspondingly, the amount of revenue received. However, decreases in gas tax or potential future VMT tax revenue could be made up by increasing the tax rates. And as between volumetric gas taxes and VMT based taxes, revenue stability would likely be more easily achieved with a VMT based fee, given the rapidly advancing shift to electric and more fuel efficient vehicles that are reducing liquid fuel consumption (National Highway Traffic Safety Administration, 2014; California Energy Commission, 2016). That is one reason states including California have been studying VMT fees (California Department of Transportation, 2016). A VMT fee would also be one of the "most effective way[s] to change behavior" to reduce VMT (Chapple, 2015). However, fees, like taxes, are commonly politically unpopular, even those with immense social benefit (Bedsworth et al., 2011).

Government Revenues – Indirect Impacts

As with household and governmental costs, VMT reducing "smart growth" land use patterns also impact governmental revenues. Litman (2016) surveyed the literature and found that "Smart Growth tends to increase economic development, including productivity, business activity, property values and tax revenue." For example, the Chicago Metropolitan Agency for Planning (CMAP) (2014) concluded, based on a comparison of Chicago area residential project case studies, that "denser projects drive higher revenues." Per capita gross domestic product (GDP) also tends to decline with rising VMT and increase with per capita transit ridership, which in turn can increase tax revenues (Kooshian and Winkelman, 2011).

Most studies look primarily at either the cost impacts or the revenue impacts of smart growth and reducing VMT, not both. But in two recent studies of Madison, Wisconsin and West Des Moines, Iowa, respectively, Smart Growth America (SGA) did a more comprehensive fiscal impact analysis (SGA, 2015a, 2015b). In the studies, SGA calculated both costs and revenues – the net fiscal impact – to the cities and their associated school districts across a range of high and low development density scenarios.

The West Des Moines study assessed the fiscal impact of the estimated residential and commercial growth in the city over 20 years using four different density scenarios (holding the product mix constant), and estimated that the net fiscal benefit for the city and the local school district would be 50 percent greater for the most compact development scenario as compared to the base density scenario (current West Des Moines density) (SGA, 2015a).

The Madison study was narrower in scope. It analyzed the fiscal impact of developing a 1,400 acre site across a range of development densities and product mixes. Comparing the baseline density and product mix scenario to the more compact development scenario with the same product mix, the study estimated that the latter – compact development – would have a slightly greater (about 5 percent) net fiscal benefit. However, the authors also concluded that their model likely underestimated the net fiscal benefit of the more compact scenario (SGA, 2015b).

Conclusion

Reducing VMT can provide many additional benefits beyond reducing GHG emissions. Studies show a broad array of co benefits including environmental, human, and fiscal health. VMT reductions can provide these co benefits directly (e.g. lowering air pollutant emissions and operating costs of vehicles with reduced use) and indirectly (e.g. realizing the benefits of alternatives to driving). As noted, there are some variations in the depth of these benefits (e.g. spatial differences in impacts, and impacts dependent on other factors in addition to VMT), but the evidence is clear that, overall, VMT reductions can help forward multiple goals in addition to GHG reduction. Additional research measuring costs and benefits of transportation on a per distance traveled basis, which was not yet available for all impacts reviewed in this paper, would be helpful in further ascertaining the depth and breadth of potential co benefits of VMT reductions.

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Exhibit 5

Inequity in consumption of goods and services adds to racial–ethnic disparities in air pollution exposure

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Fine particulate matter ($PM_{2.5}$) air pollution exposure is the largest environmental health risk factor in the United States. Here, we link $PM_{2.5}$ exposure to the human activities responsible for $PM_{2.5}$ pollution. We use these results to explore "pollution inequity": the difference between the environmental health damage caused by a racial–ethnic group and the damage that group experiences. We show that, in the United States, $PM_{2.5}$ exposure is disproportionately caused by consumption of goods and services mainly by the non-Hispanic white majority, but disproportionately inhaled by black and Hispanic minorities. On average, non-Hispanic whites experience a "pollution advantage": They experience ∼17% less air pollution exposure than is caused by their consumption. Blacks and Hispanics on average bear a "pollution burden" of 56% and 63% excess exposure, respectively, relative to the exposure caused by their consumption. The total disparity is caused as much by how much people consume as by how much pollution they breathe. Differences in the types of goods and services consumed by each group are less important. $PM_{2.5}$ exposures declined ∼50% during 2002–2015 for all three racial–ethnic groups, but pollution inequity has remained high.

air quality | environmental justice | fine particulate matter | input output | life cycle assessment

Fine particulate matter ($PM_{2.5}$) exposure is a major health risk factor in the United States, responsible for 63% of deaths from environmental causes and 3% of deaths from all causes (1). It is a risk factor that is inequitably distributed among demographic groups, including racial ethnic groups, owing in part to differences in pollution concentrations at locations of residence (2, 3). The extent to which differences in consumption of goods and services by racial ethnic groups contribute to observed disparities in exposure is unknown, as is whether racial ethnic groups have benefited equitably from recent improvements in $PM_{2.5}$ air quality.

Here, we explore racial ethnic disparities in the causation and effect of exposure to $PM_{2.5}$ in the United States. We do this by investigating links among pollution, the parties responsible for its emission, and the health impacts that result. First, we estimate mortality from $PM_{2.5}$ for all emission sources in the United States. Next, we attribute these emissions to the end use activities and to the end user parties ultimately responsible for their generation. Finally, we compare results among racial ethnic groups to explore what we term "pollution inequity": the extent to which groups disproportionately contribute to or bear the burden of pollution.

We estimate mortality impacts in the United States from $PM_{2.5}$ exposure using spatially explicit emissions data from all pollutant emission sources (4), the Intervention Model for Air Pollution (InMAP) air quality model (5), and spatially explicit population and health data (ref. 6; see *Materials and Methods*). We consider emissions of primary $PM_{2.5}$ and of secondary $PM_{2.5}$ precursors, both of which contribute to increased atmospheric $PM_{2.5}$ concentrations. Our approach yields estimates of premature deaths caused by $PM_{2.5}$ exposure in the United States for each year during 2003 2015, disaggregated by 5,435 emissions source types, at a spatial resolution varying between 1 and 48 km depending on population density. We aggregate impacts into 15 emitter groups. (See *Materials and Methods*; *SI Appendix*, Tables S1 S14 show the largest emitter types in the 14 anthropogenic and domestic emitter groups.)

We estimate a population weighted average ambient $PM_{2.5}$ exposure concentration of 7.7 $\mu g \cdot m^{-3}$ for the United States in 2015, causing 131,000 premature deaths (Fig. 1 and *SI Appendix*, Fig. S1; see *SI Appendix*). Of these, 102,000 are caused by US anthropogenic emissions and 29,000 by other sources, largely wildfires and natural biogenic emissions (26,000), with minor contributions from Canadian and Mexican emissions (3,000). The total number of deaths reported here is higher than a commonly cited estimate of 93,000 (1), but at the low end of the range of a recently published estimate of 121,000 213,000 deaths (7), which uses a concentration response relationship similar to the one employed here (6). (*SI Appendix*, Table S15 reports estimates of $PM_{2.5}$ mortalities using several concentration response functions.)

Responsibility for air pollution is typically assigned to its emitters (8) (e.g., a factory), but it can also be ascribed to end uses (e.g., the purchase and use of manufactured goods) by end users (e.g., individual consumers) that ultimately result in its release (Fig. 1). Here, we connect $PM_{2.5}$ air pollution and its health impacts to end uses

Significance

Racial–ethnic disparities in pollution exposure and in consumption of goods and services in the United States are well documented. Some may find it intuitive that, on average, black and Hispanic minorities bear a disproportionate burden from the air pollution caused mainly by non-Hispanic whites, but this effect has not previously been directly established, let alone quantified. Our "pollution inequity" metric is generalizable to other pollution types and provides a simple and intuitive way of expressing a disparity between the pollution that people cause and the pollution to which they are exposed. Our results are timely, given public debate on issues relating to race, equity, and the regulation of pollution.

Author contributions: C.W.T., J.D.M., and J.D.H. designed research; C.W.T., K.A.M., D.A.P., N.P.S., S.K.T., J.D.M., and J.D.H. performed research; C.W.T., D.A.P., J.D.M., and J.D.H. contributed new reagents/analytic tools; C.W.T., K.A.M., J.D.M., and J.D.H. analyzed data; and C.W.T., J.S.A., A.L.G., N.Z.M., K.A.M., D.A.P., S.P., N.P.S., S.K.T., J.D.M., and J.D.H. wrote the paper.

The authors declare no conflict of interest.

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Data deposition: The model used in this paper has been deposited in Zenodo, https://zenodo.org/record/2549859.

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SUSTAINABILITY SCIENCE

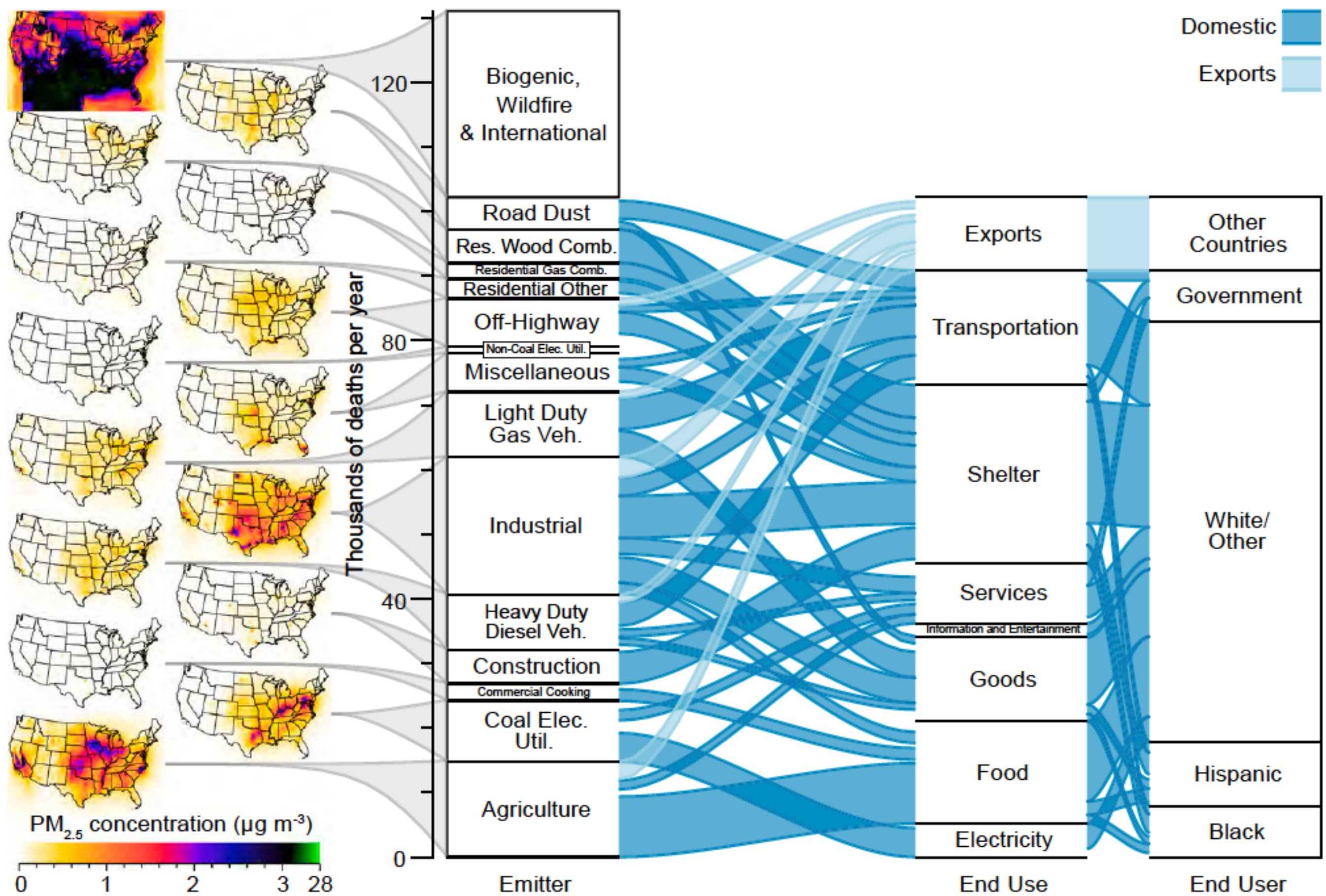

Fig. 1. Sources of US mortality from $PM_{2.5}$. $PM_{2.5}$ concentrations resulting from emissions from each emitter group [maps on *Left*; color scale contains a discontinuity at the 99th percentile of concentrations (i.e., 3.1 μg·m ^{3})] and relationships among $PM_{2.5}$ health impacts as attributed to emitters (*Left* bar), end uses (*Middle* bar), and end users (*Right* bar). The height of the bar on the *Left* shows the number of $PM_{2.5}$ attributable premature deaths caused by the physical production of emissions from each group of emitters, the height of the *Middle* bar shows the number of deaths caused by demand for each group of end uses, and the height of the bar on the *Right* shows the number of deaths caused by different types of end users. The blue connecting lines show re lationships among emitters, end uses, and end users; connecting lines representing <1,000 deaths are not shown. (Detailed relationships between end uses and emitters for each racial ethnic end user group are shown in Fig. 2; time trends are shown in *SI Appendix*, Fig. S4.)

and end users by coupling economic input output relationships to pollution emission sources (https://www.bea.gov/industry/io_annual.htm). Our approach allows us to attribute responsibility to (*i*) emitter entities that physically emit air pollutants; (*ii*) end uses that lead to air pollution emissions, often through intermediate eco nomic transactions; and (*iii*) end users. We track 19 end user types, which we aggregate here into four groups (personal consumption by each of three racial ethnic groups, as well as government con sumption), and 389 end use categories, which we aggregate here into seven groups (electricity, food, goods, information and enter tainment, services, shelter, and transportation).

Of 102,000 premature deaths from domestic anthropogenic emissions, we estimate 11,000 (11%) are caused by demand for goods that are exported (Fig. 1). Of the remaining 91,000 pre mature deaths caused by end uses within the United States, 83,000 (91%) are attributed to personal consumption (i.e., indi vidual consumers); the remaining 8,000 (9%) are caused by pol lution related to governmental expenditures.

To determine racial ethnic inequity, we disaggregate personal consumption and exposure to $PM_{2.5}$ by race ethnicity. Here, "exposure" is the population weighted average ambient concentra tion at places of residence. We focus on the subset of impacts (83,000 premature deaths) that we can attribute to consumption by individ uals in the United States, excluding the 48,000 premature deaths caused by governmental end uses, exports, and nonanthropogenic sources. (Racial ethnic disparities in overall exposure to $PM_{2.5}$ from all sources are shown in *SI Appendix*, Fig. S2.) We consider persons self identifying as black or African American (hereafter, "black"; 12% of the population), Hispanic or Latino ("Hispanic"; 17% of the population), and the remainder [non Hispanic white (62% of the population) plus all other race ethnicity groups (8% of the population); hereafter, "white/other" (70% of the population)].

We define and quantify pollution inequity for a group g (I_g) as the fractional difference between a racial ethnic group's exposure to $PM_{2.5}$ caused by all groups (E_g) and that group's population adjusted contribution to the overall $PM_{2.5}$ exposure of all groups (C_g) (Eq. **1**):

$$\left[I_g=\frac{E_g}{C_g}\ \ 1\right]. \qquad \textbf{[1]}$$

Positive values for pollution inequity indicate that a group expe riences more exposure than it causes (on average and after adjusting for population sizes); negative values indicate the opposite.

We find that blacks are exposed to 6.0 $\mu g{\cdot}m^{-3}$ of $PM_{2.5}$ (E_g), which is 21% greater than the overall population average expo sure of 5.0 $\mu g{\cdot}m^{-3}$, while their population adjusted consumption causes $PM_{2.5}$ exposure of 3.8 $\mu g{\cdot}m^{-3}$ to the overall population (C_g), which is 23% less exposure than average (Fig. 2). We there fore estimate for blacks a pollution inequity of 56% (Fig. 3*A*; $6.0\,\mu g{\cdot}m^{-3}/3.8\,\mu g{\cdot}m^{-3}-1=(1+0.21)/(1-0.23)-1=56\%$). His panics are exposed to 12% more $PM_{2.5}$ than average (5.5 $\mu g{\cdot}m^{-3}$),

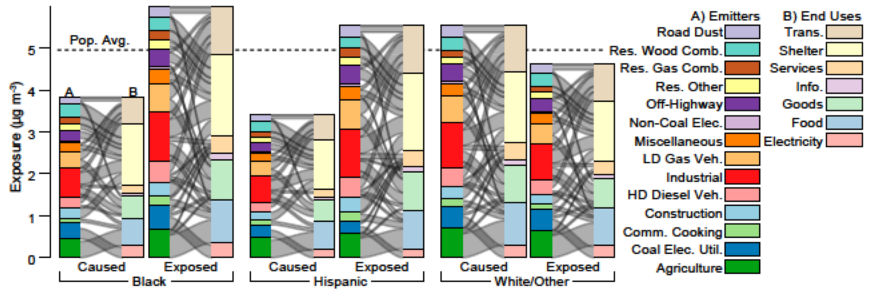

Fig. 2. Average $PM_{2.5}$ exposure experienced and caused by racial ethnic groups. Total exposure to $PM_{2.5}$ caused by population adjusted group consumption ("caused," or C_g) and group exposure to $PM_{2.5}$ caused by total personal consumption ("exposed," or E_g), stratified by racial ethnic group. Pollution inequity is the percent difference between a group's "exposed" and "caused" bars. Each group of bars shows the (*A*) emitters and (*B*) end uses responsible for the exposure, with gray connecting lines showing relationships among emitters and end uses. Connecting lines rep resenting <0.04 μg·m $^{-3}$ are not shown.

but cause 31% less exposure than average (3.4 μg·m^{-3}), for a pollution inequity of 63%. Whites/others are exposed to 7% less $PM_{2.5}$ than average (4.6 μg·m^{-3}), but cause 12% more exposure than average (5.5 μg·m^{-3}), for a pollution inequity of –17%.

Blacks are more exposed than whites/others to pollution from every emitter group (Fig. 2). The same holds for Hispanics, with the exceptions of $PM_{2.5}$ originating from agriculture, from coal electric utilities, and from residential wood combustion, for which they are exposed to 11%, 40%, and 14% less, respectively, than whites/others. Those three types of emissions are concentrated in regions of the United States with relatively low Hispanic populations (Fig. 1). Whites/others consume more and cause more exposure than do blacks and Hispanics across all seven end use categories; the end uses representing the greatest differences in consumption caused exposure are food (for which whites/others cause 61% and 49% more exposure than blacks and Hispanics, respectively), transportation (74% and 93%), and services (118% and 114%).

Differences in consumption across groups are comparable or larger contributors to pollution inequity than are differences in exposure across groups. Consumption differences account for 52%, 73%, and 63% of overall pollution inequity for blacks, Hispanics, and whites/others, respectively (Fig. 3*A*). Previous analyses have found that when considering only differences in locations of residence, exposure disparities by race are much larger than disparities by income (9, 10). Our results suggest that income, to the extent that it correlates with consumption, is an important factor in determining how much pollution a person causes, even if it may be statistically less important as a deter minant of exposure. We also find that differences in racial ethnic groups' contribution to exposure are driven more by differences in their overall amount of consumption (magnitude effect) than by differences in the types of goods and services they consume (composition effect) (Fig. 4 and *SI Appendix*, Fig. S3).

Exposure to $PM_{2.5}$ caused by personal consumption by all three racial ethnic groups decreased by an average of 51% during 2003 2015 (Fig. 3*B*, *SI Appendix*, Fig. S4, and Movie S1), even as personal consumption expenditures increased (*SI Appendix*, Fig. S4 and Tables S16 S18). Furthermore, absolute differences in exposure caused by overall consumption decreased among groups, as did absolute differences in overall exposure caused by each group's consumption (Fig. 3*B*). Pollution inequity has remained high, however, decreasing by 23% for blacks (from 73% in 2003 to 56% in 2015) but increasing by 5% for Hispanics (from 60% in 2003 to 63% in 2015; Fig. 3*C*). Increases in consumption during 2003 2015 were larger for blacks than Hispanics for most sectors of the economy; two notable examples are spending on shelter (17% and 2% increases, respectively) and goods (21% and 6%, respectively) (*SI Appendix*, Tables S16 S18). Decreases in absolute exposure differences were primarily caused by decreases in the $PM_{2.5}$ concentrations where blacks and Hispanics live, rather than by blacks and Hispanics moving to locations with lower $PM_{2.5}$ concentrations (*SI Appendix*, Fig. S2).

Here, we have described linkages between human end use activities and air pollution and the racial ethnic disparities therein. We find that, in the United States, $PM_{2.5}$ air pollution is disproportionately induced by the racial ethnic majority and disproportionately inhaled by racial ethnic minorities. All have benefited from recent reductions in atmospheric $PM_{2.5}$ concentrations. Our analysis shows for the first time how pollution inequity is driven by differences among racial ethnic groups in both exposure and the consumption that leads to emissions. Still, questions remain about the spatial context of pollution inequity, its underlying causes, how best to address it, and its generalizability. For example, little is known about the "spatial scale" of inequity, such as whether consumers tend to live near to or far from the people exposed to the pollution resulting from their consumption. Further information on this issue would clarify whether this inequity could best be investigated and addressed at the city, state, or national level. Another open question is whether the patterns of pollution inequity described here are observed for other pollutants, times, or locations (e.g., in other countries). The pollution inequity metric defined here could be used to explore such questions and to inform discussion of inequity in other environmental burdens, including climate change, for which inequities can occur across continents and generations, in addition to across race ethnicities.

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Materials and Methods

Environmentally extended economic input output analysis has been used to track air pollutant and greenhouse gas emissions induced by economic demand within and among national economies (11 16). Fewer studies have reported air quality related health impacts induced by domestic (17, 18) and international trade (19 21). Here, we explore relationships among human end use activities in the United States, $PM_{2.5}$ related health impacts caused by those activities, the corresponding consumption exposure inequity among race ethnicity groups, and related temporal trends.

Unlike analyses of greenhouse gas emissions for use in climate change impact assessment, analyses of health impacts from non greenhouse gas air pollution strongly benefit from spatial differentiation. For example, within the United States, health impacts per unit of emissions of $PM_{2.5}$ and its precursors

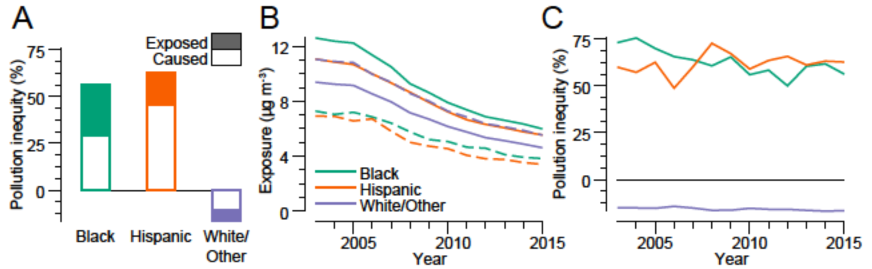

Fig. 3. Pollution inequity contributions and trends. (*A*) Contributions of differences in consumption (caused, or C_g) and location of residence (exposed, or E_g) to pollution inequity. (*B*) Exposure of each racial ethnic group to $PM_{2.5}$ caused by the total combined personal consumption of all groups (exposed or E_g; solid lines) and total population exposure to $PM_{2.5}$ caused by each group's population adjusted consumption (caused, or C_g; dashed lines), 2003 2015. (*C*) Pollution inequity levels, 2003 2015.

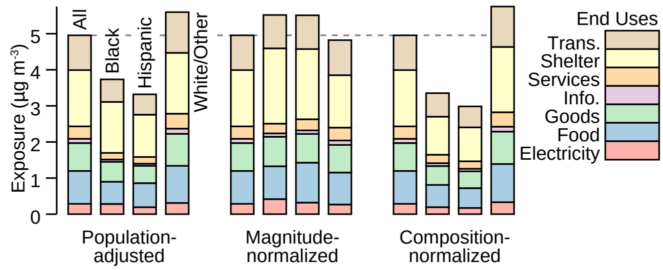

Fig. 4. Effect of magnitude and composition of consumption on $PM_{2.5}$ ex posure. Population adjusted $PM_{2.5}$ exposure (*Left*): actual population adjusted exposure (as seen in Fig. 2). Magnitude normalized $PM_{2.5}$ exposure (*Middle*): hypothetical exposure in which the overall magnitude of per capita con sumption for each race ethnicity is adjusted to match "All" without changing the composition of goods and services consumed. Composition normalized $PM_{2.5}$ exposure (*Right*): hypothetical exposure where the composition of goods and services consumed by each race ethnicity is adjusted to match All without changing the overall magnitude of consumption.

vary greatly across emission locations (22, 23). Spatial resolution is especially important when quantifying disparities in exposure among demographic groups (9). Therefore, to create a spatially explicit environmentally extended economic input output model for the United States, we couple economic input output (https://www.bea.gov/industry/io annual.htm) and consumption (https://www.bls.gov/cex/) data with spatially explicit emissions data (4), the InMAP air quality model (5), and spatially explicit population and health data (ref. 6; https://www.census.gov/programs surveys/acs/technical documentation/table and geography changes/2015/5 year.html; https://www.cdc.gov/nchs/data access/cmf.htm). The resulting model relates air pollution emissions, concentrations, and health impacts with economic activity in the United States at a spatial scale varying between 1 and 48 km, depending on population density and emissions density. We refer to the model as the Extended InMAP Economic Input Output (EIEIO) model, which is freely available at the Zenodo repository (24). InMAP is able to spatially resolve both the entire contiguous United States and within city concentration gradients, which is critical for quantifying within and among city differences in exposure.

EIEIO uses economic data to trace human end use activities that directly and indirectly cause air pollutant emissions and the resulting human exposure to $PM_{2.5}$. The model tracks relationships between final "end users," the activities or "end uses" they are participating in (or "final demand for commodities," in economic input output terminology) that induce air pollution emissions, and the "emitter" entities that are physically releasing air pollutant emissions. EIEIO also tracks "intermediate uses." Intermediate uses are purchases by businesses to produce something that they are selling, whereas end uses are purchases or activities for reasons other than producing something to be directly sold. For example, the purchase of electricity to heat a home is an end use, whereas the purchase of electricity to manufacture fertilizer is an intermediate use. Our analysis includes both the emissions caused by an end use itself (e.g., tailpipe emissions from driving a car) and the emissions from economic activities in support of the end use (e.g., emissions from the production of gasoline to fuel the car).

EIEIO tracks 19 end user types, 389 end use categories, and 5,434 categories of emitters. For ease of display and communication, we present results here in groups of four users, seven uses, and 14 emitters; further details are in *SI Ap pendix*. Mappings from the use and emitter categories to corresponding groups are in Tessum et al. (24). Unless otherwise noted, all results are for year 2015.

Methods are described below and in Tessum et al. (24). The model source code includes a graphical interface that can be used for exploratory analysis and vi sualization. Results here were generated using a 2018 vintage Google Compute Engine instance with 32 CPU cores, 208 GB of RAM, and a 500 GB hard drive.

Economic Production. To relate final economic demand for commodities to economic activity or production in individual industries, we use the following US Bureau of Economic Analysis (BEA) Input Output Accounts Data (https://www.bea.gov/industry/io annual.htm):

i) Final demand (d_f): Economic activity that leads to the final consumption of a good or service and that is not induced by economic activity in another sector of the economy. This can include demand for exports.

ii) Import final demand (d_{fi}): Economic activity that leads to the final con sumption of an imported good or service and that is not induced by economic activity in another sector of the economy.

iii) Total requirements (R_t): Direct plus indirect purchases from an industry required to produce a dollar of output of a commodity (25).

iv) Total domestic requirements ($R_{t,d}$): Domestic (i.e., within the United States) direct plus indirect purchases from an industry required to pro duce a dollar of output of a commodity.

v) Total import requirements ($R_{t,i}$): Calculated as $R_{t,i} = R_t \quad R_{t,d}$.

where d_f and $d_{f,i}$ are vectors with one entry for each of 389 commodity sectors, and R_t, $R_{t,d}$, and $R_{t,i}$ are matrices with one row for each of 389 in dustry sectors and one column for each of 389 commodity sectors.

We calculate economic production, ρ, caused by final demand as in Eq. **2**:

$$\rho = R d_f, \qquad [2]$$

where R is one of R_t, $R_{t,d}$, or $R_{t,i}$ depending on whether total, domestic, or international economic production is desired. For imports, d_f is replaced with d_{fi}. ρ is a vector with one entry for each industry sector.

BEA input output data are disaggregated to the detailed level of 389 industries and 389 commodities for year 2007, and to the summary level of 71 industries and 73 commodities for years 1997 2015. To perform calcula tions for years other than 2007, we scale the detailed 2007 data as in Eq. **3**:

$$v_{d,i,c,y} = \frac{v_{d,i,c,2007}\, v_{s,i,c,y}}{v_{s,i,c,2007}}, \qquad [3]$$

where $v_{d,i,c,y}$ is a value at the detailed level of aggregation for industry i and commodity c for the year of interest, $v_{d,i,c,2007}$ is the corresponding value at the detailed level of aggregation for year 2007, and $v_{s,i,c,y}$ and $v_{s,i,c,2007}$ are values for the corresponding summary level of aggregation for the year of interest and 2007, respectively.

Some negative values for final demand exist in the BEA input output data tables. These typically relate to divestments or reductions in amounts of stocks. Because our objective is to use economic relationships to model air pollution emissions and impacts, and divestments or stock reductions do not cause neg ative emissions in the same way that investments and increases in stocks can be said to cause positive emissions, we set all negative final demand values to zero.

Demographic Specific Personal Consumption Demand. BEA input output data report final demand from personal expenditures, but the data do not dis aggregate consumption by racial or ethnic groups. To calculate demographic specific consumption, we match categories in the US Bureau of Labor Statistics Consumer Expenditure Survey (CES) (https://www.bls.gov/cex/) to the BEA in put output sectors, then use the demographic information in the CES data to allocate BEA personal expenditures among demographic groups. The CES data report expenditures separately for the following: Hispanics or Latinos; Not Hispanic or Latino: whites and all other races; and Not Hispanic or Latino: blacks or African Americans.

As of this writing, CES data are available for the years 2003 2015. EIEIO does not account for geographic variation in consumption amounts or in the proportions of goods and services consumed.

Augmented Personal Consumption. In addition to personal consumption (causing 46,000 premature deaths from $PM_{2.5}$), we also attribute BEA private expenditure final demand categories to individual end users and allocate the expenditures among demographic groups. We do this by directly adding final demand for "Residential private fixed investment" (16,000 premature deaths from $PM_{2.5}$) to personal consumption, as individuals are the ultimate end users of residential buildings. The remaining private expenditure cate gories include expenditures on nonresidential structures (9,400 deaths), nonresidential equipment (9,400 deaths), and intellectual property (500 deaths), as well as changes in inventory (1,700 deaths). Because consumption activities provide the revenue streams that organizations use to make capital investments and to generate inventory, albeit with time lags that we do not account for here, we consider these expenditures and the resulting air pollution to be caused by personal consumption. Therefore, we attribute these additional categories of demand to demographic groups proportionate to each group's overall fraction of combined personal consumption and resi dential investments. Although government expenditures are also ultimately funded by individuals, the taxes that fund the government are compulsory, and relationships between individual tax contributions and government spending decisions are uncertain. Therefore, we do not attribute government expendi tures to individuals, but instead track and display them as their own category.

Emission Factors. We create spatially explicit emissions factors in units of mass per time of emissions of primary $PM_{2.5}$ and secondary $PM_{2.5}$ precursors [oxides of nitrogen (NO_x), oxides of sulfur (SO_x), ammonia (NH_3), and volatile organic compounds (VOCs)] per dollar for each of the 5,434 EPA source classification codes (SCCs) in the year 2014 US National Emissions Inventory (NEI), version 1 (4). Each emissions record in the NEI contains an SCC that specifies the type of source creating the emissions. First, we match each SCC to one or more of the 389 BEA industries. Some sources of emissions cannot be directly matched to BEA industries because they do not result from economic transactions. We match these sources to the BEA industry to which it is most closely related. The largest source of these nontransactional emissions is the personal use of light duty vehicles, which we match to the "automobile manufacturing" industry based on the assumption that the individuals and entities that drive light duty vehicles and create the resulting emissions are the same as the individuals and entities that purchase auto mobiles. Other nontransactional sources of emissions include leisure activi ties such as barbecuing and operating recreational vehicles, which we attribute to relevant residential or recreational industries. The cross walk between SCCs and BEA industries can be found in Tessum et al. (24). We use this cross walk to map the economic production vector, ρ, which has one element for each BEA industry, to vector $\hat{\rho}$, which has one element for each SCC equal to the sum of economic production in the BEA industry or industries that the SCC is matched to. $\hat{\rho}$ double counts economic production in some cases, but is used in a way that ensures emissions are not double counted.

Next, we process the NEI emissions (excluding emissions occurring in Canada and Mexico, which are tracked separately) using the InMAP Air Emissions Preprocessor program, also included in Tessum et al. (24). We assign each emissions record to the BEA industry or industries it belongs to and allocate the emissions to a spatial grid with cell edge lengths varying be tween 1 and 48 km, depending on population density and emission density. [The grid employed by InMAP is described further by Tessum et al. (5).] We allocate county specific emissions to grid cells within counties using spatial surrogates, as described by the US EPA (4).

Finally, we calculate spatially explicit emissions factors by dividing the emissions from each SCC by the total domestic economic production in the matched industry or industries (i.e., $\hat{\rho}$) resulting from domestic and export final demand. The result is a series of emissions factor matrices, E_p, where p is one of the pollutants in (primary $PM_{2.5}$, NO_x, SO_x, NH_3, VOC). Each emissions factor matrix has one row for each spatial grid cell, one column for each SCC, and dimensions of [mass·time ^{1}·\$ ^{1}].

For analysis years other than 2014, we adjust the 2014 NEI emissions according to state and source group specific annual trends in emissions published by the US EPA (https://www.epa.gov/air emissions inventories/air pollutant emissions trends data). To quantify health impacts from non human related emissions sources, we also include combined biogenic and wildfire emissions from year 2005, as processed by Tessum et al. (26). Further information is in *SI Appendix*. We calculate spatially explicit emissions of a pollutant p (e_p) induced by human activity (using economic final demand as a surrogate for human activity) as shown in Eq. **4**:

$$e_p = E_p \hat{\rho}, \tag{4}$$

where e_p is a vector with length equaling the number of spatial grid cells and dimensions of [mass·time ^{1}].

$PM_{2.5}$ Concentrations. Primary $PM_{2.5}$ and secondary $PM_{2.5}$ precursors are emit ted into the atmosphere where they are transported by wind, transformed by chemistry, and ultimately inhaled by humans or otherwise removed. We ac count for these phenomena using InMAP, version 1.2.1 (5); InMAP creates spatially explicit estimates of ambient $PM_{2.5}$ concentrations caused by the emissions estimated by EIEIO. For computational expedience, we use InMAP to create a set of source receptor matrices, which describe linear relationships between (*i*) emissions in each of many source locations and (*ii*) concentrations in each of many receptor locations. We create the InMAP source receptor matrix (ISRM) by running separate InMAP simulations that estimate the ground level changes in $PM_{2.5}$ concentrations of emissions of SO_x, NO_x, VOCs, NH_3, and primary $PM_{2.5}$ in each of ~50,000 InMAP grid cells. This is repeated three times to consider emissions plume height ranges of 0 57, 240 380, and 760 1,000 m, for a total of ~150,000 simulations. The result can be represented as a rank four tensor describing independent linear relationships between emissions and $PM_{2.5}$ concentrations for discrete combinations of pollutant emitted, emissions source location, emissions plume height, and concentration receptor location. By using linear interpolation to calculate impacts for sources with plume heights that do not fall within the modeled height ranges, ISRM can quickly calculate $PM_{2.5}$ concentrations resulting from arbitrary combinations of emissions sources and locations. ISRM model performance evaluation is in *SI Appendix*.

Ground level concentrations of $PM_{2.5}$ depend on the height and location of emissions; therefore, instead of directly using the E_p matrices to calculate concentration impacts, we create a separate series of matrices for the con centration factor, C_p, for each emitted pollutant, p, by using the ISRM to calculate total concentrations from the NEI emissions records associated with each SCC while accounting for individual plume heights from each emis sions record and dividing the result by the total transformed domestic economic production, $\hat{\rho}$. The resulting matrices, C_p, have one row for each spatial grid cell, one column for each SCC, and units of micrograms per cubic meter per dollar. Total $PM_{2.5}$ concentration impacts (c) of economic final demand are calculated by summing impacts from each emitted pollutant as in Eq. **5**:

$$c = \sum_p \{C_p \hat{\rho}\}, \tag{5}$$

where c is a vector with length equaling the number of spatial grid cells and units of micrograms per cubic meter.

Health Impacts. Air pollution related health impacts from economic final demand are a function of population counts, underlying incidence rates, and concentration response relationships, in addition to the $PM_{2.5}$ concentrations themselves.

Population counts. Population counts are based on data from the US Census Bureau American Community Survey (ACS) 5 Year Estimates (https://www.census.gov/programs surveys/acs/technical documentation/table and geography changes/2015/5 year.html) for midpoint years 2007 2014, plus the year 2000 decennial census, downloaded from the National Historical Geographic Information System (27) at census block group spatial resolu tion. We calculate health impacts for several race ethnicity categories:

i) Total population (314 million people in our study domain, as of 2014).

ii) People of all races who are Hispanic or Latino; we refer to this group as Hispanic (54 million people).

iii) People who are not Hispanic or Latino and are black or African Amer ican alone; we refer to this group as black (39 million people).

iv) All people who are not in the Hispanic or black groups; we refer to this group as white/other; this group includes 196 million whites, 15 million Asians or Pacific Islanders, 2 million American Indians, and 8 million Others/Multiple Races.

Population counts for years 2001 2006 are estimated using spatially explicit interpolation with 2000 and 2007 as the endpoints, years 1997 1999 use year 2000 population counts without modification, and year 2015 uses year 2014 population counts without modification. Data for years 2007 2014 are directly available from ACS. We use the total population count to calculate total health impacts, and we use the separate counts for each demographic group to cal culate inequity in $PM_{2.5}$ exposure. The racial ethnic groups used here were chosen to align with the demographic groups in the Consumer Economics Survey (https://www.bls.gov/cex/). We use population counts for people of all ages, rather than restricting the analysis to a specific age range. One reason for this is that publicly available US Census data do not include both race ethnicity and age information at the block group spatial resolution. We allocate population counts to spatial grid cells, using area weighting for census block groups that overlap more than one grid cell. The resulting vectors, p_g, where g is the set of demographic groups above, have one row for each grid cell and units of [persons].

Underlying incidence rates. We use county specific data for baseline all cause mortality rates from the US Centers for Disease Control and Prevention (https://www.cdc.gov/nchs/data access/cmf.htm) for years matching the population years above. We use mortality rates for the full population, rather than for a specific age range. Following Apte et al. (28), we calculate the county average underlying mortality incidence rate, I_o, as in Eqs. **6** and **7**:

$$I_{o,c} = \frac{I_c}{\overline{\mathrm{HR}}_c}, \tag{6}$$

$$\overline{\mathrm{HR}}_c = \frac{\sum_{i}^{N_c} {}_1 P_i \times \mathrm{HR}(C_i) f_{i,c}}{\sum_{i}^{N} {}_1 P_i}, \tag{7}$$

where I_c is the reported mortality rate in a given county; $\overline{\mathrm{HR}}_c$ is the aver age mortality hazard ratio caused by $PM_{2.5}$ in county c; i is one of N_c grid cells in county c; P_i is population count in grid cell i; $\mathrm{HR}(C_i)$ is the result of the con centration response relationship described below for total $PM_{2.5}$ concentration C_i, calculated as described in *$PM_{2.5}$ Concentrations*; and $f_{i,c}$ is the area fraction of grid cell i that overlaps with county c. The term $I_{o,c}$ represents a hypothetical mortality incidence rate in the absence of ambient $PM_{2.5}$. For health impact calculations, we assume that the underlying incidence rate for all racial ethnic groups is the same as the population average. We calculate a US population average $I_{o,c}$ of 763 deaths per 100,000 people per year in 2014.

Concentration response relationship. We represent the effect of changes in $PM_{2.5}$ concentration on mortality rates using the relationship described by Nasari et al. (6) and Burnett et al. (7), as in Eq. **8**:

$$\mathrm{HR}(C) = \exp\left(\frac{\gamma * \ln(C+1)}{1+\exp[\quad(C\quad\delta)/\lambda]}\right), \qquad [8]$$

where $\mathrm{HR}(C)$ is the hazard ratio of mortality incidence at $PM_{2.5}$ concentra tion C in units of micrograms per cubic meter compared with a hypo thetical underlying incidence rate, I_o, in the absence of ambient $PM_{2.5}$. γ, δ, and λ are empirically determined constants. Nasari et al. use an ensemble version of Eq. **8**, where γ, δ, and λ take many combinations of values and the prediction of each combination is weighted by its performance in predicting health outcomes in the American Cancer Society cohort. To reduce model complexity and computational expense, we use a deterministic version of the relationship, where $\gamma = 0.0478$, $\delta = 6.94$, and $\lambda = 3.37$ are determined us ing nonlinear regression to predict the expected value of the ensemble prediction. The relationship used here and by Nasari et al. (6) differs from the relationship presented by Burnett et al. (7) in that it is derived from the US based American Cancer Society cohort rather than from 41 global cohorts.

The term $\mathrm{HR}(C)$ is a nonlinear function; therefore, the impact of a change in concentration depends on the initial concentration. It follows that if a number of emissions sources are consecutively added or subtracted from an area, their health impact per unit emission will depend on the order that they were added or subtracted. We assume that the impact of each unit $PM_{2.5}$ is equal to the average per unit impact of $PM_{2.5}$ in a given location, as in Eq. **9**:

$$\overline{\mathrm{HR}}_i = \frac{\mathrm{HR}(C_{t,i})}{C_{t,i}}, \qquad [9]$$

where $\overline{\mathrm{HR}}_i$ is the average per unit concentration hazard ratio at location i, and $C_{t,i}$ is the total concentration at location i.

As a sensitivity analysis, we also use three other hazard ratio models based on the work of Krewski et al. (29) and Lepeule et al. (30), which all take the form shown in Eq. **10**:

$$\mathrm{HR}(C) = \exp(\beta \times \max[0, C\quad C_o]), \qquad [10]$$

where β is an empirically determined constant. We use two β values reported by Krewski et al. (29): $\beta = \ln(1.06)/10$ and $\beta = \ln(1.078)/10$. We also use $\beta = \ln(1.14)/10$ as reported by Lepeule et al. (30). C_o represents the lowest observed concentration: 5 $\mu g \cdot m\ \ 3$ for Krewski et al. (29) and 8 $\mu g \cdot m\ \ 3$ for Lepeule et al. (30); our method assumes that for concentrations below this threshold, the risk of $PM_{2.5}$ caused premature mortality is zero.

Health impact calculation. We calculate the health impacts of air pollution using Eq. **11**:

$$M(C_i) = p_i \sum_c^n I_{o,c} f_{i,c} \overline{\mathrm{HR}}_i, \qquad [11]$$

where $M(C_i)$ is the number of mortalities caused by the concentration of pollution (C_i) at location i, p_i is the population count in grid cell i, $I_{o,c,i}$ is the underlying incidence rate for one of n counties (c) overlapping grid cell i, and $f_{i,c}$ is the fraction of grid cell i that overlaps county c. We then calculate the $PM_{2.5}$ health impacts, d, of economic final demand by combining Eqs. **5** and **11** in Eq. **12**:

$$d = M\quad \sum_p \{C_p \hat{\rho}\}\Bigg), \qquad [12]$$

where d is a vector with length equaling the number of spatial grid cells and units of [deaths].

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National Center for Sustainable Transportation

POLICY BRIEF

Environmental Reviews Fail to Accurately Analyze Induced Vehicle Travel from Highway Expansion Projects

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Issue

Induced travel is a well-documented effect in which expanding highway capacity increases the average travel speed on the highway, which in turn reduces the perceived "cost" of driving and thereby induces more driving.[1] This increase in vehicle miles traveled (VMT) increases congestion (often back to pre-expansion levels) and air pollutant emissions, reducing or eliminating the purported benefits of the expansion (Figure 1). Yet highway expansion projects continue to be proposed across California, often using congestion relief—and sometimes greenhouse gas reductions—as a justification for adding lanes. These rosy projections about the benefits of highway expansion projects indicate that the induced travel effect is often not fully accounted for in travel demand models or in the projects' environmental review process.

With this problem in mind, researchers at the University of California, Davis developed an online tool to help agencies estimate the VMT induced annually by adding lanes to major roadways in California's urbanized counties. The Induced Travel Calculator estimates project-induced VMT using the project length (in lane miles) entered by the user, lane-mile and VMT data from Caltrans, and estimates of elasticities (the percentage change in VMT that results from a 1% increase in lane miles) from peer-reviewed studies.

The researchers also applied the calculator to estimate the vehicle travel induced by five highway expansion projects in California that had gone through environmental review within the past 12 years. They then compared their estimates with the induced travel analysis completed for the projects' actual environmental impact assessments. The five projects include (1) the U.S. Highway 101 High-Occupancy Vehicle (HOV) Widening (Marin-Sonoma Narrows), (2) the State Route 1 Corridor Analysis of HOV Lanes (Santa Cruz), (3) the State Route 210 Mixed-Flow Lane Addition (San Bernardino), (4) the State Route 99 South Stockton Six-Lane Project, and (5) the Interstate 405 HOV Widening.

Key Findings

Environmental reviews of highway expansion projects include inconsistent, if any, analysis of induced vehicle travel. The environmental analysis documents for the five projects varied wildly in their discussion of induced vehicle travel impacts. Two documents did not discuss the induced travel phenomenon at all. And the only two documents to analyze it in detail did so in responses to comments, not in the original analysis. Even when the documents did analyze induced travel in detail, the discussion of the effect was contradictory within the documents and inconsistent with the induced travel literature.

Projects' environmental review documents underestimate induced vehicle travel. Only three of the five documents reported estimates of induced VMT. All three estimates were lower than what the researchers estimated using the

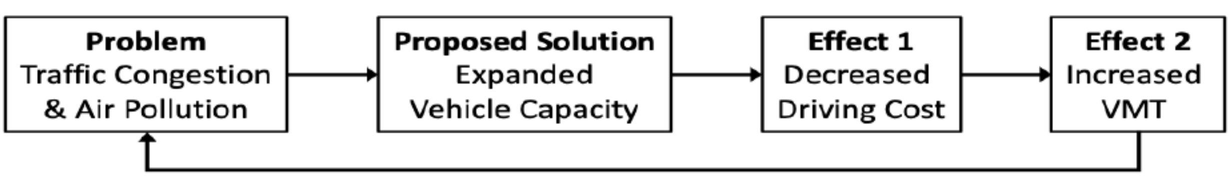

Figure 1. Induced vehicle travel effect of highway capacity expansions

Induced Travel Calculator. In two of the three cases, the estimates were an order of magnitude lower (Figure 2).

Policy Implications

The results provide additional evidence that environmental analyses often fail to consistently and accurately discuss—let alone estimate—the induced travel effects of highway capacity expansion projects. Going forward, the Induced Travel Calculator can help agencies consistently quantify induced travel by using elasticity-based estimates of VMT levels derived from the project's lane-mile changes. Indeed, Caltrans' 2020 Transportation Analysis Framework recommends that the Induced Travel Calculator be used where possible to estimate or at least benchmark induced VMT for California state highway system projects.

More Information

This policy brief is drawn from "Induced Vehicle Travel in the Environmental Review Process," a paper in the *Transportation Research Record: Journal of the Transportation Research Board* by Jamey M.B. Volker, Amy E. Lee, and Susan Handy of the University of California, Davis. The article is available at https://ncst.ucdavis.edu/research-product/induced-vehicle-travel-environmental-review-process.

NCST's Induced Travel Calculator can be accessed at https://ncst.ucdavis.edu/research-product/induced-travel-calculator.

For more information about the findings presented in this brief, please contact Jamey Volker at jvolker@ucdavis.edu.

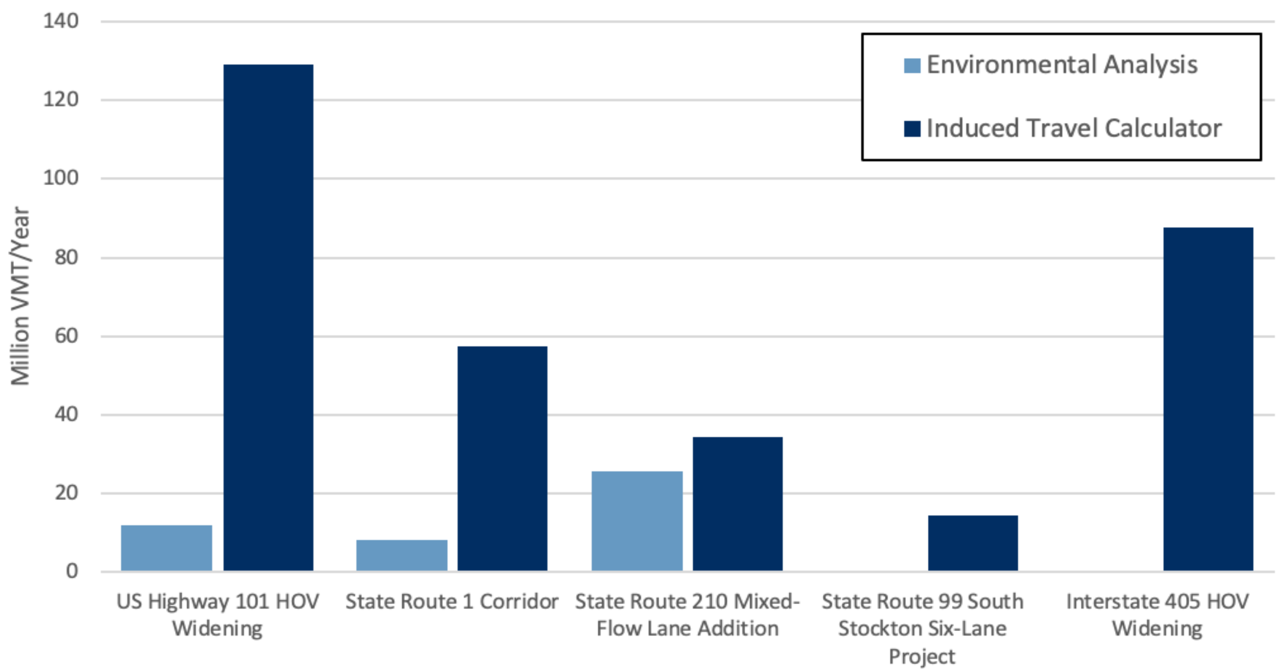

Figure 2. Comparison of induced VMT estimates in highway expansion project environmental analyses versus the Induced Travel Calculator (analyses for the State Route 99 and Interstate 405 projects did not estimate induced travel)

[1] *Handy, S. (2015). Increasing Highway Capacity Unlikely to Relieve Traffic Congestion. UC Davis: National Center for Sustainable Transportation.* https://escholarship.org/uc/item/58x8436d

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Draft Transportation Analysis Framework:

Induced Travel Analysis

March 2020

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INTRODUCTION

In response to recent state laws, revisions to CEQA regulations, CEQA case law, and in order to achieve better alignment with state objectives on greenhouse gas emissions reduction, preservation of the environment, and betterment of human health, Caltrans has determined that Vehicle Miles Traveled (VMT) is the most appropriate primary measure of transportation impacts for capacity-increasing transportation projects on the State Highway System (SHS). The determination of significance of VMT impact will require a supporting induced travel analysis methodology for capacity-increasing transportation projects on the SHS when Caltrans is lead agency or when Caltrans designates another entity as lead agency. The Governor's Office of Planning and Research (OPR) has prepared a Technical Advisory on Evaluating Transportation Impacts in CEQA (California Governor's Office of Planning and Research, 2018) to assist agencies in VMT analysis for both land use and transportation projects. Caltrans recommends using the VMT analysis approaches recommended in OPR's advisory when evaluating the transportation impacts of projects on the State Highway System (SHS).

PURPOSE OF THE TRANSPORTATION ANALYSIS FRAMEWORK

The purpose of this Transportation Analysis Framework is to assist Caltrans Districts in identifying the best approach for analyzing VMT (induced travel) under CEQA in various settings and for projects on the SHS. It provides Caltrans District engineers and planners additional information and recommendations to enable analysts to successfully and consistently implement the new CEQA guidelines in the analysis of transportation impacts. The guidance supports robust, context-sensitive approaches that may in some cases streamline the project delivery process. This framework may also be useful to others assessing the transportation impacts of transportation projects on the SHS. The Framework is not intended to be used for NEPA analyses or other CEQA analyses (such as air and noise). Those analyses have their own distinct requirements.

CONSIDERING INDUCED TRAVEL UNDER CEQA

CEQA requires assessing and disclosing environmental impacts resulting from a project, i.e. impacts that would not occur but for the project. Therefore, under CEQA, the transportation impact of a roadway capacity project is the overall increase in VMT that is attributable to the project, distinct from any background changes in VMT due to other factors such as population or economic growth. The VMT impact is the difference in VMT with the project and without the project.

With a hypothetical project, Figure 1 illustrates the induced travel effect unfolding over time. The baseline trend, shown in the figure by the line labeled "VMT Without Project", shows VMT on the network growing over time, perhaps the result of population and/or economic growth. As described above, an increase in capacity generally leads to an increase in vehicle travel on the network, as shown by the line labeled "VMT With Project". The VMT attributable to the project, or induced travel is the difference in VMT on the network with the project and without the project, counted in the horizon year.

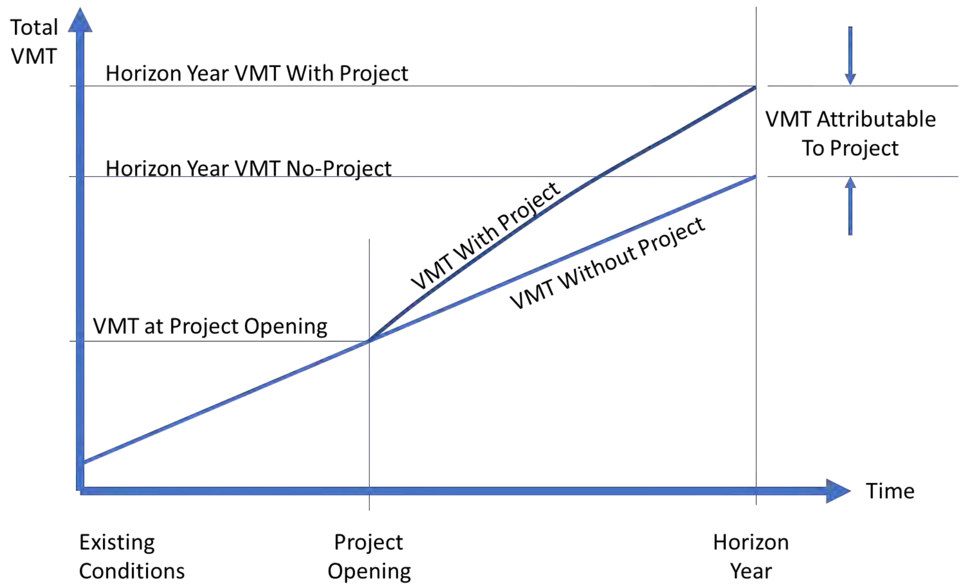

Figure 1: Identification of VMT Attributable to a Transportation Project

METHODS FOR ASSESSING INDUCED VMT

In general, two approaches exist for induced travel assessment. The first is the empirical approach, which applies elasticities from empirical studies that quantify the induced travel effect (the National Center for Sustainable Transportation (NCST) Induced Travel Calculator applies this approach (Susan Handy[1]). The other is the travel demand model-based approach. The general guideline is to use both methods and disclose both induced travel numbers wherever applicable.

The OPR Technical Advisory states that induced travel is generally most accurately assessed by directly applying the "empirical research". OPR also states that the "empirical approach" is also the simplest and most transparent approach for assessing induced travel. For these reasons, the OPR Technical Advisory recommends the empirical approach be used (pp 23-24) where applicable. The NCST has developed a tool to apply this approach, and a project that falls within its scope of application, as stated in the "About" tab of the NCST tool website (https://blinktag.com/induced-travel-calculator/), should employ it for induced VMT assessment. The Department endeavors to use the empirical approach or the NCST induced travel calculator as the primary tool where applicable. For most General Purpose (GP) or High Occupancy Vehicle (HOV) lane addition projects on the SHS, the NCST tool can be applied to assess induced travel.

Where the NCST tool is not applicable, a travel demand model-based approach supplemented with off-model post-processing and/or iteration may be called for. For example, when a project and/or project alternative involves more than just GP/HOV lane facilities, or when in a single environmental document, a consistent set of VMT information is needed to enable the evaluation of air quality conformity or noise level analysis together with induced travel analysis, including a travel demand model-based approach may be necessary. Figure 2 provides a selection matrix for choosing the applicable VMT assessment method(s) for various locations and project types.

<table>
<tr><th>Project Location*</th><th>Add Capacity (GP or HOV) Lane to Interstate Freeway</th><th>Add Capacity (GP or HOV) to Other State Routes</th><th>Other Potentially VMT Inducing Projects on a State Route</th><th>Non-VMT Inducing Projects</th></tr>
<tr><td>Urban counties in MSA with Class I facilities**</td><td colspan="2">- Use NCST Induced Travel Calculator for proposed project.
- Use travel demand model (with off-model post processing and/or iteration.
- Report both results.</td><td rowspan="2">Use travel demand model (off-model post processing and/or iteration) for induced VMT analysis of proposed project, alternatives, and mitigations (as appropriate).</td><td rowspan="4">Brief description about why the project is not likely to result in substantial induced travel.</td></tr>
<tr><td>Other Urban Counties***</td><td>Use travel demand model (with off-model post processing and/or iteration) for induced VMT analysis of proposed project, alternatives, and mitigations (as appropriate).</td><td>- Use NCST Induced Travel Calculator for proposed project.
- Use travel demand model (with off-model post processing and/or iteration).
- Report both results.</td></tr>
<tr><td>Rural counties with existing or forecasted congestion at or near project site****</td><td colspan="2">Use travel demand model (off-model post processing and/or iteration) for induced VMT analysis of proposed project, alternatives, and mitigations (as appropriate).</td><td>Use travel demand model (off-model post processing and/or iteration) for induced VMT analysis of proposed project, alternatives, and mitigations (as appropriate).</td></tr>
<tr><td>Rural county with <u>No</u> existing or forecasted congestion at or near project site</td><td colspan="3">Qualitative assessment of likely VMT effects.</td></tr>
</table>

Figure 2: Induced VMT Assessment Method Selection Matrix

*Note that this chart applies only to the forecasting of state highway project induced VMT attributable to the project (induced travel) for CEQA transportation impact analysis. Other methods and tools are necessary to forecast total VMT in the horizon year for other CEQA and NEPA (when applicable) impact analysis purposes. Consult with Caltrans Division of Environmental Analysis (DEA) and Division of Transportation Planning (DOTP) for details.

** According to its technical documentation, the NCST Induced Travel Calculator can be applied to mainline general-purpose lane additions and mainline HOV lane additions on Class 1 facilities (Interstate freeways) and Class 2/3 facilities (Other Freeways, Expressways, and Other Principal Arterial state routes) as defined by FHWA (see Appendix C). Freeway ramps and minor arterials or collector-distributor roads associated with a freeway fall outside the scope of application for the NCST Induced Travel Calculator. The VMT inducing effects for ramp, minor arterial, and collector-distributor road capacity projects should be evaluated as "Other Potentially VMT Inducing Project" in this matrix.

Urban counties located within metropolitan statistical areas (MSA's) with sufficient Class I facilities for application of NCST Induced Travel Calculator tool are: Alameda, Contra Costa, Fresno, Imperial, Kern, Kings, Los Angeles, Marin, Merced, Orange, Placer, Riverside, Sacramento, San Benito, San Bernardino, San Diego, San Francisco, San Joaquin, San Mateo, Santa Cruz, Shasta, Solano, Stanislaus, Sutter, and Yolo.

*** Urban counties where the NCST Induced Travel Calculator is limited to Class 2 and 3 facilities are: Butte, El Dorado, Madera, Monterey, Napa, San Luis Obispo, Santa Barbara, Santa Clara, Sonoma, Tulare, Ventura, Yuba.

**** Rural counties where the NCST Induced Travel Calculator should not be used for forecasting induced VMT are: Alpine, Amador, Calaveras, Colusa, Del Norte, Glenn, Humboldt, Inyo, Lake, Lassen, Mariposa, Mendocino, Modoc, Mono, Nevada, Plumas, Sierra, Siskiyou, Tehama, Trinity, Tuolumne.

PROCESS FOR RECONCILING VMT ASSESSMENT METHODS FOR PROJECTS ON THE STATE HIGHWAY SYSTEM

SB 743 calls for a modernization of transportation impact analysis. With this modernization comes a necessary recognition that the current methods have known limitations with estimating the induced VMT phenomenon. Current practice for estimating project-generated VMT is about to undergo a necessary evolution, and Caltrans will adapt its recommendations to stay in step with the state of the science and the technical practice as methods evolve and improve.

This draft guidance document puts forward two possible methods for assessing induced VMT from state highway projects, and acknowledges that both methods (i.e., the elasticity approach and the travel demand modeling-based approach) have limitations. Ultimately, an impact determination is required, so a single estimate of project-generated VMT will be necessary.

To advance this discussion, Caltrans plans to convene a panel of expert practitioners that specialize in induced VMT estimation. This panel will prepare recommendations on how to select the best method, or reconcile multiple methods, to obtain a defensible, full accounting of induced VMT from different transportation project types. The expert panel's recommendations will be made available for stakeholder review and incorporated into subsequent versions of Caltrans' guidance.

In the meantime, projects that are currently undergoing environmental review and analysis should follow the framework in Figure 2 to assess project-generated VMT. This way, projects can continue to move forward with scoping and analysis while additional expertise is collected. Because the NCST tool is free and straightforward to use, reporting the elasticity-based result in combination with a travel demand model-generated result should not increase the cost of the analysis.

EMPIRICAL APPROACH

As stated above, many past studies investigated the induced travel effect, quantifying it in terms of elasticities (the percent increase in VMT resulting from a given percent increase in lane miles). The studies apply various approaches to controlling for confounding factors such as population and economic growth, and for simultaneity bias[1], so they capture only the VMT caused by the roadway capacity expansion (i.e. the induced travel). Using various approaches, they reported the average magnitude of the induced travel effect per lane mile of additional capacity in each county or Metropolitan Statistical Area (MSA). Many of these studies are summarized in the California Air Resources Board's Policy Brief, *Impact of Highway Capacity and Induced Travel on Passenger Vehicle Use and Greenhouse Gas Emissions* (Handy

[1] Simultaneity bias can arise from the simultaneous effects of (1) added lane miles inducing VMT and (2) growth in VMT leading to the adding of lane miles. Most recent induced travel studies apply methods to control for it.

and Boarnet, 2014). Note that the results of these studies are generally limited in applicability to roadway expansions on freeways, expressways, and principal arterials (but not on minor arterials, collector or local streets).

To assess induced travel using the empirical approach, simply use the formula for an elasticity, and solve for the final VMT:

$$\frac{\%Change\ in\ VMT}{\%Change\ in\ Lane\ Miles} = Elasticity$$

In its VMT Technical Advisory, OPR provides the algebraic form of this equation that can be used directly, and lists the required inputs:

To estimate VMT impacts from roadway expansion projects:

1. Determine the total lane-miles over an area that fully captures travel behavior changes resulting from the project (generally the region, but for projects affecting interregional travel look at all affected regions).
2. Determine the percent change in total lane miles that will result from the project.
3. Determine the total existing VMT over that same area.
4. Multiply the percent increase in lane miles by the existing VMT, and then multiply that by the elasticity from the induced travel literature:

[% increase in lane miles] x [existing VMT] x [elasticity] = [VMT resulting from the project]

A National Center for Sustainable Transportation tool can be used to apply this method:
https://ncst.ucdavis.edu/research/tools

Technical Advisory on Evaluating Transportation Impacts in CEQA, OPR 2018.

While the assessment is straightforward, it is important to apply the appropriate data. Specifically, it is important to choose VMT and lane mile data to match the federal functional facility classifications used in the research from which the elasticity is taken. And, it must be applied to facility types and geographies that match the studies from which the elasticities are taken. NCST's Induced Travel Calculator is designed to automatically address these issues. Advantages of using the tool include that it has assembled all the needed data, it automatically chooses an elasticity appropriate for the location and functional classification of the facility, it automatically pulls the correct VMT and lane-mile information to undertake the calculation, and it is free and publicly available.

The empirical approach has the advantage of being based directly on the best available science; it entails a direct application of empirical studies that quantify induced travel. It also has the advantage over travel demand models that it captures the full induced travel effect, including the effect of the project on land use, which is required for analysis under CEQA. Note that the NCST tool assesses induced travel by applying county- or MSA-level total lane miles and VMT and an elasticity applicable to the facility's functional classification. It may not be sensitive to localized circumstances. The current release of the NCST Tool is based on the 2016 VMT and lane mile data from the Caltrans Highway Performance Monitoring System (HPMS) Program. Effort is underway to make sure the tool is updated using the most current data available.

The NCST tool assesses induced travel for the horizon year. It does not distinguish between GP and HOV lanes, so the tool cannot be used to assess the difference in induced travel between those two project types.

TRAVEL DEMAND MODEL-BASED APPROACH

A travel demand model-based approach may be used to assess induced VMT in conjunction with off-model post-processing and/or iteration. Note that OPR's technical advisory recommends checking results from a travel demand model-based approach using the empirical approach (i.e. the elasticity-based approach) wherever possible (OPR Technical Advisory, p. 34).

Travel demand models assess travel between land uses explicitly, applying mathematical functions to predict travel between locations. They are not, however, able to assess changes in land use that will result from the project, and some are unable to assess increases in trips resulting from the project, each of which can lead to an underestimation of induced vehicle travel if that effect is not addressed off-model. Also, models employing static trip assignment may fail to constrain modeled vehicle flows along links, impeding ability to assess the difference in vehicle travel with and without a capacity-increasing project (Marshall 2018).

As noted by the OPR Technical Advisory (Appendix 2, page 33):

"Proper use of a travel demand model can capture the following components of induced VMT:

- *Trip length (generally increases VMT)*[2]
- *Mode shift (generally shifts from other modes toward automobile use, increasing VMT)*
- *Route changes (can act to increase or decrease VMT)*
- *Newly generated trips (generally increases VMT)*
    - *Note that not all travel demand models have sensitivity to this factor [newly generated trips], so an off-model estimate may be necessary if this effect could be substantial.*

However, estimating long-run induced VMT also requires an estimate of the project's effects on land use…If a lead agency chooses to use a travel demand model, additional analysis would be needed to account for induced land use." An add-on approach, such as use of a land use model (if an accurate one is available) or the input of an expert panel, should be applied to assess the land use change component of the induced travel effect, and that should be fed back into the travel demand model for VMT

[2] The Advisory is here speaking of road capacity projects and not transportation projects in general.

assessment. OPR's technical advisory recommends checking the results using the empirical approach (i.e. the elasticity-based approach) described above (p. 34).

For projects, alternatives, or mitigations for which the NCST Induced Travel Calculator is not applicable, a travel demand model can be used so long as off-model post processing and/or iteration with an add-on approach is applied to cover any known deficiencies (e.g. land use, trip generation).

Where a travel demand model is used, generally the regional travel demand model will be the most appropriate. However, near a model boundary, a regional travel demand model may truncate the VMT assessment, which may result in an underestimate of induced VMT. This truncation can be addressed by adding exterior "halo zones" to the model to extend its geographical reach, or with an off-model estimate of VMT (for example, multiplying gateway volumes provided by the California Statewide Travel Demand Model (CSTDM) with distance to the next major destination or job center, and adding that to the model's assessment).

In some cases, a regional travel demand model may not be available. In those cases, a qualitative assessment may be appropriate.

No sensitivity to trip generation (some travel demand models). If the trip generation sub-model is not sensitive to travel time and cost, then the analyst will need to provide for a manual intervention in the trip generation stage of the model to adjust the trip generation rates in the model for off-line computed induced travel effects of the project, its alternatives, and potential mitigation measures.

The analyst can employ activity based travel model parameters borrowed from a similar region to manually estimate off-model the effects of the project, its alternatives, and potential mitigation measures on trip generation with and without the project for the desired forecast years (with the land use linkage described above activated) and noting the predicted percentage change in trip generation by purpose predicted by the activity based travel demand model parameters. These percentages, which will vary by project alternative, may then be applied to the output of the trip generation stage of the trip-based model.

No sensitivity to land use (all travel demand models). Any travel demand model used to assess induced travel must be paired, or iterated, with an approach for predicting changes in land use caused by the project.

OPR's VMT Technical Advisory (*Appendix 2, Induced Travel Mechanisms, Research, and Additional Assessment Approaches*, p. 34) lists options for incorporating land use effects in a travel model-based assessment:

"*Options for estimating and incorporating the VMT effects that are caused by the subsequent land use changes include:*

1. *Employ an expert panel. An expert panel could assess changes to land use development that would likely result from the project. This assessment could then be analyzed by the travel demand model*

to assess effects on vehicle travel. Induced vehicle travel assessed via this approach should be verified using elasticities found in the academic literature.

2. *Adjust model results to align with the empirical research. If the travel demand model analysis is performed without incorporating projected land use changes resulting from the project, the assessed vehicle travel should be adjusted upward to account for those land use changes. The assessed VMT after adjustment should fall within the range found in the academic literature.*
3. *Employ a land use model, running it iteratively with a travel demand model. A land use model can be used to estimate the land use effects of a roadway capacity increase, and the traffic patterns that result from the land use change can then be fed back into the travel demand model. The land use model and travel demand model can be iterated to produce an accurate result."*

Model forecast year doesn't match project horizon year. If the model forecast years do not match the needed project analysis assessment years, then the analyst may:

- Run the model for the project analysis forecast year with and without the project with new interpolated or extrapolated socio-economic and network data inputs to the model.
- Run the model with and without the proposed project for the model's original forecast years and manually extrapolate or interpolate the results to the desired project analysis years.

Lack of coverage. The analyst should ensure assessment of VMT impacts is not truncated geographically. Also, the analyst should ensure a model assesses VMT for an appropriate day of the week or season of the year.

Geographical Coverage: Using a select link analysis, the analyst should check whether links that run up to the model's edge show increased volumes as a result of the project. If they do, that indicates VMT increases likely continue outside the model's boundary. Where that is the case, one of three approaches can be used to capture that VMT. First, "halo zones" can be added to capture the additional VMT within the model. Second, a reasonable assumption can be made about length of the missing portion of the trip (e.g. use the distance to next major jobs or population center, if trips are likely headed there), and that distance can be multiplied by the volume. Third, a model with greater coverage, such as the CSTDM, can be used.

Temporal Coverage: The analyst should examine the peaking of traffic flows in the area served by the project to determine the needed temporal coverage of the model (weekday peak hours, peak periods, daily, weekends and holidays, recreational seasons, full year), and then check to ensure the model assesses those time periods.

The VMT attributable to a project is the difference between the project and no-project network-wide VMT for the same forecast year.

Additional model checks for trip-based models

Many trip-based model operators provide for the feedback of congested travel times and costs to the trip distribution stage. This feedback is not often equilibrated, so the analyst should check that origin-destination travel times at the end of traffic assignment are similar to those input into the trip distribution stage. The comparison should be on a cell by cell basis of the travel time skim matrix used to distribute trips. The analyst should use their judgement as to how close the two sets of times must be on a cell-by-cell basis and overall (such as average trip time across all the cells of each matrix).

Many trip-based model operators provide for the feedback of congested travel times and costs to the mode choice stage. This feedback is not often equilibrated, so the analyst should check that origin-destination travel times by mode at the end of traffic assignment are similar to those input into the mode choice stage. The comparison should be on a cell by cell basis of the modal travel time skim matrices used to split trips between modes of travel. The analyst should use their judgement as to how close the two sets of times for each mode must be on a cell-by-cell basis and overall (such as average trip time across all the cells of each mode's travel time matrix).

Trip-based models employing equilibrium traffic assignment automatically incorporate route choice induced travel effects. Analysts should review the model documentation for models employing alternate traffic congestion sensitive traffic assignment methods to assess the sufficiency of the method for the analyst's needs.

Trip-based models employing all-or-nothing assignment, assigning all trips to the shortest path do not capture the demand inducing effects of a project on route choice. If congestion is likely with or without the project, then the analyst should consider adding a congestion sensitive traffic assignment method to the model.

PROJECTS SCREENING

The OPR Technical Advisory (California Governor's Office of Planning and Research, 2018) lists (starting on page 20 of that document) many categories of highway projects "that <u>would not likely</u> lead to a substantial or measurable increase in vehicle travel, and therefore <u>generally should not require</u> an induced travel analysis". The list includes:

- *"Rehabilitation, maintenance, replacement, safety, and repair projects designed to improve the condition of existing transportation assets (e.g., highways; roadways; bridges; culverts; Transportation Management System field elements such as cameras, message signs, detection, or signals; tunnels; transit systems; and assets that serve bicycle and pedestrian facilities) and that do not add additional motor vehicle capacity.*
- *Roadside safety devices or hardware installation such as median barriers and guardrails.*
- *Roadway shoulder enhancements to provide "breakdown space," dedicated space for use only by transit vehicles, to provide bicycle access, or to otherwise improve safety, but which will not be used as automobile vehicle travel lanes.*
- *Addition of an auxiliary lane of less than one mile in length designed to improve roadway safety.*
- *Installation, removal, or reconfiguration of traffic lanes that are not for through traffic, such as left, right, and U-turn pockets, two-way left turn lanes, or emergency breakdown lanes that are not utilized as through lanes.*

- *Addition of roadway capacity on local or collector streets provided the project also substantially improves conditions for pedestrians, cyclists, and, if applicable, transit.*
- *Conversion of existing general-purpose lanes (including ramps) to managed lanes or transit lanes, or changing lane management in a manner that would not substantially increase vehicle travel.*
- *Addition of a new lane that is permanently restricted to use only by transit vehicles.*
- *Reduction in number of through lanes.*
- *Grade separation to separate vehicles from rail, transit, pedestrians or bicycles, or to replace a lane in order to separate preferential vehicles (e.g., HOV, HOT, or trucks) from general vehicles.*
- *Installation, removal, or reconfiguration of traffic control devices, including Transit Signal Priority (TSP) features.*
- *Installation of traffic metering systems, detection systems, cameras, changeable message signs and other electronics designed to optimize vehicle, bicycle, or pedestrian flow.*
- *Timing of signals to optimize vehicle, bicycle, or pedestrian flow.*
- *Installation of roundabouts or traffic circles.*
- *Installation or reconfiguration of traffic calming devices.*
- *Adoption of or increase in tolls.*
- *Addition of tolled lanes, where tolls are sufficient to mitigate VMT increase.*
- *Initiation of new transit service.*
- *Conversion of streets from one-way to two-way operation with no net increase in number of traffic lanes.*
- *Removal or relocation of off-street or on-street parking spaces.*
- *Adoption or modification of on-street parking or loading restrictions (including meters, time limits, accessible spaces, and preferential/reserved parking permit programs).*
- *Addition of traffic wayfinding signage.*
- *Rehabilitation and maintenance projects that do not add motor vehicle capacity.*
- *Addition of new or enhanced bike or pedestrian facilities on existing streets/highways or within existing public rights-of-way.*
- *Addition of Class I bike paths, trails, multi-use paths, or other off-road facilities that serve nonmotorized travel.*
- *Installation of publicly available alternative fuel/charging infrastructure.*
- *Addition of passing lanes, truck climbing lanes, or truck brake-check lanes in rural areas that do not increase overall vehicle capacity along the corridor."*

APPENDIX A. BACKGROUND: INDUCED TRAVEL

When capacity is increased on a congested roadway, vehicle travel times dip, making vehicle travel quicker and easier, which in turn leads to more vehicle travel. This additional vehicle travel induced by the added roadway capacity is called "induced travel". The chart below, from Milam et al., (2017), illustrates how the effect unfolds over time:

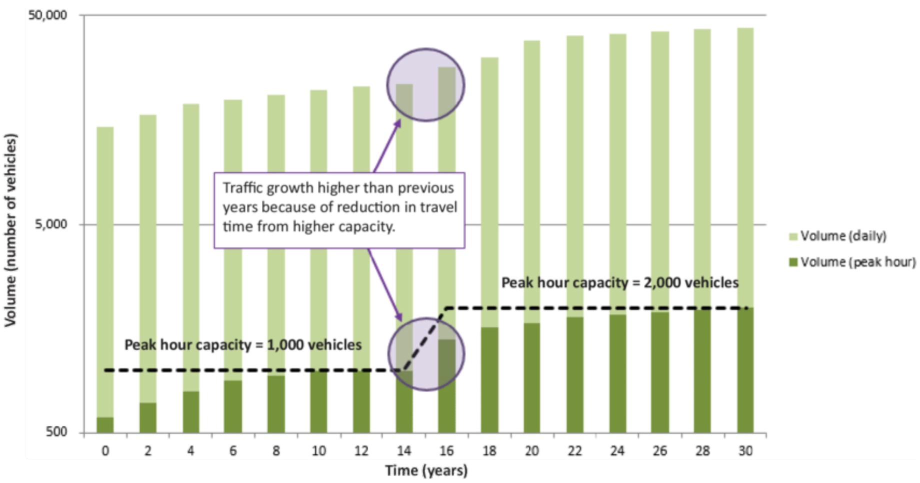

Figure A-1 Example of Induced Travel: Influence of Capacity Expansion on Vehicle Traffic Growth

Adding capacity to an existing roadway generally causes traffic congestion to dip, reducing the "time-cost" of travel. That reduction leads to more vehicle travel, as shown in the following figure from Milam et al., (2017). Much like any public utility (e.g. electricity or water), more is used when the impedance or cost is reduced.

Adding a new road where there wasn't one before has a similar effect. It opens new and more distant areas to development. This increases vehicle travel regardless of the volume to capacity ratio after the new link is opened.

Induced travel occurs via five mechanisms:

- Route changes (may increase or decrease overall VMT)
- Mode shift (increases overall VMT)
- Longer trips (increases overall VMT)
- More trips (increases overall VMT)
- More disperse development (increases overall VMT)

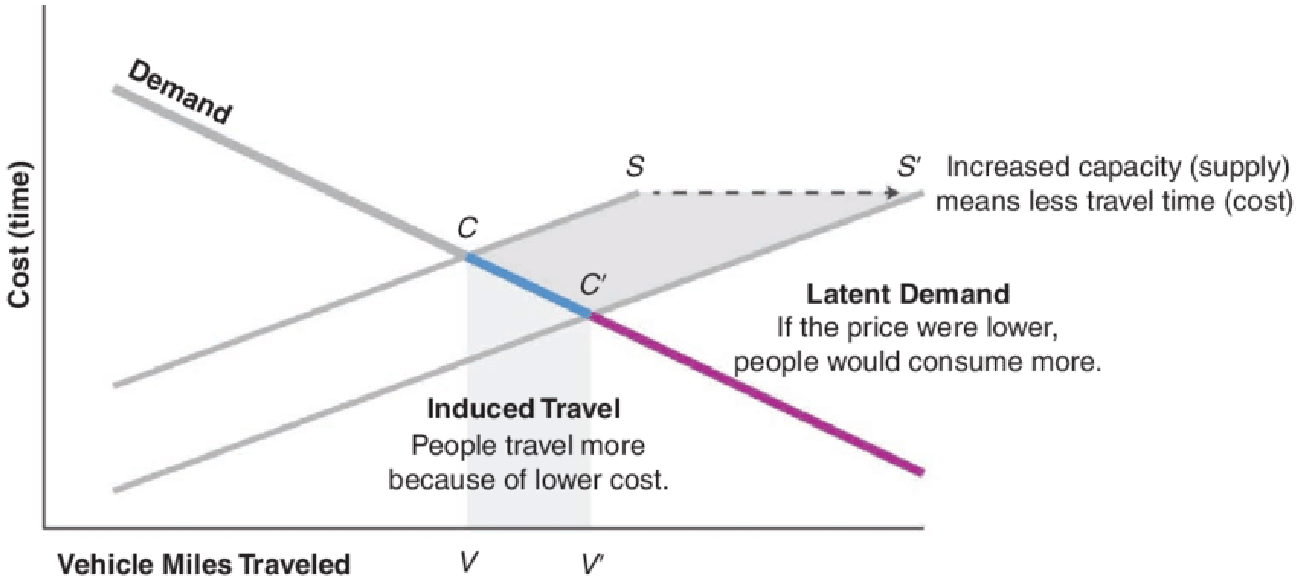

Figure A-2 Supply and Demand Relationships for Induced Travel (C=initial cost; C’=new cost; S=initial supply/capacity; S’=new supply/capacity; V=initial VMT; V’=new VMT)

APPENDIX B. A CASE STUDY

There will be one comprehensive case study covering the entire gamut of the CEQA document development process, using both TAF and Transportation Analysis under CEQA (TAC). To be added!

APPENDIX C. THE NCST INDUCED TRAVEL CALCULATOR

The UC Davis National Center for Sustainable Transportation (NCST) Induced Travel Calculator is designed to enable the estimation of *"the VMT induced annually as a result of adding general-purpose or high-occupancy-vehicle (HOV) lane miles to roadways managed by the California Department of Transportation (Caltrans) in one of California's urbanized counties (counties within a Metropolitan Statistical Area (MSA))."*

The NCST calculator predicts only those changes in regional annual VMT that are due to capacity improvements. In order to isolate those effects, it purposefully excludes changes in VMT due to land use changes, population, employment, income, tolls, price of gasoline, or other travel cost changes.

The calculator applies only to Caltrans-managed facilities with Federal Highway Administration (FHWA) functional classifications of 1, 2 or 3, which respectively corresponds to interstate highways (Class 1), other freeways and expressways (Class 2), and other principal arterials (Class 3).

The tool and additional documentation on the tool are available at: https://blinktag.com/induced-travel-calculator/index.html . The "About" tab at the website provides the technical documentation.

CONCEPTS

Handy and Boarnet (Handy & Boarnet, Impact of Highway Capacity and Induced Travel on Passenger Vehicle Use and Greenhouse Gas Emissions Policy Brief, 2014) define "induced travel" as an "increase in vehicle miles traveled (VMT) attributable to increases in capacity."

According to Handy and Boarnet, "*Increased highway capacity can lead to increased VMT in the short run in several ways: if people shift from other modes to driving, if drivers make longer trips (by choosing longer routes and/or more distant destinations), or if drivers make more frequent trips. Longer-term effects may also occur if households and businesses move to more distant locations or if development patterns become more dispersed in response to the capacity increase. Capacity expansion can lead to increases in commercial traffic as well as passenger travel.*"

"*The induced-travel impact of capacity expansion is generally measured with respect to the change in VMT that results from an increase in lane miles, determined by the length of a road segment and its number of lanes (e.g. a two mile segment of a four-lane highway equates to eight lane miles). Effect sizes are usually presented as the ratio (elasticity) of the percent change in VMT associated with a one percent change in lane miles."*

According to a survey of the literature by Handy and Boarnet, *"Elasticity estimates of the short-run effect of increased highway capacity range from 0.3 to 0.6. Estimates of the long-run effect of increased highway capacity are considerably higher, mostly falling into the range from 0.6 to just over 1.0."*

RESEARCH BASIS

Handy and Boarnet (Handy & Boarnet, Impact of Highway Capacity and Induced Travel on Passenger Vehicle Use and Greenhouse Gas Emissions Technical Background Document, 2014) provides some of the technical background for six of the studies they included in their policy brief. Key characteristics shared by many of the research studies upon which the elasticity estimates are based are:

- They measure changes in regional, county, or statewide VMT and lane-miles of road in most cases only on freeways. Some focused on state owned highways. One used samples from the US DOT Highway Statistics database for all road types in that database.
- Data on changes in capacity and traffic volumes for non-freeways, minor roads and arterials was not available to the researchers in most cases so they could not account for diversion effects, where traffic shifts to and from minor roads and arterials in the region to the freeways. The background documentation for the UC Davis NCST Induced Travel Calculator states that Duranton estimated this unmeasured diversion effect to be between zero and 10% (which would have no effect or reduce the reported elasticity).
- The long-term time frames considered varied from 14 years to 22 years.
- They fitted log-linear regression models with lane-miles as one of various explanatory factors for observed changes in regional or county VMT.
- They all included changes in population as one of the explanatory factors but varied in what additional variables impacting VMT were included. Some included income, some employment density, some fuel cost. The additional explanatory factors usually lowered the elasticity with respect to lane-miles.
- They used different approaches to control for demand driven capacity construction, called simultaneity bias.
- Three of the studies used only California data. Three used data from around the United States.

CALTRANS/FHWA HPMS FUNCTIONAL CLASSIFICATION SYSTEM

The Caltrans/FHWA functional classification system used in the UC Davis NCST Induced Travel Calculator is defined in an FHWA memorandum (https://www.fhwa.dot.gov/policy/ohpi/hpms/fchguidance.cfm):

Functional Class 1 = Interstate
Functional Class 2 = Other Freeways and Expressways
Functional Class 3 = Other Principal Arterial
Functional Class 4 = Minor Arterial
Functional Class 5 = Major Collector
Functional Class 6 = Minor Collector
Functional Class 7 = Local

Note that according to the technical documentation for the NCST Induced Travel Calculator, functional classes 1, 2, and 3 are within the scope of the NCST tool provided that they are state highways.

The FHWA memorandum states in Section 5, Ramps and Other Non-Mainline Highways*: "Note that at this time, there is no change to the status of ramps with respect to public road mileage or lane mileage or vehicle-miles traveled for apportionment purposes; they are not considered mainline and are not included in those public road mileage inventories."*

Regarding other non-mainline roadways, the memorandum states: *"At their option, States may collect data and assign functional classifications to other kinds of non-mainline roadways. These may include other collector-distributor roads, other turning movement facilities not associated with a grade-separated interchange, and other auxiliary roadways. In general, such roadways within the interchanges should be assigned the same functional classification as the highest facility served. However, since many configurations exist, States may assign the functional classification as they deem appropriate. While data for other non-mainline roadways is not required for HPMS, States have the option of reporting it beginning with the 2009 HPMS data reported in 2010."*

SCOPE OF NCST INDUCED TRAVEL CALCULATOR

The technical documentation for the NCST Induced Travel Calculator defines the scope of application for the tool (see https://blinktag.com/induced-travel-calculator/about.html *accessed October 31, 2019):*

- *"The calculator is limited to use for capacity expansions. It cannot be used to estimate VMT effects of capacity reductions or lane type conversions.*
- *The calculator is limited to use for additions of general-purpose and high occupancy vehicle lanes.*
    - *It should not be used for additions of toll lanes or high occupancy-toll (HOT) lanes.*
    - *Hundreds of both general-purpose and HOV lane mile additions were included in the two studies used to derive the elasticities for the calculator* (Duranton & Turner, 2011)*;* (Cervero & Hansen, 2002)*;* (Long & Curry, 2000)*. By contrast few toll and high-occupancy toll (HOT) lanes were added to Caltrans-managed roadways before the end of the data collection periods for the two studies. The studies' estimated elasticities therefore might not reflect – and this calculator should not be used to estimate the induced travel impacts of toll and HOT lanes.*
- *The calculator is limited to use for lane additions to Caltrans-managed roadways with FHWA functional classifications of 1, 2 or 3. See Caltrans' California highway system map with functional class delineations.*
- *The calculator is limited to use in California's 37 urbanized counties (counties within MSAs). The calculator cannot be used to assess the VMT effects of roadway expansions in California counties outside of MSAs, or in any geography outside California.*
- *Please also be aware that there are 10 MSAs in which there are no interstate highways. In addition, sufficient data are not available on baseline VMT for interstate lane miles in the Napa MSA to calculate induced VMT from interstate capacity expansions there.*
- *The calculator produces long-run estimates of induced VMT, the additional annual VMT that could be expected 5 to 10 years after facility installation.*
- *All estimates account for the possibility that some of increased VMT on the expanded facility is traffic diverted from other types of roads in the network. In general, the studies show that*

"capacity expansion leads to a net increase in VMT, not simply a shifting of VMT from one road to another" (Handy & Boarnet, Impact of Highway Capacity and Induced Travel on Passenger Vehicle Use and Greenhouse Gas Emissions Policy Brief, 2014)

- *The calculator currently uses 2016 lane mileage and VMT data. The data will be updated periodically as new data become available.*
- *Knowledge of local conditions can help contextualize the calculator's estimates."*

Table C-1 lists the California counties where according to the technical documentation on the NCST Induced Travel Calculator website the NCST tool can be applied. There are eleven counties which have insufficient interstate freeway mileage or interstate VMT data for the NCST tool's elasticities to be applied to interstate freeways (Class 1) within the county. In these eleven counties the tool can be used only for Class 2 and 3 state highway lane additions. There are 21 rural counties where the tool cannot be used for any state highway project, according to its technical documentation.

Table C-1: California Counties Where NCST Induced Travel Calculator Can be Used

County	OK to Use?	County	OK to Use?
1. Alameda	Classes 1, 2, and 3	**30. Orange**	Classes 1, 2, and 3
2. Alpine	No	**31. Placer**	Classes 1, 2, and 3
3. Amador	No	**32. Plumas**	No
4. Butte	Classes 2, 3	**33. Riverside**	Classes 1, 2, and 3
5. Calaveras	No	**34. Sacramento**	Classes 1, 2, and 3
6. Colusa	No	**35. San Benito**	Classes 1, 2, and 3
7. Contra Costa	Classes 1, 2, and 3	**36. San Bernardino**	Classes 1, 2, and 3
8. Del Norte	No	**37. San Diego**	Classes 1, 2, and 3
9. El Dorado	Classes 1, 2, and 3	**38. San Francisco**	Classes 1, 2, and 3
10. Fresno	Classes 1, 2, and 3	**39. San Joaquin**	Classes 1, 2, and 3
11. Glenn	No	**40. San Luis Obispo**	Classes 2, 3
12. Humboldt	No	**41. San Mateo**	Classes 1, 2, and 3
13. Imperial	Classes 1, 2, and 3	**42. Santa Barbara**	Classes 2, 3
14. Inyo	No	**43. Santa Clara**	Classes 2, 3
15. Kern	Classes 1, 2, and 3	**44. Santa Cruz**	Classes 1, 2, and 3
16. Kings	Classes 1, 2, and 3	**45. Shasta**	Classes 1, 2, and 3
17. Lake	No	**46. Sierra**	No
18. Lassen	No	**47. Siskiyou**	No
19. Los Angeles	Classes 1, 2, and 3	**48. Solano**	Classes 1, 2, and 3
20. Madera	Classes 2, 3	**49. Sonoma**	Classes 2, 3
21. Marin	Classes 1, 2, and 3	**50. Stanislaus**	Classes 1, 2, and 3
22. Mariposa	No	**51. Sutter**	Classes 1, 2, and 3
23. Mendocino	No	**52. Tehama**	No
24. Merced	Classes 1, 2, and 3	**53. Trinity**	No
25. Modoc	No	**54. Tulare**	Classes 2, 3
26. Mono	No	**55. Tuolumne**	No
27. Monterey	Classes 2, 3	**56. Ventura**	Classes 2, 3
28. Napa	Classes 2, 3	**57. Yolo**	Classes 1, 2, and 3
29. Nevada	No	**58. Yuba**	Classes 2, 3

Source: See text and links embedded in https://blinktag.com/induced-travel-calculator/about.html

APPENDIX D. GLOSSARY

Capacity	The Sixth Edition of the Highway Capacity Manual defines capacity as: The maximum sustainable hourly flow rate at which persons or vehicles reasonably can be expected to traverse a point or a uniform section of a lane or roadway during a given time period under prevailing roadway, environmental, traffic, and control conditions.
CEQA	California Environmental Quality Act
EIR	Environmental Impact Report (state)
EIS	Environmental Impact Statement (federal)
Elasticity	The percentage change of something divided by the percentage change in something else. In transportation forecasting, we can apply studies that provide the percent change in regional VMT divided by the percent change in regional lane-miles of state highways as elasticity.
FHWA	Federal Highway Administration
HCM	Highway Capacity Manual
Induced Travel (VMT)	Induced travel or the VMT attributable to a transportation capacity increase is the increased amount of vehicle travel on the transportation network that is caused by the highway capacity increase. Over the short run, travel behavior changes including longer trips, more trips, mode shift, and route shift all tend to occur as a result of a highway capacity increase. Over the long run, these effects intensify (e.g. as people shift job or residential location to benefit from the infrastructure), and also land use development may become more dispersed, adding additional vehicle travel; for these reasons, long run induced travel is generally greater than short run induced travel. Additionally, other factors, such as population growth, economic growth, and changes in the price of vehicle travel may also add to the amount of vehicle travel on the transportation network; however, these additions in vehicle travel are not part of induced travel and are not attributable to the project.

Latent Demand	Latent demand is the travel that would occur on the transportation network if travel times (or costs) were reduced. Much like any public utility (e.g. electricity or water), consumers will use more of it when its cost or impedance of use is reduced or made free. Note that unless the current price of travel is zero (instantaneous travel at will at no cost), there is always latent demand.
NEPA	National Environmental Protection Act
Network	The connectivity of a transportation system. Changes in connectivity may change travel time and cost. Travel demand models will usually represent network connectivity within modes and across modes through a set of links connecting nodes.
OPR	Governor's Office of Planning and Research
Travel Demand Model	A travel demand model is any relatively complex computerized set of procedures for predicting future trip making as a function of land use, demographics, travel costs, the road system, and the transit system. These models often cover an entire metropolitan area or the entire state, but may also focus on a single city or county.
Transit	Transit generally includes all forms of shared common carrier passenger ground transportation in moderate to high capacity vehicles ranging from dial-a-ride vans to buses, trolleys, light rail, commuter rail, and intercity rail transportation. Less common modes of travel, such as employer provided buses, charter buses, taxis, and transportation network company (TNC) services, have historically not been modeled as explicit transit modes in MPO travel demand models.
Trip-Based Model	Trip-based travel models use the individual person trip as the fundamental unit of analysis. Trip-based models are often referred to as "4-step" models because they split the trip making decision process into 4 discrete steps: trip generation by time of day, destination choice, mode choice, and route choice (traffic assignment).

Trucks	Trucks are a subtype of the heavy vehicles category which includes trucks, intercity buses, and recreational vehicles. This Framework follows the Highway Capacity Manual definition of what constitutes a heavy vehicle: “A vehicle with more than four wheels touching the pavement during normal operation.” This is consistent with the Caltrans Traffic Census definition of a truck: “The two-axle (truck) class includes 1-1/2-ton trucks with dual rear tires and excludes pickups and vans with only four tires.”
Vehicle Miles Traveled (VMT)	The number of miles traveled by motor vehicles on roadways in a given area over a given time period. VMT may be subdivided for reporting and analysis purposes into single occupant passenger vehicles (SOVs), high occupancy vehicles (HOV’s), buses, trains, light duty trucks, and heavy-duty trucks. For example, an air quality analysis may require daily VMT by vehicle class and average speed or vehicle operating mode (idle, acceleration, cruise, deceleration, etc.). For a CEQA compliant transportation impact analysis, automobile VMT (cars and light trucks) may be evaluated.
VMT Attributable to a Project	In the context of a CEQA analysis, the OPR Technical Advisory suggests that the VMT attributable to a transportation project, or induced travel, is the difference in VMT between the with project and without project alternatives. The OPR Technical Advisory also suggests that heavy duty trucks might be excluded from the VMT attributable to a project.

APPENDIX E. REFERENCES

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STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Upper Front Range TPR GHG Rulemaking Comments

1 me age

[redacted] Thu, Oct 14, 2021 at 2:55 PM
To: "DOT_Rules@state.co.us" <DOT_Rules@state.co.us>
Cc Rebecca White CDOT rebecca white@ tate co u , [redacted]

Good afternoon,

Plea e ee the attached letter which pre ent comment from the UFR Regional Planning Commi ion on the Transportation Commission’s proposed revision to the Rules Governing Statewide Transportation Planning Process and Transportation Planning Regions.

We acknowledge and appreciate CDOT’s efforts to extend the written comment deadline and are hopeful the anticipated rule amendments will address the UFR comments during this extension timeframe. Please do not hesitate to reach out if you have any follow up que tion We really appreciate your time and con ideration!

Thank you,

[redacted]

1861 WELD COUNTY

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208K

UPPER FRONT RANGE
TRANSPORTATION PLANNING REGION
REGIONAL PLANNING COMMISSION

[redacted]

Dear Transportation Commissioners and Executive Director Lew:

The Upper Front Range Transportation Planning Region (UFRTPR) appreciates the opportunity to comment on the proposed Greenhouse Gas (GHG) rule and acknowledges the transportation sector is one of the largest contributors to GHG and ozone precursor emissions. Therefore, the UFRTPR generally supports reasonable options applicable by region type, which achieve reductions in greenhouse gas emissions.

The UFR is a rural transportation planning region unique from the other rural TPRs of the state because we have been located within the 8-hour ozone nonattainment boundary since 2008. We are the only rural TPR to have this designation, which is more typically associated with urbanized areas (MPO's). The proposed rule speaks to CDOT being responsible for the non-MPO areas, which implies the rural TPR's. However, the rule does not speak to how CDOT will manage the nonattainment boundary requirements of the rule for the UFRTPR. Management of the nonattainment boundary requirements are only addressed to the MPO's. The UFRTPR would like CDOT to amend the rule to better address how they will manage the rule requirements identified for the nonattainment boundary for the UFRTPR. Similar to the MPO's, it seems more reasonable for the UFRTPR to manage the nonattainment boundary requirements for their jurisdiction and recommends CDOT modify the rule accordingly.

In addition, the illustrative mitigation measures provided in the rule are not applicable options for rural areas. The UFRTPR requests CDOT identify and evaluate mitigation measures applicable for rural regions. Many rural areas do not have the same air quality issues more commonly found in the urban areas. The GHG mitigation strategies for the transportation sector have been targeted to more densely populated areas. How do you reduce VMT to rural areas that already have lower traffic volumes? Rural areas generally have less resources and may bear disproportionate financial burdens from increased taxes, fuel costs and vehicle costs. The infrastructure to support electrification is not available and electric vehicles for many rural residents are impractical, unattainable, or both.

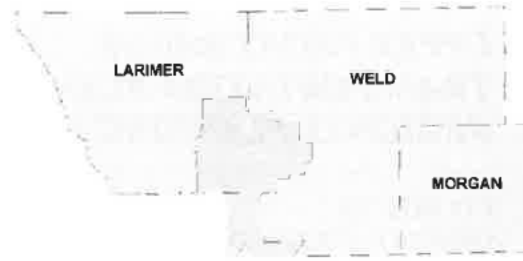
Rural areas should be allowed to implement non-transportation sector mitigation measures to realize GHG emissions reductions. A holistic statewide approach that encourages, incentivizes, and rewards climate-smart agricultural practices and other mitigation measures pertinent to rural areas should be embraced.

The proposed rule implies a punitive approach to mitigation measures. Currently, the Transportation Commission (TC) may restrict certain funds to projects, which is a contradiction, since the rule implies there will be no capacity projects in the rural areas. If it is not the intent of the TC to restrict funds to projects, then the rule should be amended to say so. The easiest way to address this issue is to modify the rule so mitigation measures do not apply to rural areas.

There is also a fallacy to the baseline figures assuming no capacity projects will occur in the rural areas, yet the proposed rule requires CDOT to implement the second highest GHG emission reduction standards for rural areas, which currently have nominal GHG pollution. Rural areas need capacity safety projects, such as passing lanes, intersection auxiliary lanes, and safety shoulders. CDOT has not proven capacity projects adversely affect GHG emissions and should not take this position without providing scientific data to support it. This rule should be based on data driven, quantifiable facts and not model simulation assumptions.

The proposed rule is vague in addressing capacity project waivers and what criteria is being used to ensure a fair and reasonable evaluation of the waivers. No quantifiable measure is identified and therefore no assurance the TC will evaluate

UPPER FRONT RANGE
TRANSPORTATION PLANNING REGION
REGIONAL PLANNING COMMISSION



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capacity projects in a consistent manner. The UFR requests the rule be amended to include quantifiable evaluation criteria for capacity project waiver requests.

As previously mentioned, the UFRTPR is part of the ozone nonattainment boundary and the proposed rule does not elaborate how the enterprises created by SB21-260 would be utilized to reduce GHG emissions. The congestion, mitigation, and air quality (CMAQ) funding associated with the nonattainment boundary is fundamentally used to improve air quality. Why would the proposed rule make this funding source punitive to projects in the nonattainment boundary or enterprise? The UFRTPR is the only rural area to receive CMAQ funding and would ask the rule to be amended to remove CMAQ funding from consideration of being eliminated as a funding source on projects that do not meet GHG emission standards. It should be apparent that a project that improves ozone also reduces GHG emissions.

It is unclear in the rule how the UFR Regional Transportation Plan (RTP) project list will be affected by this rulemaking. CDOT is discussing updating the 10-year plan but not the process for how the project lists of all the rural TPR's will be reviewed. The proposed rule only speaks to how MPO's will have to update their regional plans. Is CDOT saying the rural TPR's don't need to update their project lists because CDOT is assuming no capacity projects will occur in rural areas before 2050?

The TPR RTP's are an integral part of the statewide plan and any changes to that statewide plan should be vetted by the TPRs. This summons the question of how CDOT will amend the rule to accommodate for a new 10-year list of projects that will be different then what is being used to create the GHG baseline standards for this rule. For example, the UFRTPR has identified capacity projects that would meet the definition of regionally significant project, i.e., SH 71 widening/passing lanes and the grade separated interchange at I-76 and Weld County Road (WCR) 8 to accommodate a future intermodal facility, of which, both projects should be included in CDOT's 10-year plan. How will this rule allow a regionally significant project to occur in rural areas that are not currently in CDOT's 10-year plan?

The UFRTPR is committed to working with CDOT through these issues and concerns but requests more time to be able to accomplish a transportation rule that works for the entire state and not just the urban areas. More evaluation time fosters greater transparency and trust. While we believe it is the role of the Colorado Department of Public Health and Environment's (CDPHE) to implement air quality strategies and CDOT's role to maintain existing and future multimodal transportation systems, we appreciate TC's consideration for amending the current rule to address our concerns.

Sincerely,

[redacted]

LARIMER COUNTY ***WELD COUNTY*** ***MORGAN COUNTY***

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

I support a strong Greenhouse Gas Pollution Standard

1 me age

[redacted] Thu, Oct 14, 2021 at 11:58 AM
Reply-To: [redacted]
To: dot rule @ tate co u

Dear CDOT Rulemaking Comments,

I'm writing because I'm excited that CDOT is pursuing a rulemaking process for a Greenhouse Gas Pollution Standard and I have a few recommendation for improving the draft A a per on who ride a bike in Colorado, I'm acutely aware of the air quality crisis we're experiencing. Since transportation is a top contributor to pollution, this rulemaking is a critical place to start. I urge you to outline specific goals for pollution reduction that will help us meet existing air quality targets.

Our current tran portation y tem i built to move car Our tate' climate roadmap call for a 10% reduction in driving by 2030. People across the state, in both rural and urban communities, need more options, like biking, walking, and public transit, for getting around safely and sustainably. This rule should prioritize projects that put people first in our transportation system.

Please consider these changes and continue to strengthen this rule through the revision process.

Sincerely,
[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Fwd: 2CCR 601-22, CDOT Comments from Gunnison County Board of County Commissioners

1 message

Takushi - CDOT, Theresa <theresa.takushi@state.co.us> Thu, Oct 14, 2021 at 10:58 AM
To: DOT_ Rules - CDOT <dot_rules@state.co.us>

For our rulemaking record, thank you!

---------- Forwarded message ---------
From: [redacted]
Date: Thu, Oct 14, 2021 at 9:35 AM
Subject RE 2CCR 601 22, CDOT Comment from Gunni on County Board of County Commi ioner
To: Theresa.takushi@state.co.us <Theresa.takushi@state.co.us>

Please see the attached comments from the Gunnison County Board of County Commissioners, regarding 2CCR 601-22.

Best regards,

[redacted]

Gunnison County COLORADO

[redacted]

"Gunnison County cherishes its sense of community and place. We strive to preserve and promote the wellbeing of the County's Citizens, natural environment and rural character. We will deliver services and set standards that reflect our values and preserve our unique quality of life for present and future generations to enjoy."

--
Aloha,

[redacted]

Theresa

Theresa Takushi (she/her/hers)
Greenhouse Gas Climate Action Specialist

COLORADO
Department of Transportation
Division of Transportation Development

P 303.757.9977
2829 W. Howard Pl., Denver, CO 80204
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BOCC CDOT Comment Letter re 2CCR 601 22 pdf
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Gunnison County
COLORADO

[redacted]

To: Theresa Takushi; Theresa.takushi@state.co.us
Date: 10/14/2021
RE: CDOT Proposed Rulemaking Governing Statewide Transportation Planning Process and Transportation Regions; 2 CCR 601-22

The Gunnison County Board of County Commissioners is pleased to submit the following comments regarding CDOT's proposed rulemaking. The aspiration of the proposed rules to tie funding of projects to measurable reductions in greenhouse gases (GHG's) is applauded. Transportation is a major source of GHG emissions which has causes and influencing factors that extend beyond the political boundaries of local government. A state-wide approach that is integrated into local transportation and land-use strategies to planning and projects that will reduce transportation related emissions is vital.

Rural areas of Colorado contribute a disproportionate portion of emissions on a per-capita basis. The reasons for this are clear, rural residents have less access to mass transit and, on average, rural commutes are longer than those in metro regions. Long commutes are a function of sprawl which rural communities have enabled and allowed in the past. In mountain communities' long commutes are also caused by the housing affordability crisis. Service workers are forced to commute long-distances to work in communities they cannot afford. In Gunnison County the bus service that connects the north and south ends of the valley offers an alternative to driving for commuters but even at full capacity only scratches the surface of the commuter demand and traffic on highway 135. Walking and biking, from residential neighborhoods proximate to city services and jobs is made dangerous by high speed traffic on highways immediately outside of Town and City boundaries.

As has been outlined in the State of Colorado's GHG mitigation roadmap; land-use policies that encourage dense development near services, and rules that allow mixed development patterns so services, jobs, and housing can co-exist are our best tools to reduce the reliance on cars over time. Affordable housing policies that provide access to attainable housing for workers near their jobs also have a significant impact on transportation. As County and municipal planners adapt land use regimes to encourage denser and mixed-use development near population centers changes are also needed in how highways are planned in the immediate boundaries around rural towns. CDOT and local planners must coordinate to ensure that transportation allows for and encourages dense development patterns in transitional areas.

In rural areas CDOT has prioritized speed and highway capacity over multi-modal transportation safety, and support of dense development patterns. High speeds require CDOT to create policies that reduce the amount of accesses to a highway to maintain safety, new developments consolidate access via collector streets that funnel traffic to the highway at single points. However, limiting access points to a highway promotes sprawling development patterns with frontage roads and large setbacks utilizing valuable land space. Such designs also make multi-modal connections difficult. Slower speeds in areas that planners have identified for dense development patterns allows for accesses to highways to be closer together, which can reduce the need for redundant roads within a development and allow for more space to be devoted to buildings than roads. Slow speeds also allow for multi-modal routes to

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cross highways at crosswalks rather than having to build expensive pedestrian overpasses or underpasses. Planners need to bolster these efforts by promoting grid-like connections of roads between developments which offer alternative routes to highways and connections that serve multi-modal traffic. Finally, dense development patterns will create intersections with highways that require additional traffic calming developments and traffic controls. Funding intersections near population centers that calm traffic and account for multi-modal travel will enable denser development patterns in transitional areas. Gunnison County envisions changes to our land-use regime to promote these goals and believes that coordination of long-range planning with CDOT for highway planning will help both CDOT and the County achieve our GHG reduction goals in a way that also meets the needs of our growing community.

Section 8 of the proposed rules describes and quantifies the GHG baseline estimates as well as reduction targets and describes the process for determining if plans comply with targeted goals by forecasting GHG reductions directly related to long-range plans and regionally significant projects. Gunnison County has also developed GHG baseline data and forecasting methodology to estimate future emissions based on policy outcomes. VMT growth in Gunnison County is outpacing population growth which indicates that current influencing factors are pushing people to drive more. The data indicates that our current population is moving away from jobs and services and new growth is concentrated in the same manner. To change this trajectory Gunnison County is focused on building affordable housing near jobs, and updating our land use regulations to encourage dense development near population centers. Gunnison County encourages CDOT to develop long-range plans that coordinate with County planning efforts to encourage rural land use growth near population centers. We can measure the impact of diverting a portion of population growth in the future toward population centers and away from sprawling areas of the County. We can also estimate the GHG and transportation impacts of affordable housing projects. Much of this work is not included in high-cost regionally significant projects but in low or now cost policy decisions about traffic speeds and highway access. However, some traffic calming and intersection improvements will have a direct effect on affordable housing projects. Affordable housing projects are already difficult to fund and meet long-term affordability goals. Prioritizing funding that enables and enhances affordable housing projects will reduce costs and enable communities to house more people near jobs, resulting in reduced commuter traffic. Examples include; traffic calming and lower speed limits adjacent to dense development so development can utilize all of the land and move buildings closer to highways, funding intersections from affordable housing projects onto highways will also benefit such projects and contribute to reduced emissions.

Transit systems in rural areas also operate differently than similar systems in urban areas. Gunnison County's bus service operates at highway speeds over long-distance routes in extreme weather at very high duty cycles. Gunnison County found that utilizing CNG buses was the best choice for low carbon mass transit especially when combined with renewable natural gas (RNG). The transition to electric transportation must include options for alternatives to bridge technology gaps. CNG heavy vehicles can meet extreme service duty cycles with products that are available now. Gunnison County has commissioned studies measuring the relative life-cycle GHG impact of diesel, electric, CNG, and CNG with RNG vehicles which concluded that CNG vehicles would result in emissions reduction over diesel and electric and that RNG significantly lowered emissions over all. The Colorado Energy Office has published similar studies. Because vehicles are a relatively short and predictable life-cycle investment it makes sense to invest in the lowest emission option now and continually re-evaluate to switch to new electric or possibly hydrogen technology when those options are proven to provide lower life-cycle emissions. CDOT could immediately deploy CNG buses in its Bustang service out of Gunnison County. Fueling options are available as are the buses. Baggage storage areas that are lost to CNG tanks can easily be replaced by converting a couple of seats at the front of the bus to a bag rack. The forecasts of electrification of passenger vehicles included in the draft rules are encouraging. Gunnison County is working to increase electric charging access in partnership with the local REA electric utility and at our own facilities to encourage the transition to electric vehicles.

Just as the proposed rule focuses funding toward MPO plans and regionally significant projects that will have the highest impact on reducing GHG's, rural communities and relatively small projects that align efforts to reduce emissions should also be prioritized for funding. Rural communities' tools to reduce emissions are less direct and constitute a more distributed effort than what is possible in dense urban environments. However, the combined impact of rural Colorado on transportation related emissions is significant. The proposed rules can be improved by allowing for and promoting collaborative planning with communities and a review of policies that may conflict with community goals to increase density and encourage multi-modal transportation.

Thank you for your consideration of our comments, we look forward to working with CDOT in the future to further our shared goals to reduce GHG emissions and respond to the needs of our community.

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

PPACG Comment Letter on Proposed GHG Rule

1 me age

[redacted] Thu, Oct 14, 2021 at 10:42 AM
To: "dot_rules@state.co.us" <dot_rules@state.co.us>
Cc [redacted]

CDOT Hearing Officer –

Please find attached comments to the proposed GHG rulemaking for the Pikes Peak Area Council of Governments (PPACG).

Please confirm that our letter was received and will be made part of the official record.

Thank you, please let us know if you have any questions.

[redacted]

Pikes Peak Area Council of Governments

GHG Comment letter - signed.pdf
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[redacted]

Pikes Peak Area
Council of Governments
Communities Working Together

October 14, 2021

State of Colorado Transportation Commission
VIA EMAIL: dot_rules@state.co.us
CDOT Headquarters
2829 W. Howard Pl.
Denver, CO 80204

RE: Transportation Greenhouse Gas Emissions Rulemaking – PPACG comments

Dear Governor Polis, State Transportation Commission members, and CDOT Executive Director Shoshana Lew:

We would like to thank Director Lew and the CDOT staff for their efforts in developing this rule. We believe they made the best of the situation given the challenging parameters set by the legislature and the diverse stakeholders involved in this process. We observed that many of stakeholders have different perspectives and levels of understanding regarding the role and authority of metropolitan planning organizations (MPOs), as well as the role roadways play in traffic generation compared to statewide population increases and the travel choices we all make.

We would be remiss if we did not state, for the record, that we believe the original legislation is based on assumptions with which we do not agree. Ultimately, the amount of greenhouse gases (GHG) emitted by a vehicle is directly related to the operational time and load of its internal combustion engine, not the distance the vehicle travels. An idling vehicle stuck in traffic over a short distance will emit more GHG than a moving vehicle able to travel twice the distance in half the time. While perhaps well-intended, the original legislation misses the mark of addressing how we can improve our travel network's ability to move people and goods more efficiently, while still addressing air quality and providing more of the travel choices that people desire.

From a process perspective, our greatest concern is that if this rule is adopted as written, PPACG and its member jurisdictions have no real understanding of the rule's impact on transportation project selection. It is understood that, at a minimum, the rule will create more focus on selecting alternate mode projects; however, certain sections may be interpreted in a way that would allow PPACG's programming process to be indirectly controlled at the state level. We believe that this is counter to the tenet of local control over project selection, and the overall Federal requirement of 'Comprehensive, Continuing, and Cooperative' planning. This rule takes a "one-size-fits-all" approach that does not maintain a cooperative approach with local and regional planning partners.

Additionally, applying this rule to each individual MPO and region across the state without consideration towards their existing air quality and mitigation efforts does not convey equitable application of the rule. While certain areas of the state are experiencing declining air quality, there are other regions which have already implemented congestion reduction efforts and improved their air quality to achieve attainment. The current rulemaking offers no recognition or credit towards these efforts for the areas which have worked to reach attainment.

[redacted] [redacted]

We are grateful that the State of Colorado is actively working to deliver attainment. We are eager to be a part of the solution and will continue to work with the state on these issues. We believe that in order to do that most effectively we must continue to strive to balance structure with flexibility. We also want to encourage Coloradoans' freedom of mobility and choice while encouraging economic vitality. Part of this rule making adds additional criteria for being out of attainment for federal pollutants, pollutants that often come outside our region, outside our state and outside our nation. It is important that we not be held accountable for pollution we do not produce. We do however acknowledge that we are all a part of the problem and need greater flexibility to do our part to effectively address the challenge.

Our comments will focus on how the proposed rule can be improved to better address the intent, with the shared desire to reduce emissions and improve air quality on a statewide basis.

Our specific comments/recommendations on the current rule as proposed:

1. **1.42 Regionally Significant Project** – The definition cited allows for the MPO to use a different definition if approved by the EPA. However, only MPOs in non-attainment would be required to have their definition approved by the EPA.

   Recommendation: Allow areas in Attainment to use the basic FHWA definition of all principal arterial highways and all fixed guideway transit facilities that offer an alternative to regional highway travel (with an emphasis placed on "offer an alternative to regional highway travel", meaning roadways that are functionally classified as State Highway and above in the federal functional classification system).

2. **8.02.1 Analysis Requirements** – It is our understanding that the rule requires the MPO to model TIP documents when they are first adopted for each of the horizon years. If we understand this correctly, there should be no change in results, as the modeling will be exactly the same as when the long-range plan was first adopted. If the intent is to only model the projects included in the TIP against horizon year goals, this is meaningless unless greater direction is provided in the rule. Either way, the rule provides insufficient detail to apply to the adoption of TIP documents.

   Recommendation: Strike "TIP" from the definition of section 1.02 "Applicable Planning Document"

3. **8.02.2 Agreements on Modeling Assumptions** – This section requires the MPO to enter into an IGA with CDOT on modeling assumptions. Currently each region has authority to make assumptions based on their region's size, population and geographic and economic characteristics. Each MPO is different, and we feel it is inappropriate for CDOT, at the staff level, to inject itself into the MPO modeling process. For example, it is unlikely that PPACG staff would agree with CDOT on how the state is implementing the concept of "induced demand". While the rule makes it seem as if the MPO has a choice in the development of the IGA, the reality is that CDOT is not required to cooperatively develop the assumptions as the lack of an IGA would only harm the MPO.

   Recommendation: Reword the section to remove the IGA requirement, and have the MPO consult with CDOT on modeling assumptions. We believe that consultations are more consistent with the federal transportation planning guidelines.

4. **8.03 GHG Mitigation Measures** – We believe that this section is the key to making the rule workable in the long term. If the "credit" for implementing these activities is not meaningful, then, in concert with the sizable GHG reduction goals and CDOT modeling assumptions, federally-funded capacity projects will be difficult if not impossible to program/implement.

We understand that certain stakeholders may actually desire eliminating future roadway capacity projects in the MPO areas. However, we believe that a de facto ban on capacity projects is bad public policy and in fact could lead to more GHG through increased congestion, and have the unintended consequence of directing future growth outside of the existing urban areas.

Recommendation: Direct CDOT staff to develop a meaningful credit system that will allow important projects to move forward while at the same time promotes the implementation of mitigation measures that are appropriate as context-sensitive solutions to the needs of each individual MPO area.

5. **8.05.2.1 Waiver** – This section, and its subsections, allow for a waiver but then severely limits its application. We believe that it is bad public policy to have an appointed commission that does not have the ability to overturn decisions based on modeling, which is merely the output from a computer based on human assumptions and interpretations of past data.

   Additionally, the rule allows the Transportation Commission to not act on a waiver request, which would automatically result in the denial of the request. We believe that this lacks transparency and accountability.

   Recommendation: At a minimum, the language that allows for waivers to be denied without action should be corrected to an automatic approval to encourage the Commission to act on each waiver request. Additionally, we would also recommend that the waiver section be rewritten to allow more human control and discretion over the waiver process (and not driven solely by model results).

One last comment addresses something not currently included in the rule. The nature of federal funding is such that if projects have been started with federal funds (design, utility relocation, right-of-way acquisition, etc.), that project needs to be completed within 10 years, or the sponsoring jurisdiction is required to repay FHWA the funds expended to date. Although this may not be a pervasive issue, we anticipate the rule could impact such capacity projects, and we don't believe the canceling of projects already underway was the intent of the legislature when directing this rulemaking. This could be addressed in the waiver process if it is adjusted to allow for the Transportation Commission to have greater flexibility. But if the PPACG recommendation on waivers is not accepted, we would strongly encourage that the Commission direct CDOT staff to draft additional language to address the need to "grandfather" capacity projects that have already expended federal funds and that are subject to repayment.

PPACG appreciates the Transportation Commission's time and effort in reviewing this proposed rulemaking and we are hopeful the Commission will make the adjustments necessary for this rule to be more palatable for all impacted parties involved.

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Pikes Peak Rural Transportation Authority Public Comments re Proposed Rules (2 CCR 601-22)

1 message

[redacted] Thu, Oct 14, 2021 at 10:39 AM
To: "dot_rules@state.co.us" <dot_rules@state.co.us>
Cc: [redacted]

Ms Takushi,

Please find attached written comments submitted on behalf of the Pikes Peak Rural Transportation Authority regarding the Proposed Rules Governing Statewide Transportation Planning Process and Transportation Planning Regions (2 CCR 601-22).

Thank you,

[redacted]

[redacted]

ICENOGLE SEAVER POGUE

LAWYERS OF DISTINCTION 2019

[redacted]

Process (SIGNED w Attachment).pdf
291K

[redacted]

October 14, 2021

SUBMITTED VIA ELECTRONIC MAIL: dot_rules@state.co.us

℅ Theresa Takushi
Colorado Department of Transportation
Greenhouse Gas
2829 W. Howard Place
Denver, CO 80204-2305

Re: Proposed Rules Governing Statewide Transportation Planning Process and Transportation Planning Regions (2 CCR 601-22)

Dear Ms. Takushi:

On behalf of the Pikes Peak Rural Transportation Authority (the "PPRTA"), I am submitting comments in response to the Transportation Commission's proposed Rules Governing Statewide Transportation Planning Process and Transportation Planning Regions (2 CCR 601-22) (the "Proposed Rule").

As an initial matter, the PPRTA would like to express its position that while Senate Bill 21-260's intent to address air quality and greenhouse gas emissions is, of course, of paramount importance, it fails to recognize that increased transportation capacity which results in more efficient travel and less emission of greenhouse gases from idling vehicles is also a fundamental component in addressing these concerns. With this in mind, the PPRTA encourages more flexibility be incorporated into the waiver provisions in Section 8.05.2.1 and that the yet-to-be-released administrative process for selecting, measuring, confirming, and verifying GHG Mitigation Measures incorporate meaningful credits that would allow important transportation capacity projects to move forward.

The PPRTA is also deeply concerned with the ambiguous effect that the Proposed Rule will have on planned transportation projects that have been approved by voters, utilize alternative funding mechanisms, and are constructed and managed by entities other than the Colorado Department of Transportation or a metropolitan planning organization.

Please see attached an outline of PPRTA's most pressing concerns and suggested revisions to Proposed Rule as currently drafted which the PPRTA believes would address these concerns.

[redacted]
On behalf of the Board of Directors
Pikes Peak Rural Transportation Authority

I. TIMELINE FOR CONSIDERATION AND IMPLEMENTATION

The Proposed Rule Schedule Published by the Colorado Department of Transportation Does Not Allow Adequate Time for Review, Careful Consideration of Impacts of, and Revisions to the Proposed Rules. Implementation of the proposed rules should be delayed to no earlier than January 1, 2023, in order to allow for release of a draft of the administrative process for selecting, measuring, confirming, and verifying GHG Mitigation Measures (discussed in II below) and additional time for review, revisions, assessment of impact, feasibility assessments of various mitigation measures, planning, budgeting, and implementation.

II. TRANSPORTATION SYSTEMS CANNOT CONSIDER THE PRACTICAL AND FINANCIAL IMPLICATIONS OF GHG MITIGATION MEASURES

By Not Including a Proposed Draft of the Administrative Process for GHG Mitigation Measures, Transportation Systems Cannot Meaningfully Respond to the Proposed Regionally Transportation Planning Reduction Levels. Without a draft of the administrative process for selecting, measuring, confirming, and verifying GHG Mitigation Measures, transportation systems cannot consider whether such measures can be incorporated into transportation plans in order to reach the Regional GHG Planning Reduction Levels in Table 1. There is no assurance that these future GHG Mitigation Measures will adequately capture the practical and funding difference of different transportation systems throughout the State so that transportation systems can effectively balance the need for certain GHG emitting projects and the GHG Mitigation Measures that may be available to offset them. At the very least, we encourage CDOT to release a draft of how GHG Mitigation Measures will be measured prior to completion of the public comment period regarding the Proposed Rule. Without such a draft, there is no way to meaningfully consider whether the Regional GHG Planning Reduction Levels in Table 1 can be achieved. We believe that the GHG Mitigation Measures are of paramount importance in making the Proposed Rule viable and would encourage CDOT to develop a meaningful credit system that will allow important transportation projects to move forward while at the same time promoting the implementation of mitigation measures that are appropriate for each such project.

III. PPRTA CONCERNS WITH THE DEFINITION OF "REGIONALLY SIGNIFICANT PROJECT"

A. ***The Definition of "Regionally Significant Project" is Detrimentally Ambiguous for Other Entities Constructing and Operating Transportation Projects.*** While the current definition of "Regionally Significant Project" uses the same definition as that set forth in 23 CFR § 450.104 requiring the inclusion of such projects within long-range transportation planning for public information and conformity purposes, it does not accurately capture the various entities and funding mechanisms responsible for multiple large-scale transportation systems throughout the State of Colorado. Rather, the Proposed Rules presumes that CDOT or an MPO facilitate the construction and financing of most large transportation projects. This creates uncertainty as to how local and regional governments will work together regarding transportation projects that will be subject to the Proposed Rules and has the potential to jeopardize the cooperation between local and regional planning partners. The Greenhouse Gas Pollution Reduction Standard for Transportation Planning Frequently Asked Questions dated August 30, 2021 recognizes that Proposed Rule does not give the Transportation Commission the authority to prevent a locally funding project from occurring, however, by not providing any accommodations for these locally funded projects, the Proposed Rule has the very real potential of adversely impacting the cooperative approach between local and regional planning partners which is essential to ensure that important transportation projects move forward in a manner that helps meet the GHG mitigation standards.

B. *Proposed Change to the Definition of "Regionally Significant Project" (1.42)*

Regionally Significant Project - a transportation project that is federally, state, or MPO-funded and is on a facility which serves regional transportation needs (such as access to and from the area outside of the region, major activity centers in the region, major planned developments such as new retail malls, sports complexes, etc., or transportation terminals as well as most terminals themselves) and would normally be included in the modeling of a metropolitan area's transportation network or state transportation network, including at a minimum all principal arterial highways and all fixed guideway transit facilities that offer an alternative to regional highway travel. If the MPOs have received approval from the EPA to use a different definition of regionally significant project as defined in 40 C.F.R. § 93.101, the State Interagency Consultation Team will accept the modified definition. Necessary specificity for MPO Models or the Statewide Travel Model will be approved by the State Interagency Consultation Team

OR

Regionally Significant Project - a transportation project subject to the approval of an MPO and/or CDOT that is on a facility which serves regional transportation needs (such as access to and from the area outside of the region, major activity centers in the region, major planned developments such as new retail malls, sports complexes, etc., or transportation terminals as well as most terminals themselves) and would normally be included in the modeling of a metropolitan area's transportation network or state transportation network, including at a minimum all principal arterial highways and all fixed guideway transit facilities that offer an alternative to regional highway travel. If the MPOs have received approval from the EPA to use a different definition of regionally significant project as defined in 40 C.F.R. § 93.101, the State Interagency Consultation Team will accept the modified definition. Necessary specificity for MPO Models or the Statewide Travel Model will be approved by the State Interagency Consultation Team

OR

Regionally Significant Project - a transportation project that is on a facility which serves regional transportation needs (such as access to and from the area outside of the region, major activity centers in the region, major planned developments such as new retail malls, sports complexes, etc., or transportation terminals as well as most terminals themselves) and would normally be included in the modeling of a metropolitan area's transportation network or state transportation network, including at a minimum all principal arterial highways and all fixed guideway transit facilities that offer an alternative to regional highway travel. This definition does not include transportation projects disclosed to CDOT and MPO for purposes of 23 C.F.R. § 450.326(f). If the MPOs have received approval from the EPA to use a different definition of regionally significant project as defined in 40 C.F.R. § 93.101, the State Interagency Consultation Team will accept the modified definition. Necessary specificity for MPO Models or the Statewide Travel Model will be approved by the State Interagency Consultation Team

C. *Proposed Change to the Process for Determining Compliance (8.02.1)*

8.02.1 Analysis Requirements When Adopting or Amending an Applicable Planning Document - Each MPO and CDOT shall conduct a GHG emissions analysis using MPO Models or the Statewide Travel Model, and the Approved Air Quality Model, to estimate total CO2e emissions. Such analysis shall include the existing transportation network and implementation of Regionally Significant Projects; provided that such analysis shall not include transportation projects disclosed to CDOT and MPO for purposes of 23 C.F.R. § 450.326(f). The emissions analysis must estimate total CO2e emissions in million metric tons (MMT) for each year in Table 1 and compare these emissions to the Baseline specified in Table 1. This provision shall not apply to MPO TIP amendments.

IV. THE WAIVER PROCESS PROPOSED FOR SPECIFIC PROJECTS CANNOT BE MEANINGFULLY UTILIZED

A. ***It is Unclear What Transportation Requirements Would Satisfy the Waiver Requirements under the Proposed Rule (8.05.2.1)***. It is unclear what type of project would satisfy the waiver requirements wherein (1) the overall GHG Transportation Report provided by an MPO to the Transportation Commission must reflect effort and priority placed collectively on projects and mitigation efforts that reduce GHG emissions; and (2) the transportation project does not "substantially increase" GHG emissions. There is no context for what would be deemed a "substantial increase" in GHG emissions in the context of the GHG reduction levels. On its face, the proposed waiver provision is effectively limited to projects that wouldn't need the waiver process to begin with.

B. *Proposed Change to the Waiver Process (8.05.2.1)*

8.05.2 If the Commission determines, by resolution, the requirements of Rule 8.02.5 have not been met, the Commission shall restrict the use of funds pursuant to Rules 8.02.5.1.1 or 8.02.5.1.2, as applicable, to projects and approved GHG Mitigation Measures that reduce GHG. Prior to the enforcement of such restriction, an MPO, CDOT or a TPR in a nonMPO area, may, within thirty (30) days of Commission action, issue one or both of the following opportunities to seek a waiver or to ask for reconsideration accompanied by an opportunity to submit additional information:

8.05.2.1 Request a waiver from the Commission imposing restrictions on specific projects not expected to reduce GHG emissions. The Commission may waive the restrictions on specific projects ~~on the following basis:~~

~~8.05.2.1.1 The~~ if the GHG Transportation Report reflected significant effort and priority placed, in total, on projects and GHG Mitigation Measures that reduce GHG emissions.~~; and~~

~~8.05.2.1.2 In no case shall a waiver be granted if such waiver results in a substantial increase in GHG emissions when compared to the required reduction levels in this Rule.~~

V. THE PROPOSED RULES DO NOT ACCOUNT FOR REGIONS IN ATTAINMENT AREAS

A. *The Proposed Rules Impose Financially and Administratively Detrimental Requirements on Regions Within an Attainment Area.* The Proposed Rules do not account for regions that have continued to remain in attainment with federally-regulated air quality standards.

B. *Proposed Change to the Timing for Determining Compliance*

8.02.4 Timing for Determining Compliance

8.02.4.1 By October 1, 2022, CDOT shall update their 10-Year Plan and DRCOG and NFRMPO shall update their RTPs pursuant to § 43-4-1103, C.R.S. and meet the reduction levels in Table 1 or the requirements pursuant to § 43-4-1103, C.R.S and restrictions on funds.

8.02.4.2 After October 1, 2022

8.02.4.2.1 CDOT must for each Applicable Planning Document, meet either the reduction levels within Table 1 for Non-MPO areas or the requirements as set forth in Rule 8.05.

8.02.4.2.2 MPOs in a Nonattainment Area must meet either the corresponding reduction levels within Table 1 for each Applicable Planning Document, or the ~~relevant~~ applicable MPO and CDOT each must meet the requirements as set forth in Rule 8.05. An MPO in Attainment Areas may, in its sole discretion, consider the corresponding reduction levels within Table 1 for each Applicable Planning Document and may voluntarily provide any Applicable Planning Document to APCD and/or the Commission for review and comment.

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Comments on the GHG Pollution Standard for Transportation Planning

1 me age

[redacted] Wed, Oct 13, 2021 at 5:51 PM
To: dot_rules@state.co.us

Despite this July being the hottest month **ever** recorded, yet Colorado is not on track to meet its climate targets. Our state must embrace bold, transformative policies that drive broad scale decarbonization. The current draft rule is not a bad start, but we should be more ambitious and demonstrate our leadership if we have any intention of reaching decarbonization targets.

- **GHG reduction levels in the draft rules do not add up to the 12.7 million metric tons of CO2e reductions from Transportation by 2030 figure outlined in the state's GHG Pollution Reduction Roadmap** issued by Governor Polis' Office in January of this year. Coloradans deserve a clear, enforceable, and equitable plan to reduce GHG emi ion from the tran portation ector not more accounting tricks.
- **Disproportionately impacted communities and communities of color must be at the heart of any decision-making process** to ensure access to affordable, multimodal, transportation options that reduce toxic air pollution and traffic congestion. Please develop an equity framework beyond this rulemaking that ensures that such individuals are given a real seat at the decision making table. Furthermore, models, assumptions, estimates, and figures used to guide CDOT policy must be **transparent to the public**.
- **The draft rules rely heavily upon optimistic electric vehicle (EV) adoption rates** and provide no alternative or complementary proposals. This rule should adopt stricter carbon budgets and **holistic transportation solutions** -- like bicycles and scooters, pedestrian areas, public transit and light rail, and better land use decisions -- that will actually allow us to meet our emissions reduction targets given the likelihood that EV adoption does not occur as fast as this rule anticipates, nor is it a silver bullet even if it did. Highway expansions will only increase traffic and displace neighborhoods while generating more emi ion and pollution
- **The draft rules do not account for all greenhouse gas sources from vehicles.** Hydrofluorocarbons (HFCs) are not included in the definition of a greenhouse gas. This is a significant omission because HFCs from vehicle air conditioners and refrigeration trucks are powerful GHGs with Global Warming Potentials hundreds to thousands of times greater than that of CO2. With summers getting hotter than ever and supply chains limping along, this is only likely to get worse in the future.

--
[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

CDOT GHG Rulemaking Comment

1 me age

[redacted] Wed, Oct 13, 2021 at 4:47 PM
To: "dot_rules@state.co.us" <dot_rules@state.co.us>

My comment is as follows:

I believe it would be cost-effective and potentially more data accurate for CDOT to consider using Google's Environmental In ight E plorer functionality to calculate tran portation mileage and related GHG emi ion ICLEI a an organization may be the best pathway to make a direct connection to those google services and employees, but that data may be a phenomenal source of actual (as opposed to modeled) trip miles, possibly GHG calculations and baseline data as well. Information is available by county and municipality, included in-boundary and out-of-boundary trips, and could likely be cu tomized for tatewide and even CDOT region

While CDOT would have less ability to manipulate the data and less control over how it is collected, the tradeoff in greater accuracy and methodological consistency as well with tracking % changes over time along with potentially a zero-cost implementation seem to outweigh those constraints. It may be possible to get a dedicated employee contact at Google or provide the type of nece ary control to meet CDOT requirement

Feel free to follow up with que tion

[redacted]

[redacted]

[redacted]

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

UPDATED: Move Colorado Comment Submission

1 me age

[redacted] Wed, Oct 13, 2021 at 4:03 PM
To: "dot_rules@state.co.us" <dot_rules@state.co.us>

Friends,

Please consider this comment version, I found a typo.
Apologie

Warmly,

[redacted]

From: [redacted]
Sent: Wednesday, October 13, 2021 3:40 PM
To dot rule @ tate co u
Subject: Move Colorado Comments

Thank you for the opportunity to provide public comment regarding the Rules Governing the Statewide Transportation Planning Process and Transportation Planning Regions. Move Colorado's comments are attached.

Should you have questions please do not hesitate to contact me at [redacted]

Warmly,

[redacted]

[redacted]

Move Colorado GHG Rulemaking Comment 10 13 21 FINAL pdf
172K

Transmitted Electronically Via: dot_rules@state.co.us.

October 13, 2021

Colorado Transportation Commission
Colorado Department of Transportation
2829 W. Howard Place
Denver, Colorado 80204

Dear Colorado Transportation Commissioners,

Thank you for the opportunity to provide comments regarding the Rules Governing the Statewide Transportation Planning Process and Transportation Planning Regions (Rules). We applaud the approach you are utilizing to allow interested parties from across Colorado to engage in the public process. Additionally, we would like to formally thank Herman Stockinger and Rebecca White of the Colorado Department of Transportation (CDOT) for the thoughtful presentation regarding the proposed Rules they provided Move Colorado's membership in September.

For more than 25 years, Move Colorado – and our 30-plus member organizations representing planning and engineering consultants, contractors, and transportation interests – have engaged in transportation policy discussions, with a focus on increasing investment in our state's multi-modal transportation system. Our members have expertise as professionals in environmental analysis, planning, infrastructure design, engineering, and construction. In addition, many of our member firms also employ scientists and environmental specialists with local, national, and international expertise and experience in air quality and greenhouse gas (GHG) analyses and emissions reduction strategies. It is with this expertise that we write to seek additional clarity related to several proposed Rule provisions, and to assist the Transportation Commission is establishing an implementable and enforceable program that improves the quality of life of Colorado residents and reduces ambiguity as these Rules relate to other existing policies and regulations.

Move Colorado supports the overall goal of taking meaningful steps to reduce GHG emissions in Colorado, and our comments are focused primarily on the administrative process and technical aspects of the rulemaking.

Our comments or requests for clarity are not intended to be in conflict with the overall goal. However, we do seek greater clarification of the proposed changes to the transportation planning process to ensure the changes help to achieve the intended outcome and proposed to ease implementation.

Our membership agrees with the proposed process and approach, including the following areas:

- the existence of a waiver process,
- the creation of the State Interagency Consultation Team,
- plans to establish a GHG Mitigation Measure process outside the rulemaking, and
- that the Transportation Commission will not withhold funds from MPOs as a punitive measure if they do not reach their goals.

The areas in which we seek additional evaluation or clarification are organized by rulemaking section below. Move Colorado would be willing to expand on these comments, should additional clarification be requested by the Transportation Commission.

General

We suggest adding clarity around how the Rules works with the National Environmental Policy Act (NEPA). Federally funded projects require adherence to NEPA to assess environmental impacts from a proposed action. In addition, CDOT has committed to generally following the NEPA process and assessing impacts and mitigation for state-funded transportation projects. The Federal Highway Administration NEPA process has very specific definitions of what constitutes an "impact" for an environmental resource and requires mitigation for those impacts. The use of the term "mitigation" throughout the Rules could be misconstrued as it is commonly used in NEPA documents; clarity around the interplay between the Rules and NEPA process and definitions should be included to provide clarity and minimize ambiguity during project development.

Section 1.00 Definitions

Many of the terms used in the preamble and overview are not defined until later in the document. To provide clarity and improve readability, the definitions should be moved to the beginning of the document.

- Add a definition for "transportation capacity projects." We suggest defining a capacity project as one that physically expands a road, usually by adding through lanes. Projects that focus on operational (improving traffic flow) or safety improvements, such as auxiliary lanes, should not be included in this definition.
- 1.12 Disproportionately Impacted Communities: In less populated areas, Census Block Groups tend to be geographically very large and population centers are not always located near a project area. Clarification should be added to assess where the population is located in relation to a proposed project.
- 1.35: National Ambient Air Quality Standards (NAAQS): "Small particles" is not the correct terminology for particulate matter. This should be changed to reflect the exact wording of the criteria pollutants.
- 1.36: Nonattainment Area: Clarification should be added that a nonattainment area is where the NAAQS are being exceeded; not solely where NAAQS exist.

- 1.42 Regionally Significant Project: The definition included in the Rules is the definition provided by the Environmental Protection Agency, which is meant to provide a general definition for all states. We suggest modifying the definition to rely on what the MPOs currently include in their models as “regionally significant”.
- 1.59 Transportation Systems Planning: It is unclear what this planning process is—if it is referencing CDOT’s 10-year plan and related process, it should be stated as such since the definition could also include what is identified during the NEPA process.

Section 8.01 GHG Emission Requirements

- We request clarity on whether establishing a future year GHG emission target was considered rather than setting a baseline and reduction. Setting future GHG emission targets would be more directly comparable to the modeled emissions.
- Table 1: GHG Transportation Planning Reduction Levels in MMT of CO2e—additional clarification is requested regarding whether the baseline values listed for each MPO are consistent with the MPOs’ own methods and calculations. If the methods and calculations are not compatible, it could lead to two discrete calculation processes: one that is compliant with the Clean Air Act and one that is compliant with the Rules.
- Table 1: The “total” in each column should each the sum of all cells in the column. The rounding in the “total” row does not match the sum in some columns.

Section 8.02 Process for Determining Compliance

- 8.02.1: Similar to the comment on Table 1, i.e., whether data from the different agencies will be directly comparable, is there a plan in place in case the baseline CO2e values differ? If the MPO's calculated value is under the Table 1 baseline value, would that difference count toward GHG reduction?
- 8.02.3: Please provide clarity on how GHGs impacts to Disproportionally Impacted Communities will be assessed. Similar to ozone, GHGs are usually examined on a larger scale and not on a smaller scale, like a neighborhood or specific project study area.

8.03: GHG Mitigation Measures

We understand that the list of GHG mitigation measures is not exhaustive; however, many of these appear to be actions neither CDOT nor MPOs will have the authority to mandate. We request clarity on how CDOT and the MPOs will utilize these measures.

In addition, we request clarity on how GHG emission reduction estimates will be calculated. It will be nearly impossible to generate defensible GHG emission reduction estimates for the mitigation measures listed in paragraph 8.03.

<u>8.05: Enforcement</u>

The Rules refer to projects or mitigation measures that reduce GHG emissions; however, no guidance is provided on how to evaluate these reductions. We request clarity on how GHG reductions will be assessed for individual projects.

- 8.05.2.1.2: Waiver denial mentions a "substantial" increase in GHGs. Please provide a definition of "substantial" to remove any ambiguity.

Move Colorado thanks you for the opportunity to share our feedback regarding the Rules. While we agree that time is of the essence in addressing GHG and its impact, **we strongly urge you to amend the rulemaking process to allow for a second round of public review following any amendments made by CDOT in response to feedback gathered through this initial public outreach process. We believe the additional review will help bring greater confidence and transparency to the process and increase acceptance for the revised Rule. Additionally, if of interest, we sincerely offer the expertise of our members with backgrounds in environmental science and air quality analysis, should that be of benefit.**

If you have questions or would like additional details, please do not hesitate to contact [redacted] Move Colorado's Executive Director, at [redacted]

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

GHG Transportation Planning Standard - CEO Comments

1 me age

Blynn - CEO, Kelly <kelly.blynn@state.co.us> Wed, Oct 13, 2021 at 2:41 PM
To: dot_rules@state.co.us
Cc Will Toor will toor@ tate co u , [redacted]

Please accept the attached comments on the GHG Transportation Planning Standard from CEO. Many thanks,

Kelly

Kelly Blynn
Transportation Climate Change Specialist
COLORADO
Energy Office
W (303) 866 3362 | M (610) 220 5378
1600 Broadway, Suite 1960, Denver, CO 80202
kelly.blynn@state.co.us | energyoffice.colorado.gov

CDOT GHG Rule - CEO Comments.pdf
290K

COLORADO
Energy Office

October 13, 2021

SUBJECT: Comments on the Proposed Greenhouse Gas Reduction Planning Standard

Dear Transportation Commission:

Thank you for the opportunity to provide public comments on the proposed changes to the Rules Governing Statewide Transportation Planning Process Transportation Planning Regions, containing the Greenhouse Gas Transportation Planning Standard, proposed on August 13, 2021 (the "Rules"). The Colorado Energy Office ("CEO") supports the Rules and would like to offer the following comments.

CDOT has both the authority and the obligation to adopt the Rules.

Recent legislation and actions by the Polis administration concerning economy-wide greenhouse gas ("GHG") reduction goals provides background and context to the Rules. On January 14, 2021, Colorado released the Colorado Greenhouse Gas Reduction Roadmap ("Roadmap") which assessed 2005 emissions, laid out an achievable pathway to meet the state's science-based climate targets, and presented a list of near-term actions that would help achieve the state's 2030 targets. The Roadmap recognized "the transportation sector []is now] the leading source of GHG emissions and a significant contributor to local air pollution."[1] One of the Roadmap's "Key Findings" declared "[m]aking changes to transportation planning and infrastructure to reduce growth in driving is an important tool in reducing emissions."[2].

House Bill 19-1261 recognized that "climate change adversely affects Colorado's economy, air quality and public health, ecosystems, natural resources, and quality of life[,]" acknowledged that "Colorado is already experiencing harmful climate impacts[,]" and that "many of these impacts disproportionately affect" certain communities. *See* § 25-7-102(2), C.R.S. The general assembly also recognized that "[b]y reducing [GHG] pollution, Colorado will also reduce other harmful air pollutants, which will, in turn, improve public health, reduce health care costs, improve air quality, and help sustain the environment." § 25-7-102(2)(d), C.R.S. Accordingly, House Bill ("HB") 19-1261 set state goals of economy-wide reductions in GHG emissions of 25% below 2005 levels by 2025, 50% below 2005 levels by 2030 and 90% by 2050. § 25-7-102(2)(g), C.R.S.

Senate Bill ("SB") 21-260 provides further background and explicit authority for the Commission to adopt the Rules. In that bill, the general assembly recognized that "transportation capacity projects … [that] increas[e] the capacity of highways in major transportation corridors can cause adverse environmental impacts, including but not limited to incremental acceleration of climate change, and adverse health impacts[.]" § 43-1-128(1)(a), C.R.S. To minimize these impacts, the general assembly directed the Colorado Department of Transportation ("CDOT") and metropolitan planning organizations ("MPOs") to "engage in an enhanced level of planning, modeling and other analysis." § 43-1-128(1)(c), C.R.S. The general assembly also directed CDOT and the Transportation Commission ("Commission") to take steps to account for the impacts of transportation capacity projects on GHG pollution and Vehicle Miles Traveled and to help achieve statewide GHG pollution targets established in section 25-7-102(2)(g), C.R.S. § 43-1-128(3), C.R.S. The general assembly has also recognized that CDOT is "the proper body, in cooperation with regional planning commissions and local government officials, for developing and maintaining the state transportation planning process and the state transportation plan." § 43-1-1101, C.R.S. The Commission is responsible for formulating policy with respect to transportation systems in the State and promulgating and adopting all CDOT financial budgets for construction based on the Statewide Transportation Improvement Programs. *See* § 43-1-106(8), C.R.S. The Commission is statutorily charged "to assure that the preservation and enhancement of Colorado's environment, safety, mobility and economics be considered in the planning, selection, construction and operation of all transportation

[1] *Colorado Greenhouse Gas Pollution Reduction Roadmap* (Jan. 14, 2021), at XII.
[2] *Id.* at 32.

projects in Colorado." § 43-1-106(8)(b), C.R.S. In addition, the Commission is generally authorized "to make all necessary and reasonable orders, rules and regulations in order to carry out the provisions of this part . . ." § 43-1-106(8)(k), C.R.S. As such, CDOT and the Commission are primarily responsible for ensuring compliance with GHG reductions in transportation planning.

Finally, CEO notes that should the Commission not adopt the Rules, then the Air Quality Control Commission ("AQCC") would likely need to adopt rules affecting transportation planning. The Roadmap originally envisioned AQCC adoption of such rules.[3] The agencies made the determination that development by CDOT and adoption by the Commission was preferable given the greater depth of connection to transportation stakeholders and the greater level of expertise in transportation planning. However, statute ultimately makes the AQCC responsible for the economy-wide GHG targets set by HB 19-1261, and SB 21-260 states that CDOT shall implement relevant rules and regulations adopted by the AQCC to reduce GHG emissions. § 43-1-128(3)(a), C.R.S. Given the need identified in the GHG Roadmap for reductions due to transportation planning, the AQCC would likely need to take action if the Commission did not.

In addition to State authorities, the U.S. Department of Transportation ("US DOT") is reprioritizing GHG reduction. As one initial step, US DOT's 2021 regulatory agenda includes a directive for the Federal Highway Administration to "Re-establish a [GHG] Emissions Performance Measure for state and metropolitan planning" that was revoked during the previous administration.[4] Previously, this performance measure would have required agencies to set GHG performance targets and track their progress and would have prohibited setting targets allowing an increase in carbon pollution. The work that CDOT and the Transportation Commission are undertaking in developing this rule could provide an important model for the nation as federal policies regarding GHG reduction mature.

The reduction levels should be adopted as proposed to maximize benefits.

The Rules should be adopted with the reduction levels proposed, as opposed to any lesser reduction levels contemplated in alternative proposals, in order to meaningfully contribute to the GHG reduction goals of the Roadmap for the transportation sector, as well as to maximize the co-benefits from implementation of the Rules outlined in the Cost-Benefit Analysis. To meet the goals of the Roadmap, the state needs to reduce GHG emissions from transportation by 12.7 million metric tons ("MMT") by 2030. Colorado's Low Emission Vehicle and Zero Emission Vehicle programs, as well as programs and investments designed to reach about 1 million Electric Vehicles on the road by 2030, are estimated to achieve a combined 8 MMT GHG reduction by 2030, leaving a 4.7 MMT gap. The Roadmap includes these Rules as one of the key near-term strategies to fill this gap, and given the uncertainty surrounding implementation and timing of other possible strategies, reduction levels in the Rules should be maximized to the extent possible. Nevertheless, it will also be critical to quickly pursue complementary strategies in the transportation sector to tackle issues like truck emissions.

Modeling conducted to set the reduction levels proposed in the Rules indicates that these levels are achievable for the state and MPOs given ambitious yet feasible shifts in transportation spending and land use. The Cost-Benefit Analysis (or "CBA"), which quantifies the substantial benefits for Colorado residents and businesses from the implementation of the Rules, highlights that the reduction levels proposed are estimated to bring \$3.9 to \$6.6 billion more in cumulative benefits between 2022 and 2050 relative to Alternatives 1 and 2 respectively.

The Cost-Benefit Analysis, which meets statutory requirements and utilizes reasonable methods and assumptions, demonstrates the substantial benefits of the Rules.

CDOT's CBA meets the statutory requirements that the CBA include:

[3] *Id.* at 66.
[4] *US Department of Transportation Releases Spring Regulatory Agenda | US Department of Transportation*, US Department of Transportation (June 11, 2021).

(I) The reason for the rule or amendment;

(II) The anticipated economic benefits of the rule or amendment, which shall include economic growth, the creation of new jobs, and increased economic competitiveness;

(III) The anticipated costs of the rule or amendment, which shall include the direct costs to the government to administer the rule or amendment and the direct and indirect costs to business and other entities required to comply with the rule or amendment;

(IV) Any adverse effects on the economy, consumers, private markets, small businesses, job creation, and economic competitiveness; and

(V) At least two alternatives to the proposed rule or amendment that can be identified by the submitting agency or a member of the public, including the costs and benefits of pursuing each of the alternatives identified.

§§ 24-4-103(2.5)(a)(I)-(V), C.R.S. CDOT engages in a lengthy analysis of each of these topics and the CBA exceeds the requirement that the agency make “a good faith effort to comply.” § 24-4-103(2.5)(d), C.R.S.

We support the methodology and conclusions of the Cost-Benefit Analysis, and appreciate the important air pollution, safety, health and economic co-benefits from investments in pedestrian, bicycle, and transit infrastructure that were included. The Cost-Benefit Analysis was developed by Cambridge Systematics, a longstanding, leading transportation consulting firm that has performed heavily cited research for federal, state, and local agencies, and relies upon assumptions from rigorous and credible studies that are commonly used in similar analyses.

While CDOT and the MPOs can achieve compliance with the Rules in a variety of ways, the Cost-Benefit Analysis illustrates a likely pathway that involves shifting some investments away from roadway capacity expansion projects into multimodal projects, and mitigating some remaining capacity projects. Under this scenario, the Cost-Benefit Analysis estimates substantial net economic benefits from savings in vehicle operating costs, monetized benefits from reduced impacts of greenhouse gas and air pollution emissions, monetized benefits from reduced traffic fatalities and injuries, and improvements in physical health. The net present value of total societal benefits anticipated from implementation of the Rules is estimated to total roughly $40B between 2022 and 2050.

For several assumptions, research indicates a range of possible outcomes that are dependent on the context and design of specific projects, and are difficult to capture in a high-level, long-range analysis such as this. One important such assumption is induced demand elasticity, or the increase in trip-making that can be expected to result over time per lane-mile of road capacity added. The Cost-Benefit analysis conservatively utilizes the lower end of the range reported in a literature review of induced demand analysis for corridor-level studies, due to the statewide nature of the CBA. As a result, the estimated benefits of the Rules should be considered a lower bound in cases where implementation includes a shifting of investments away from capacity projects into transit, bicycling, and pedestrian projects. While reasonable arguments can be made for a range of larger levels of elasticity, these would only have the effect of showing even larger net benefits for the preferred scenario compared to the other two scenarios and a no action scenario and would not change the conclusion that the preferred scenario maximizes net benefits among the options considered.

Similarly, there are a range of assumptions that could be made for the cost of gas. The CBA uses the reference case scenario in the US Department of Energy 2021 annual Energy Outlook, which is a reasonable choice. However, it is worth noting that this scenario shows costs for gasoline in the range of $2.22-$2.58 throughout the decade of the 2020s; the current price for regular gasoline in Colorado has been hovering around $3.55. As is the case with a higher elasticity of induced demand, a higher gasoline price would have the effect of increasing the net benefits of the preferred scenario compared to the two alternatives or a no action scenario.

In addition to the substantial benefits quantified, the Cost-Benefit Analysis also mentions several unquantified categories of benefits that nevertheless would provide real benefits to Coloradans. The following provides order of magnitude estimates of the additional benefits that could be expected from the Rules as proposed, as well as additional benefits from reduced demand for parking spaces.:

- **Reduced vehicle ownership costs:** Based on the projected reduction in VMT from the baseline in Table A.11 and the assumption of 10,450 annual VMT per vehicle in the Cost-Benefit Analysis, the reduced number of vehicles owned by Coloradans can be estimated. Based on an average annual vehicle ownership cost of $6,200, Coloradans would save an additional $4.1B annually by 2030, $5.0B annually by 2040, and $5.8B annually by 2050 in vehicle ownership costs under the Proposed Rule Implementation scenario.[5]
- **Increased access to jobs and other services:** Increased multimodal transportation options would provide improved access to jobs, higher education, medical appointments, and other services for people with disabilities, those who can't afford a vehicle, those who lack a driver's license, and others with transportation barriers. As one example, 165,000 Coloradans with disabilities are unemployed or not in the labor force, and nationally about 11% of persons with disabilities cite transportation barriers as a reason they aren't in the labor force.[6] If the substantial investments in transit, bicycling, and walking infrastructure assumed in the Cost-Benefit Analysis enabled 20% of persons with disabilities who are not working and face transportation barriers to access employment (approximately 4,000 people per year in 2030), estimated additional wages per year would total $139M in 2030, $156M in 2040, and $168M in 2050.[7]
- **Parking:** A significant additional unquantified benefit from the Rules would be savings from the reduced need for parking, including land, construction, and operations and maintenance costs. In a typical urban area, it's estimated there are at least 3 off-street parking spaces for each vehicle (one residential and two non-residential), with researchers finding much higher ratios in some cities. Based on the estimated reduction in car ownership described above and estimates of annualized cost per parking space for construction, operations, and maintenance, the implementation of the Rules as proposed would save Coloradans an additional $4.5-$5.7B annually by 2030, $5.4-$6.9B annually by 2040, and $6.4-$8.1B annually by 2050.[8]

Thus, CEO concludes that the Cost-Benefit Analysis is based upon reasonable assumptions; that it meets all statutory requirements; and that it presents a lower bound on the net benefits associated with the preferred scenario. CDOT's analysis finds that the preferred scenario has the largest net benefits of the options analyzed even at this lower bound; incorporating additional economic benefits would not change this conclusion but would amplify the size of the net benefits associated with the preferred scenario. The range and magnitude of co-benefits from adopting the preferred scenario is so large as to support the adoption of the rule at the highest level of emissions reductions analyzed.

We support the Rule's approach to create a process for establishing GHG Mitigation Measures.

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[5] *Average Cost of Owning and Operating an Automobile*, 2019 American Community Survey, Bureau of Transportation Statistics.

[6] https://www.bls.gov/news.release/dissup.nr0.htm, Bureau of Labor Statistics (2020).

[7] The average wage is assumed to be $35,582 for public transit commuters, according to 2019 American Community Survey data for Colorado. The number of persons with disabilities is assumed to grow at the same rate as the state population, as projected by the Colorado State Demography Office.

[8] Litman, T., & Doherty, E. (2011). Transportation Cost and Benefit Analysis II—Parking Costs. Transportation Cost and Benefit Analysis Techniques, Estimates and Implications. Cost ranges vary based on the estimated average cost per space for surface parking vs. structured or underground parking in suburban, urban, and CBD contexts.

We support the Rule's approach to establish an ongoing process for selecting, measuring, confirming, and verifying GHG Mitigation Measures, and its focus on prioritizing Disproportionately Impacted communities. This approach will enable CDOT and the MPOs to continuously improve mitigation strategies over time, leveraging measured improvements and best practices to inform Mitigation Action Plans. In addition to the proposed types of mitigation measures in the Rule, some additional possible measures to explore include:

- **Parking policies:** Local government action within an MPO area to reform parking policy could count as a mitigation measure, due to the impact parking supply and pricing has on travel behavior, car ownership, and housing costs.[9] Actions could include local governments removing parking minimums or implementing parking maximums for new development, instituting local regulations that require parking to be "unbundled" (i.e. requiring separate payment for parking from housing costs), or regulations requiring employers to offer parking cash out to employees who do not drive to work.
- **Removal of exclusionary zoning:** Local government actions within an MPO area that remove exclusionary zoning restrictions, such as allowing accessory dwelling units, duplexes, triplexes, and/or fourplexes by right in all residential zones, could count as a mitigation measure due to these actions supporting incrementally more compact, walkable land use patterns within existing communities that help reduce VMT and increase walking, biking, and transit trips.[10]
- **Targeting growth to infill areas and existing urban areas:** MPO action to target growth to existing urban areas and limit growth in greenfield or unincorporated areas could count as a mitigation measure, again due to these actions supporting compact land use patterns that enable lower VMT per capita.[11] These actions could include adopting funding allocation rules that target investments to infill areas, adopting a regional urban growth boundary, counties within an MPO area prohibiting urban levels of development in unincorporated areas, cities and counties signing intergovernmental agreements that establish countywide urban growth boundaries, and housing commitments by cities in urban growth areas.
- **Conversion of existing lanes to transit lanes:** The conversion of existing arterial roadway lanes to dedicated bus rapid transit lanes could count as a mitigation measure, due to the improvements this would make to transit service quality and reliability that support increased ridership.[12]
- **Creation of low emission zones:** Cities could adopt low emission zones, using curb management or pricing strategies to reduce emissions from both light and heavy-duty vehicles. These could be incorporated into MPO plans.

CEO would also like to offer the following suggestions for minor changes to specific sections to further clarify the Rule:

Applicable planning document (Section 1.02): We suggest including all TIPs because of the intention of the Rule to reduce GHGs, which are a global pollutant.

- **Suggested language (in red):** Applicable Planning Document - refers to MPO Fiscally Constrained RTPs, TIPs for MPOs ~~in NAAs~~, CDOT's 10-Year Plan and Four-Year Prioritized Plan in non-MPO areas, and amendments to the MPO RTPs and CDOT's 10-Year Plan and Four-Year Prioritized Plan in non-MPO areas that include the addition of Regionally Significant Projects.

[9] Spears, S., Boarnet, M. G., & Handy, S. (2014). Impacts of Parking Pricing and Parking Management on Passenger Vehicle Use and Greenhouse Gas Emissions. Manville, M. (2017). Bundled parking and vehicle ownership: Evidence from the American Housing Survey. Journal of Transport and Land Use, 10(1), 27–55. Litman, T. (2021). Parking requirement impacts on housing affordability.

[10] Wegmann, J. (2020). Death to single-family zoning… and new life to the missing middle. *Journal of the American Planning Association*, *86*(1), 113-119.

[11] Ewing, R., Bartholomew, K., Winkelman, S., Walters, J., Chen, D., McCann, B., & Goldberg, D. (1997). Growing cooler: The evidence on urban development and climate change.

[12] NCHRP Project 20-65, Task 22, Cost/Benefit Analysis of Converting a Lane for Bus Rapid Transit-Phase II Evaluation and Methodology.

We do understand that there may be initial challenges for MPOs outside of NAAs, which may have less experience and technical capacity for the necessary modeling, and that it may require technical assistance from the state or phasing in the requirements. Given the magnitude of emissions that are associated with large, urbanized areas on the front range, we would support a phased approach that first brought in the MPOs along the front range, particularly the Pikes Peak Area Council of Governments.

Incorporating TIPs is important because these are the stages in the process where funds are actually allocated to projects. Longer range planning documents are an important roadmap, but priorities change over time, and some projects in long range plans may not actually be implemented. It would be possible for a long-range plan to comply with the pollution reduction standard, but for a series of TIPs to implement projects that do not ultimately achieve the required level of pollution reduction.

Induced travel (Section 8.02.2): Given that many travel demand models have historically not accounted for induced travel or underestimated its effects, it's important this issue is sufficiently accounted for in any modeling to demonstrate compliance.[13] Otherwise, the strength of the Rule may be undermined, as in fact, projects that will increase pollution in real world operations could be shown, on paper, to decrease emissions. To assess each MPO's model, we suggest developing a checklist or other documentation that specifies model capabilities needed for assessing induced travel in travel demand models[14]**,** or allowing MPOs to rely on off-model calculations based upon synthesis research that has established the range of corridor-level induced demand elasticity.[15] In addition, it is important to consider induced demand from smaller operational projects, such as intersection improvements and signal timing projects, which tend to reduce congestion and idling in the near term, but also may increase total traffic volumes and associated pollution, safety impacts, and costs. CDOT should develop a uniform, simplified off-model approach to incorporating induced demand into assessments of the emissions impacts of operational projects that are not regionally significant projects.

- **Suggested language (in red):** Agreements on Modeling Assumptions and Execution of Modeling Requirements. Prior to the adoption of the next RTP for any MPO, CDOT, CDPHE, and each MPO shall enter into an Intergovernmental Agreement which outlines CDOT, CDPHE, and MPO responsibilities for development and execution of MPO Models or the Statewide Travel Model, and Approved Air Quality Model. Travel demand models shall be evaluated for adequacy in assessing corridor-level induced travel from regionally significant highway capacity projects, utilizing a checklist developed by the Commission. If adequacy cannot be demonstrated, and for evaluation of induced demand from operational improvements that are not regionally significant projects, off-model calculations relying on robust estimates of induced travel elasticity in similar contexts may be utilized.

Project-level analysis (Section 8.02.1): Lessons learned from similar policies elsewhere suggest including project-level emissions and induced travel is important for public transparency and project prioritization. While it's understandable that it would be difficult to do project-level analysis for all projects, particularly in long range plans, many projects closer to funding and construction will have undergone individual project-level analysis and these outputs could be reported. This is certainly true for regionally significant projects that are funded in the TIP process, so that even if it is not possible to do this project level analysis for the evaluation of GHG impacts of long range plans, it should be possible when evaluating the emissions associated with TIP approvals.

- **Suggested language (in red):** Analysis Requirements When Adopting or Amending an Applicable Planning Document - Each MPO and CDOT shall conduct a GHG emissions analysis using MPO Models or the Statewide Travel Model, and the Approved Air Quality Model, to estimate total CO2e emissions. Such analysis shall include the existing transportation network and implementation of Regionally Significant Projects. The emissions analysis must estimate total CO2e emissions in million metric tons (MMT) for each year in Table 1 and compare these emissions to the Baseline specified in

[13] Milam, R. T., Birnbaum, M., Ganson, C., Handy, S., & Walters, J. (2017). Closing the induced vehicle travel gap between research and practice. *Transportation research record*, *2653*(1), 10-16.
[14] Ibid. This paper includes a checklist that can be used to assess travel demand model sensitivity to induced demand.
[15] Volker, J.M.B., and S. L. Handy (2021). The Induced Travel Calculator and Its Applications. University of California Institute of Transportation Studies, UC-ITS-2021-04.

COLORADO
Energy Office

Table 1. For Regionally Significant Projects that have undergone project-level modeling and analysis, the project-level GHG emissions and estimated induced travel shall also be included. This provision shall not apply to MPO TIP amendments.

Clarifying the baseline and EV adoption assumptions (Sections 1.03, 8.02.1): As written, it isn't clear if the Rule indicates whether CDOT and MPOs are intended to assume the "rapid growth" EV adoption trajectory that informs the baseline figures in Table 2 and reduction levels in Table 1, a slower growth EV adoption assumption that underlies the baseline figures in Table 1, or something else when modeling GHG emissions. We think the Transportation Commission should specify this to help clarify which baseline the reduction levels are from. Because the reduction levels were developed based on modeling scenarios that assumed a rapid growth EV adoption trajectory and because this is what CEO and other state agencies are planning for, we suggest that the MPOs and CDOT assume that trajectory when conducting their modeling, and that the reduction levels then be from the baseline figures in Table 2.

- **Suggested language (in red): 1.03:** Approved Air Quality Model - the most recent Environmental Protection Agency issued model that quantifies GHG emissions from transportation. The Transportation Commission shall specify a standard assumption for projected light duty EV adoption through 2050, **consistent with the goals established in the Colorado GHG Roadmap and Colorado EV Plan**, that CDOT and all MPOs shall use in estimating total CO2e emissions. This assumption may vary by region, and may be updated over time.

  8.02.1: Analysis Requirements When Adopting or Amending an Applicable Planning Document - Each MPO and CDOT shall conduct a GHG emissions analysis using MPO Models or the Statewide Travel Model, and the Approved Air Quality Model, to estimate total CO2e emissions. Such analysis shall include the existing transportation network and implementation of Regionally Significant Projects. The emissions analysis must estimate total CO2e emissions in million metric tons (MMT) for each year in Table 1 and compare these emissions to the Baseline specified in Table ~~1~~2. This provision shall not apply to MPO TIP amendments.

Requiring comparisons between modeled results and measured results (Section 8.06): While CDOT has developed sophisticated and modern travel models, there is an inherent level of uncertainty in all forward-looking models. It would be valuable to build into the rule a periodic process for comparing VMT and GHG pollution that were projected by the models with actuals at both the statewide and MPO scale, to allow models or input assumptions to be changed as necessary to match real world experience over time.

- **Suggested language (in red):** Reporting. Beginning July 1, 2025, and every 5 years thereafter, the Executive Director on behalf of CDOT shall prepare and make public a comprehensive report on the statewide GHG reduction accomplishments. This shall include a comparison of modeled VMT for regionally significant capacity projects with real world VMT, and these results shall be utilized to update the modeling requirements as needed.

We appreciate CDOT and the Transportation Commission's groundbreaking leadership on this issue, and look forward to the positive benefits this Rule will bring to Colorado. Thank you for the opportunity to comment.

Sincerely,

Will Toor

Will Toor
Executive Director, Colorado Energy Office

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

I support a strong Greenhouse Gas Pollution Standard

1 me age

[redacted] Wed, Oct 13, 2021 at 11:00 AM

To dot rule @ tate co u

Dear CDOT Rulemaking Comments,

I'm writing because I'm excited that CDOT is pursuing a rulemaking process for a Greenhouse Gas Pollution Standard and I have a few recommendation for improving the draft A a per on who ride a bike in Colorado, I'm acutely aware of the air quality crisis we're experiencing. Since transportation is a top contributor to pollution, this rulemaking is a critical place to start. I urge you to outline specific goals for pollution reduction that will help us meet existing air quality targets.

Our current tran portation y tem i built to move car Our tate' climate roadmap call for a 10% reduction in driving by 2030. People across the state, in both rural and urban communities, need more options, like biking, walking, and public transit, for getting around safely and sustainably. This rule should prioritize projects that put people first in our transportation system.

Please consider these changes and continue to strengthen this rule through the revision process.

Sincerely,

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Mesa County RTPO- GHG Rule Comments

1 me age

[redacted] Wed, Oct 13, 2021 at 10:47 AM
To: dot_rules@state.co.us

Dear Tran portation Commi ion

Thank you for the opportunity to comment on the Greenhouse Gas Pollution Reduction for Transportation Planning Proposed Standards. Attached you will find the comments from the Mesa County Regional Transportation Planning Office ubmitted on behalf of the Grand Valley Metropolitan Planning Organization, Grand Valley Tran portation Planning Region and Grand Valley Transit. We look forward to working with CDOT staff to finalize and implement this rule.

Sincerely,

[redacted]

GHG Rule- GVMPO Comments- FINAL_SIGNED.pdf
326K

[redacted]

Mesa County Regional
Transportation Planning Office

October 11, 2021

Transportation Commission of Colorado
c/o Herman Stockinger
Commission Secretary
CDOT Headquarters
2829 W. Howard Pl.
Denver, CO 80204

Dear Commissioners:

Thank you for the opportunity to provide public comment on the Greenhouse Gas (GHG) Pollution Reduction for Transportation Planning Rule Proposal (Rule). The Regional Transportation Planning Office (RTPO) includes the Grand Valley Metropolitan Planning Organization (GVMPO), the Grand Valley Transportation Planning Region (TPR) and is the contract administrator for Grand Valley Transit (GVT). RTPO staff have been engaged in the advisory group and as a stakeholder with Colorado Department of Transportation (CDOT) staff throughout the development of this rule.

The GVMPO encompasses the urbanized area of Mesa County and includes the City of Grand Junction, City of Fruita, Town of Palisade and parts of unincorporated Mesa County. The Grand Valley TPR encompasses all of the rural areas of Mesa County. The Grand Valley Regional Transportation Committee (GVRTC) is the transportation policy board that oversees the GVMPO/TPR and includes elected officials from these four entities all of whom also help to fund the transportation planning functions of the MPO, TPR and the transit system.

The RTPO in all of its different capacities generally supports the rule as it supports the development of a true multimodal system across Colorado. However, we do have a number of concerns. The comments submitted include feedback from the perspective of the GVMPO, the rural area of the TPR and the small-urban transit system.

Grand Valley Metropolitan Planning Organization (GVMPO)
GVMPO will be responsible for demonstrating compliance with the Greenhouse Gas Rule within the MPO as well as determining mitigation measures if the modeled emissions reduction levels do not satisfy the requirements. Per the draft Rule, GVMPO is not required to model reductions until 2030. As this is a new requirement for the GVMPO, and unlike DRCOG and NFRMPO, the GVMPO is in full attainment for all NAAQSs and we do not currently have the capacity or funding to do it earlier. Therefore, we request that this date remain 2030.

As a small MPO in Colorado with few GHG-increasing projects, it is unlikely that the full reductions will be possible through project mix and the MPO may need to develop a Mitigation Action Plan for compliance.

Though we understand that stakeholders will be involved in the development of the administrative process for the mitigation measures, the lack of specificity is a concern as it is hard to determine if we can comply with the set reduction levels without details on how the mitigation measures will work. With this, we request inclusion in the Rule additional details regarding how the mitigation measures will be used to determine compliance.

Also concerning is funding for the mitigation measures. The Cost-Benefit Analysis for Rules Governing Statewide Transportation Planning (CBA) states that "…all dollars shifted away from certain capacity projects are assumed to fund worthy transportation investments that improve competitiveness, quality of place and life, safety, economic vitality, public health, air quality, and more…The projected cost of these policy choice packages is assumed to be absorbed into current transportation plan budgets (a net neutral approach)." While the GVMPO supports all of these types of projects, historically there has been insufficient funding for them, and with few capacity projects in our transportation plan, it is unclear where these funds will come from in an amount that will make the meaningful impact to the modelling described in the Rule and CBA. We understand that the Multimodal Transportation and Mitigation Options Fund (MMOF) is intended to fund these measures. However, the GVMPO feels that this amount is insufficient to make the meaningful impact needed to drive change in mode-choice and reach the reduction levels shown in the Rule. Additionally, there has never been sustained funding for multimodal projects at the state or local level and because of this, there are many gaps in the multimodal system that must now be addressed. With this, we request additional, sustained funding to implement these mitigation measures at a scale that will reduce GHG emissions across the state. Indeed the funding should be sufficient not just for mitigation measures but for the eventual completion of a true multimodal system.

Since the Rule will create the need for additional travel modeling expertise within the MPO as well as statewide, additional funding should be provided to the MPO and CDOT staff to meet this need. This point is underscored in the September 29, 2021 joint Federal Highway Administration (FHWA) / Federal Transit Administration, FY 2022 Unified Planning Work Program Approvals letter addressed to CDOT Executive Director Lew. In the letter under the heading of Areas of Concern, item 4 states:

> "The new requirements of the state GHG rule will require MPOs to provide financial resources and staffing capabilities to improve the travel modeling state of practice."

Clearly, FHWA does not seem to be poised to increase funding for compliance with the state-level rule. Likewise, current GVMPO funding would not allow for adding the required staff resources and therefore respectfully requests that CDOT allocate the needed funding to the MPO.

While GVMPO was involved throughout the development of this Rule, we have not received the specific inputs and outputs to the GHG model and request that prior to adoption of the Rule, these be reviewed with each MPO to confirm the modelling.

Transportation Planning Region

While we appreciate that CDOT has been included in the Rule as a responsible party with respect to areas outside of the MPOs, there is also concern of how this rule will impact the rural areas of the state, including rural areas of the Grand Valley TPR. The CBA states, "Virtually none of these rural projects would trigger the need for GHG Mitigation Measures under this rule because, with rare exception, they do not add capacity or change land use patterns. Rather, they are generally focused on state of good repair (e.g. repaving projects), safety and resiliency improvements like adding shoulders and passing lanes, and increasingly, supporting the economic vitality of communities by investing in revitalizing main streets across the state.” While this is true in many cases, this is not the case for large interstate projects such as those needed on I-25 and I-70 which travel through rural areas. With this, in order to meet GHG goals, we are concerned that funds may be pulled from one part of the state to be used for mitigation measures in another part of the state. We request text in the rule that speaks to the equity of funds for mitigations measures across the state and CDOT regions and acknowledgement that mitigation measures in rural areas may look different from mitigation measures in more urban areas, as rural areas do not have the same access to transportation alternatives as urban areas.

Grand Valley Transit

As the transit operator in the Grand Valley, we are excited to see changes in this rule that are supportive to the expansion of transit systems across Colorado. GVT operations is funded by FTA 5307 funds matched with local funds from our funding partners. Federal funding for our system is based on population and population density, not on service or ridership as stated in the CBA. The CBA clearly speaks of moving funds from capacity projects to transit in order to increase transit services across Colorado which will require additional funds from the federal, state and/or local government for capital and operating expenses. It will also require additional buses, mechanics, maintenance facilities, and drivers to support this service, all of which can be difficult to find. Additional staff support from CDOT’s Division of Transit and Rail, Procurement and Contracting and additional local staff will be needed to support expanded services. As mentioned above, we request funding in addition to currently proposed MMOF funding to expand transit services. Commensurate with that, additional CDOT staff will be needed to assist in expansion of transit services, particularly as funds will be flowing through CDOT to local transit agencies such as GVT.

Additional Proposed Text Changes

The RTPO has the following general comments/changes regarding the proposed rule. Added text is in red, deleted text is struck out.

- Table 1: Chart include baseline and reduction levels through 2050. Suggest adding text that explains when and how future years beyond 2050 will be added to the chart.

- Table 2: Suggest changing title to Baseline Emissions Modelled with Projected Number of Light Duty Electric Vehicles and improving explanation in 8.01.1 and purpose of inclusion of chart in rule.

- Section 8.02.4.2- Rewrite sections as : MPOs must ~~meet~~ either demonstrate compliance set forth in 8.02.05, ~~the corresponding reduction levels within Table 1 for each Applicable Planning Document~~ or the relevant MPO and CDOT each must meet the requirements as set forth in Rule 8.05.

- Section 8.02.5.1- GHG emissions analysis demonstrating that the Applicable Planning Document is in compliance with the GHG Reduction Levels in MMT of CO2e for each compliance year in Table 1 and/or a Mitigation Action Plan that meets the requirements of 8.02.5.3 or that the requirements in Rules 8.02.5.1.1 or 8.02.5.1.2., as applicable, have been met.

- 8.02.5.1.1- In non-MPO areas or for MPOs that are not in receipt of federal suballocations pursuant to the CMAQ and/or STBG programs~~, the Department utilizes~~ 10-Year Plan funds must be ~~anticipated to be~~ expended on Regionally Significant Projects in those areas ~~on projects~~ that reduce GHG emissions.

Again, we thank you for your consideration of these suggestions and revisions which we feel will clarify and strengthen the Rule considering both urban and rural portions of the state as well as transit agencies.

Sincerely,

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

reduce greenhouse gas emissions

1 me age

[redacted] Wed, Oct 13, 2021 at 9:30 AM
To: dot_rules@state.co.us

CDOT has proposed a new standard to reduce greenhouse gas emissions from the transportation sector, improve air quality and reduce smog, and provide more travel options.

I upport thi trongly. We need ta credit to encourage EV purcha e . We need carbon ta . And we need the standards CDOT proposes.

[redacted]

STATE OF COLORADO

Rathburn - CDOT, Rebecca <rebecca.rathburn@state.co.us>

Fwd: CCA comments on proposed GHG rule

2 messages

Uebelher - CDOT, Jennifer <jennifer.uebelher@state.co.us> Mon, Oct 11, 2021 at 2:02 PM
To: Theresa Takushi - CDOT <theresa.takushi@state.co.us>, Rebecca White - CDOT <rebecca.white@state.co.us>, "Rathburn - CDOT, Rebecca" <rebecca.rathburn@state.co.us>

Hello ladies-

Please see the GHG comment below. Thanks.

Kind Regards,

Jennifer Uebelher
Transportation Commission Liaison
Office of Policy and Government Relations

P 303.757.9025
2829 W. Howard Place, Denver, CO 80204
Jennifer.Uebelher@state.co.us | www.codot.gov | www.cotrip.org

COLORADO
Department of Transportation
Office of Policy and Government Relations

---------- Forwarded message ---------
From: [redacted]
Date: Mon, Oct 11, 2021 at 1:55 PM
Subject: CCA comments on proposed GHG rule
To: [redacted]

Hello Commissioners-

Thank you for the opportunity to provide written comments regarding the Greenhouse Gas Pollution Reduction for Transportation Planning Proposed Standards. CCA has been closely following this rulemaking on behalf of its membership. CCA appreciates the work that has gone into this process and the willingness of the Colorado Department of Transportation ("CDOT") staff to engage with CCA and discuss issues of importance. We certainly recognize the importance of this rule in terms of both its role in reducing the greenhouse gas ("GHG") emissions produced by the transportation sector. We also recognize the ways in which this rule will shape and change the transportation funding processes in Colorado.

As discussed in greater detail within the attached letter, CCA expresses the following concerns with the draft rule: (I) the timeline provided to stakeholders to engage in this process is inadequate; (II) there has been insufficient time and insufficient technical information provided to demonstrate that the GHG reduction standards are feasible and that the baseline levels are accurate; (III) the draft rule has the potential to shift new transportation funding revenues in ways that are contrary to the public's expectations based on adopted transportation plans; (IV) the GHG reduction levels and baselines should be periodically re-evaluated and updated to improve their accuracy over time; (V) the waiver process should be modified to create a transparent, public process for granting waivers from the GHG standards.

We appreciate your consideration of our concerns and look forward to your reply.

Sincerely,

[redacted]

[redacted]

EXECUTIVE DIRECTOR

COLORADO CONTRACTORS ASSOCIATION
BRINGING INFRASTRUCTURE TO LIFE

[redacted]

PROUD CHAPTER OF AGC AMERICA

CCA Letter to CDOT on GHG Rulemaking.pdf
215K

Rathburn - CDOT, Rebecca <rebecca.rathburn@state.co.us> Mon, Oct 11, 2021 at 4:56 PM
To: "Uebelher - CDOT, Jennifer" <jennifer.uebelher@state.co.us>
Cc: Theresa Takushi - CDOT <theresa.takushi@state.co.us>, Rebecca White - CDOT <rebecca.white@state.co.us>

Thanks, Jennifer. I will add this to the record!

Best,
Becca

[redacted]

[Quoted text hidden]

COLORADO CONTRACTORS ASSOCIATION
BRINGING INFRASTRUCTURE TO LIFE
6880 S. YOSEMITE COURT, SUITE 200
CENTENNIAL, COLORADO 80112

October 11, 2021

Colorado Department of Transportation
Transportation Commission
2829 W. Howard Pl.
Denver, CO 80204

Re: Greenhouse Gas Rulemaking

Dear Commissioners:

Thank you for the opportunity to provide written comments regarding the Greenhouse Gas Pollution Reduction for Transportation Planning Proposed Standards. The Colorado Contractors Association ("CCA") has been closely following this rulemaking on behalf of its membership. CCA appreciates the work that has gone into this process and the willingness of the Colorado Department of Transportation ("CDOT") staff to engage with CCA and discuss issues of importance. We certainly recognize the importance of this rule in terms of both its role in reducing the greenhouse gas ("GHG") emissions produced by the transportation sector. We also recognize the ways in which this rule will shape and change the transportation funding processes in Colorado.

As discussed in greater detail below, CCA expresses the following concerns with the draft rule: (I) the timeline provided to stakeholders to engage in this process is inadequate; (II) there has been insufficient time and insufficient technical information provided to demonstrate that the GHG reduction standards are feasible and that the baseline levels are accurate; (III) the draft rule has the potential to shift new transportation funding revenues in ways that are contrary to the public's expectations based on adopted transportation plans; (IV) the GHG reduction levels and baselines should be periodically re-evaluated and updated to improve their accuracy over time; (V) the waiver process should be modified to create a transparent, public process for granting waivers from the GHG standards.

I. Timeline of Rulemaking

The draft rule was published on August 13, 2021 and the Transportation Commission (the "TC") may adopt this rule on November 18, 2021. The process and schedule for this rulemaking may meet the minimum timelines established within state law, but it is not adequate for meaningful stakeholder engagement. The timeline is not sufficient to allow for a full review of the technical aspects of the draft rule, including the modeling methodology, the cost-benefit analysis, the regulatory analysis, and other materials produced to support the proposed changes to the rule. Meaningful engagement, public outreach, and informed dialog can build consensus during times of significant societal change. CCA commends CDOT for conducting public hearings throughout the state to provide stakeholders the opportunity to comment on the draft rule.

As you are likely observing during the public hearing process, the three-minute comment period provided to stakeholders presents challenges to providing substantive feedback on a complex framework for transportation planning and funding. CCA strongly recommends that the TC extend the public comment process, direct the staff to publish a revised draft rule in response to public comments, and conduct additional stakeholder outreach. This additional time could help CDOT build consensus around the goals and objectives of the draft rule.

II. GHG Standards and Modeling Methodology

The most critical element of the draft rule is the proposed GHG Reduction Levels that the rule establishes. The Transportation GHG Roadmap Briefing Update memo provided to stakeholders on July 13, 2021 provides a brief outline of the processed used to develop the pollution reduction planning levels. This memo describes four scenarios that CDOT modeled to determine the impact of combining various measures to achieve pollution reduction targets. CCA recognizes this was a complex and lengthy analysis and appreciates the work that CDOT has done. However, there is insufficient technical documentation available to fully understand the methodology and conduct independent analysis. This is especially true based upon the significance of this shift in the framework for transportation planning and funding. The proposed rule requires the TC to restrict funding to mitigation measures if GHG reduction levels are not met. This enforcement mechanism makes it vitally important to have broad agreement that the baseline and targets are accurate, are based upon appropriate assumptions and data inputs, and have been developed using the appropriate travel model. CCA supports increased transparency and additional review time surrounding the technical methodology used to create the GHG standards within the draft rule.

III. Transportation Funding Outcomes

It is important to note that CCA supported SB21-260, which allocates significant levels of funding to priorities that will reduce GHGs, including infrastructure and incentives to support the transition to electric vehicles, air pollution monitoring, and pollution mitigation. CCA worked closely with its members, CDOT staff, and other stakeholders on Section 30 of SB 260 to ensure that regionally significant transportation projects are planned and constructed in ways that benefit the general public, while not imposing burdens on disproportionately impacted communities. Those who supported SB 260 did so because the new revenues it creates are clearly necessary to fund a wide variety of needs, especially the projects in CDOT's 10-Year Plan. The public, legislators, and stakeholders have an expectation that the $5 billion in new transportation funding in SB 260 will be spent to deliver certain transportation projects, including the portions of funding that are primarily to be spent on the CDOT 10-Year Plan.

The draft rule does not account for the increased environmental requirements in Section 30 of SB 260. There has not been an acknowledgement of the decreased environmental impact new regionally significant transportation projects will have as a result of these requirements. In addition, there are concerns that the draft rule will cause certain transportation capacity projects and safety projects that are desperately needed to languish without funding if the GHG reduction targets are infeasible. The pollution caused by the congestion on these corridors will continue to go unaddressed.

The cost benefit analysis anticipates significant decreases in funding for transportation capacity projects between 2022-2050, as compared to the baseline. It is important that some of this shift in funding be directed toward state of good repair programs, which do not increase GHG levels and serve a valuable purpose in maintaining public trust.

IV. Periodic Re-Evaluation of GHG Reduction Levels and Baselines

There are questions about the accuracy of the baseline and reduction targets within the rule. There are also questions about the feasibility of these reductions, even if all available efforts are taken to achieve these goals. As this effort is new for Colorado and it is proceeding at a concerning pace, the GHG reduction levels should have a mechanism in place to make necessary adjustments. This could account for unanticipated changes, including population growth that differs from what was projected, boundary changes of MPOs, or the potential for the discovery of errors in the original modeling. CDOT should consider taking the baselines out of the rule so that any future adjustments do not require a full rulemaking process.

V. Waiver Process

Section 8.05.02 of draft rule provides a process for seeking a waiver from the TC if the TC determines that the requirements of Rule 8.02.05 have not been met. The waiver process allows the TC to waive restrictions on specific projects that are not expected to reduce GHG emissions. This section of the draft rule could be strengthened with additional guidance, including criteria for the TC's decision on waivers. In addition, the process to obtain a waiver should require that the TC take a vote after conducting a public hearing on each waiver. Currently, the TC can take no action and the waiver fails after 30 days or the next scheduled meeting of the TC, whichever is later.

VI. Conclusion

For the foregoing reasons, CCA respectfully requests that CDOT extend the comment period, publish an updated draft rule in response to public comments, provide a technical memo to demonstrate CDOT's methodology utilized to develop the GHG reduction targets, create a process for regular evaluation of the baselines and GHG reduction targets to reflect changes as they occur between 2021 and 2050, and modify the waiver process to create more certainty and transparency.

CCA appreciates the work that CDOT has devoted to this effort and the staff's willingness to discuss matters of importance to our organization. Thank you for the opportunity to comment in this rulemaking.

[redacted]

cc: Shoshana Lew, Rebecca White, Herman Stockinger, Theresa Takushi

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

RE Greenhouse Gas Emissions Reduction

1 me age

[redacted] Tue, Oct 12, 2021 at 3:11 PM
To: rebecca.white@state.co.us
Cc dot rule @ tate co u

Hi Rebecca,

I recently was at a meeting with you regarding the state's new Greenhouse gas reduction initiatives and CDOT's role in that.

Like most Coloradan (and U.S. citizens), I agree that vehicle travel on roads is among the heaviest contributors to the heat-trapping gases that play a crucial role in warming the Earth's climate Therefore I applaud your greenhouse gas reduction initiatives. I sincerely do.

However, I would like to suggest that reducing greenhouse gas emissions goes well beyond just new CDOT projects.

I would suggest that one of the best ways to reduce greenhouse gas emissions would be to simply better coordinate traffic signals on state highways.

One can travel down any metro area state highway – Colorado Blvd, 6th Avenue in Aurora, Colfax, Parker Road, Wadsworth etc., and the lights are so un-coordinated it's almost laughable. When the light in front of you turns red, you know yours is about to turn green, even when you are traveling the posted speed limit.

As such, you sit at each traffic light for prolonged periods spewing out climate-harming emissions. When I have asked about this before I have heard every excuse from traffic volumes to invisible pedestrians pressing the crosswalk signal getting the light uncoordinated.

For a city and state trying to paint itself as this fantastic eco-friendly place, this traffic light situation kind of blows holes in that theory. Sitting for prolonged periods at every red traffic light is no better for the climate than sitting in gridlock on an Interstate. If your truly serious about wanting to reduce greenhouse gas emissions it really does not matter what the e cuse is this is a problem that needs to be fi ed

Coordinating the traffic lights would help dramatically achieve the greenhouse positive results you're trying to attain and help tremendously in this state's speeding issues.

From folks I have spoken with, their speeding results from:

1. Trying to make up all of their lost time sitting at every red traffic light that CDOT is unable (or unwilling?) to coordinate.

2. Trying to be the eco-conscious person CDOT and State want's them to become by making it through the next light down the road before it turns red Thus being one less red light they must sit at spewing out their climate harming emissions.

If CDOT and the state are sincere in their desire to reduce Greenhouse gas emissions, then coordinating traffic lights has to play a role in this effort. Until that is done, it's clear that there is no sincerity in the desire to attain the outcome you and the state proclaim you are after.

I appreciate your consideration of this.

Respectfully,

[redacted]

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

GHG Transportation Planning Standard

1 me age

[redacted] Tue, Oct 12, 2021 at 2:33 PM
To: dot_rules@state.co.us

I applaud thi effort to addre the climate and air pollution impact of our tran portation y tem, but I fear the propo ed rule do not meet the urgency of the moment I am concerned that the reliance on imperfect predictive model will allow u to largely continue doing bu ine a u ual By the time we find that highway e pan ion have increa ed air pollution and greenhou e ga emi ion , it will be too late to mitigate them Rather than mitigating the harm of our tran portation y tem, we hould aim to avoid the harm to begin with

Ju t a we are not permitting new coal burning power plant , we hould not be permitting new highway e pan ion through our urban corridor that we know will increa e air pollution, greenhou e ga emi ion and re piratory illne Highway e pan ion already being planned uch a I 25 through the Sun Valley neighborhood and I 270 through Commerce City mu t not e cape crutiny under the e greenhou e ga reduction rule Fund for tho e project hould be redirected to infra tructure that reduce air pollution and VMT and imultaneou ly improve the live of Di proportionately Impacted Communitie

A both a GHG reduction trategy and equity i ue, CDOT' 10 year plan hould be amended to give the ame priority to urban arterial and tate highway a it doe to rural road and inter tate highway In thi pirit, the metro Denver bu rapid tran it network hould be funded thi decade Thi priority would be a key trategy to reduce VMT and GHG emi ion in the near term and would provide crucial mobility option to environmental ju tice communitie

Lastly, I would like to address the CDOT briefing memo from July 13th stating that GHG rulemaking will abandon the 10% VMT reduction goal as modeled by Colorado's Greenhouse Gas Reduction Roadmap. The memo emphasizes other solutions such as the employee trip reduction program that has already been cancelled. It is clear that without reducing VMT this decade we will simply not attain the air pollution and greenhouse gas reductions necessary for a livable climate. Furthermore, if we do not achieve the ambitious EV goals set forth in the roadmap, VMT mandates will need to be ratcheted up accordingly. I urge the transportation commission to ensure that all CDOT and MPO plans are consistent with this reduction in VMT.

[redacted]

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

2 CCR 601-22 - Written Comment

1 me age

[redacted] Tue, Oct 12, 2021 at 2:06 PM
To: dot_rules@state.co.us

The commi ion' propo al "to e tabli h greenhou e ga (GHG) pollution reduction planning level for tran portation that will improve air quality, reduce smog, and provide more sustainable options for travelers across Colorado" is admirable and well needed.

Colorado driver adopting EV to replace their internal combu tion engine car will be a major, if not the primary, contributor to reducing transportation based GHG emissions within the state.

A barrier to this adoption is the lack of rapid EV charger stations at a density that will allow EV owners to plan travel with the ame ea e a ga powered vehicle traveler I e , traveler can count on rapid EV charging tation being available in locations in which gasoline is available.

While the question will be what is the necessary density of EV rapid charger stations needed for a given area to reach parity with ga oline availability a pre ent day plan hould be put in place by the commi ion to achieve thi goal

Thank you,
[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Sustainability in Transportation Letter from Cyclists 4 Community

1 me age

[redacted] Tue, Oct 12, 2021 at 1:27 PM
To: dot_rules@state.co.us, theresa.takushi@state.co.us

Dear M Taku hi and/or Whom It May Concern

Please see the attached letter stating the position of Cyclists 4 Community, 501c3 in regards to Sustainability in Transportation and GHG rulemaking.

Thank you in advance for attending to this topic.

[redacted]

GHG Planning Standard Draft Letter of Support for C4C_PDF.pdf
34K

Dear Ms. Theresa Takushi,

Cyclists 4 Community would like to thank CDOT and the State of Colorado for acknowledging the climate crisis and would like to offer our support for the proposed Greenhouse Gas Transportation Planning Standard. To meet Colorado's greenhouse gas (GHG) reduction targets, urgent action is needed, and we are pleased to see CDOT's leadership in this regard. Given the magnitude of the climate crisis, we urge CDOT to pursue the greatest possible GHG reductions being considered for this rule and keep the standard at 1.5 million metric tons of CO_2 reduction.

As Colorado's private automobile fleet is many years away from being 100% electric and since our electricity generation is many years away from being 100% renewable; achieving the GHG reductions mandated by this rule will out of necessity include a reduction in driving or reduction in vehicle miles traveled (VMT). Given the many other positive outcomes that reducing VMT will lead to such as improved safety on our roadways, especially for cyclists, decreased air pollution, and decreased congestion; we support the focus on reducing driving in addition to electrification.

Improving safety for people riding bikes is part of Cyclists 4 Community's core mission and we are excited that this rulemaking will lead to additional funding being made available for bicycle, pedestrian, and safety improvements. Additionally, projects that maintain our existing infrastructure should be a much higher priority than projects that increase vehicle capacity such as expanded interstates, highways, interchanges, etc.

We would like to offer several suggested revisions to further improve the draft rule which we have detailed below. We are disturbed by the proposed waiver process and its allowance to undo the benefits of this rule. If in a state of non-compliance, waivers to use federal transportation funds on non-GHG-reducing projects should only be granted to GHG-neutral projects, preferably only safety improvements. In a state of non-compliance, it adds to harmful outcomes to grant waivers for capacity projects that continue the status quo.

We applaud CDOT for acknowledging the phenomenon of induced demand but urge CDOT to acknowledge that induced demand is caused by a far broader range of projects beyond just additional general-purpose lane miles. In addition to adding lane miles, everything else we do to make driving easier – including additional turn lanes and auxiliary lanes – adds capacity and thereby causes people to drive more miles. "Operations" projects which address bottlenecks or chokepoints must be recognized for the increased capacity they provide. Any project that makes it easier to drive must be recognized as a capacity project which, through induced demand, will lead to increased VMT and increased GHG emissions. Accurate modeling of these projects is essential for this rulemaking to be effective.

Again, thank you for the opportunity to provide comments on the draft rule, for your public process and for advancing this necessary change that can decrease Colorado's contribution to global warming.

Sincerely,

[redacted]

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

350CO Comment on Proposed Rules

1 me age

[redacted] Tue, Oct 12, 2021 at 12:40 PM
To: dot_rules@state.co.us

Hello,

350 Colorado respectfully submits the attached comment for review by the Transportation Commission of CDOT.

We greatly appreciate the work that ha gone into the development of thi novel rule, and ugge t everal improvement that should be made to the rule to give 350CO confidence that it will result in equitable emissions reductions from the transportation sector at appropriate speed and scale.

Sincerely,

[redacted]

[redacted]

[redacted]RulemakingComment.pdf
153K

BEFORE THE COLORADO TRANSPORTATION COMMISSION
COLORADO DEPARTMENT TRANSPORTATION

COMMENTS ON RULEMAKING BY 350 COLORADO

IN THE MATTER OF PROPOSED REVISIONS TO 2 CCR 601-22, RULES GOVERNING STATEWIDE TRANSPORTATION PLANNING PROCESS AND TRANSPORTATION PLANNING REGIONS

October 10, 2021

350 Colorado ("350CO") respectfully submits the following comment on the Colorado Department of Transportation's (CDOT's) draft Greenhouse Gas (GHG) Transportation Planning Standard (TPS).

350CO is a 501(c)3 non-profit, non-partisan and non-governmental organization with a mission to work locally towards building a global grassroots movement to solve the climate crisis and accelerate the transition to a sustainable future. We have over 20,000 members statewide working to address the root causes of the climate crisis and to promote equitable and lasting solutions. Many of our members reside in ozone nonattainment areas or are disproportionately impacted by climate change and the pollution associated with greenhouse gas emissions.

COMMENTS ON CDOT'S PROPOSAL

We greatly appreciate the work of CDOT staff to develop a novel framework for encouraging transportation sector emissions reductions. This comment is submitted with the aim of constructively contributing to the policy development process.

Coloradans and society at large currently face a 'code red' climate emergency. The emissions trajectory of the global economy is projected to raise Earth's temperature by an average of 2.7°C above pre-industrial temperatures by 2100. The impacts of this level of warming would be catastrophic[1]. Urgent greenhouse gas (GHG) reductions are needed this decade for averting the severe future climate change scenarios that we are on track to experience. The Transportation Commission (the Commission) of CDOT has direct influence over our state's emissions trajectory, and therefore, a grave responsibility to ensure swift reductions are achieved to avert

[1]The Economist. (2021, July 24). *Three Degrees of global warming is quite plausible and truly disastrous*. Link

the worst of climate change. 350 Colorado calls on the Commission to, in the words of Greta Thunberg, “act as if our house is on fire, because it is”.

We believe it is critically important that the Commission embrace the most ambitious, equitable, and enforceable version of the GHG TPS rule. We cannot afford an ineffective rule that fails to drive emissions reductions this decade. **To be effective, the draft should target more substantial emissions reductions, establish concrete VMT reduction goals, improve equity provisions, eliminate potential waiver loopholes, require transparent modeling, and establish a moratorium on highway expansion projects.** Without these improvements, we are not confident that this rule will equitably reduce Colorado’s transportation sector emissions at appropriate speed and scale.

The following sections lay out specific suggestions for how we believe the draft rule can be improved:

1. Increase ambition of GHG reduction targets to account for inevitable shortfalls of other planned reductions.

The draft GHG TPS rule targets a 1.5 MMT (million metric ton) reduction in CO2e from the transportation sector by 2030. This 1.5 MMT reduction from transportation planning represents a small fraction of the 12.7 MMT reduction from the transportation sector by 2030 target outlined in the state’s GHG Pollution Reduction Roadmap[2] (the Roadmap). Evidently, the GHG TPS rule is intended to compliment other emission reduction strategies, including a 6 MMT reduction from existing low and zero emissions vehicles and a supposed 2 MMT reduction from light-duty fleet turnover and investments in electric vehicle (EV) infrastructure[3]. How these strategies ultimately play out remains an open question. It’s quite possible that the nearly 1 million EVs by 2030 target underlying the 6 MMT reduction from low and zero emissions vehicles will not be met. This uncertainty in the total emissions reduced under current and proposed rules is concerning given what is at stake for Colorado and our global climate. We cannot afford to come up short of the emissions reductions that are required by law by HB19-1261.

Further, what is more concerning still is the reality that all current and proposed rules combined will leave a substantial gap between statewide reductions from transportation by 2030 and the 12.7 MMT target in the Roadmap. **Thus, we urge the Commission to substantially increase the size and scope of the GHG TPS rule, to achieve a minimum 2 MMT reduction by 2030**

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[2] Office of the Governor of Colorado, Colorado Greenhouse Gas Pollution Reduction Roadmap (Jan 14, 2021).

[3] Colorado Dept. of Transportation. (2021, August 30). *Greenhouse Gas Pollution Reduction Standard for Transportation Planning Frequently Asked Questions*. Link

and to strive for a 3 MMT reduction to account for shortfalls in other programs – many of which (like an indirect source rule from the AQCC) have yet to be developed.

The most equitable way to reduce transportation emissions is to expand multimodal travel opportunities. Yet, it's evident in the transit modeling that is going into this rulemaking that CDOT is only projecting a 6% annual increase in transit service from 2022-2030, then only 1% per year after that[4]. CDOT also assumes that 75% of future housing growth from 2023 to 2045 will occur in mixed use areas for DRCOG, but there are no future policies in place to either encourage or mandate this happening[5].

2. Reopen the TIPS and STIPS to ensure that investments made over the next several years are aligned with emissions reduction targets.

Lastly, we echo the concerns of others that by not reopening TIPs and STIPs, CDOT is delaying emissions reductions that are absolutely necessary for meeting our 2025 and 2030 emissions reduction targets. By failing to reopen these critical transportation planning processes that will guide investments over the next several years so the plans can be made to comply with emission reduction targets, we are losing precious opportunities to drive low-carbon investments now that will determine the carbon intensity of our transportation system for decades to come.

Failing to assess the carbon-intensity of projects in the strategic project pipeline and prioritize the flow of investment to low-carbon projects will lock in unnecessary emissions in this critical decade when we must see substantial emissions reductions.

3. Improve equity provisions to secure 'distributive justice'.

As a matter of environmental justice, DICs and communities of color must have a seat at the table for all decision-making processes to ensure their views are heard and that access to affordable, multimodal, transportation options that reduce toxic air pollution and traffic congestion are actually delivered. In addition to the bare minimum of achieving "procedural justice" by including DICs in decision making processes, this rule must also achieve concrete reductions in pollution in Colorado's communities that have been breathing heavy air pollution for far too long. If this rule results in more words and plans but fails to reduce air pollution in Colorado's DICs, then the rule will be a failure.

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[4] Colorado Dept. of Transportation. (2021, August 31). *Cost-benefit analysis for rules governing statewide transportation planning*. (p. 15) Link

[5] Colorado Dept. of Transportation. (2021, August 31). *Cost-benefit analysis for rules governing statewide transportation planning*. (p. 21) Link

The draft rules do not go far enough to target investments in Colorado's Disproportionately Impacted Communities (DICs), to ensure they benefit from transportation improvement planning (TIP) and GHG mitigation measures implemented under the rule. To improve the rule, the Commission could stipulate that a significant percentage (around 40%) of TIP projects be allocated towards improvements in DICs, which exist in every MPO across the state. Whatever the percentage of funds allocated towards DICs, which may be different for each MPO, it should significantly exceed the percentage of the MPO's population that is classified as a DIC. For instance, if 30% of the population of a given MPO is classified as a member of a DIC, then that MPO should allocate significantly more than 30% of its transportation funds towards DICs in order to remedy decades of disinvestment, neglect, and environmental racism.

Equity provisions for DICs could also require the Commission and MPOs to implement transportation plans that reduce air pollution and increase equitable access to multimodal transit options within DICs — that consistently suffer from worse air quality, higher rates of childhood asthma, higher COVID-19 hospitalization rates[6], and many other pollution-related ailments.

350 Colorado supports the addition of Definition 1.12 – Disproportionately Impacted Communities – in the GHG TPS. However, the definition of DICs in the TPS rule falls short of that defined by HB21-1266: Environmental Justice Disproportionate Impacted Community – which includes a provision for state agencies (such as the Transportation Commission) to designate a community as a DIC, "if: The community has a history of environmental racism perpetuated through redlining, anti-Indigenous, anti-immigrant, anti-Hispanic, or anti-Black laws; or the community is one where multiple factors, including socioeconomic stressors, disproportionate environmental burdens, vulnerability to environmental degradation, and lack of public participation, may act cumulatively to affect health and the environment and contribute to persistent disparities."[7] Therefore, we request the above provision be added to the draft rules, and that the draft rules affirm the TC's authority to designate DICs for the purpose of GHG transportation planning.

4. Expand the scope of the rule by including VMT reduction targets and HFCS as a regulated greenhouse gas

In addition to specifying GHG reduction targets in Table 1 that transportation plans must achieve, the rule should also specify VMT reduction targets in line with the Governor's Roadmap. Transportation plans should require that concrete VMT budgets are met, and these VMT reductions must be intensified if we fail to meet our ambitious EV adoption goals. A 10% reduction in VMT by 2030 is a minimum standard to be met. According to research published in

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[6] Weis, K. (2021, September 23). *Hispanic neighborhoods in Denver metro area with high COVID hospitalizations consistently have poorer air quality*. CBS Denver. Link

[7] Colorado Revised Statute §24-4-109 (2)(b)(II). Link

the journal Environmental Research, without government policy to buy back gas vehicles, in order to have a 100% electric vehicle grid by 2050, the last year to allow ICE vehicle sales should have been 2020[8]. Without policies to reduce driving, Colorado's short term goal of a 50% reduction in GHGs by 2030 and a longer term goal of 90% by 2050 will be impossible to meet. A more aggressive target would challenge the commission and MPOs to prioritize not only GHG reductions but also changes in travel behavior that inevitably lead to less traffic congestion, lower emissions of co-pollutants, fewer traffic accidents, and better health.

Further, the draft rules define a greenhouse gas as "carbon dioxide, methane, and nitrous oxide" while excluding hydrofluorocarbons (HFCs). However, the US EPA recognizes that HFCs are extremely potent GHGs[9] with 100-year Global Warming Potentials (GWPs) ranging from 124 to 14,800 times that of CO2 according to the IPCC's 2018 AR4-WG1 Report.[10] Thus, unless otherwise accounted for, HFCs should be included in the definition of 'Greenhouse Gas' specified in section 1.17 of the draft rules.

5. Close loophole by tightening the conditions upon which waivers are granted

At present, section 8.05.02 of the draft rules stipulate the conditions under which waivers may be granted to planning agencies that exempt specific projects from the emissions reductions requirements. Where possible, the language should be tightened to eliminate discretion so that the waiver process does not create a loophole that can be gamed to receive approval for ghg-intensive projects. Highway expansions already being planned such as I-25 through the Sun Valley neighborhood and I-270 through Commerce City should not escape scrutiny under these greenhouse reduction rules.

Current and future waivers and permits should be re-evaluated to adhere to the new transportation planning standard, and no waiver should be granted for any project irreconcilably beyond compliance. At most, only a single waiver should be granted for a given project, and all waiver should be temporary while additional mitigation measures are identified to bring said project into compliance. All other conditions for waivers must be strictly defined and supported by data, e.g. a safety waiver must be supported with relevant safety data to be approved.

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[8]Alarfaj, A. F., Griffin, W. M., & Samaras, C. (2020). Decarbonizing US passenger vehicle transport under electrification and automation uncertainty has a travel budget. *Environmental Research Letters*, *15*(9), 0940c2. https://doi.org/10.1088/1748-9326/ab7c89

[9]Environmental Protection Agency. (n.d.). *Sources of Greenhouse Gas Emissions*. Transportation Sector Emissions, EPA. Retrieved October 5, 2021, Link

[10]Intergovernmental Panel on Climate Change (IPCC) (2018) AR4-WG1 Report, see: Table 2.14. Link

6. Require Transparent Modeling

Transportation models, assumptions, estimates and figures used to guide transportation policy by CDOT must be transparent for the public to meaningfully engage in decision making processes that impact their health, traffic patterns, and our state's GHG emissions. Both the transportation behavior and the transportation emissions models have limitations that must be clearly conveyed to both policymakers and members of the public. All pertinent modeling assumptions should be clearly documented, in order for members of the public to have confidence that model results accurately reflect the GHG emissions that a particular project or mitigation measure would emit or prevent.

Transparent modeling is critical to an open dialogue with the public, and would lead to greater trust between transportation planning agencies and the communities that have historically borne disproportionate burdens on public health, economic opportunity, and quality of life as a result of redlining and environmental racism. Specifically, we request that draft rule rule 8.02.2 be amended to require that the intergovernmental agreement outlining how modeling is to happen be made public well in advance of being finalized. Doing so would allow independent modeling experts and members of the public to review these assumptions and engage in constructive dialogue to improve the effort.

7. Put an end to highway expansions in urban areas

CDOT should enact a moratorium on highway expansions through urban neighborhoods. Just as we are not permitting new coal-fired power plants, we should not be permitting new highway expansions that we know will increase GHG emissions, air pollution and respiratory illness. Specifically, this moratorium should apply to I-270 and I-25 expansions currently being planned, as such projects will almost certainly increase VMT and exacerbate the inequity of air pollution for DICs in close proximity.

Instead of more highway expansion projects, Coloradans need more and better transportation alternatives to driving a vehicle — like electric bicycles for shorter trips, affordable and efficient public transit for longer trips, expanded light rail and bus rapid transit along major routes, and better land use decisions to provide more bike lanes, sidewalks, and pedestrian-centric urban centers.

CONCLUSION

The direction the Transportation Commission takes in this rulemaking period is of paramount importance for the current and future conditions of public health, economic interest and the necessary movements towards distributive and procedural environmental justice in our state. These decisions will have far-reaching implications for climate justice globally. 350 Colorado recognizes the novel, admirable work that CDOT staff is undertaking in limiting GHG emissions from the transportation sector. Our staff and community of volunteers across Colorado appreciate the opportunity to participate in the rulemaking process by providing detailed guidance on how to achieve and enhance the goals set by HB19-1261. However, these legally binding goals are neither achievable nor enforceable without the following provisions to the draft rules:

- A substantial increase in the size and scope of the GHG TPS rule, accomplishing a minimum 2 MMT reduction by 2030 and striving for a 3 MMT reduction. This is achieved through expanding multimodal travel opportunities.
- Transportation plans should require that concrete VMT budgets are met, and these VMT reductions must be intensified if EV adoption goals fail. A 10% reduction in VMT by 2030 is a minimum standard to be met. Additionally, HFCs must be included in the draft rule's definition of a GHG.
- An Improvement in equity provisions by including DICs in TIP and GHG mitigation measures as a matter of procedural environmental justice.
- Current and future waivers and permits to the rules should be re-evaluated to adhere to the new guidelines. No waiver should be granted for any project irreconcilably beyond compliance.
- An amendment to draft rule rule 8.02.2 to require that the intergovernmental agreement outlining modeling should be made public in advance of being finalized for greater transparency.
- The enactment of a moratorium on highway expansion projects while providing greater transportation options beyond personal internal combustion engine vehicles for journeys of all durations.

Submitted by 350CO on October 12th, 2021

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STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

GHG Rulemaking Comments

1 me age

[redacted] Mon, Oct 11, 2021 at 2:44 PM
To: "DOT_Rules@state.co.us" <DOT_Rules@state.co.us>
Cc "White CDOT, Rebecca" rebecca white@ tate co u , [redacted]

Good afternoon,

Please see the attached letter and redline which presents the substantive comments of the North Front Range Metropolitan Planning Organization (NFRMPO) on the Transportation Commission's (TC's) proposed revision to the Rules Governing Statewide Transportation Planning Process and Transportation Planning Regions.

I'd like to highlight one element of the letter, which is the NFRMPO's gratitude for all the time and effort CDOT staff have devoted to thi rulemaking, e pecially for the countle hour pent reviewing and an wering our que tion We really appreciate it!

Thank you,

[redacted]

North Front Range Metropolitan Planning Organization

[redacted]

NFRMPO GHG Comment Letter Final - signed.pdf
1701K

North Front Range Metropolitan Planning Organization

Date: October 11, 2021

To: Director Shoshana Lew, Hearing Officers Andrew Hogle and Christine Reece, and

Transportation Commissioners (via email to dot_rules@state.co.us)

From: North Front Range Metropolitan Planning Organization (NFRMPO)

Re: NFRMPO Comments on the Proposed GHG Rule

Introduction

Thank you for the opportunity to submit comments on the Transportation Commission's (TC's) proposed revision to the Rules Governing Statewide Transportation Planning Process and Transportation Planning Regions which identifies a process for addressing greenhouse gas (GHG) emissions and sets GHG standards for transportation plans. The North Front Range Transportation & Air Quality Planning Council, also known as the NFRMPO, is comprised of 15 elected officials representing portions of Larimer and Weld counties. As a Metropolitan Planning Organization (MPO), the NFRMPO will be responsible for demonstrating compliance with the proposed rule and NFRMPO staff have engaged extensively in the stakeholder process conducted by the Colorado Department of Transportation (CDOT) that began in January 2021. This comment letter presents the substantive comments of the NFRMPO on the GHG rule, which supplements comments submitted previously by the NFRMPO on September 8, 2021, and September 13, 2021.

The substantive comments presented below are not as comprehensive as they could be due to the inability to review two requested datasets. As explained in the comment letter submitted by the NFRMPO on September 13, 2021, there are four datasets that should be released during the public comment period to allow fully informed decision making and meaningful stakeholder involvement, all of which had been requested by the NFRMPO in July and/or August, prior to sending the letter. Several of the requested datasets have subsequently been provided to the NFRMPO; however, corrections to the GHG Reduction Levels and the technical report describing the modeling process have still not been provided.[1] As such, **the NFRMPO continues to recommend an extension of the public comment period** to provide at least 30 days of public comment past the delivery of requested datasets to allow for the submission of data-driven comments and development of a data-driven rule.

The NFRMPO strongly supports development of a data-driven, feasible, and effective rule to reduce GHG emissions resulting from implementation of transportation plans. The remainder of this comment letter is organized into two sections: Rule Context, which provides background on understanding the rule and the NFRMPO's recommendations, and Recommended Improvements, which identifies 13

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[1] The reasons both datasets are important for developing data-driven comments are described in the NFRMPO's comment letter dated September 13, 2021, which is available on pages 61-63 at https://www.codot.gov/business/rules/documents/redacted-written-comment_ghg-pollution-standard.pdf.

[redacted]

recommendations for improving the rule. Please see the attached redline for the NFRMPO's specific wording suggestions for the GHG rule.

Rule Context

To develop a data-driven, feasible, and effective rule, it is important to understand the context of the rule. The following three fundamental concepts should inform the GHG rulemaking process and are explained further below:

1. Importance of developing a clearly written, procedurally sound GHG rule
2. Amount of emission reductions from the GHG Rule needed to achieve State GHG goals
3. The role of vehicle miles traveled (VMT)

For additional information on the provisions of the proposed rule and analysis of relevant datasets informing the NFRMPO's recommendations, recordings of three presentations by NFRMPO staff are available at https://nfrmpo.org/air-quality/ghg-rulemaking/. These recordings are available as a resource for decision makers and stakeholders who wish to develop a greater understanding of the proposed rule and its implications.

1. Importance of developing a clearly written, procedurally sound GHG rule

Rulemakings are significant undertakings that set regulations permanently unless a sunset provision is included. Once a regulation is in place, modification requires initiating a new rulemaking process, which takes substantial time and effort. Regulations may have associated policy documents, such as procedural directives and/or policy directives, to guide implementation and clarify processes, but it is important for rules to provide a clear framework that can stand the test of time. Rulemakings receive higher public scrutiny than associated policy documents and should address any contentious issues through the public rulemaking process rather than delegating those issues to supporting documents. Due to the permanence of regulations, many different staff members and Transportation Commissioners will be involved in implementing the proposed rule. By ensuring the rule is clear and procedurally sound, there is a greater likelihood of implementing the rule as envisioned by the TC.

2. Amount of emission reductions from the GHG Rule needed to achieve State GHG goals

The proposed rule under consideration by the TC is identified in the State's GHG Pollution Reduction Roadmap ("GHG Roadmap")[2] as one of seven near term strategies to reduce GHG emissions from the transportation sector. To achieve the State's statutory goal of cutting GHG emissions 50 percent by 2030, the GHG Roadmap proposed the transportation sector reduce GHG emissions by 12.7 million metric tons (MMT) in 2030. Fleet turnover and transportation electrification is expected to reduce GHG emissions by 8 MMT in 2030, leaving a GHG reductions gap of 4.7 MMT.

[2] Colorado Greenhouse Gas Pollution Reduction Roadmap, 1/14/2021, accessed on 10/4/2021 at https://drive.google.com/file/d/1jzLvFcrDryhhs9ZkT_UXkQM_0LiiYZfq/view.

The status of six of the seven near-term transportation strategies is identified in **Table 1**, as presented by the Colorado Energy Office (CEO) and Air Pollution Control Division (APCD).[3] Collectively, the strategies are intended to reduce GHG emissions by 4.7 MMT in 2030; there is no single strategy that is intended to close the gap on its own. Because the strategies are being developed through independent processes with varying timelines, it can be challenging to determine how much GHG emissions each strategy should be designed to reduce. It is vitally important that each strategy be designed to be feasible and cost effective so that it can successfully produce reductions in GHG emissions. If, however, a strategy is designed to reduce GHG emissions by an unachievably high amount, the likelihood of failing to meet the State's statutory GHG reduction goal could increase.

Based on Colorado's GHG Roadmap, there is no specific amount of GHG reductions that need to be achieved by this proposed rule to meet the State's GHG reduction goals. Designing the rule to be feasible and cost effective is the best way to support the State's GHG reduction goals.

Table 1: Status of GHG Roadmap's Transportation Sector Near Term Actions Intended to Reduce GHG Emissions by 4.7 MMT in 2030

Near Term Actions	**Status**
GHG Pollution Standards for transportation plans	In progress - CDOT TC Rulemaking – hearing 11/2021
Incentivize land use to increase housing near jobs and reduce VMT and pollution	HB 21-1271, HB 21-1117; CDOT stakeholder process; interim affordable housing committee
Clean trucking strategy - infrastructure, fleet incentives, consider regulatory tools such as advanced clean trucks and fleet rules	In progress - Study to be released October 2021 Stakeholder Engagement – Summer/Fall 2021; fleet investments from SB21-260
Participate in developing post 2025 vehicle standards (state and federal)	Federal and CARB processes
AQCC evaluation of indirect source rules	RAQC has convened committee to start developing proposals
Expansion of public transit, including setting the stage for Front Range Rail	In progress - SB21-238, SB 21-260, Main Streets investments, on-going multimodal emphasis

Source: Adapted from CEO and APCD presentation to the Air Quality Control Commission (AQCC) on 9/17/2021, accessed on 9/23/2021 from https://drive.google.com/drive/folders/1q91ZWsWD8KHvODzflOoSq5gKTOw_O2MJ. (See Slide 21)

3. The role of vehicle miles traveled (VMT)

As explained in the Preamble for the 2021 Rulemaking, SB21-260 requires CDOT and the TC to establish procedures and guidelines "to account for the impacts of transportation capacity projects on GHG pollution and Vehicle Miles Traveled and to help achieve statewide GHG pollution targets established in § 25-7-102(2)(g), C.R.S."[4] It is important to note SB21-260 has distinct requirements regarding GHG

[3] The seventh strategy, omitted from the table, is the Commute Trip Reduction Program, which was dismissed from an AQCC rulemaking in August 2021 but is currently being explored as a voluntary program.

[4] Preamble for 2021 Rulemaking, Rules Governing Statewide Transportation Planning Process and Transportation Planning Regions, https://www.codot.gov/business/rules/documents/2-ccr-601-22_redline_8-13-21.pdf.

emissions and vehicle miles traveled (VMT) for the TC's procedures and guidelines. For GHG emissions, SB21-260 requires a *reduction* in GHG emissions to help achieve the statewide pollution targets. For VMT, SB21-260 requires an *accounting* of the impact of capacity projects on VMT; it does not require reductions in VMT.

Vehicle Miles Traveled (VMT) plays an important role in determining the amount of greenhouse gas emissions from transportation, but it is not the only factor. As explained in FHWA's "Handbook for Estimating Transportation Greenhouse Gases for Integration into the Planning Process" ("FHWA Handbook"), GHG emissions from each mile of travel vary based on vehicle type, classes within vehicle types, technology/fuel type, speeds, and operating conditions.[5] On a mile for mile basis, a transportation system with more congestion, starts and stops, and vehicle idling will have higher GHG emissions than a system with less congestion, starts and stops, and vehicle idling. Improving system operations, such as through Intelligent Transportation Systems (ITS), can provide net reductions in GHG emissions without reducing VMT.

As required by SB21-260, the proposed rule establishes targets for GHG emissions reductions. The proposed rule does not establish targets for VMT reductions, nor should it. However, the Cost-Benefit Analysis (CBA) inaccurately portrays the proposed rule as a VMT-reduction rule instead of as a GHG-reduction rule. The CBA states "CDOT developed illustrative policy choice packages that assume implementation of three broad categories of VMT reduction measures."[6] However, included in those measures is the electrification of buses, which is not a VMT-reduction measure. The CBA states the "costs and benefits of bus electrification are not considered here, since bus electrification is not a VMT reduction measure." In fact, the benefits of bus electrification are incorporated into the scenario used to set the GHG Reduction Levels, as evidenced by the GHG emissions reductions reported in Table A.15 of the CBA which match the emissions reductions reported in the CDOT presentation dated July 13, 2021.[7] Even though the benefits of bus electrification are included, the additional cost of purchasing electric buses are not considered, resulting in an incomplete assessment of the costs of the proposed rule.

Currently, the proposed rule includes two illustrative examples of GHG Mitigation Measures which reduce GHG through non-VMT strategies, including efforts to accelerate truck electrification in §8.03.7 and clean construction policies in §8.03.8. The rule would be strengthened by considering the full range of strategies available to CDOT and MPOs to reduce GHG emissions from transportation, including other types of fleet improvements such as alternative fuel transit buses, improving system operations through ITS, and any other type of operations improvement that results in reduced greenhouse gas emissions.

[5] FHWA, "Handbook for Estimating Transportation Greenhouse Gases for Integration into the Planning Process," 2013, accessed on 10/4/2021 at https://www.fhwa.dot.gov/environment/sustainability/energy/publications/ghg_handbook/ghghandbook.pdf.

[5] CDOT, Cost-Benefit Analysis For Rules Governing Statewide Planning, 8/31/2021, accessed on 10/4/2021 at https://www.codot.gov/business/rules/documents/cdot-cost-benefit-analysis-for-ghg-rule-sept-2021.pdf.

[7] Permanent Rulemaking Exhibits, "Rules Governing Statewide Transportation Planning Process and Transportation Planning Regions," GHG Pollution Standard GHG Reduction Targets & GHG Policy Paper, 7/13/2021, Exhibit 8, accessed on 10/4/2021 at https://www.codot.gov/business/rules/documents/00_2ccr60122_exhibits_redacted.pdf, See pages 270-278.

The Clean Air Act (CAA) identifies a wide range of transportation strategies that reduce emissions. The CAA includes 16 strategies, called Transportation Control Measures (TCMs), which reduce emissions by one of three mechanisms:

- reducing VMT (e.g. trip-reduction ordinances, improved public transit),
- improving operations (e.g. programs to control extended idling in vehicles, traffic flow improvement programs that achieve emission reductions), or
- fleet improvements (e.g. programs to voluntarily remove pre-1980 vehicles from use).[8]

As with the CAA, the GHG rule should allow for a wide range of effective strategies and not restrict the GHG Mitigation Measures or the strategies informing the GHG Reduction Levels to only those that reduce GHG through VMT reductions. As explained above, the rule already incorporates non-VMT reducing strategies into both the GHG Mitigation Measures and GHG Reduction Levels; however, there are additional non-VMT strategies such as operations improvements that should also be included. For more information on this topic, please see Recommendation #7 on page 10 of this comment letter.

Recommended Improvements

The NFRMPO offers the following recommendations for improving the clarity, effectiveness, and feasibility of the proposed rule, each of which are explained further below:

1. Remove or Update GHG Baselines
2. Set Per Capita GHG Reduction Levels
3. Develop Practicable GHG Reduction Levels
4. Correct Errors in GHG Reduction Levels
5. Require Reassessment of GHG Reduction Levels
6. Expand Implementers of GHG Mitigation Measures
7. Include Operations Strategies in the GHG Mitigation Measures
8. Require a Vote of the TC to Deny Waiver and Reconsideration Requests
9. Remove or Modify Requirement for TIPs
10. Remove Restrictions on CMAQ-Funded Projects
11. Allow Non-Regionally Significant Projects Funded with STBG to Proceed
12. Additional Clarifications to Processes
13. Clarify and Update Assumptions in the Cost-Benefit Analysis

The attached redline provides the specific wording suggestions for many of the recommended improvements, including Recommendations #5-#8 and #10-#12. The remaining recommendations are not included in the attached redline because they either require additional analysis to update the GHG

[8] Clean Air Act, 42 U.S.C. §7408(f) (1990).

emissions values in the rule, have multiple ways of being addressed, or are focused on the CBA. The NFRMPO will work cooperatively with CDOT to clarify and identify solutions for all recommended improvements.

1. Remove or Update GHG Baselines

There are three issues with the GHG Baseline Projections ("baselines") in Table 1 of the proposed rule:

- The baselines are estimated from the statewide travel model for each regional area,
- The baselines do not account for projected electric vehicle (EV) shares, and
- The baselines for each regional area were assigned by their share of statewide vehicle miles traveled (VMT) instead of their share of GHG emissions.

The proposed rule provides valuable flexibility by allowing MPOs to assess compliance with the rule using their own travel model or the statewide travel model. Because different models have different sensitivities, the GHG Baseline Projections should be based on MPO travel models for any MPO that will use its own model to assess compliance, thus allowing for an apples-to-apples comparison. The NFRMPO will be assessing compliance using its in-house travel model for several reasons, including the ability to quickly test different sets of strategies and to ensure the model reflects the latest planning assumptions for the region.

The GHG Baseline Projections do not account for projected EV shares; however, the scenarios used to develop the GHG Reduction Levels do account for projected EV shares[9]. Because of the difference in methodology, it is not possible to subtract the GHG Reduction Level from the GHG Baseline Projection to identify the amount of GHG emissions allowed for each regional area. Incorporation of projected EV shares is fundamental to understanding the amount of GHG emissions that can feasibly be reduced due to changes to transportation plans because transportation systems with higher shares of EVs have lower potential to reduce GHG emissions through project mix revisions. The baselines should account for the projected EV shares that are expected to result from current state requirements for vehicle electrification.

Lastly, the baselines for each regional area should be based on the GHG emissions resulting from each individual area and not based on an approximation assigned based on their share of VMT. Currently, the baselines in Table 1 are based on assigning the statewide GHG emissions estimate to each regional area according to their statewide share of Vehicle Miles Traveled (VMT), which fails to account for the GHG impacts of different operating conditions and fleet mix in each regional area.

Due to the issues listed above, the NFRMPO recommends removing the GHG Baseline Projections from the rule and placing them in a supporting policy document. Alternatively, if the GHG Baseline Projections are retained in the rule, they should be updated to values based on MPO travel models for any MPO that will use its own model to assess compliance, to account for projected EV shares, and to reflect GHG emissions in each regional area. For the NFRMPO, the updated baseline values are 2.35 MMT in 2025, 1.63 MMT in 2030, 1.18 MMT in 2040, and 0.77 MMT in 2050.

[9] To be clear, the projected EV shares do not increase the amount of GHG emissions in the GHG Reduction Levels; instead, they lower the amount of GHG emissions. Efforts to electrify the light duty fleet are anticipated to occur through other State requirements and do not count toward achievement of the GHG Reduction Levels for this rule.

2. Set Per Capita GHG Reduction Levels

The GHG Reduction Levels in Table 1 of the proposed rule were developed based on current MPO boundaries and current projections for population and employment growth, both of which are subject to change. MPOs may choose to expand their planning area or may be required to expand their planning area due to updates to Urbanized Areas after a Decennial Census. Per federal planning requirements, MPOs obtain the latest population and employment growth forecasts prior to updating the long-range transportation plan. The updated forecasts may be higher or lower than the previous forecast.

The NFRMPO recommends the rule account for these two sources of change by setting GHG Reduction Levels on a per capita basis, thus allowing the GHG Reduction Levels to remain relevant regardless of changes to MPO planning area boundaries and growth forecasts. The per capita approach is used in California, under SB 375, which requires MPOs meet GHG reductions in terms of percentage reductions in per capita emissions compared to 2005 levels.[10]

3. Develop Practicable GHG Reduction Levels

The GHG Reduction Levels in the proposed rule were developed from "illustrative policy choice packages"[11] intended to represent feasible reductions related to transportation policy/investment choices available to MPOs and CDOT. Some of the policy choices informing the GHG Reduction Levels include measures that are not within the control of MPOs or CDOT and/or reflect market forces instead of policy choices, such as:

- Changing land use to be more transportation-efficient. According to the CBA, this strategy is "assumed to be achieved mainly through the operation of market forces."[12] In addition to assuming the strategy will be implemented without any substantive policy changes, authority over land use decisions in the State of Colorado belongs to counties and municipalities, not to MPOs or CDOT. While there are some limited opportunities for MPOs and CDOT to encourage adoption of land use and zoning codes to reduce reliance on driving, such as through revised requirements or scoring criteria in Calls for Projects, these efforts should count in the GHG Mitigation Measure process instead of being factored into the GHG Reduction Levels. An additional benefit of removing the land use assumptions from the GHG Reduction Levels is it ensures the benefits from the two land use-related transportation strategies in the GHG Roadmap are not double counted (i.e. Indirect Source Rule and land use incentives).
- Increasing the share of workers teleworking by a factor of 3, from 6.3% to 18.9%. According to the CBA, this strategy "reflect[s] a continuation of trends observed during the COVID pandemic."[13] In addition to assuming the strategy will be implemented without any substantive policy changes, MPOs and CDOT do not have the authority to require employers to offer telework. Instead, the role of MPOs and CDOT is limited to providing information and grants to

[10] California Air Resources Board, "SB 375 Regional Plan Climate Targets", accessed on 10/4/2021 at https://ww2.arb.ca.gov/our-work/programs/sustainable-communities-program/regional-plan-targets.

[11] CDOT, Cost-Benefit Analysis For Rules Governing Statewide Transportation Planning, 8/31/2021, accessed from https://www.codot.gov/business/rules/documents/cdot-cost-benefit-analysis-for-ghg-rule-sept-2021.pdf, page 2.

[12] IBID, page 15.

[13] IBID, page 18.

support telework efforts, the potential impact of which would be much less than tripling telework rates statewide.

- Expanding broadband access from 82.6 percent of households (as of 2019) to 97 percent of households by 2030, thus allowing households with new access to broadband to replace 10 percent of personal business trips such as banking or medical appointments with teletravel. The CBA states this strategy is anticipated to be implemented with federal and State funds and through the efforts of the Colorado Broadband Office.[14]
- Revising State health care regulations to permit or encourage more telehealth visits to the degree feasible and appropriate.[15]
- Expanding transit service by 151 percent between 2019 and 2050[16] (as compared with a population growth forecast of around 50 percent) and reducing transit fares by 50 percent.[17] Strategies to expand transit service and reduce transit fares are more closely related to the strategies available to MPOs and CDOT than the strategies listed above, but there are important caveats. MPOs and CDOT work cooperatively with transit agencies in the metropolitan and statewide planning process, respectively; however, service expansion and transit fare decisions are ultimately determined by each independent transit agency. Providing funding to transit agencies to expand transit service and reduce transit fares is a possibility through CDOT. In contrast, MPOs are severely restricted in the funding they can provide to transit agencies for those two strategies. None of the federal funding programs available through MPOs can provide ongoing transit fare subsidies and none can provide ongoing funding for transit operations.[18]

CDOT developed three scenarios to assess feasible ranges of GHG Reductions. The proposed rule uses the "Travel Choices + Transit + Land Use" scenario to set the GHG Reduction Levels, which is a collectively exhaustive list of all tested strategies, including the strategies listed previously that are assumed to occur through market forces and/or are not within the control of MPOs or CDOT. Instead of using the "Travel Choices + Transit + Land Use" scenario to set the GHG Reduction levels, the NFRMPO recommends setting the GHG Reduction Levels using policies and investment choices available to MPOs and CDOT, not on strategies outside their control or changes anticipated to occur through market forces.

[14] IBID, page 12.
[15] IBID.
[16] IBID, page 20.
[17] Permanent Rulemaking Exhibits, "Rules Governing Statewide Transportation Planning Process and Transportation Planning Regions," GHG Pollution Standard GHG Reduction Targets & GHG Policy Paper, 7/13/2021, Exhibit 8, accessed on 10/4/2021 at https://www.codot.gov/business/rules/documents/00_2ccr60122_exhibits_redacted.pdf, See page 274.
[18] The Congestion Mitigation and Air Quality (CMAQ) program allows intermittent or limited funding for these strategies, including fare subsidies only during ozone action days and transit operations funding for new service for up to five years. The Surface Transportation Block Grant (STBG) program cannot subsidize transit fares or fund transit operations.

4. Correct Errors in GHG Reduction Levels

As explained in the CBA, the GHG Reduction Levels in the proposed rule "assume a high level of electrification of the future vehicle fleet" which results in "absolute GHG reductions from VMT measures [that] are substantially lower in 2050 than in 2030."[19] According to the proposed rule, the light duty fleet is assumed to be 97 percent electric by 2050 (See §8.01.1). With only three percent of light duty vehicles emitting at the tailpipe in 2050, and with the scenario informing the GHG Reduction Levels primarily relying on reductions to light duty VMT, the GHG Reduction Levels for 2050 in each regional area are unreasonably high. Across the state, the 2050 GHG Reduction Levels sum to 0.7 MMT, a reduction value which would require no more than 32 percent of light-duty vehicles to be electric given a light duty VMT reduction of 12 percent.[20]

The unreasonably high GHG Reduction Levels in 2050 and other out years are likely caused, at least in part, by inadvertently applying the reductions in light duty VMT to all vehicle types when transferring the outputs of the travel model into the air quality model. The NFRMPO recommends recalculating the GHG Reduction Levels to ensure they accurately represent emissions reductions given the high percentage of light duty EVs assumed in the future.

5. Require Reassessment of GHG Reduction Levels

No provision is provided in the rule for reassessing the GHG Reduction Levels to determine if they are still feasible. The rule focuses solely on GHG reductions through planning efforts, such as VMT reductions, which are less effective at reducing GHG emissions when vehicle technologies improve.[21] With technology rapidly changing the transportation sector, the GHG Reduction Levels should be regularly reassessed with consideration of factors such as fuel economy standards and EV shares to determine if the planning-related GHG Reduction Levels are feasible.

Regular revisions to GHG targets are a component of California's GHG requirement for MPOs under SB 375. Specifically, the California Air Resources Board (CARB) is required to update the regional GHG targets for MPOs every eight years and has the option of revising the targets every four years.[22]

The NFRMPO recommends the rule should require the GHG Reduction Levels be reassessed at least every four years by the State Interagency Consultation Team to ensure the GHG Reduction Levels are still feasible. In addition, the rule should allow MPOs, CDOT, and the TC to request a feasibility review at any time by the State Interagency Consultation Team, with the State Interagency Consultation Team retaining discretion over which requests to fulfill. Upon completion of a feasibility review, the TC would

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[19] CDOT, Cost-Benefit Analysis For Rules Governing Statewide Transportation Planning, 8/31/2021, accessed from https://www.codot.gov/business/rules/documents/cdot-cost-benefit-analysis-for-ghg-rule-sept-2021.pdf, page 24.

[20] As shown in Table A.11 of the CBA, the Proposed Rule Implementation Scenario reduces light duty VMT by 9,814 million miles in 2050 compared to the 78,587 million miles expected for the baseline scenario in 2050, which corresponds to a 12 percent reduction in VMT.

[21] Consider, for example, the potential GHG emissions resulting from reducing VMT by five percent if the average fuel economy of the fleet is 25 mpg vs an average fuel economy of 50 mpg.

[22] California Air Resources Board, "SB 375 Regional Plan Climate Targets", accessed on 10/4/2021 at https://ww2.arb.ca.gov/our-work/programs/sustainable-communities-program/regional-plan-targets.

have the opportunity to commence a rulemaking to allow the GHG Reduction Levels to potentially be revised.

6. Expand Implementers of GHG Mitigation Measures

The proposed rule defines GHG Mitigation Measures as "non-Regionally Significant Project strategies *implemented by CDOT and MPOs* that reduce transportation GHG pollution" (See §1.19, emphasis added). However, the illustrative examples of GHG Mitigation Measures in §8.03 of the proposed rule include several measures that cannot be implemented by MPOs, such as:

- Adding transit resources to displace VMT (see page 8 of this comment letter),
- Adopting parking policies, and
- Establishing clean construction policies.

The NFRMPO recommends the rule not restrict implementers of GHG Mitigation Measures to only CDOT and MPOs. Many of the illustrative examples of GHG Mitigation Measures are implemented by transit agencies and local governments and the efforts of those entities should count toward the region's transportation GHG emissions reductions targets.

7. Include Operations Strategies in the GHG Mitigation Measures

The illustrative examples of GHG Mitigation Measures in §8.03 of the proposed rule should include representative examples from the full range of strategies available to CDOT and MPOs to reduce GHG emissions from transportation, including operations strategies. As explained on page 4 of this comment letter, the CAA includes operations improvement strategies in the list of TCMs, and the CAA's TCMs should serve as a template and resource for the State's GHG rule.

Specifically, the NFRMPO recommends adding the following example to the illustrative list of GHG Mitigation Measures in §8.03 of the proposed rule:

> "Implementing or encouraging the implementation of operations improvements such as ramp metering, signal timing, intersection improvements, access control plans, anti-idling programs, incident management, and Intelligent Transportation Systems (ITS) strategies that result in GHG reductions."

8. Require a Vote of the TC to Deny Waiver and Reconsideration Requests

If the TC determines the GHG Transportation Report is non-compliant, the proposed rule offers two options for an MPO, CDOT, or TPR in a non-MPO area to request accommodations: waivers and reconsiderations. The waiver option could allow for specific projects not expected to reduce GHG emissions to proceed and the reconsideration option could allow for the TC to reconsider a non-compliance determination.

These two options are important provisions in the proposed rule and should be retained. Currently, the proposed rule allows the TC to deny waiver requests and deny requests for reconsideration without review by the TC and without a vote, simply by not taking up the request (See §8.05.2.3). Instead of allowing automatic denial of such requests through inaction, the NFRMPO recommends the rule require the TC to go on record with a vote to deny waiver and reconsideration requests.

9. Remove or Modify Requirement for TIPs

The proposed rule applies to Transportation Improvement Programs (TIPs) for MPOs in nonattainment areas but it does not apply to the Statewide Transportation Improvement Program (STIP) even though some portions of the non-MPO area are designated as nonattainment areas. To provide consistency in MPO and non-MPO areas, the NFRMPO recommends removing or modifying the requirements for TIPs.

The proposed rule requires a GHG Transportation Report for each applicable planning document, which includes TIPs for MPOs in nonattainment areas. TIPs provide the short-range program of projects, typically covering four years. In accordance with federal requirements, TIPs must be consistent with long-range regional transportation plans (RTP), which means any regionally significant project included in the TIP must also be included in the RTP. It is unclear from the proposed rule if two separate GHG Transportation Reports are required when adopting a TIP and RTP, or if the same report can be used for both documents.

The NFRMPO recommends removing the requirements for TIPs for MPOs in nonattainment areas, which would provide consistency with the approach used for nonattainment areas outside of MPOs. Alternatively, the NFRMPO recommends modifying the requirement to clarify that TIPs consistent with the RTP can rely on the GHG Transportation Report for the associated RTP.

10. Remove Restrictions on CMAQ-Funded Projects

For areas that cannot meet the specified GHG Reduction Levels, the proposed rule would restrict the types of projects eligible for some of the State's 10-Year Plan funds and, if available within the region, the rule would restrict the type of projects eligible for federal funding from the Congestion Mitigation and Air Quality (CMAQ) and Surface Transportation Block Grant (STBG) programs awarded through the MPO.

CMAQ funding is awarded to projects that reduce federally regulated criteria pollutants including carbon monoxide, ozone precursors, and particulate matter. In the NFRMPO, CMAQ funds are often awarded to alternative fuel transit buses, such as electric buses and Compressed Natural Gas (CNG) buses, and to ITS and operations improvements. Based on the current rule language, it is unclear if these project types could receive CMAQ funds in the event the NFRMPO cannot meet the specified GHG Reduction Levels. Importantly, the NFRMPO does not restrict the types of projects that can be submitted for CMAQ funding and uses scoring criteria that emphasize the amount of ozone precursor emissions reductions achieved by the project and the cost effectiveness of those emissions reductions.

With the Denver Metro/North Front Range area designated by the EPA as Nonattainment for ozone, the NFRMPO recommends CMAQ funding should continue to be awarded to projects that most effectively reduce ozone precursors regardless of the region's ability to meet the GHG Reduction Levels specified in the proposed rule.

11. Allow Non-Regionally Significant Projects Funded with STBG to Proceed

As explained in Recommendation #10, the proposed rule imposes restrictions on the types of projects eligible to receive CMAQ, STBG, and some 10-year Plan funds in the event the GHG Reduction Levels cannot be achieved. The 10-Year Plan fund restriction in the proposed rule applies only to regionally significant projects, whereas the CMAQ and STBG restriction applies to all projects. STBG funding is awarded to projects that meet needs identified in the federally required metropolitan planning process, such as safety, mobility, and operations.

The NFRMPO recommends non-regionally significant projects funded with STBG, such as important safety and operations improvements, be able to proceed without a waiver in the event the GHG Reduction Levels cannot be achieved, similar to non-regionally significant projects funded with the State's 10-Year Plan funds.

12. Additional Clarifications to Processes

There are a variety of other process clarifications recommended in the attached redline, including, but not limited to the following:

- Allowing a waiver to be requested at any time, including concurrently with the submission of a GHG Transportation Report.
- Allowing up to sixty (60) days to submit a request for reconsideration instead of thirty (30) days.
- Clarifying which projects are subject to funding restrictions based on project implementation status.
- Allowing conflicts to be resolved through the Governor, similar to the process used in federal air quality conformity.
- Clarifying the timing and requirements of the Mitigation Action Plan.
- Ensuring the APCD Verification is available to the TC.
- Streamlining the Annual Status Report on GHG Mitigation Measures by allowing measures to be grouped.
- Identifying additional responsibilities for the State Interagency Consultation Team.
- Requiring TC Action on GHG Transportation Reports within sixty (60) days, instead of allowing an unlimited time for TC Action.

13. Clarify and Update Assumptions in the Cost-Benefit Analysis

The Cost-Benefit Analysis is an important resource for the proposed rule by providing an explanation of the policy choices included in the scenario selected to set the GHG Reduction levels and by assessing the costs and benefits of the proposed rule. The NFRMPO suggests clarifying the following assumptions in the CBA:

- The CBA identifies the total cost of projects in the five MPOs' long-range plans and CDOT's 10-Year Plan for 2022 through 2050 as $28B in 2021 dollars. This value is well below the sum of expenditures identified in the NFRMPO's 2045 RTP and DRCOG's 2050 RTP, which exceeds $100B. The CBA should clarify which project types were used to calculate the $28B cost. The CBA should also be updated to clarify that long-range plans are federally required to be fiscally constrained and to account for the cost of operations and maintenance.

- Several of the Tables in Appendix A: Detailed Analysis of Economic Benefits and Costs, appear to have sufficient explanations in the associated "basis for cost estimates" section to calculate the costs displayed in the associated table; however, NFRMPO staff have been unsuccessful in calculating the costs displayed in the table using the provided information. In each case, the values calculated by NFRMPO staff using the information in the "basis for cost estimates" result in costs that are 2.4 to 3.7 times higher than the costs displayed in the associated table. The CBA should be updated to clarify the "basis for cost estimates" and/or correct any errors in the identified costs.
- Several of the unit costs appear to be too low and rely on out-of-state or nationwide sources that may not apply to Colorado. For example, the CBA uses a unit cost of $170,000 per mile for new or replaced sidewalk sourced from the Florida Department of Transportation (FDOT). For Colorado, a report from CoPIRG Foundation and Southwest Energy Efficiency Project (SWEEP) identifies costs of $282,691 per mile of new sidewalk and $192,931 per mile of replaced sidewalk.[23]
- The CBA does not account for the costs of transit electrification or the costs of reducing transit fares but still references these strategies as included in the scenarios and therefore in the GHG Reduction Levels. It appears the benefits of transit electrification and reducing transit fares are included in the rule and CBA without accounting for their costs.
- The CBA estimates cost savings from improved safety by assuming fatality and injury motor vehicle crashes are "reduced in proportion to VMT reduced".[24] This assumption fails to consider the alarming increase in traffic fatalities that occurred concurrently with substantial reductions in VMT in 2020. According to the National Highway Traffic Safety Administration, early data indicate traffic fatalities increased 7.2 percent from 2019 to 2020 in the U.S. even as VMT decreased by an estimated 13.2 percent nationwide over the same time period.[25] The increase in fatalities is suspected to be due in part to speeding occurring when fewer vehicles are on the road.[26] The CBA should be updated to provide a more realistic estimate of the impacts of reduced VMT on safety and/or consider the costs of the necessary street calming efforts to ensure improved safety can be delivered concurrently with reduced VMT.

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[23] CoPIRG and SWEEP, "Colorado's Transit, Biking & Walking Needs Over The Next 25 Years," August 2016, accessed on 10/4/2021 at https://copirgfoundation.org/sites/pirg/files/reports/COPIRG%20Transit%20Report_Screen.pdf. The report identifies costs of $36.54 per linear foot of sidewalk and $34.64 per linear foot of curb and gutter, which are assumed to be required in 50 percent of new sidewalks.

[24] CDOT, Cost-Benefit Analysis For Rules Governing Statewide Transportation Planning, 8/31/2021, accessed from https://www.codot.gov/business/rules/documents/cdot-cost-benefit-analysis-for-ghg-rule-sept-2021.pdf, page 26.

[25] NHTSA, "2020 Fatality Data Show Increased Traffic Fatalities During Pandemic", 6/3/2021, accessed on 10/4/2021 at https://www.nhtsa.gov/press-releases/2020-fatality-data-show-increased-traffic-fatalities-during-pandemic.

[26] Minor, Nathaniel. "Colorado's Roads are Emptier, But Deadlier So Far This Year," 9/2/2021, accessed on 10/4/2021 at https://www.cpr.org/2020/09/02/colorados-roads-are-emptier-but-deadlier-so-far-this-year/.

Conclusion

The NFRMPO recognizes the importance of reducing GHG emissions resulting from the implementation of transportation plans and contends that setting GHG reductions at feasible levels will provide meaningful contributions to the State's GHG reduction goals. In addition to helping to achieve GHG reductions, the proposed rule would also provide co-benefits by reducing ozone precursor emissions and expanding transportation options.

The NFRMPO appreciates the time and effort CDOT staff has committed to developing a rule to reduce GHG emissions resulting from implementation of transportation plans. We respectfully request the Hearing Officers, TC Ad Hoc Committee, and the TC consider the enclosed recommendations and ensure there is adequate time for public comment. The NFRMPO looks forward to continuing the collaboration with CDOT staff in the development of this rulemaking and in subsequent implementation efforts. If you have any questions, please contact Medora Bornhoft at [redacted]

[redacted]

Enclosure: NFRMPO Suggested Redlines, 10/11/2021

NFRMPO Suggested Redlines, 10/11/2021

Formatting Key:
Revisions Proposed by CDOT - Green
NFRMPO Round 1 Redlines (9/8/2021) - Purple
NFRMPO Round 2 Redlines (10/11/2021) - Red

DEPARTMENT OF TRANSPORTATION

Transportation Commission

RULES GOVERNING STATEWIDE TRANSPORTATION PLANNING PROCESS AND TRANSPORTATION PLANNING REGIONS

2 CCR 601-22

[Editor's Notes follow the text of the rules at the end of this CCR Document.]

August 13, 2021, Version

Please note the following formatting key:

Font Effect	Meaning
Underline	New Language
~~Strikethrough~~	Deletions
[Blue Font Text]	Annotation

STATEMENT OF BASIS AND PURPOSE, ~~AND~~ STATUTORY AUTHORITY AND PREAMBLE

The purpose of the Rules Governing the Statewide Transportation Planning Process and Transportation Planning Regions (Rules) is to prescribe the statewide transportation planning process through which a long-range ~~multimodal~~Multimodal, comprehensive ~~statewide~~ Statewide ~~transportation~~ Transportation ~~plan~~ Plan will be developed, integrated, updated, and amended by the Colorado Department of Transportation (Department or CDOT), in cooperation with local governments, Metropolitan Planning Organizations (MPOs) , Regional Planning Commissions, Indian tribal governments, relevant state and federal agencies, the private sector, transit and freight operators, ~~special interest groups,~~ and the general public. This cooperative process is designed to coordinate regional transportation planning, guided by the statewide transportation policy set by the Department and the ~~transportation~~ Transportation ~~commission~~ Commission of Colorado ("Commission"), as a basis for developing the ~~statewide~~ Statewide ~~transportation~~ Transportation ~~plan~~Plan. The result of the statewide transportation planning process shall be a long-range, financially feasible, environmentally sound, ~~multimodal~~ Multimodal transportation system plan for Colorado that will reduce traffic and smog.

Further, the purpose of the Rules is to define the state's Transportation Planning Regions for which long-range Regional Transportation Plans are developed, prescribe the process for conducting and initiating transportation planning in the non-MPO Transportation Planning Regions and coordinating with the ~~Metropolitan Planning Organizations~~MPOs for planning in the metropolitan areas. Memoranda of Agreement (MOA) that serve as the Metropolitan Planning Agreements (MPAs) ~~per~~ pursuant to 23 C.F.R. § 450 between the Department, each MPO, and applicable transit provider(s) further prescribe the transportation planning process in the MPO ~~transportation~~ Transportation ~~planning~~ Planning ~~regions~~Regions. In addition, the purpose of the Rules is to describe the organization and function of the

Statewide Transportation Advisory Committee (STAC) as established by § 43-1-1104, Colorado Revised Statutes (C.R.S.).

The Rules are promulgated to meet the intent of both the U.S. Congress and the Colorado General Assembly for conducting a continuing, cooperative, and comprehensive statewide performance-based ~~multimodal~~ Multimodal transportation planning process for producing a Statewide Transportation Plan and Regional Transportation Plans that address the transportation needs of the ~~state~~State. This planning process, through comprehensive input, results in systematic project prioritization and resource allocation.

The Rules, governing the statewide planning process, emphasize Colorado's continually greater integration of Multimodal, cost-effective, and environmentally sound means of transportation which leads to cleaner air and reduced traffic. The Rules reflect the Commission's and the Department's focus on Multimodal transportation projects including highways, transit, rail, bicycles and pedestrians. Section 8 of these Rules establishes an ongoing administrative process for identifying, measuring, confirming, and verifying those best practices and their impacts, so that CDOT and MPOs can easily apply them to their plans in order to achieve the pollution reduction levels required by these Rules.

The Rules are promulgated by the Commission pursuant to the specific statutory authority in § 43-1-1103 (5), C.R.S., and § 43-1-106 (8)(k), C.R.S.

Preamble for 2018 Rulemaking

In 2018, rulemaking was initiated to update the rules to conform to recently passed federal legislation, update expired rules, clarify the membership and duties of the ~~Statewide Transportation Advisory Committee~~STAC pursuant to HB 16-1169 and HB 16-1018, and to make other minor corrections. ~~The Rules are intended to be consistent with and not be a replacement for the federal transportation planning requirements contained in 23 United States Code (U.S.C.) §§ 134, 135 and 150, Pub. L. No. 114-94 (Fixing America's Surface Transportation Act or the "FAST Act") signed into law on December 4, 2015, and its implementing regulations, where applicable, contained in 23 Code of Federal Regulations (C.F.R.) Part 450, including Subparts A, B and C and 25 C.F.R. § 170.421 in effect as of August 1, 2017, which are hereby incorporated into the Rules by this reference, and do not include any later amendments. All referenced laws and regulations shall be available for copying or public inspection during regular business hours from the Office of Policy and Government Relations, Colorado Department of Transportation, 2829 W. Howard Pl., Denver, Colorado 80204.~~

~~Copies of the referenced United States Code may be obtained from the following address:~~

~~Office of the Law Revision Counsel~~
~~U.S. House of Representatives~~
~~H2-308 Ford House Office Building~~
~~Washington, DC 20515~~
~~(202) 226-2411~~

~~Copies of the referenced Code of Federal Regulations may be obtained from the following address:~~

~~U.S. Government Publishing Office~~
~~732 North Capitol Street, N.W.~~
~~Washington, DC 20401~~
~~(202) 512-1800~~

~~The Statewide Planning Rules, governing the statewide planning process, emphasize Colorado's continually greater integration of multimodal, cost-effective and environmentally sound means of transportation. The Rules reflect the Department's focus on multimodal transportation projects including highways, aviation, transit, rail, bicycles and pedestrians.~~

~~The Rules are promulgated by the Commission pursuant to the specific statutory authority in § 43-1-1103 (5), C.R.S., and § 43-1-106 (8)(k), C.R.S. The Commission may, at their discretion, entertain petitions for declaratory orders pursuant to § 24-4-105(11), C.R.S.~~

Preamble for 2021 Rulemaking

Overview

Section 8 of these Rules establishes Greenhouse Gas (GHG) pollution reduction planning levels for transportation that will improve air quality, reduce smog, and provide more sustainable options for travelers across Colorado. The purpose of these requirements is to limit the GHG pollution which would result from the transportation system if the plan was implemented, consistent with the state greenhouse gas pollution reduction roadmap. This is accomplished by requiring CDOT and MPOs to establish plans that meet targets through a mix of projects that limit and mitigate air pollution and improve quality of life and Multimodal options. CDOT and MPOs will be required to demonstrate through travel demand modeling and approved air quality modeling that statewide and regional aggregate emissions resulting from its state or regional plans do not exceed a specified emissions level in total. In the event that a plan fails to comply, CDOT and MPOs have the option to commit to implementing GHG Mitigation Measures that provide travelers with cleaner and more equitable transportation options such as safer pedestrian crossings and sidewalks, better transit and transit-access, or infrastructure that supports access to housing, jobs, and retail.

Examples of these types of mitigations, which also benefit quality of place and the economic resilience of communities, will include but not be limited to: adding bus rapid transit facilities and services, enhancing first-and-last mile connections to transit, adding bike-sharing services including electric bikes, improving pedestrian facilities like sidewalks and safe accessible crosswalks, investments that support vibrant downtown density and local zoning decisions that favor sustainable building codes and inclusive multi-use facilities downtown, and more. The process of identifying and approving mitigations will be established by a policy process that allows for ongoing innovations from local governments and other partners to be considered on an iterative basis.

If compliance still cannot be demonstrated, even after committing to GHG Mitigation Measures, the Commission shall restrict the use of certain funds, requiring that dollars be focused on projects that help reduce transportation emissions ~~and~~or are recognized as approved mitigations. These requirements address the Colorado General Assembly's directive to reduce statewide GHG pollution in § 25-7-102(2)(g), C.R.S., as well as the directive for transportation planning to consider environmental stewardship and reducing GHG emissions, § 43-1-1103(5), C.R.S.

Commented [redacted]: The rule says or, not and.

Context of Section 8 of these Rules Within Statewide Objectives

The passage of House Bill (HB)19-1261 set Colorado on a course to dramatically reduce GHG emissions across all sectors of the economy. In HB 19-1261, now codified in part at §§ 25-7-102(2) and 105(1)(e), C.R.S., the General Assembly declared that "climate change adversely affects Colorado's economy, air quality and public health, ecosystems, natural resources, and quality of life[,]" acknowledged that "Colorado is already experiencing harmful climate impacts[,]" and that "many of these impacts disproportionately affect" certain Disproportionately Impacted Communities. *see* § 25-7-102(2), C.R.S. The General Assembly also recognized that "[b]y reducing [GHG] pollution, Colorado will also reduce other harmful air pollutants, which will, in turn, improve public health, reduce health care costs, improve air quality, and help sustain the environment." *see* § 25-7-102(2)(d), C.R.S.

Since 2019, the State has been rigorously developing a plan to achieve the ambitious GHG pollution reduction goals in § 25-7-102(2)(g), C.R.S. In January 2021, the State published its Greenhouse Gas Pollution Reduction Roadmap (Roadmap). The Roadmap identified the transportation sector as the single largest source of statewide GHG pollution as of 2020, with passenger vehicles the largest contributor within the transportation sector. Additionally, the Roadmap determined that emissions from transportation are a "significant contributor to local air pollution that disproportionately impacts lower-income communities and communities of color." *see* Roadmap, p. XII.

A key finding in the Roadmap recognized that "[m]aking changes to transportation planning and infrastructure to reduce growth in driving is an important tool" to meet the statewide GHG pollution reduction goals. *see* Roadmap, p. 32. Section 8 of these Rules also advances the State's goals to reduce emissions of other harmful air pollutants, including ozone.

Why the Commission is Taking This Action

Senate Bill 21-260, signed into law by the Governor on June 17, 2021, and effective upon signature, includes a new § 43-1-128, C.R.S., which directs CDOT and MPOs to engage in an enhanced level of planning, modeling and other analysis to minimize the adverse environmental and health impacts of planned transportation capacity projects. Section 43-1-128, C.R.S. also directs CDOT and the Commission to take steps to account for the impacts of transportation capacity projects on GHG pollution and Vehicle Miles Traveled and to help achieve statewide GHG pollution targets established in § 25-7-102(2)(g), C.R.S.

Under Colorado law governing transportation planning, CDOT is charged with and identified as the proper body for "developing and maintaining the state transportation planning process and the state transportation plan" in cooperation with Regional Planning Commissions and local government officials. *see* § 43-1-1101, C.R.S.

The Commission is responsible for formulating policy with respect to transportation systems in the State and promulgating and adopting all CDOT financial budgets for construction based on the Statewide Transportation Improvement Programs. *see* § 43-1-106(8), C.R.S. The Commission is statutorily charged "to assure that the preservation and enhancement of Colorado's environment, safety, mobility and economics be considered in the planning, selection, construction and operation of all transportation projects in Colorado." *see* § 43-1-106(8)(b), C.R.S. In addition, the Commission is generally authorized "to make all necessary and reasonable orders, rules and regulations in order to carry out the provisions of this part . . ." *see* § 43-1-106(8)(k), C.R.S.

As such, CDOT and the Commission are primarily responsible for ensuring compliance with GHG reductions in transportation planning.

What Relevant Regulations Currently Apply to Transportation Planning

Transportation planning is subject to both state and federal requirements. Under federal law governing transportation planning and federal-aid highways, it is declared to be in the national interest to promote transportation systems that accomplish a number of mobility objectives "while minimizing transportation-related fuel consumption and air pollution through metropolitan and statewide transportation planning processes…" *see* 23 U.S.C. § 134; *see also* 23 U.S.C. § 135(a)(1). In the metropolitan planning process, consideration must be given to projects and strategies that will "protect and enhance the environment, promote energy conservation, improve the quality of life…" *see* 23 U.S.C. § 134(h)(1)(E); *see also* 23 C.F.R. Part 450, Subpart B (federal regulations governing statewide transportation planning and programming). The same planning objective applies to statewide transportation planning. *see* 23 U.S.C. § 135(d)(1)(E); *see also* 23 C.F.R. Part 450, Subpart C (governing metropolitan transportation planning and programming). Further, the Statewide Transportation Plan shall be developed, as appropriate, in consultation with State…local agencies responsible for…environmental protection…" *see* 23 U.S.C. § 135(f)(2)(D)(i).

Under conforming Colorado law, the Statewide Transportation Plan is developed by integrating and consolidating Regional Transportation Plans developed by MPOs and regional transportation planning organizations into a "comprehensive statewide transportation plan" pursuant to rules and regulations promulgated by the Commission. *see* § 43-1-1103(5), C.R.S. The Statewide Transportation Plan must address a number of factors including, but not limited to, "environmental stewardship" and "reduction of greenhouse gas emissions," *see* § 43-1-1103(5)(h) and (j), C.R.S.

Regional Transportation Plans must account for the "expected environmental, social, and economic impacts of the recommendations in the plan, including a full range of reasonable transportation alternatives...in order to provide for the transportation and environmental needs of the area in a safe and efficient manner," *see* § 43-1-1103(1)(d), C.R.S. Further, in developing Regional Transportation Plans, MPOs "[s]hall assist other agencies in developing transportation control measures for utilization in accordance with state...regulations...and shall identify and evaluate measures that show promise of supporting clean air objectives." *see* § 43-1-1103(1)(e), C.R.S.

Putting Section 8 of these Rules into Perspective

Section 8 establishes GHG regulatory requirements that are among the first of their kind in the U.S. However, from an air pollutant standpoint, connecting transportation planning to emissions is not a new policy area. In fact, transportation conformity provisions within the Clean Air Act approach ozone much the same way. Transportation conformity ensures that federally funded or approved highway and transit activities within a Nonattainment Area are consistent with or "conform to" a state's plan to reduce emissions. Colorado's front range has been in ozone nonattainment for many years, which has required the North Front Range and the Denver Regional Council of Governments' MPOs to demonstrate conformity with each plan adoption and amendment.

However, because the transportation sector encompasses the millions of individual choices people make every day that have an impact on climate, a variety of strategies are necessary to achieve the State's climate goals. Section 8 of these Rules is one of many steps needed to achieve the totality of reduction goals for the transportation sector.

Purpose of GHG Mitigation Measures

The transportation modeling conducted for this rulemaking may demonstrate that certain projects increase GHG pollution for a variety of reasons. These reasons may include factors such as induced demand as a result of additional lane mileage attracting additional vehicular traffic, or additional traffic facilitated by access to new commercial or residential development in the absence of public transit options or bicycle/pedestrian access that provides consumers with other non-driving options. Transportation infrastructure itself can also increase or decrease GHG and other air pollutants by virtue of factors like certain construction materials, removal or addition of tree cover that captures carbon pollution, or integration with vertical construction templates of various efficiencies that result in higher or lower levels of per capita energy use. The pollution impacts of various infrastructure projects will vary significantly depending on their specifics and must be modeled in a manner that is context-sensitive to a range of issues such as location, footprint of existing infrastructure, design, and how it fits together with transportation alternatives.

Furthermore, other aspects of transportation infrastructure can facilitate reductions in emissions and thus serve as mitigations rather than contributors to pollution. For example, the addition of transit resources in a manner that can displace Vehicle Miles Traveled can reduce emissions. Moreover, improving downtown pedestrian and bike access, particularly in areas that allow individuals to shift multiple daily trips for everything from work to dining to retail, can improve both emissions and quality of life.

There is an increasing array of proven best practices for reducing pollution and smog and improving economies and neighborhoods that can help streamline decision-making for state and local agencies developing plans and programs of projects.

[Note: The Commission proposes to repeal Section 1 of these Rules in its entirety and re-enact Section 1 of these Rules below to re-format the numbering of the administrative rules into alphabetical order.]

~~1.00 Definitions.~~

~~1.01 Accessible - ensure that reasonable efforts are made that all meetings are reachable by persons from households without vehicles and that the meetings will be accessible to persons with disabilities in accordance with the Americans with Disabilities Act (ADA), and also accessible to persons with limited English proficiency. Accessible opportunities to on planning related matters include those provided on the internet and through such methods as telephone town halls comment~~

~~1.02 Attainment Area — any geographic region of the United States that meets the national primary or secondary National Ambient Air Quality Standards (NAAQS) for the pollutants as defined in the Clean Air Act (CAA) (Amendments of 1990).~~

~~1.03 Commission - the transportation commission of Colorado created by § 43-1-106, C.R.S.~~

~~1.04 Corridor - a transportation system that includes all modes and facilities within a described geographic area.~~

~~1.05 Corridor Vision - a comprehensive examination of a specific transportation corridor, which includes a determination of needs and an expression of desired state of the transportation system that includes transportation modes and facilities over a planning period.~~

~~1.06 Department - the Colorado Department of Transportation created by § 43-1-103, C.R.S.~~

~~1.07 Division — the Division of Transportation Development within the Colorado Department of Transportation.~~

~~1.08 Division Director - the Director of the Division of Transportation Development.~~

~~1.09 Fiscally Constrained - the financial limitation on transportation plans and programs based on the projection of revenues as developed cooperatively with the MPOs and the rural TPRs and adopted by the Commission that are reasonably expected to be available over the long-range transportation planning period and the Transportation Improvement Program (TIP) and Statewide Transportation Improvement Program (STIP) programming periods.~~

~~1.10 Intergovernmental Agreement – an arrangement made between two or more political subdivisions that form associations for the purpose of promoting the interest and welfare of said subdivisions.~~

~~1.11 Intermodal Facility--A site where goods or people are conveyed from one mode of transportation to another, such as goods from rail to truck or people from passenger vehicle to bus.~~

~~1.12 Land Use – the type, size, arrangement, and use of parcels of land.~~

~~1.13 Limited English Proficiency (LEP) – individuals who do not speak English as their primary language and who have a limited ability to read, speak, write, or understand English.~~

~~1.14 Long-range Planning - a reference to a planning period with a minimum 20-year planning horizon.~~

~~1.15 Maintenance Area – any geographic region of the United States previously designated by the U.S. Environmental Protection Agency (EPA) as a nonattainment area pursuant to the Clean Air Act (CAA) Amendments of 1990 and subsequently redesignated to attainment subject to the requirement to develop a maintenance plan under section 175A of the CAA, as amended in 1990.~~

~~1.16 Memorandum of Agreement (MOA) – a written agreement between two or more parties on an intended plan of action.~~

~~1.17 Metropolitan Planning Agreement (MPA) – a written agreement between the MPO, the State, and the providers of public transportation serving the metropolitan planning area that describes how they will work cooperatively to meet their mutual responsibilities in carrying out the metropolitan planning process.~~

~~1.18 Metropolitan Planning Area - a geographic area determined by agreement between the Metropolitan Planning Organization for the area and the Governor, in which the metropolitan transportation planning process is carried out pursuant to 23 U.S.C. § 134.~~

~~1.19 Metropolitan Planning Organization (MPO) - an organization designated by agreement among the units of general purpose local governments and the Governor, charged to develop the regional transportation plans and programs in a metropolitan planning area pursuant to 23 U.S.C. § 134.~~

~~1.20 Mobility - the ability to move people, goods, services, and information among various origins and destinations.~~

~~1.21 Multimodal - an integrated approach to transportation that takes into account all modes of travel, such as bicycles and walking, personal mobility devices, buses, transit, rail, aircraft, and motor vehicles.~~

~~1.22 National Ambient Air Quality Standards (NAAQS) – are those established by the U.S. Environmental Protection Agency for air pollutants considered harmful to public health and environment. These criteria pollutants are: carbon monoxide, lead, nitrogen dioxide, ozone, small particles, and sulfur dioxide.~~

~~1.23 Nonattainment Area - any geographic region of the United States which has been designated by the EPA under section 107 of the CAA for any pollutants for which an NAAQS exists.~~

~~1.24 Non-metropolitan Area – a rural geographic area outside a designated metropolitan planning area.~~

~~1.25 Plan Integration – Plan integration is a comprehensive evaluation of the statewide transportation system that includes all modes, an identification of needs and priorities, and key information from other related CDOT plans.~~

~~1.26 Planning Partners – local and tribal governments, the rural Transportation Planning Regions and MPOs.~~

~~1.27 Project Priority Programming Process ("4P") – the process by which CDOT adheres to 23 U.S.C. § 135 and 23 C.F.R. Part 450 when developing and amending the statewide transportation improvement program (STIP).~~

~~1.28 Regional Planning Commission (RPC) - a planning body formed under the provisions of § 30-28-105, C.R.S., and designated under these Rules for the purpose of transportation planning within a rural Transportation Planning Region.~~

~~1.29 Regional Transportation Plan (RTP) - a long-range plan designed to address the future transportation needs for a Transportation Planning Region including, but not limited to, anticipated funding, priorities, and implementation plans, pursuant to, but not limited to, § 43-1-1103, C.R.S. and 23 C.F.R. Part 450. All rural and urban Transportation Planning Regions in the state produce RTPs.~~

~~1.30 State Transportation System – refers to all state owned, operated, and maintained transportation facilities in Colorado, including, but not limited to, interstate highways, other highways, and aviation, bicycle and pedestrian, transit, and rail facilities.~~

~~1.31 Statewide Transportation Advisory Committee (STAC) - the committee created by § 43-1-1104, C.R.S., comprising one representative from each Transportation Planning Region and one representative from each tribal government to review and comment on Regional Transportation Plans, amendments, and updates, and to advise both the Department and the Commission on the needs of the transportation system in Colorado.~~

~~1.32 Statewide Transportation Improvement Program (STIP) - a staged, fiscally constrained, multi-year, statewide, multimodal program of transportation projects which is consistent with the statewide transportation plan and planning processes, with metropolitan planning area plans, Transportation Improvement Programs and processes, and which is developed pursuant to 23 U.S.C. § 135.~~

~~1.33 Statewide Transportation Plan - the long-range, comprehensive, multimodal statewide transportation plan covering a period of no less than 20 years from time of adoption, developed through the statewide transportation planning process described in these Rules and 23 U.S.C. § 135, and adopted by the Commission pursuant to § 43-1-1103, C.R.S.~~

~~1.34 System Continuity - includes, but is not limited to, appropriate intermodal connections, integration with state modal plans, and coordination with neighboring Regional Transportation Plans, and, to the extent practicable, other neighboring states' transportation plans.~~

~~1.35 Traditionally Underserved - refers to groups such as seniors, persons with disabilities, low-income households, minorities, and student populations, which may face difficulties accessing transportation systems, employment, services, and other amenities.~~

~~1.36 Transit and Rail Advisory Committee (TRAC) – an advisory committee created specifically to advise the Executive Director, the Commission, and the Division of Transit and Rail on transit and rail related activities.~~

~~1.37 Transportation Commonality - the basis on which Transportation Planning Regions are established including, but not limited to: Transportation Commission Districts, the Department's Engineering Regions, travelsheds, watersheds, geographic unity, existing intergovernmental agreements, and socioeconomic unity.~~

~~1.38 Transportation Improvement Program (TIP) - a staged, fiscally constrained, multi-year, multimodal program of transportation projects developed and adopted by MPOs, and approved by the Governor, which is consistent with an MPO's RTP and which is developed pursuant to 23 U.S.C. § 134.~~

~~1.39 Transportation Mode - a particular form of travel including, but not limited to, bus, motor vehicle, rail, transit, aircraft, bicycle, pedestrian travel, or personal mobility devices.~~

~~1.40 Transportation Planning and Programming Process - all collaborative planning-related activities including the development of regional and statewide transportation plans, the Department's Project Priority Programming Process, and development of the Transportation Improvement Programs (TIPs) and Statewide Transportation Improvement Program (STIP).~~

~~1.41 Transportation Planning Region (TPR) - a geographically designated area of the state, defined by section 2.00 of these Rules in consideration of the criteria for transportation commonality, and for which a regional transportation plan is developed pursuant to the provisions of § 43-1-1102 and 1103, C.R.S. and 23 U.S.C. § 134. The term TPR is inclusive of these types: non-MPO Transportation Planning Regions, MPO Transportation Planning Regions, and Transportation Planning Regions with both MPO and non-MPO areas.~~

~~1.42 Transportation Systems Planning – provides the basis for identifying current and future deficiencies on the state highway system and outlines strategies to address those deficiencies and make improvements to meet Department goals.~~

~~1.43 Travelshed - the region or area generally served by a major transportation facility, system, or corridor.~~

~~1.44 Tribal Transportation Improvement Program (TTIP) – a multi-year fiscally constrained list of proposed transportation projects developed by a tribe from the tribal priority list or tribal long-range transportation plan, and which is developed pursuant to 25 C.F.R. Part 170. The TTIP is incorporated into the STIP without modification.~~

~~1.45 Urbanized Area - an area with a population of 50,000 or more designated by the Bureau of the Census.~~

~~1.46 Watershed - a land area that drains to a common waterway, such as a stream, lake, estuary, wetland, or ultimately the ocean.~~

[Note: The Commission proposes to add nineteen (19) new definitions. New proposed defined terms include: Applicable Planning Document, Approved Air Quality Model, Baseline, Carbon Dioxide Equivalent, Congestion Mitigation and Air Quality, Disproportionately Impacted Communities, Four-Year Prioritized Plan, Greenhouse Gas, Greenhouse Mitigation Measures, Greenhouse Gas Reduction Levels, Mitigation Action Plan, MPO Model, Multimodal Transportation and Mitigation Options Fund, Regionally Significant Project, State Interagency Consultation Team, Statewide Travel Model, Surface Transportation Block Grant, Vehicle Miles Traveled, and 10-Year Plan. Only minor non-substantive changes, such as correcting grammar errors or capitalizing defined terms, were made to the existing forty-six (46) defined terms.]

1.00 Definitions.

1.01 Accessible - ensure that reasonable efforts are made that all meetings are reachable by persons from households without vehicles and that the meetings will be accessible to persons with disabilities in accordance with the Americans with Disabilities Act (ADA), and also accessible to persons with Limited English Proficiency. Accessible opportunities to comment on planning related matters include those provided on the internet and through such methods as telephone town halls.

1.02 Applicable Planning Document - refers to MPO Fiscally Constrained RTPs,TIPs for MPOs in NAAs, CDOT's 10-Year Plan and Four-Year Prioritized Plan in non-MPO areas, ~~CDOT's STIP in in non-MPO areas within an NAA,~~ and amendments to the MPO RTPs and CDOT's 10-Year Plan and Four-Year Prioritized Plan in non-MPO areas that include the addition of Regionally Significant Projects.

1.03 Approved Air Quality Model - the ~~most recent~~ version of the Environmental Protection Agency issued model that quantifies GHG emissions from transportation and is required for transportation conformity analyses per federal regulations.

1.04 Attainment Area - any geographic region of the United States that meets the national primary or secondary National Ambient Air Quality Standards (NAAQS) for the pollutants as defined in the Clean Air Act (CAA) (Amendments of 1990).

1.05 Baseline - estimates of GHG emissions for each of the MPOs, and for the non-MPO areas, prepared using the MPO Models or the Statewide Travel Model. Estimates must include GHG emissions resulting from the existing transportation network and implementation of the most recently adopted RTP for all MPOs and the 10-Year Plan in non-MPO areas as of the effective date of these Rules.

1.06 Carbon Dioxide Equivalent (CO2e) - a ~~metric measure used~~ tostandard unit for comparinge the emissions from various GHG based upon the 100-year global warming potential (GWP). CO2e is calculated by multiplying the mass amount of emissions (metric tons per year), for each GHG constituent by that gas's GWP, and summing the resultant values to determine CO2e (metric tons per year). This calculation allows comparison of different greenhouse gases and their relative impact on the environment over differenta standard time periods.

Commented [redacted] MMT is a metric measure, but CO2e is not inherently metric

1.07 Commission - the Transportation Commission of Colorado created by § 43-1-106, C.R.S.

~~1.08 Congestion Mitigation and Air Quality (CMAQ) - a federally mandatedfederal funding program established in 23 U.S.C § 149 to improve air quality in Nonattainment and Maintenance Areas for ozone, carbon monoxide, and particulate matter. References related to this program include any successor programs as established by the federal government.~~

1.09 Corridor - a transportation system that includes all modes and facilities within a described geographic area.

1.10 Corridor Vision - a comprehensive examination of a specific transportation Corridor, which includes a determination of needs and an expression of desired state of the transportation system that includes Transportation Modes and facilities over a planning period.

1.11 Department or CDOT - the Colorado Department of Transportation created by § 43-1-103, C.R.S.

1.12 Disproportionately Impacted Communities - defined in § 24-38.5-302(3), C.R.S. as a community that is in a census block group, as determined in accordance with the most recent United States Decennial Census where the proportion of households that are low income is greater than forty percent (40%), the proportion of households that identify as minority is greater than forty percent (40%), or the proportion of households that are housing cost-burdened is greater than forty percent (40%).

1.13 Division - the Division of Transportation Development within CDOT.

1.14 Division Director - the Director of the Division of Transportation Development.

1.15 Fiscally Constrained - the financial limitation on transportation plans and programs based on the projection of revenues as developed cooperatively with the MPOs and the rural TPRs and adopted by the Commission that are reasonably expected to be available over the long-range transportation planning period and the TIP and STIP programming periods.

1.16 Four-Year Prioritized Plan - a four-year subset of the 10-Year Plan consisting of projects prioritized for near-term delivery and partial or full funding.

1.17 Greenhouse Gas (GHG) - for purposes of these Rules, GHG is defined as the primary transportation greenhouse gases: carbon dioxide, methane, and nitrous oxide.

1.18 Greenhouse Gas (GHG) Reduction Level - the amount of the GHG expressed as CO2e reduced from the projected Baseline that CDOT and MPOs must attain through transportation planning.

1.19 Greenhouse Gas (GHG) Mitigation Measures - non-Regionally Significant Project strategies ~~implemented by CDOT and MPOs~~ that reduce transportation GHG pollution and help meet the GHG Reduction Levels.

Commented [redacted]: Any agency's GHG measures should be able to count, same as how any regionally significant project (even if locally funded) counts. In addition, better to not use the past tense because almost all the measures are planned measures for future implementation.

1.20 Intergovernmental Agreement - an arrangement made between two or more political subdivisions that form associations for the purpose of promoting the interest and welfare of said subdivisions.

1.21 Intermodal Facility - a site where goods or people are conveyed from one mode of transportation to another, such as goods from rail to truck or people from passenger vehicle to bus.

1.22 Land Use - the type, size, arrangement, and use of parcels of land.

1.23 Limited English Proficiency - individuals who do not speak English as their primary language and who have a limited ability to read, speak, write, or understand English.

1.24 Long-Range Planning - a reference to a planning period with a minimum 20-year planning horizon.

1.25 Maintenance Area - any geographic region of the United States previously designated by the U.S. Environmental Protection Agency (EPA) as a Nonattainment Area pursuant to the Clean Air Act (CAA) Amendments of 1990 and subsequently redesignated to attainment subject to the requirement to develop a maintenance plan under § 175A of the CAA, as amended in 1990.

1.26 Memorandum of Agreement (MOA) - a written agreement between two or more parties on an intended plan of action.

1.27 Metropolitan Planning Agreement (MPA) - a written agreement between the MPO, the State, and the providers of public transportation serving the Metropolitan Planning Area that describes how they will work cooperatively to meet their mutual responsibilities in carrying out the metropolitan planning process.

1.28 Metropolitan Planning Area - a geographic area determined by agreement between the MPO for the area and the Governor, in which the metropolitan transportation planning process is carried out pursuant to 23 U.S.C. § 134.

1.29 Metropolitan Planning Organization (MPO) - an organization designated by agreement among the units of general purpose local governments and the Governor, charged to develop the RTPs and programs in a Metropolitan Planning Area pursuant to 23 U.S.C. § 134.

1.30 Mitigation Action Plan - an element of the GHG Transportation Report that specifies which GHG Mitigation Measures shall be implemented that help achieve the GHG Reduction Levels.

1.31 Mobility - the ability to move people, goods, services, and information among various origins and destinations.

1.32 MPO Models - one (1) or more of the computer-based models maintained and operated by the MPOs which depict the MPO areas' transportation systems (e.g., roads, transit, etc.) and development patterns (i.e., number and location of households and jobs) for a defined year (i.e., past, present, or forecast) and produce estimates of roadway VMT, delays, operating speeds, transit ridership, and other characteristics of transportation system use.

1.33 Multimodal - an integrated approach to transportation that takes into account all modes of travel, such as bicycles and walking, personal mobility devices, buses, transit, rail, aircraft, and motor vehicles.

1.34 Multimodal Transportation and Mitigation Options Fund (MMOF) - a program created in the State Treasury pursuant to § 43-4-1003, C.R.S. which funds bicycle, pedestrian, transit and other Multimodal projects as defined in § 43-4-1002(5), C.R.S. and GHG Mitigation projects as defined in § 43-4-1002(4.5), C.R.S.

1.35 National Ambient Air Quality Standards (NAAQS) - are those established by the U.S. Environmental Protection Agency for air pollutants considered harmful to public health and environment. These criteria pollutants are: carbon monoxide, lead, nitrogen dioxide, ozone, small particles, and sulfur dioxide.

1.36 Nonattainment Area - any geographic region of the United States which has been designated as nonattainment by the EPA under section 107 of the CAA for any pollutants for which a NAAQS exists.

1.37 Non-Metropolitan Area - a rural geographic area outside a designated Metropolitan Planning Area.

1.38 Plan Integration - a comprehensive evaluation of the statewide transportation system that includes all modes, an identification of needs and priorities, and key information from other related CDOT plans.

1.39 Planning Partners - local and tribal governments, the rural TPRs and MPOs.

1.40 Project Priority Programming Process - the process by which CDOT adheres to 23 U.S.C. § 135 and 23 C.F.R. Part 450 when developing and amending the STIP.

1.41 Regional Planning Commission (RPC) - a planning body formed under the provisions of § 30-28-105, C.R.S., and designated under these Rules for the purpose of transportation planning within a rural TPR.

1.42 Regionally Significant Project - a transportation project that is on a facility which serves regional transportation needs (such as access to and from the area outside of the region, major activity centers in the region, major planned developments such as new retail malls, sports complexes, etc., or transportation terminals as well as most terminals themselves) and would normally be included in the modeling of a metropolitan area's transportation network or state transportation network, including at a minimum all principal arterial highways and all fixed guideway transit facilities that offer an alternative to regional highway travel. If the MPOs have received approval from the EPA to use a different definition of regionally significant project as defined in 40 C.F.R. § 93.101, the State Interagency Consultation Team will accept the modified definition. Necessary specificity for MPO Models or the Statewide Travel Model will be approved by the State Interagency Consultation Team.

1.43 Regional Transportation Plan (RTP) - a long-range plan designed to address the future transportation needs for a TPR including, but not limited to, Fiscally Constrained or anticipated funding, priorities, and implementation plans, pursuant to, but not limited to, § 43-1-1103, C.R.S. and 23 C.F.R. Part 450. All rural and urban TPRs in the state produce RTPs.

1.44 State Interagency Consultation Team - consists of the Division Director or the Division Director's designee, the Colorado Department of Public Health and Environment (CDPHE) Director of Air Pollution Control Division or the Director's designee, and the Director of each MPO or their designee.

1.45 State Transportation System - refers to all state-owned, operated, and maintained transportation facilities in Colorado, including, but not limited to, interstate highways, other highways, and aviation, bicycle and pedestrian, transit, and rail facilities.

1.46 Statewide Transportation Advisory Committee (STAC) - the committee created by § 43-1-1104, C.R.S., comprising one representative from each TPR and one representative from each tribal government to review and comment on RTPs, amendments, and updates, and to advise both the Department and the Commission on the needs of the transportation system in Colorado.

Commented [redacted] EPA also designates areas as attainment, maintenance, or unclassifiable.

Commented [redacted] Recommend clarifying if this applies to all areas or just those without an EPA-approved definition.

1.47 Statewide Transportation Improvement Program (STIP) - a Fiscally Constrained, multi-year, statewide, Multimodal program of transportation projects which is consistent with the Statewide Transportation Plan and planning processes, with Metropolitan Planning Area plans, Transportation Improvement Programs and processes, and which is developed pursuant to 23 U.S.C. § 135.

1.48 Statewide Travel Model - the computer-based model maintained and operated by CDOT which depicts the state's transportation system (roads, transit, etc.) and development scale and pattern (number and location of households, number and location of firms/jobs) for a selected year (past, present, or forecast) and produces estimates of roadway VMT and speed, transit, ridership, and other characteristics of transportation system use.

1.49 Statewide Transportation Plan - the long-range, comprehensive, Multimodal statewide transportation plan covering a period of no less than 20 years from time of adoption, developed through the statewide transportation planning process described in these Rules and 23 U.S.C. § 135, and adopted by the Commission pursuant to § 43-1-1103, C.R.S.

1.50 Surface Transportation Block Grant (STBG) - a flexible federal funding source established under 23 U.S.C. § 133 for state and local transportation needs. Funds are expended in the areas of the State based on population. References related to this program include any successor programs established by the federal government.

1.51 System Continuity - includes, but is not limited to, appropriate intermodal connections, integration with state modal plans, and coordination with neighboring RTPs, and, to the extent practicable, other neighboring states' transportation plans.

1.52 Traditionally Underserved - refers to groups such as seniors, persons with disabilities, low-income households, minorities, and student populations, which may face difficulties accessing transportation systems, employment, services, and other amenities.

1.53 Transit and Rail Advisory Committee (TRAC) - an advisory committee created specifically to advise the Executive Director, the Commission, and the Division of Transit and Rail on transit and rail-related activities.

1.54 Transportation Commonality - the basis on which TPRs are established including, but not limited to: Transportation Commission Districts, the Department's Engineering Regions, Travelsheds, Watersheds, geographic unity, existing Intergovernmental Agreements, and socioeconomic unity.

1.55 Transportation Improvement Program (TIP) - a staged, Fiscally Constrained, multi-year, Multimodal program of transportation projects developed and adopted by MPOs, and approved by the Governor, which is consistent with an MPO's RTP and which is developed pursuant to 23 U.S.C. § 134.

1.56 Transportation Mode - a particular form of travel including, but not limited to, bus, motor vehicle, rail, transit, aircraft, bicycle, pedestrian travel, or personal mobility devices.

1.57 Transportation Planning and Programming Process - all collaborative planning-related activities including the development of regional and Statewide Transportation Plans, the Department's Project Priority Programming Process, and development of the TIPs and STIP.

1.58 Transportation Planning Region (TPR) - a geographically designated area of the state, defined by section 2.00 of these Rules in consideration of the criteria for Transportation Commonality, and for which a regional transportation plan is developed pursuant to the provisions of § 43-1-1102 and 1103, C.R.S. and 23 U.S.C. § 134. The term TPR is inclusive of these types: non-MPO TPRs, MPO TPRs, and TPRs with both MPO and non-MPO areas.

1.59 Transportation Systems Planning - provides the basis for identifying current and future deficiencies on the state highway system and outlines strategies to address those deficiencies and make improvements to meet Department goals.

1.60 Travelshed - the region or area generally served by a major transportation facility, system, or Corridor.

1.61 Tribal Transportation Improvement Program (TTIP) - a multi-year Fiscally Constrained list of proposed transportation projects developed by a tribe from the tribal priority list or tribal long-range transportation plan, and which is developed pursuant to 25 C.F.R. Part 170. The TTIP is incorporated into the STIP without modification.

1.62 Urbanized Area - an area with a population of 50,000 or more designated by the Bureau of the Census.

1.63 Vehicle Miles Traveled (VMT) - the traffic volume of a roadway segment or system of roadway segments multiplied by the length of the roadway segment or system.

1.64 Watershed - a land area that drains to a common waterway, such as a stream, lake, estuary, wetland, or ultimately the ocean.

1.65 10-Year Plan - a vision for Colorado's transportation system that includes a specific list of projects categorized across priority areas as identified in the Statewide Transportation Plan.

2.00 Transportation Planning Regions (TPR).

2.01 Transportation Planning Region Boundaries. ~~Transportation Planning Region~~TPRs are geographically designated areas of the state with similar transportation needs that are determined by considering transportation commonalities. Boundaries are hereby established as follows:

2.01.1 The Pikes Peak Area ~~Transportation Planning Region~~TPR comprises the Pikes Peak Area Council of Governments' metropolitan area within El Paso and Teller counties.

2.01.2 The Greater Denver ~~Transportation Planning Region~~TPR, which includes the Denver Regional Council of Governments' planning area, comprises the counties of Adams, Arapahoe, Boulder, Broomfield, Clear Creek, Denver, Douglas, Gilpin, Jefferson, and parts of Weld.

2.01.3 The North Front Range ~~Transportation Planning Region~~TPR comprises the North Front Range Transportation and Air Quality Planning Council's metropolitan area within Larimer and Weld counties.

2.01.4 The Pueblo Area ~~Transportation Planning Region~~TPR comprises Pueblo County, including the Pueblo Area Council of Governments' metropolitan area.

2.01.5 The Grand Valley ~~Transportation Planning Region~~TPR comprises Mesa County, including the Grand Valley Metropolitan Planning Organization's metropolitan area.

2.01.6 The Eastern ~~Transportation Planning Region~~TPR comprises Cheyenne, Elbert, Kit Carson, Lincoln, Logan, Phillips, Sedgwick, Washington, and Yuma counties.

2.01.7 The Southeast ~~Transportation Planning Region~~TPR comprises Baca, Bent, Crowley, Kiowa, Otero, and Prowers counties.

2.01.8 The San Luis Valley ~~Transportation Planning Region~~TPR comprises Alamosa, Chaffee, Conejos, Costilla, Mineral, Rio Grande, and Saguache counties.

2.01.9 The Gunnison Valley ~~Transportation Planning Region~~TPR comprises Delta, Gunnison, Hinsdale, Montrose, Ouray, and San Miguel counties.

2.01.10 The Southwest ~~Transportation Planning Region~~TPR comprises Archuleta, Dolores, La Plata, Montezuma, and San Juan counties, including the Ute Mountain Ute and Southern Ute Indian Reservations.

2.01.11 The Intermountain ~~Transportation Planning Region~~TPR comprises Eagle, Garfield, Lake, Pitkin, and Summit counties.

2.01.12 The Northwest ~~Transportation Planning Region~~TPR comprises Grand, Jackson, Moffat, Rio Blanco, and Routt counties.

2.01.13 The Upper Front Range ~~Transportation Planning Region~~TPR comprises Morgan County, and the parts of Larimer and Weld counties, that are outside both the North Front Range and the Greater Denver (metropolitan) TPRs.

2.01.14 The Central Front Range ~~Transportation Planning Region~~TPR comprises Custer, El Paso, Fremont, Park, and Teller counties, excluding the Pikes Peak Area Council of Governments' metropolitan area.

2.01.15 The South Central ~~Transportation Planning Region~~TPR comprises Huerfano, and Las Animas Counties.

2.02 Boundary Revision Process.

2.02.1 TPR boundaries, excluding any MPO-related boundaries, will be reviewed by the Commission at the beginning of each regional and statewide transportation planning process. The Department will notify counties, municipalities, MPOs, Indian tribal governments, and RPCs for the TPRs of the boundary review revision requests. MPO boundary review shall be conducted pursuant to 23 U.S.C. § 134 and 23 C.F.R. Part 450 Subpart B and any changes shall be provided to the Department to update the Rules. All boundary revision requests shall be sent to the Division Director, and shall include:

2.02.1.1 A geographical description of the proposed boundary change.

2.02.1.2 A statement of justification for the change considering transportation commonalities.

2.02.1.3 A copy of the resolution stating the concurrence of the affected ~~Regional Planning Commission~~RPC.

2.02.1.4 The name, title, mailing address, telephone number, fax number and electronic mail address (if available) of the contact person for the requesting party or parties.

2.02.2 The Department will assess and STAC shall review and comment (as set forth in these Rules) on all ~~non~~Non-~~metropolitan~~ Metropolitan ~~area~~ Area TPR boundary revision requests based on transportation commonalities and make a recommendation to the Commission concerning such requests. The Department will notify the Commission of MPO boundary changes. The Commission may initiate a rule-making proceeding under the ~~State~~ Colorado Administrative Procedure Act, § 24-4-103, C.R.S. to consider a boundary revision request. Requests received for a MPO or non-metropolitan TPR boundary revision outside of the regularly scheduled boundary review cycle must include the requirements identified above.

2.02.3 In the event that the Commission approves a change to the boundary of a TPR that has a ~~Regional Planning Commission~~RPC, the RPC in each affected TPR shall notify the Department of any changes to the ~~intergovernmental~~ Intergovernmental ~~agreement~~ Agreement governing the RPC as specified in these Rules.

2.03 Transportation Planning Coordination with MPOs.

2.03.1 The Department and the MPOs shall coordinate activities related to the development of ~~Regional Transportation Plan~~RTPs, the Statewide Transportation Plan, TIPs, and the STIP in conformance with 23 U.S.C. § 134 and 135 and § 43-1-1101 and § 43-1-1103, C.R.S. The Department shall work with the MPOs to resolve issues arising during the planning process.

2.04 Transportation Planning Coordination with Non-MPO RPCs.

2.04.1 The Department and RPCs shall work together in developing ~~Regional Transportation Plan~~RTPs and in planning future transportation activities. The Department shall consult with all RPCs on development of the Statewide Transportation Plan; incorporation of RTPs into the Statewide Transportation Plan; and the inclusion of projects into the STIP that are consistent with the RTPs. In addition, the Department shall work with the RPCs to resolve issues arising during the planning process.

2.05 Transportation Planning Coordination among RPCs.

2.05.1 If transportation improvements cross TPR boundaries or significantly impact another TPR, the RPC shall consult with all the affected RPCs involved when developing the ~~regional transportation plan~~RTP. In general, RPC planning officials shall work with all ~~planning~~ Planning ~~partners~~ Partners affected by transportation activities when planning future transportation activities.

2.06 Transportation Planning Coordination with the Southern Ute and the Ute Mountain Ute Tribal Governments.

2.06.1 Regional transportation planning within the Southwest TPR shall be coordinated with the transportation planning activities of the Southern Ute and the Ute Mountain Ute tribal governments. The long-range transportation plans for the tribal areas shall be integrated in the Statewide Transportation Plan and the ~~Regional Transportation Plan~~RTP for this TPR. The TTIP is incorporated into the STIP without modification.

3.00 Statewide Transportation Advisory Committee (STAC).

3.01 Duties of the ~~Statewide Transportation Advisory Committee (~~STAC~~)~~. Pursuant to § 43-1-1104 C.R.S. the duties of the STAC shall be to meet as necessary and provide advice to both the Department and the Commission on the needs of the transportation system in Colorado including, but not limited to: budgets, ~~transportation improvement programs~~TIPs of the ~~metropolitan planning organizations~~MPOs, the ~~Statewide Transportation Improvement Program~~STIP, transportation plans, and state transportation policies.

The STAC shall review and provide to both the Department and the Commission comments on:

3.01.1 All ~~Regional Transportation Plan~~RTPs, amendments, and updates as described in these Rules.

3.01.2 Transportation related communication and/or conflicts which arise between RPCs or between the Department and a RPC.

3.01.3 The integration and consolidation of RTPs into the Statewide Transportation Plan.

3.01.4 Colorado's ~~mobility~~ Mobility requirements to move people, goods, services, and information by furnishing regional perspectives on transportation problems requiring interregional and/or statewide solutions.

3.01.5 Improvements to modal choice, linkages between and among modes, and transportation system balance and ~~system~~ System ~~continuity~~Continuity.

3.01.6 Proposed TPR boundary revisions.

3.02 Notification of Membership

3.02.1 Each RPC and tribal government shall select its representative to the STAC pursuant to § 43-1-1104(1), C.R.S. The Ute Mountain Ute Tribal Council and the Southern Ute Indian Tribal Council each appoint one representative to the STAC. Each TPR and tribal government is also entitled to name an alternative representative who would serve as a proxy in the event their designated representative is unable to attend a STAC meeting and would be included by the Department in distributions of all STAC correspondence and notifications. The Division Director shall be notified in writing of the name, title, mailing address, telephone number, fax number and electronic mail address (if available) of the STAC representative and alternative representative from each TPR and tribal government within thirty (30) days of selection.

3.03 Administration of ~~Statewide Transportation Advisory Committee~~STAC

3.03.1 STAC recommendations on Regional and Statewide Transportation Plans, amendments, and updates shall be documented in the STAC meeting minutes, and will be considered by the Department and Commission throughout the statewide transportation planning process.

3.03.2 The STAC shall establish procedures to govern its affairs in the performance of its advisory capacity, including, but not limited to, the appointment of a chairperson and the length of the chairperson's term, meeting times, and locations.

3.03.3 The Division Director will provide support to the STAC, including, but not limited to:

3.03.3.1 Notification of STAC members and alternates of meeting dates.

3.03.3.2 Preparation and distribution of STAC meeting agendas, supporting materials, and minutes.

3.03.3.3 Allocation of Department staff support for STAC-related activities.

4.00 Development of Regional and Statewide Transportation Plans.

4.01 ~~Regional Planning Commission~~RPCs, MPOs, and the Department shall comply with all applicable provisions of 23 U.S.C. § 134 and § 135, 23 C.F.R. Part 450, and § 43-1-1103, C.R.S. and all applicable provisions of Commission policies and guidance documents in development of regional and statewide transportation plans, respectively.

4.02 Public Participation

4.02.1 The Department, in coordination with the RPCs of the rural TPRs, shall provide early and continuous opportunity for public participation in the transportation planning process. The process shall be proactive and provide timely information, adequate public notice, reasonable public access, and opportunities for public review and comment at key decision points in the process. The objectives of public participation in the transportation planning process include: providing a mechanism for public perspectives, needs, and ideas to be considered in the planning process; developing the public's understanding of the problems and opportunities facing the transportation system; demonstrating explicit consideration and response to public input through a variety of tools and techniques; and developing consensus on plans. The Department shall develop a documented public participation process pursuant to 23 C.F.R. Part 450.

4.02.2 Statewide Plans and Programs. Pursuant to 23 C.F.R. Part 450 Subpart B, the Department is responsible, in cooperation with the RPCs and MPOs, for carrying out public participation for developing, amending, and updating the ~~statewide~~ Statewide ~~transportation~~ Transportation ~~plan~~Plan, the ~~Statewide Transportation Improvement Program (~~STIP~~)~~, and other statewide transportation planning activities.

4.02.3 MPO Plans and Programs. Pursuant to 23 C.F.R. Part 450 Subpart C, the MPOs are responsible for carrying out public participation for the development of ~~regional transportation plan~~RTPs, ~~transportation improvement programs~~TIPs and other related regional transportation planning activities for their respective ~~metropolitan~~ Metropolitan ~~planning~~ Planning ~~areas~~Areas. Public participation activities carried out in a metropolitan area in response to metropolitan planning requirements shall by agreement of the Department and the MPO, satisfy the requirements of this subsection.

4.02.4 Non-MPO TPR Plans and Programs. ~~Regional Planning Commission~~RPCs for non-MPO TPRs are responsible for public participation related to regional planning activities in that TPR, in cooperation with the Department. Specific areas of cooperation shall be determined by agreement between the ~~Regional Planning Commission~~RPC and the Department.

4.02.5 Public Participation Activities. Public participation activities at both the rural TPR and statewide level shall include, at a minimum:

4.02.5.1 Establishing and maintaining for the geographic area of responsibility a list of all known parties interested in transportation planning including, but not limited to: elected officials; municipal and county planning staffs; affected public agencies; local, state, and federal agencies eligible for federal and state transportation funds; local representatives of public transportation agency employees and users; freight shippers and providers of freight transportation services; public and private transportation providers; representatives of users of transit, bicycling and pedestrian, aviation, and train facilities; private industry; environmental and other interest groups; Indian tribal governments and the U.S. Secretary of the Interior when tribal lands are involved; and representatives of persons or groups that may be underserved by existing transportation systems, such as minority, low-income, seniors, persons with disabilities, and those with ~~limited~~ Limited English ~~proficiency~~Proficiency; and members of the general public expressing such interest in the transportation planning process.

4.02.5.2 Providing reasonable notice and opportunity to comment through mailing lists and other various communication methods on upcoming transportation planning-related activities and meetings.

4.02.5.3 Utilizing reasonably available internet or traditional media opportunities, including minority and diverse media, to provide timely notices of planning-related activities and meetings to members of the public, including ~~LEP~~ Limited English Proficiency individuals, and others who may require reasonable accommodations. Methods that will be used to the maximum extent practicable for public participation could include, but not be limited to, use of the internet; social media, news media, such as newspapers, radio, or television, mailings and notices, including electronic mail and online newsletters.

4.02.5.4 Seeking out those persons or groups ~~traditionally~~ Traditionally ~~underserved~~ Underserved by existing transportation systems including, but not limited to, seniors, persons with disabilities, minority groups, low-income, and those with ~~limited~~ Limited English ~~proficiency~~Proficiency, for the purposes of exchanging information, increasing their involvement, and considering their transportation needs in the transportation planning process. Pursuant to § 43-1-601, C.R.S., the Department shall prepare a statewide survey identifying the transportation needs of seniors and of persons with disabilities.

4.02.5.5 Consulting, as appropriate, with ~~Regional Planning Commission~~RPCs, and federal, state, local, and tribal agencies responsible for land use management, natural resources, environmental protection, conservation and historic preservation concerning the development of long-range transportation plans.

4.02.5.6 Providing reasonable public access to, and appropriate opportunities for public review and comment on criteria, standards, and other planning-related information. Reasonable public access includes, but is not limited to, ~~LEP~~ Limited English Proficiency services and access to ADA-compliant facilities, as well as to the internet.

4.02.5.7 Where feasible, scheduling the development of regional and statewide plans so that the release of the draft plans may be coordinated to provide for the opportunity for joint public outreach.

4.02.5.8 Documentation of Responses to Significant Issues. ~~Regional Planning Commissions~~RPCs and the Department shall respond in writing to all significant issues raised during the review and comment period on transportation plans, and make these responses available to the public.

4.02.5.9 Review of the Public Involvement Process. All interested parties and the Department shall periodically review the effectiveness of the Department's public involvement process to ensure that the process provides full and open access to all members of the public. When necessary, the process will be revised and allow time for public review and comment per 23 C.F.R. Part 450.

4.03 Transportation Systems Planning. ~~Regional Planning Commission~~RPCs, and the Department, shall use an integrated ~~multimodal~~ Multimodal ~~transportation~~ Transportation ~~systems~~ Systems ~~planning~~ Planning approach in developing and updating the long-range ~~Regional Transportation Plans~~RTPs and the long-range Statewide Transportation Plan for a minimum 20-year forecasting period. ~~Regional Planning Commission~~RPCs shall have flexibility in the methods selected for ~~transportation~~ Transportation ~~systems~~ Systems ~~planning~~ Planning based on the complexity of transportation problems and available resources within the TPR. The Department will provide guidance and assistance to the ~~Regional Planning Commission~~RPCs regarding the selection of appropriate methods.

4.03.1 Transportation ~~systems~~ Systems ~~planning~~ Planning by ~~Regional Planning Commission~~RPCs and the Department shall consider the results of any related studies that have been completed. ~~Regional Planning Commission~~RPCs and the Department may also identify any ~~corridor~~Corridor(s) or sub-area(s) where an environmental study or assessment may need to be performed in the future.

4.03.2 Transportation ~~systems~~ Systems ~~planning~~ Planning by ~~Regional Planning Commission~~RPCs shall consider ~~corridor vision~~ needs and desired state of the transportation system including existing and future land use and infrastructure, major activity centers such as industrial, commercial and recreation areas, economic development, environmental protection, and modal choices.

4.03.3 Transportation ~~systems~~ Systems ~~planning~~ Planning by ~~Regional Planning Commission~~RPCs shall include operational and management strategies to improve the performance of existing transportation facilities to relieve vehicular congestion and maximize the safety and ~~mobility~~ Mobility of people goods, and services.

4.03.4 Transportation ~~systems~~ Systems ~~planning~~ Planning by the Department should include capital, operations, maintenance and management strategies, investments, procedures, and other measures to ensure the preservation and most efficient and effective use of the ~~state~~ State ~~transportation~~ Transportation ~~system~~System.

4.03.5 Transportation ~~systems~~ Systems P~~p~~lanning by the Department shall consider and integrate all modes into the Statewide Transportation Plan and include coordination with Department modal plans and modal committees, such as the ~~Transit and Rail Advisory Committee (~~TRAC~~)~~.

4.03.6 Transportation Systems Planning by the Department shall provide for the establishment and use of a performance-based approach to transportation decision-making to support the national goals described in 23 U.S.C. § 150 (FAST Act, P.L. 114-94). Performance targets that the Department establishes to address the performance measures described in 23 U.S.C. § 150, where applicable, are to be used to track progress towards attainment of critical outcomes for the state. The state shall consider the performance measures and targets when developing policies, programs, and investment priorities reflected in the Statewide Transportation Plan and STIP.

4.04 Regional Transportation Plans (RTP). Long-range ~~regional transportation plans~~RTPs shall be developed, in accordance with federal (23 U.S.C. § 134 and § 135) and state (§ 43-1-1103 and § 43-1-1104, C.R.S.) law and implementing regulations. Department selection of performance targets that address the performance measures shall be coordinated with the relevant MPOs to ensure consistency, to the maximum extent practicable.

4.04.1 Content of ~~Regional Transportation Plan~~RTPs. Each RTP shall include, at a minimum, the following elements:

4.04.1.1 Transportation system facility and service requirements within the MPO TPR over a minimum 20-year planning period necessary to meet expected demand, and the anticipated capital, maintenance and operating cost for these facilities and services.

4.04.1.2 State and federal transportation system planning factors to be considered by ~~Regional Planning Commission~~RPCs and the Department during their respective ~~transportation~~ Transportation ~~systems~~ Systems ~~planning~~ Planning shall include, at a minimum, the factors described in § 43-1-1103 (5), C.R.S., and in 23 U.S.C. § 134 and § 135.

4.04.1.3 Identification and discussion of potential environmental mitigation measures, ~~corridor~~ Corridor studies, or ~~corridor~~ Corridor ~~visions~~Visions, including a discussion of impacts to minority and low-income communities.

4.04.1.4 A discussion of potential environmental mitigation activities and potential areas to carry out these activities, including activities that may have the greatest potential to restore and maintain the environmental functions affected by the plan.

4.04.1.5 For rural RTPs, the integrated performance-based ~~multimodal~~ Multimodal transportation plan based on revenues reasonably expected to be available over the minimum 20-year planning period. For metropolitan RTPs, a ~~fiscally~~ Fiscally ~~constrained~~ Constrained financial plan.

4.04.1.6 Identification of reasonably expected financial resources developed cooperatively among the Department, MPOs, and rural TPRs for ~~long~~Long-~~range~~ Range ~~planning~~ Planning purposes, and results expected to be achieved based on regional priorities.

4.04.1.7 Documentation of the public notification and public participation process pursuant to these Rules.

4.04.1.8 A resolution of adoption by the responsible ~~Metropolitan Planning Organization~~MPO or the ~~Regional Planning Commission~~RPC.

4.04.2 Products and reviews

4.04.2.1 Draft Plan. ~~Transportation Planning Region~~TPRs shall provide a draft of the RTP to the Department through the Division ~~of Transportation Development~~.

4.04.2.2 Draft Plan Review. Upon receipt of the draft RTPs, the Department will initiate its review and schedule the STAC review (pursuant to these Rules). The Department will provide its comments and STAC comments to the ~~Transportation Planning Region~~TPR within a minimum of 30 days of receiving the draft RTP. ~~Regional transportation plan~~RTPs in metropolitan areas completed pursuant to the schedule identified in 23 C.F.R. § 450.322 shall be subject to the provisions of this section prior to being submitted to the Department for consideration as an amendment to the ~~statewide~~ Statewide ~~transportation~~ Transportation ~~plan~~Plan.

4.04.2.3 Final Plan. ~~Transportation Planning Region~~TPRs shall provide the final RTP to the Department through the Division ~~of Transportation Development~~.

4.04.2.4 Final Plan Review. Upon receipt of the final RTP, the Department will initiate its review and schedule the STAC review (pursuant to these

Rules) of the final RTPs to determine if the plans incorporate the elements required by the Rules. If the Department determines that a final RTP is not complete, including if the final RTP does not incorporate the elements required by these Rules, then the Department will not integrate that RTP into the statewide plan until the ~~Transportation Planning Region~~TPR has sufficiently revised that RTP, as determined by the Department with advice from the STAC. The Department will provide its comments and STAC comments to the ~~Transportation Planning Region~~TPR within a minimum of 30 days of receiving the final RTP. ~~Transportation Planning Region~~TPRs shall submit any RTP revisions based on comments from the Department and STAC review within 30 days of the Department's provision of such comments. ~~Regional transportation plans~~RTPs in metropolitan areas completed pursuant to the schedule identified in 23 C.F.R. § 450.322 shall be subject to the provisions of this section prior to being submitted to the Department for consideration as an amendment to the ~~statewide~~ Statewide ~~transportation~~ Transportation ~~plan~~Plan.

4.05 Maintenance and Nonattainment Areas. Each RTP, or RTP amendment, shall include a section that:

4.05.1 Identifies any area within the TPR that is designated as a ~~maintenance~~ Maintenance or ~~nonattainment~~ Nonattainment ~~area~~Area.

4.05.2 Addresses, in either a qualitative or quantitative manner, whether transportation related emissions associated with the pollutant of concern in the TPR are expected to increase over the ~~long~~Long-~~range~~ Range ~~planning~~ Planning period and, if so, what effect that increase might have in causing a ~~maintenance~~ Maintenance ~~area~~ Area for an NAAQS pollutant to become a ~~nonattainment~~ Nonattainment ~~area~~Area, or a ~~non-attainment~~Nonattatinment ~~area~~ Area to exceed its emission budget in the approved State Implementation Plan.

4.05.3 If transportation related emissions associated with the pollutant are expected to increase over the ~~long~~Long-~~range~~ Range ~~planning~~ Planning period, identifies which programs or measures are included in the RTP to decrease the likelihood of that area becoming a ~~nonattainment~~ Nonattainment ~~area~~ Area for the pollutant of concern.

4.06 Statewide Transportation Plan. The ~~Regional Transportation Plans~~RTPs submitted by the ~~Regional Planning Commissions~~RPCs shall, along with direction provided through Commission policies and guidance, form the basis for developing and amending the Statewide Transportation Plan. The Statewide Transportation Plan shall cover a minimum 20-year planning period at the time of adoption and shall guide the development and implementation of a performance-based ~~multimodal~~ Multimodal transportation system for the State.

4.06.1 The Statewide Transportation Plan shall:

4.06.1.1 Integrate and consolidate the RTPs and the Department's systems planning, pursuant to these Rules, into a long-range 20-year ~~multimodal~~ Multimodal transportation plan that presents a clear, concise path for future transportation in Colorado.

4.06.1.2 Include the long-term transportation concerns of the Southern Ute Indian Tribe and the Ute Mountain Ute Tribe in the development of the Statewide Transportation Plan.

4.06.1.3 Coordinate with other state and federal agencies responsible for land use management, natural resources, environmental protection, conservation, and historic preservation.

4.06.1.4 Include a discussion of potential environmental mitigation activities and potential areas to carry out these activities that may have the greatest potential to restore and maintain the environmental functions affected by the plan developed in consultation with federal, state, and tribal wildlife, land management and regulatory agencies.

4.06.1.5 Include a comparison of transportation plans to state and tribal conservation plans or maps and to inventories of natural or historical resources.

4.06.1.6 Provide for overall ~~multimodal~~ Multimodal transportation system management on a statewide basis.

4.06.1.7 The Statewide Transportation Plan shall be coordinated with metropolitan transportation plans pursuant to 23 C.F.R. Part 450, § 43-1-1103 and § 43-1-1105, C.R.S. Department selection of performance targets shall be coordinated with the MPOs to ensure consistency, to the maximum extent practicable.

4.06.1.8 Include an analysis of how the Statewide Transportation Plan is aligned with Colorado's climate goals and helps reduce, prevent, and mitigate GHG pollution throughout the State.

4.06.1.9 Includes the 10-Year Plan as an appendix.

4.06.2 Content of the Statewide Transportation Plan. At a minimum, the Statewide Transportation Plan shall include priorities as identified in the RTPs, as identified in these Rules and pursuant to federal planning laws and regulations. The Statewide Transportation Plan shall be submitted to the ~~Colorado Transportation~~ Commission for its consideration and approval.

4.06.3 Review and Adoption of the Statewide Transportation Plan.

4.06.3.1 The Department will submit a draft Statewide Transportation Plan to the Commission, the STAC, and all interested parties for review and comment. The review and comment period will be conducted for a minimum of 30 days. The Statewide Transportation Plan and appendices~~The publication~~ will be available in physical form upon request~~at public facilities, such as at the Department headquarters and region offices, state depository libraries, county offices, TPR offices, Colorado Division offices of the Federal Highway Administration and Federal Transit Administration~~, and made available on the internet.

4.06.3.2 The Department will submit the final Statewide Transportation Plan to the ~~Colorado Transportation~~ Commission for adoption.

5.00 Updates to Regional and Statewide Transportation Plans.

5.01 Plan Update Process. The updates of ~~Regional Transportation Plan~~RTPs and the Statewide Transportation Plan shall be completed on a periodic basis through the same process governing development of these plans pursuant to these Rules. The update cycle shall comply with federal and state law and be determined in consultation with the ~~Transportation~~ Commission, the Department, the STAC and the MPOs so that the respective update cycles will coincide.

5.02 Notice by Department of Plan Update Cycle. The Department will notify ~~Regional Planning Commission~~RPCs and the MPOs of the initiation of each plan update cycle, and the schedule for completion.

6.00 Amendments to the Regional and Statewide Transportation Plans.

6.01 Amendment Process

6.01.1 The process to consider amendments to ~~Regional Transportation Plan~~RTPs shall be carried out by rural RPCs and the MPOs. The amendment review process for ~~Regional Transportation Plan~~RTPs shall include an evaluation, review, and approval by the respective RPC or MPO.

6.01.2 The process to consider amendments to the Statewide Transportation Plan shall be carried out by the Department, either in considering a proposed amendment to the Statewide Transportation Plan from a requesting RPC or MPO or on its own initiative.

6.01.3 The process to consider amendments to the 10-Year Plan shall be carried out by CDOT in coordination with the rural RPCs and the MPOs.

7.00 Transportation Improvement Programs (TIPs) and Statewide Transportation Improvement Program (STIP).

7.01 TIP development shall occur in accordance with 23 C.F.R. Part 450, Subpart C. The Department will develop the STIP in accordance with 23 C.F.R. Part 450, Subpart B.

7.02 The Department will work with its ~~planning~~ Planning ~~partners~~ Partners to coordinate a schedule for development and adoption of TIPs and the STIP.

7.03 A TIP for an MPO that is in a ~~non-attainment~~Nonattainment or Maintenance Area must first receive a conformity determination by FHWA and FTA before inclusion in the STIP pursuant to 23 C.F.R. Part 450.

7.04 MPO TIPs and Colorado's STIP must be ~~fiscally~~ Fiscally ~~constrained~~Constrained. Under 23 C.F.R. Part 450, each project or project phase included in an MPO TIP shall be consistent with an approved metropolitan RTP, and each project or project phase included in the STIP shall be consistent with the long-range ~~statewide~~ Statewide ~~transportation~~ Transportation ~~plan~~Plan. MPO TIPs shall be included in the STIP either by reference or without change upon approval by the MPOs and the Governor.

8.00 GHG Emission Requirements

8.01 Establishment of Regional GHG Transportation Planning Reduction Levels

8.01.1 The GHG emission reduction levels within Table 1 apply to MPOs and the Non-MPO area within the state of Colorado ~~as of the effective date of these Rules~~. Baseline ~~values~~projections are specific to each MPO and CDOT area and represent estimates of GHG emissions resulting from the existing transportation network and implementation of the most recently adopted RTP for all MPOs and the 10-Year Plan in non-MPO areas as of the effective date of these Rules. ~~Table 2 reflects the difference in~~ The Baseline ~~levels~~projections ~~from year to year assuming~~ account for estimates of population and employment growth as provided by the state demographer and assume a rapid growth in electric vehicles across the State (940,000 light duty electric vehicles in 2030, 3.38 million in 2040 and a total of 97% of all light duty vehicles in 2050). ~~Values in both tables include estimates of population and employment growth as provided by the state demographer.~~

8.01.2 Regional GHG Transportation Planning Reduction Levels

Table 1: GHG Transportation Planning Reduction Levels in MMT of CO2e

Regional Areas	2025 Baseline Projections (MMT)	2025 Reduction Level (MMT)	2030 Baseline Projections (MMT)	2030 Reduction Level (MMT)	2040 Baseline Projections (MMT)	2040 Reduction Level (MMT)	2050 Baseline Projections (MMT)	205 Reduc Leve (MM
DRCOG	14.9	0.27	11.8	0.82	10.9	0.63	12.8	0.37
NFRMPO	2.3	0.04	1.8	0.12	1.9	0.11	2.2	0.07
PPACG	2.7	N/A	2.2	0.15	2.0	0.12	2.3	0.07
GVMPO	0.38	N/A	0.30	0.02	0.30	0.02	0.36	0.01
PACOG	0.50	N/A	0.40	0.03	0.30	0.02	0.4	0.01
CDOT/Non-MPO	6.7	0.12	5.3	0.37	5.2	0.30	6.1	0.18
TOTAL	27.4	0.5	21.8	1.5	20.6	1.2	24.2	0.7

Commented [redacted]: For some of the compliance years, the TOTAL line at the bottom does not match the sum of the regional areas.
The same number of significant digits should be used for all baselines and reduction levels.

8.01.3 ~~Baseline Emissions Due to Projected Number of Light Duty Electric Vehicles~~Process for Reviewing and Revising GHG Transportation Planning Reduction Levels – At least every four years, the State Interagency Consultation Team shall conduct a feasibility review of the GHG Reduction Levels based on current conditions and forecasts. At any time, an MPO, CDOT, or the Commission may request the State Interagency Consultation Team conduct a feasibility review of the GHG Reduction Levels. The State Interagency Consultation Team shall determine through consultation if a submitted request will be fulfilled or denied. Upon completing a feasibility review, the State Interagency Consultation Team shall submit a report to the Commission identifying the findings of the feasibility review and a recommendation on whether the GHG Reduction Levels should be revised. The Commission shall determine by resolution if a rulemaking should commence to allow for the potential revision of the GHG Reduction Levels.

~~**Table 2: Baseline Emissions Due to Projected Number of Light Duty Electric Vehicles**~~

	~~2025 Projections (MMT)~~	~~2030 Projections (MMT)~~	~~2040 Projections (MMT)~~	~~2050 Projections (MMT)~~
~~TOTAL~~	~~27.0~~	~~20.0~~	~~14.0~~	~~8.9~~

Commented [redacted]: There is no regulatory purpose for this table. If a regulatory purpose is not provided, it should be removed from the rule. Potential regulatory purpose: Adding in the EV assumption for each year and stating if the EV assumption changes, then the reduction levels in the rule should be revisited to determine if they are still feasible.

8.02 Process for Determining Compliance

8.02.1 Analysis Requirements When Adopting or Amending an Applicable Planning Document - Each MPO and CDOT shall conduct a GHG emissions analysis using MPO Models or the Statewide Travel Model, and the Approved Air Quality Model, to estimate total CO2e emissions. Such analysis shall include the existing transportation network and implementation of Regionally Significant Projects. The emissions analysis must estimate total CO2e emissions in million metric tons (MMT) for each compliance year in Table 1, as long as the compliance year is not in the past ~~and compare these emissions to the Baseline specified in Table 1~~. This provision shall not apply to MPO TIP amendments.

8.02.2 Agreements on Modeling Assumptions and Execution of Modeling Requirements. Prior to the adoption of the next RTP for any MPO, CDOT, CDPHE, and each MPO shall enter into an Intergovernmental Agreement which outlines CDOT, CDPHE, and MPO responsibilities for development and execution of MPO Models or the Statewide Travel Model, and Approved Air Quality Model.

8.02.3 The State Interagency Consultation Team shall meet as needed to conduct and consider requests for feasibility reviews of the GHG Reduction Levels and to address any questions on the classification of projects as Regionally Significant, modeling assumptions, and projects that reduce GHG emissions.

8.02.3 By April 1, 2022, CDOT shall establish an ongoing administrative process, through a public process and in consultation with MPOs, for ~~selecting, measuring, confirming, and verifying~~ defining GHG Mitigation Measures and measuring their impact on GHG emissions and co-benefits ~~, so that~~ CDOT and MPOs may~~can~~ incorporate one or more GHG Mitigation Measures into ~~each of~~ their plans ~~in order to reach~~to assist in meeting the Regional GHG Planning Reduction Levels in Table 1. Such a process shall include, but not be limited to, determining the relative impacts of GHG Mitigation Measures, measuring ~~and prioritizing~~ localized impacts to communities, ~~and~~ prioritizing benefits to Disproportionately Impacted Communities ~~in particular~~, and identifying a method for grouping GHG Mitigation Measures that are not considered to be of appropriate scale for individual identification. The mitigation credit awarded to a specific solution shall consider both aggregate and community impact.

8.02.4 Timing for Determining Compliance

8.02.4.1 By October 1, 2022, CDOT shall update their 10-Year Plan and DRCOG and NFRMPO shall update their RTPs pursuant to § 43-4-1103, C.R.S. and meet the reduction levels in Table 1 or the requirements pursuant to § 43-4-1103, C.R.S and restrictions on funds.

8.02.4.2 After October 1, 2022

8.02.4.2.1 ~~CDOT must f~~For each Applicable Planning Document adopted or amended after October 1, 2022, CDOT must meet either the reduction levels within Table 1 for Non-MPO areas or the requirements as set forth in Rule ~~8.05~~8.02.5.1.1.

8.02.4.2.2 ~~MPOs must meet either the corresponding reduction levels within Table 1 f~~For each Applicable Planning Document adopted or amended after October 1, 2022, MPOs must either meet the corresponding reduction levels within Table 1~~,~~ or the relevant MPO and CDOT each must meet the requirements as set forth in Rule ~~8.05~~8.02.5.1.1 or Rule 8.02.5.1.2, as applicable. This provision shall not apply to MPO TIP Amendments.

Commented [redacted] The comparison to Table 1 should occur using the GHG Emissions Analysis AND the GHG mitigation measures, not just the GHG Emissions analysis.

Commented [redacted] CDOT should also have an IGA required prior to the next 10-year plan

Commented [redacted] Unclear what these terms mean. The rule already provides a process for reporting the status of the measures – would this process impact the format/approval process of the mitigation report and/or status report?

Commented [redacted] Agencies may choose to report these measures even though they don't enable reaching the reduction levels (i.e. they still fall short). Not sure if the suggested language goes far enough to explain that concept.

Commented [redacted] As proposed, the rule implies the applicable plans must comply immediately after October 1, 2022.

Commented [redacted] Only having this language in §8.02.1 means we'd still have to comply and submit a report for TIP Amendments, it just wouldn't have the emissions analysis. Is that the intent?

8.02.5 Demonstrating Compliance. At least thirty (30) days prior to adoption or amendment of any Applicable Planning Document except amendments to MPO TIPs, CDOT for Non-MPO areas and the MPOs for their areas shall provide to the Commission a GHG Transportation Report containing the following information:

8.02.5.1 GHG emissions analysis and, if applicable, a GHG Mitigation Plan demonstrating that the Applicable Planning Document is in compliance with the GHG Reduction Levels in MMT of CO_2e for each compliance year in Table 1 or that the requirements in Rules 8.02.5.1.1 or 8.02.5.1.2., as applicable, have been met.

8.02.5.1.1 In non-MPO areas or for MPOs that are not in receipt of -federal suballocations pursuant to the ~~CMAQ and/or~~ STBG program~~s~~, the Department utilizes 10-Year Plan funds anticipated to be expended on Regionally Significant Projects in those areas on projects that reduce GHG emissions.

8.02.5.1.2 In MPO areas that are in receipt of federal suballocations pursuant to the ~~CMAQ and/or~~ STBG programs, the MPO ~~utilizes~~ shall award those funds anticipated to be expended on Regionally Significant Projects ~~on~~to projects or approved GHG Mitigation Measures that reduce GHG emissions, and CDOT ~~utilizes~~shall award 10-Year Plan funds anticipated to be expended on Regionally Significant Projects in that MPO area. on projects that reduce GHG emissions.

8.02.5.2 Identification and documentation of the MPO Model or the Statewide Travel Model and the Approved Air Quality Model used to determine GHG emissions in MMT of CO_2e.

8.02.5.3 At the discretion of the MPO or CDOT, submission of Aa Mitigation Action Plan that identifies GHG Mitigation Measures, if any, ~~needed to meet~~that will count toward the reduction levels within Table 1. The Mitigation Action Plan shall include:

8.02.5.3.1 The anticipated start and completion date of each measure.

8.02.5.3.2 An estimate, where feasible, of the annual GHG emissions reductions in MMT of CO_2e achieved per year by any GHG Mitigation Measures.

8.02.5.3.3 Quantification of specific co-benefits, where feasible, including reduction of co-pollutants (PM2.5, NOx, etc.) as well as travel impacts (changes to VMT, pedestrian/bike use, transit ridership numbers, etc. as applicable).

8.02.5.3.4 Description of benefits to Disproportionately Impacted Communities.

8.02.6 Reporting on Compliance- Following the submission of a GHG Transportation Report containing a Mitigation Action Plan, ~~Annually by April 1,~~ CDOT and MPOs must provide a status report to the Commission annually by April 1 on an approved form with the

Commented [redacted]: The rule needs to clearly identify that compliance is not based solely on the GHG emissions analysis (or the GHG emissions analysis needs to clearly identify that the mitigation measures are included in the analysis)

Commented [redacted]: If "or" is retained here, it is unclear which provision applies to MPOs that receive only one of the federal suballocations

Commented [redacted]: Unclear when this takes effect. Projects currently in progress should not have their funding removed, as that would be highly disruptive. The least disruptive approach is to apply the requirement to future awards.

Commented [redacted]: Rule should allow an agency to not submit a Mitigation Action Plan. If the GHG analysis demonstrates compliance, no mitigation measures would be needed.

Commented [redacted]: Again, measures would likely be identified even if they don't allow the agency to meet the reduction levels.

following items for each GHG Mitigation Measure identified in their most recent GHG Transportation Report:

8.02.6.1 The implementation timeline;

8.02.6.2 The current status;

8.02.6.3 For measures that are in progress or completed, quantification of the benefit or impact of such measures; and

8.02.6.4 For measures that are delayed, cancelled, or substituted, an explanation of why that decision was made.

8.03 GHG Mitigation Measures. When assessing compliance with the GHG Reduction Levels, CDOT and MPOs shall have the opportunity to utilize approved GHG Mitigation Measures as set forth in Rules 8.02.3 and 8.02.5.3 to offset emissions and demonstrate progress toward compliance. Illustrative examples of GHG Mitigation Measures include, but are not limited to:

8.0.3.1 The addition of transit resources in a manner that can displace VMT.

8.03.2 Improving pedestrian and bike access, particularly in areas that allow individuals to reduce multiple daily trips.

8.03.3 Encouraging local adoption of more effective forms of vertical development and zoning plans that integrate mixed use in a way that links and rewards transportation project investments with the city making these changes.

Commented [redacted] This language is unclear.

8.03.4 Improving first-and-final mile access to transit stops and stations that make transit resources safer and more usable by consumers.

8.03.5 Improving the safety and efficiency of crosswalks for pedestrians, bicyclists, and other non-motorized vehicles, including to advance compliance with the ADA.

8.03.6 Adopting or encouraging the adoption of locally driven changes to parking policies and physical configuration that encourage more walking and transit trips.

8.03.7 Incorporating medium/heavy duty vehicle electric charging and hydrogen refueling infrastructure -- as well as upgrading commensurate grid improvements -- into the design of key freight routes to accelerate truck electrification.

8.03.8 Establishing policies for clean construction that result in scalable improvements as a result of factors like lower emission materials, recycling of materials, and lower truck emissions during construction.

Commented [redacted] This language is unclear.

8.03.9 ~~Adoption of~~Implementing or encouraging the adoption of transportation demand management practices that reduce VMT.

8.03.10 Implementing or encouraging the implementation of operations improvements such as ramp metering, signal timing, intersection improvements, access control plans, anti-idling programs, ~~and~~ incident management, and Intelligent Transportation Systems (ITS) strategies that result in GHG reductions.

8.04 Air Pollution Control Division (APCD) Confirmation and Verification

8.04.1 At least sixty (60)~~forty-five (45)~~ days prior to adoption of any Applicable Planning Document, CDOT for Non-MPO areas and the MPOs for their areas shall provide to APCD for review and verification of the technical data contained in the draft GHG Transportation Report required per Rule 8.02.5. If APCD has not provided written verification within thirty (30) days, the document shall be considered acceptable. The APCD shall submit any written verification to the agency adopting the Applicable Planning Document and to the Commission.

8.04.2 At least forty-five (45)~~thirty (30)~~ days prior to adoption or amendment of policies per Rule 8.02.3, CDOT shall provide APCD the opportunity to review and comment. If APCD has not provided written comment within thirty (30)~~forty-five (45)~~ days, the document shall be considered acceptable.

8.05 Enforcement. The Commission shall review all GHG Transportation Reports to determine whether the applicable reduction targets in Table 1 have been met and the sufficiency of any GHG Mitigation Measures needed for compliance. The Commission shall determine if the GHG Transportation Report meets the requirements of Rule 8.02.5 within sixty (60) days.

8.05.1 If the Commission determines the requirements of Rule 8.02.5 have been met, the Commission shall, by resolution, accept the GHG Transportation Report.

8.05.2 If the Commission determines, by resolution, the requirements of Rule 8.02.5 have not been met, the Commission shall restrict the use of funds pursuant to Rules 8.02.5.1.1 or 8.02.5.1.2, as applicable, to projects and approved GHG Mitigation Measures that reduce GHG. Prior to the enforcement of such restriction, an MPO, CDOT or a TPR in a non-MPO area, may~~, within thirty (30) days of Commission action,~~ issue one or both of the following opportunities to seek a waiver or to ask for reconsideration accompanied by an opportunity to submit additional information:

8.05.2.1 Request a waiver from the Commission imposing restrictions on specific projects not expected to reduce GHG emissions. A waiver may be requested at any time, including concurrently with the submission of a GHG Transportation Report. The Commission may waive the restrictions on specific projects on the following basis:

8.05.2.1.1 The GHG Transportation Report reflected significant effort and priority placed, in total, on projects and GHG Mitigation Measures that reduce GHG emissions; and

8.05.2.1.2 In no case shall a waiver be granted if such waiver results in a substantial increase in GHG emissions when compared to the required reduction levels in this Rule.

8.05.2.2 Request reconsideration of a non-compliance determination by the Commission and provide written explanation of how the requirements of Rule 8.02.5 have been met. A request for reconsideration must be submitted within sixty~~thirty~~ (~~30~~60) days of Commission action.

8.05.2.3 The Commission shall act, by resolution, on a waiver or reconsideration request within thirty (30) days of receipt of the waiver or reconsideration request or at the next regularly scheduled Commission Meeting, whichever is later. If no action is taken within this time period, the waiver or reconsideration request shall be deemed to be ~~denied~~approved.

8.05.2.4 Conflicts among MPOs and the Commission shall be escalated to the Governor if they cannot be resolved by the heads of the involved agencies. The Governor may delegate his or her role in this process, but not to the head or staff of the State or local air agency, State department of transportation, Commission, or an MPO.

8.05.3 Notwithstanding any other provision of this Rule, CDOT, DRCOG and NFRMPO must meet the requirements of § 43-4-1103, C.R.S.

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8.06 Reporting. Beginning July 1, 2025, and every 5 years thereafter, the Executive Director on behalf of CDOT shall prepare and make public a comprehensive report on the statewide GHG reduction accomplishments.

9.00 Materials Incorporated by Reference

9.01 The Rules are intended to be consistent with and not be a replacement for the federal transportation planning requirements in Rule 9.01.1 and federal funding programs in Rules 9.01.2 and 9.01.3, which are incorporated into the Rules by this reference, and do not include any later amendments.

9.01.1 Fixing America's Surface Transportation Act or the "FAST Act"), 23 U.S.C. §§ 134, 135 and 150, Pub. L. No. 114-94, signed into law on December 4, 2015, and its accompanying regulations, where applicable, contained in 23 C.F.R Part 450, including Subparts A, B and C in effect as of November 29, 2017, and 25 C.F.R. § 170 in effect as of November 7, 2016.

~~9.01.2 Congestion Mitigation and Air Quality Improvement (CMAQ) Program, 23 U.S.C. § 149, in effect as of March 23, 2018.~~

9.01.3 Surface Transportation Block Grant (STBG) Program, 23 U.S.C. § 133, in effect as of December 4, 2015.

9.02 Also incorporated by reference are the following federal laws and regulations and do not include any later amendments:

9.02.1 Americans with Disabilities Act (ADA), 42 U.S.C. § 12101, *et. seq.*, in effect as of January 1, 2009.

9.02.2 Clean Air Act (CCA), 42 U.S.C. §§ 7407-7410, and 7505a, in effect as of November 15, 1990.

9.02.2 Transportation Conformity Regulations, 40 C.F.R. § 93.101, in effect as November 24,1993.

9.03 Also incorporated by reference are the following documents, standards, and models and do not include any later amendments:

9.03.1 Greenhouse Gas Pollution Reduction Roadmap by the Colorado Energy Office and released on January 14, 2021.

9.03.2 MOVES3 Motor Vehicle Emissions Model for SIPs and Transportation Conformity released by the U.S. Environmental Protection Agency, in effect as of January 7, 2021.

9.04 All referenced laws and regulations are available for copying or public inspection during regular business hours from the Office of Policy and Government Relations, Colorado Department of Transportation, 2829 W. Howard Pl., Denver, Colorado 80204.

9.05 Copies of the referenced federal laws and regulations, planning documents, and models.

9.05.1 Copies of the referenced United States Code (U.S.C.) may be obtained from the following address:

Office of the Law Revision Counsel
U.S. House of Representatives
H2-308 Ford House Office Building
Washington, DC 20515
(202) 226-2411
https://uscode.house.gov/browse.xhtml

9.05.2 Copies of the referenced Code of Federal Regulations (C.F.R.) may be obtained from the following address:

U.S. Government Publishing Office
732 North Capitol State, N.W.
Washington, DC 20401
(866) 512-1800
https://www.govinfo.gov/

9.0.5.3 Copies of the Greenhouse Gas Pollution Reduction Roadmap (Roadmap) may be obtained from the following address:

Colorado Energy Office
1600 Broadway, Suite 1960
Denver, CO 80202
(303) 866-2100
energyoffice.colorado.gov

9.0.5.4 To download MOVES3 released by the U.S. Environmental Protection Agency may be obtained from the following address:

U.S. Environmental Protection Agency
The Office of Transportation and Air Quality
1200 Pennsylvania Ave, N.W.
Washington, DC 20460
(734) 214–4574 or (202) 566-0495
mobile@epa.gov
https://www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves

10.00 Declaratory Orders

10.01 The Commission may, at their discretion, entertain petitions for declaratory orders pursuant to § 24-4-105(11), C.R.S.

Editor's Notes

History

Entire rule eff. 12/15/2012.

Section SB&P eff. 05/30/2013.

Entire rule eff. 09/14/2018.

Annotations

Rules 1.22, 1.25, 1.42, 2.03.1 – 2.03.1.4, 4.01, 4.02.1 – 4.02.3, 4.02.5.9, 4.04.2.2, 4.04.2.4, 4.06.1.7, 6.01.2, 7.01, 7.03 – 7.04 (adopted 10/18/2012) were not extended by Senate Bill 13-079 and therefore expired 05/15/2013.

NFRMPO GHG Comment Letter Final

Final Audit Report 2021-10-11

Created:	2021-10-11
By:	NFR MPO (staff@nfrmpo.org)
Status:	Signed
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"NFRMPO GHG Comment Letter Final" History

- Document created by NFR MPO (staff@nfrmpo.org)
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  Signature Date: 2021-10-11 - 8:04:37 PM GMT - Time Source: server- IP address: 172.58.63.81

- Agreement completed.
  2021-10-11 - 8:04:37 PM GMT

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Greenhouse Gas Pollution Standard for Transportation Planning

1 me age

[redacted] Mon, Oct 11, 2021 at 5:08 PM
To: dot_rules@state.co.us

Hello CDOT Transportation Commission,

Thank you for taking some time out of your busy schedule to read some of the thoughts I and others have on the current Greenhouse Gas rule under consideration.

July was the hottest month ever recorded, our Earth is hotter than it's ever been since the beginning of the last ice age, and yet Colorado is not on track to meet its climate targets! **It is critical that our state agencies embrace bold, transformative policies that drive broad scale decarbonization.** The current draft rule is a good start, but should be more ambitious to ensure that we meet our emissions reduction targets.

As a matter of environmental justice, **disproportionately impacted communities and communities of color must be at the heart of any decision making process** to en ure acce to affordable, multimodal, transportation options that reduce toxic air pollution and traffic congestion. Please also develop an equity framework beyond thi rulemaking that en ure that individual from di proportionately impacted communities are given a real seat at the decision making table.

GHG reduction levels in the draft rules do not add up to the 12.7 million metric tons of CO2e reductions from Transportation by 2030 figure outlined in the state's GHG Pollution Reduction Roadmap issued by Governor Polis' Office in January of this year. Coloradans deserve a clear, enforceable, and equitable plan to reduce GHG emi ion from the tran portation ector   not more account tricks.

The draft rules rely heavily upon optimistic electric vehicle (EV) adoption rates and provide no alternative proposals for achieving these GHG reductions if EV adoption is slower than anticipated. Therefore, this rule should adopt stricter carbon budgets that will allow us to meet our emissions reduction targets given the likelihood that EV adoption does not occur as fast as this rule anticipates.

Along with stricter carbon budgets to compensate for slower EV adoption, **instead of more highway expansion projects, Coloradans need more and better transportation alternatives to driving a vehicle**   like electric bicycle and cooter for horter trip , affordable and efficient public tran it for longer trips, expanded light rail and bus rapid transit along major routes, and better land use decisions to provide more bike lane , idewalk , and pede trian centric urban center Thi rule hould impo e a moratorium on highway expansions, as this strategy has only been shown in all studies to increase traffic, air pollution and di place neighborhood

The draft rules do not account for all greenhouse gas sources from vehicles. Hydrofluorocarbons (HFCs) are not included in the definition of a greenhouse gas. This is a significant omission because HFCs from vehicle air conditioners and refrigeration trucks are powerful GHGs with Global Warming Potentials (GWPs) hundreds to thousands of times greater than that of CO2.

Transportation models, assumptions, estimates and **figures used to guide transportation policy by CDOT must be transparent for the public** to engage in decision making processes that impact public health, traffic congestion and our state's GHG emissions.

We all want a healthier Colorado, le impacted by mog and traffic jam We mu t make ure thi i not achieved at the cost of our vulnerable communities or future generations. Thank you for reading my thought on thi matter

--

[redacted]

"When people talk about traveling to the past, they worry about radically changing the present by doing something small, but barely anyone in the present really thinks that they can radically change the future by doing something small." ~Anonymous

"Nobody made a greater mistake than he who did nothing because he could do only a little." ~Edmund Burke

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

DRCOG Comments: Proposed GHG Rule

1 message

[redacted] Mon, Oct 11, 2021 at 2:35 PM
To: "dot_rules@state.co.us" <dot_rules@state.co.us>
Cc: [redacted] "shoshana.lew@state.co.us" <shoshana.lew@state.co.us>, Herman Stockinger <herman.stockinger@state.co.us>, Rebecca White <rebecca.white@state.co.us>, "Takushi - CDOT, Theresa" <theresa.takushi@state.co.us>

Good afternoon,

Please find attached a letter conveying comments from the DRCOG Board of Directors on the proposed Rule for Greenhouse Gas Pollution Reduction for Transportation Planning. The comments were unanimously adopted by the Board at their October 6, 2021 meeting.

Also attached are comments and questions from DRCOG staff on the Cost Benefit Analysis prepared by CDOT related to the proposed Rule.

Please contact me if you have any questions or need additional information.

Best,

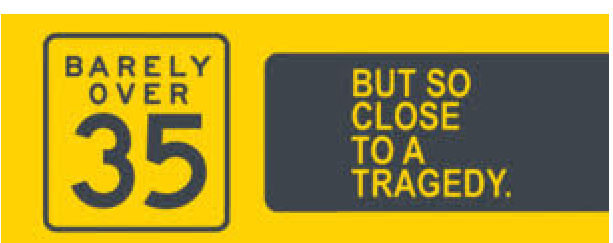
[redacted]

[redacted] | **Division Director** | **Transportation Planning and Operations**

[redacted]

drcog | DENVER REGIONAL COUNCIL OF GOVERNMENTS

[redacted]



[redacted]

2 attachments

DRCOG Board GHG Rule Comment Letter - signed[1].pdf
465K

cdot-cost-benefit-analysis-for-ghg-rule-sept-2021-DRCOG comment.pdf
381K

COLORADO

Department of Transportation

COST-BENEFIT ANALYSIS FOR RULES GOVERNING STATEWIDE TRANSPORTATION PLANNING

In performing a cost-benefit analysis, each rulemaking entity must provide the information requested for the cost-benefit analysis to be considered a good faith effort. The cost-benefit analysis must be submitted to the Office of Policy, Research and Regulatory Reform at least ten (10) days before the administrative hearing on the proposed rule and posted on your agency's web site. For all questions, please attach all underlying data that supports the statements or figures stated in this cost-benefit analysis.

DEPARTMENT:	Colorado Department of Transportation		AGENCY:	Transportation Commission

CCR:			DATE:	August 31, 2021

RULE TITLE OR SUBJECT:
RULES GOVERNING STATEWIDE TRANSPORTATION PLANNING PROCESS AND TRANSPORTATION PLANNING REGIONS

1. The reason for the rule or amendment;

The proposed "RULES GOVERNING STATEWIDE TRANSPORTATION PLANNING PROCESS AND TRANSPORTATION PLANNING REGIONS" will set a greenhouse gas standard for state and regional transportation plans. The purpose of the Proposal is to ensure ongoing greenhouse gas emissions reductions from Colorado's transportation sector, which helps achieve the reduction goals set by HB19-1261. This rule also responds to a requirement in SB21-260, directing CDOT and the Transportation Commission to address GHGs through transportation planning.

Analysis Background

This analysis assumes that capital dollars for transportation will always be finite -- based on available federal, state, and local resources -- and that the parameters and modeling requirements established in the rule will help transportation planning agencies to prioritize those dollars in ways that better balance air pollution reduction needs with other factors such as improving safety and reducing congestion, and ideally selecting a portfolio of projects that achieve all of those ends. All of these factors, and others, tend to increase economic competitiveness, and render transportation investments of all modes good economic investments.

In terms of the overall economic and societal benefits of the rule, which are described in more detail below, it assumes that the public sector budget for transportation investment is relatively fixed and that this rule will likely result in some meaningful yet nuanced and regionally tailored shifts in the nature of which projects are prioritized.

The baseline for this analysis assumes a status quo that tallies the sum of regional transportation plans (RTPs) across all five metropolitan planning areas. These RTPs include state projects that are within the Metropolitan Planning Organization (MPO) boundaries For example: all CDOT projects within the Denver metropolitan area are also included in the RTP for the Denver Regional Council of Governments (DRCOG). These long range plans typically extend out for about 30 years, so unlike the more proximate plans established at both the state and MPO levels, many of the projects included in these plans are notional and far away from delivery. Generally speaking, these RTPs are inclusive of capital investments but do not include maintenance budgets, which are typically paid for separately by the state and local governments respectively, without engagement by the MPOs.

As these plans are not fully fiscally constrained, meaning that in actuality they contain more projects than can be paid for with resource constraints, they typically fluctuate significantly before projects are transferred to nearer term, fiscally constrained plans (e.g. the first four years of the state's "ten year plan" and the MPO transportation improvement plans or TIPs). The current sum of the long range RTPs for all five MPO areas is approximately $28 billion of projects, many of which are not fully funded or planned. Notably, this baseline does not include the state's many planned projects in rural Colorado, outside of the boundaries of the MPO areas and represented by rural transportation planning regions (TPRs). Virtually none of these rural projects would trigger the need for GHG Mitigation Measures under this rule because, with rare exception, they do not add capacity or change land use patterns. Rather, they are generally focused on state of good repair (e.g. repaving projects), safety and resiliency improvements like adding shoulders and passing lanes, and increasingly, supporting the economic vitality of communities by investing in revitalizing main streets across the state.

Using the sum of the RTPs as the baseline for the size of the transportation capital program that could be subject to mode shift, the analysis below assumes that, over several periods of performance, it is estimated that between a quarter and a third of resources would need to be shifted towards transportation project types that have air quality mitigation benefits -- as well as many societal co-benefits -- in order to achieve the targets set in the rule (and notably, if total spending shifted either higher or lower than in the scenario described here, it is likely that the proportions would be fairly similar). As explained in the table below, which assumes that spending is roughly consistent across the periods of time identified, this number is significantly lower in the immediate years and increases in the outyears. This, in large part, is because the early year projects are assumed to add significant transit service, which carry operating costs that aggregate. However, while the modeling assumes that about 20% of transit costs are paid back by farebox revenue, it does not factor in other revenue sources that often become available as a transit system grows. For example, federal formula funds for transit are allocated partially on the basis of existing ridership, so more ridership tends to result in more federal funding.

Table 1
Net Neutral Investment Levels and Dollars Shifted to Multimodal Transportation and other Environmentally Beneficial Transportation Investments
(net present value, millions of 2021 dollars)

Years	Total RTPs + 10-Year Plan	Total Shift to Mitigation	Percent Shift
2022-2025	$3,842.07	$417.90	11%
2026-2030	$4,802.59	$974.90	21%
2031-2040	$9,605.17	$2,655.80	28%

2041-2050	$9,605.17	$2,691.50	28%

Importantly, the scenario described above means that important capacity projects remain, but that these are balanced out with other types of projects with offsetting impacts, like adding bus infrastructure to highway projects, improving crosswalks to make them safer for pedestrians, opening up main streets for communities to utilize downtowns with less car travel, improving first-and-last-mile connections to transit facilities, and more. There is already precedent for adding these types of complementary features to highway projects. For example, construction of a managed lane on US36 included bus infrastructure for the flatiron flyer service. In a similar vein building on that model, CDOT is currently constructing a series of “mobility hubs” as part of capacity expansion along I-25 North in preparation to run bus rapid transit service in those managed lanes. In another example, design for the Floyd Hill expansion project includes plans to build out both a new microtransit service operated by CDOT, as well as park-and-ride facilities to facilitate operation of that service.

Incorporating mitigation features into high priority capacity expansion projects is expected to complement investment in project types that do not require mitigation measures -- such as repaving broken roads and fixing bridges that are in poor or fair condition before they become worse and more expensive to fix. Thus, all dollars shifted away from certain capacity projects are assumed to fund worthy transportation investments that improve competitiveness, quality of place and life, safety, economic vitality, public health, air quality, and more. A breakdown of these specific benefits is tabulated below.

An important aspect of this rule is that it does not require a specific set of measures to be implemented by the State and its MPOs to achieve the rule’s targets. Those decisions are left to the implementing agencies who will also have ongoing opportunity to propose new mitigation measures for modeling to ensure that they result in emission reductions. Thus, in order to conduct this analysis, CDOT developed illustrative policy choice packages that assume implementation of three broad categories of VMT reduction measures: (1) expansion of transit service; (2) policies to encourage compact land use that reduces the need to drive by making it possible for travelers to access more of their preferred destinations easily within denser areas, in a manner that also facilitates strong and economically vibrant downtowns; and (3) various programs that expand travel choices through a variety of different approaches that could include investing in bicycle and pedestrian infrastructure and micro mobility services that assist with “first and last mile” connections to transit facilities; investments (e.g. in digital infrastructure) that help support tele-travel as an alternative to physical travel and also offer more workplace flexibility to employees in many work environments; or programs that encourage non-work travel by modes other than a single occupancy vehicle (e.g. a jurisdiction that provides transit passes to its residents).

The projected cost of these policy choice packages is assumed to be absorbed into current transportation plan budgets (a net neutral approach).

Per the provisions of 24-4-103(2.5)(a), Colorado Revised Statutes, the cost-benefit analysis must include the following:

2. **The anticipated economic benefits of the rule or amendment, which shall include economic growth, the creation of new jobs, and increased economic competitiveness;**

<u>Anticipated Economic Benefits</u>

Full implementation of this rule is expected to result in significant economic benefits in the form of cost savings to travelers and to the general public. Travelers will benefit from reductions in vehicle operating costs as a result of expanded travel options (e.g., transit service, tele-travel, walking and bicycling), travel time savings, and the need to use personal vehicles less because of being provided with more options through state and regional transportation planning. Implementation of the rule will also reduce economic costs associated with carbon emissions, air pollution, motor vehicle crashes (road safety), and the health consequences of physical inactivity.

Businesses are also expected to receive a share of the economic benefits. Examples include congestion reduction that saves travel time for “on-the-clock” business travel, and reduced health care costs for employees as a result of reduced air pollution, motor vehicle crashes, and physical inactivity. They may also experience increased worker retention and satisfaction as a result of employees having expanded commute or work from home options.

Additionally, policies that facilitate and reward downtown density tend to have a markedly positive impact on “main street” small businesses such as restaurants and locally-owned retail. While these benefits can be somewhat difficult to quantify in the aggregate and are thus not fully accounted for in this analysis, results from the Colorado Department of Transportation’s “Revitalizing Main Street” program indicate that they are significant and widespread across the state. Well over 100 grants awarded to more than 70 communities have largely supported projects including downtown street repurposing and parklets, sidewalks and crosswalks, park and street improvements, shared streets between cars and pedestrians, and wayfinding and signage improvements. Many recipients have affirmed to CDOT that these grants significantly improved business and saved jobs during the COVID-19 pandemic, and, when surveyed, 67 percent of respondents said they would not have implemented these innovations without the program. Though grants supported many projects on a pilot basis, survey results showed that 81 percent of projects are likely to be maintained or repeated on a seasonal basis given their success. This data provides qualitative indication of the economic development benefits associated with many of the project types that this policy would encourage.

Table 2 shows the projected change in social costs through 2025, 2030, 2040, and 2050 respectively, for full implementation of the proposed rule using the illustrative mix of strategies. The net benefits reflect the effects of reduced highway investment as well as increased investment in GHG-reducing projects. Negative values (shown in parentheses) represent a net cost savings. Future savings are discounted at a rate of 2.5 percent, consistent with Colorado Senate Bill (SB) 21-260 which requires use of the social cost of carbon dioxide (CO_2) and other pollutants using a discount rate of 2.5 percent or less. The most substantial benefits are from reduced crashes and reduced vehicle operating costs, resulting from reduced VMT. The net present value of total social benefits is roughly $8 billion in the 2026-2030 timeframe and $17 billion between 2031 and 2040.

Table 2
Economic Benefits (Cost Savings)
(Net Neutral Investment Levels after Mode Shift)
(net present value, millions of 2021 dollars)

Timeframe	Vehicle Operating Cost	Social Cost of Carbon	Air Pollution	Safety (Crashes)	Traffic Delay	Physical Inactivity	Total Social Cost Savings
2022 - 2025	$(372)	$(60)	$(21)	$(481)	$(774)	$(17)	$(1,724)

2026 - 2030	$(1,781)	$(258)	$(82)	$(2,332)	$(3,098)	$(75)	$(7,626)
2031 - 2040	$(4,670)	$(589)	$(125)	$(7,183)	$(4,693)	$(237)	$(17,497)
2041 - 2050	$(4,210)	$(323)	$(42)	$(9,027)	$397	$(289)	$(13,494)

A brief description of each of these economic benefits and how they were quantified is provided below. With the exception of physical inactivity, which is related to increased bicycling and walking, all of these economic benefits are derived from reductions in VMT and/or traffic delay. As described earlier, many of these benefits accrue to businesses as they do to individuals (e.g. a reduction in crashes leads to less lost work time). Additional detail on the assumptions underlying these estimates of economic benefits is provided in Appendix A.

- Vehicle operating cost – Fuel and maintenance costs per mile driven. Costs per mile change over time consistent with projected changes in fuel prices and the mix of the vehicle fleet including conventional fuels (e.g. gasoline and diesel) versus zero emission vehicles (e.g. electric and hydrogen). Vehicle cost savings provide travelers with more out-of-pocket money that they can spend on other goods and services of higher value to them. Businesses also save money for work travel and goods movement expenses. These savings benefit the state's economy.

- Social cost of carbon – Global climate change is expected to result in a variety of negative economic effects to the world and national economy, including Colorado. Examples include costs of flood prevention and mitigation, health care costs associated with excessive heat, and fire prevention, control, and damages. Carbon emissions are valued based on guidance issued by the Biden Administration[1] at a discount rate of 2.5 percent, consistent with Colorado Senate Bill (SB) 21-260. The social cost increases over time, from $83 per metric ton of CO_2 emissions for emissions occurring in 2025 to $116 per metric ton of CO_2 for emissions occurring in 2050.

- Air pollution – Costs associated with air pollution include higher health care costs, as well as damage to structures and natural systems. Values per ton of particulate matter (PM) and oxides of nitrogen (NOx) reduced are based on modeling conducted in support of Federal rulemakings on vehicle tailpipe emission standards.

- Safety (crashes) – Costs associated with crashes resulting in fatalities or injuries include higher medical costs, insurance costs, vehicle property damage, and lost workplace productivity. These costs impact Colorado's economy. Motor vehicle crash reductions are estimated based on national average fatality and injury crash rates per VMT, and are valued based on federal guidance on the value of a statistical life and average value of injury crashes.

- Traffic delay -- Traffic delay results in increased travel time for "on-the-clock" business travel and freight movement, as well as more time spent traveling for commuting, errands, and other personal travel. These time losses negatively impact Colorado's economy. To estimate delay reduction associated with

[1] "A Return to Science: Evidence-Based Estimates of the Benefits of Reducing Climate Pollution." The White House, 2021. https://www.whitehouse.gov/briefing-room/blog/2021/02/26/a-return-to-science-evidence-based-estimates-of-the-benefits-of-reducing-climate-pollution/

emissions-reducing transportation investments, hours of traffic delay reduced (per VMT reduced) are derived from Texas Transportation Institute studies of national traffic congestion and mitigation measures including transit expansion. For highway capacity expansion projects, which reduce delay, hours of delay reduced are based on modeled relationships between volume, capacity, and travel time. Capacity expansion projects consider the effects of “induced demand”, or increased traffic that is observed to result over time after roads are expanded. This increased traffic may lead to net increases in greenhouse gas emissions as a result of the project, and may offset to some degree the delay reduction benefits.

- Physical inactivity -- A lack of physical activity is associated with increased mortality and other negative health outcomes, increasing health care costs. Investments in walking and bicycling infrastructure and transit services increase physical activity, reducing those associated costs. Physical inactivity in this analysis is valued based on health care cost savings per mile of walking and bicycling activity.[2]

Additionally, there are several categories of benefits from mitigation measures that are real, and may be quite large, but are difficult to quantify and therefore are not reflected in the chart above. These include:

- Reduced vehicle ownership costs - to the extent that areas comply with the GHG requirements by making land use decisions that reduce the need to travel long distances, make areas more walkable and bikeable, and add transit service, it is likely that this will enable more households to reduce their vehicle ownership, for example going from from a 2 car to a 1 car family. This is particularly true for land use changes, where there is a strong correlation between average number of vehicles per household and land use types. While the analysis above captures reduced vehicle operating costs, it does not capture the reduced costs from lower levels of vehicle ownership, including depreciation of vehicle value due to reduced use per vehicle owned, lower cost due to owning fewer vehicles, etc.. Nationwide, researchers have found that households within 1/2 mile of transit stations own on average 0.9 cars, while households in the rest of the metropolitan regions owned, on average, 1.6 vehicles.[3] According to AAA, the annual fixed cost to own a vehicle - including depreciation, insurance, license and registration fees, and finance charges - was on average $6,200 in 2019, though these costs can range based on the cost and type of the vehicle, and household size.[4]

- Downtown/main street economic revitalization - policies that support dense, walkable downtowns and main streets tend to spark significant economic vitality in those areas, providing customers for restaurants and small businesses. Investments in transit also spur economic benefits such as

[2] An alternative estimate of physical activity benefits was conducted using estimates of deaths prevented and the value of a statistical life based on U.S. Department of Transportation guidance. This method showed a much higher value of benefits -- nearly $23 billion in the 2031-2040 timeframe in addition to benefits shown above. This alone is greater than the value of all other social benefits combined and could be considered as a consistent approach relative to other transportation modeling, since the cost benefit analysis for highway projects including capacity expansion projects typically incorporates the value of a statistical life on the benefits side when considering the safety impact of that project, for example safety improvements resulting from adding improved level of safety service at a chokepoint with an accident history. However, in the cases presented in the tables above, the value of benefits is based only on health care cost savings deriving from active transportation, and therefore represents a very conservative estimate of benefits.

[3] Dorn, J. (2004). Hidden in plain sight: capturing the demand for housing near transit. Oakland, CA: Center for Transit-Oriented Development. https://ctod.org/pdfs/2004HiddenPlainSight.pdf

[4] Average Cost of Owning and Operating an Automobile, Bureau of Transportation Statistics. https://www.bts.gov/content/average-cost-owning-and-operating-automobilea-assuming-15000-vehicle-miles-year

Polzin, S. E., Chu, X., & Raman, V. S. (2008). Exploration of a shift in household transportation spending from vehicles to public transportation (No. NCTR 576-02). https://www.nctr.usf.edu/pdf/77722.pdf increased property values and agglomeration benefits from more efficient land use. These benefits are real[5], but difficult to quantify and are not included in this analysis.

- Increased access to jobs - Because Colorado already has a very complete roadway network, households that have access to cars have the ability to access employment by driving. By contrast, for residents who do not own cars or have disabilities that preclude driving, many jobs are essentially inaccessible. A more robust transit network will increase access to jobs for these residents, and will provide a larger pool of potential employees for businesses. As an example, within the DRCOG region 6% of households do not have cars and 9% of residents have mobility disabilities[6]. While it is not quantified in this analysis, greater access to employment for these individuals could bring significant economic and equity benefits.

3. **The anticipated costs of the rule or amendment, which shall include the direct costs to the government to administer the rule or amendment and the direct and indirect costs to business and other entities required to comply with the rule or amendment;**

Direct costs to the government to administer the rule

In terms of regulatory implementation, one reason why the Transportation Commission, rather than the Air Quality Control Commission, is pursuing this rule is in order to optimize overhead and streamline implementation resources within the organizations that already house transportation planning functions and expertise.

However, there will be some administrative costs associated with implementing this policy change, especially within the initial years of implementation. Within the state, the Colorado Department of Transportation (CDOT) is largely relying on existing staff positions to support the Transportation Commission's rulemaking, however, CDOT expects to hire three new positions to focus on functions related to implementation. This likely amounts to a cost of up to $350,000 per year including employee benefits and other costs. Over time, it is possible that the Colorado Department of Public Health and the Environment's Air Pollution Control Division could hire an additional staff modeler to support confirmation and verification of pollution reduction analytics. This cost would amount to roughly another $125,000-$150,000 (including benefits).

Moreover, it is expected that some metropolitan planning organizations (MPOs) may require additional staff members dedicated to emissions modeling, as well as additional modeling software. CDOT is exploring options to streamline these overhead expenses and achieve economies of scale, especially as relates to centralizing certain modeling and software capabilities for use as shared services between the state and MPOs. The recently passed state legislation, SB 260, updates the Multimodal and Mitigation Options Fund (MMOF) to allow funds directed into this program to be used for modeling support.

[5] See for example, Liu and Shi, Understanding Economic and Business Impacts of Street Improvements for Bicycle and Pedestrian Mobility: A Multi-City, Multi-Approach Exploration, National Institute for Transportation and Communities, April, 2020, available at https://ppms.trec.pdx.edu/media/project_files/NITC-RR-1031-1161_Understanding_Economic_and_Business_Impacts_of_Street_Improvements_for_Bicycle_and_Pedestrian_Mobility.pdf, which found significant increases in retail and food service income and employment associated with bicycle and pedestrian access improvements.

[6] Denver Regional Active Transportation Plan, DRCOG, 2019, available at https://drcog.org/sites/default/files/resources/DRCOG_ATP.pdf

Costs to business and other entities required to comply with the rule

As described in detail in the background section above, it is assumed that costs to implementing agencies are net neutral -- representing some shift in how dollars are prioritized rather than an overall change in the amount of spending on transportation. For example, some, but by no means all, dollars would shift from highway capacity expansion projects to other types of transportation investment including but not limited to bus rapid transit lanes or queue jumps as part of road projects; walking and bicycling facilities; additional transportation services, including expanded transit service and ridesharing options; and/or consumer incentives to reduce travel or encourage travel by more efficient, lower-emissions modes (such as ridesharing or telecommuting incentives). Importantly, it is anticipated that all costs shifted towards these types of investments will themselves result in mobility benefits and economic development, as well as improvements to air quality and pollution reduction.

Importantly, as described above, it is assumed that only a portion -- roughly a third -- of capital program dollars are shifted towards projects that also serve as mitigation, in addition to providing mobility benefits of their own. This means that the most critical capacity projects are assumed to advance, likely paired with mitigation and significant investment in achieving and maintaining a state of good repair for roads, bridges, tunnels, and other transportation infrastructure assets across Colorado.

It is worthy of note that additional federal investment could augment overall resources, and especially those resources geared towards transit and multimodal investments. For example, the Senate-passed Infrastructure Investment and Jobs Act would expand transit formula funds over the next five years by about $39.5 billion, a 43% increase over the FAST Act. Under current FTA funding formulas, Colorado could receive more than $900 million over the course of 5 years, an increase of approximately $40 million a year. The Act also contains $66 billion for Amtrak while Colorado continues to work towards passenger rail along the front range.

Businesses are not expected to incur significant direct costs to comply with the rule under the proposed implementation of the rule. As noted previously, there are a variety of social benefits (cost savings) that will be realized by the rule, some of which will accrue to Colorado's businesses. Importantly, this rule does **not** require that businesses implement trip reduction strategies that would have been required in a separate rulemaking recently withdrawn by the Air Quality Control Commission (AQCC). While businesses are encouraged to pursue employee trip reduction on a voluntary basis, and MPO's and CDOT through their Travel Demand Management (TDM) programs are able to help and encourage businesses in this effort, nothing in this rule requires it.

Lastly, both the benefit and cost assumptions within the rule assume that implementing agencies come into full compliance with the rule over the period of performance. However, the way that the rule is structured, the enforcement mechanism for non-compliance requires that a portion of an agency's capital funds -- which for MPOs are only those funds sub-allocated via the state as well as those specifically noted in Senate Bill 260 as being conditioned in this manner -- become restricted to projects that are demonstrated to reduce pollution and improve mobility. The recipient retains discretion over what pollution reducing investments are made, so long as those investments are approved as mitigations pursuant to the process set forth in the proposed rule. No entity would lose funds as a result of the enforcement provisions becoming effectuated by not hitting the targets in totality. The goal of this policy is to perpetuate serious conversation and planning for how the choices that planning entities make can provide consumers with the choices that are needed to reduce pollution and improve quality of life, not to diminish the ability of any entity to invest these dollars in mobility solutions for Coloradans.

4. Any adverse effects on the economy, consumers, private markets, small businesses, job creation, and economic competitiveness; and

The proposed measures will affect Colorado industries in varying ways depending upon how spending increases or decreases for different types of vehicles, fuels, and equipment. Multipliers from the IMPLAN model were used to translate changes in spending for two industries directly affected by reductions in VMT -- gasoline and diesel sales and automotive maintenance and repairs -- into changes in direct gross state product (GSP) for those industries. IMPLAN is an economic input-output model that contains data on how spending in any one particular industry will directly and indirectly affect output, jobs, and other metrics in that industry and other industries. The IMPLAN multipliers used are $0.18 million GSP change per $million spending change on gasoline, and $0.67 million GSP change per $million spending change on automotive maintenance and repairs. The different impacts reflect the fact that more of the money spent on maintenance and repairs stays within the state of Colorado than money spent on gasoline and diesel fuel.

Table 3 shows the anticipated GSP effects for the combined VMT reduction measures for those directly affected industries, compared to baseline projected GSP levels for each industry in each year. The estimated effects are similar for both Comparison A and Comparison B since they reduce VMT to similar degrees to meet the same GHG reduction targets.

Table 3
Impacts on Directly Affected Industries
(Gross State Product, 2021 $millions)

Spending Category	2022 - 2025	2026 - 2030	2031 - 2040	2041 - 2050
Gasoline and diesel sales	($54)	($231)	($479)	($288)
Automotive maintenance and repairs	($133)	($589)	($1,380)	($1,177)

These impacts should not be taken as a bottom line impact to Colorado’s economy as a whole. The changes in costs and benefits described above will impact Colorado's economy in a variety of different ways. As shown in Table 2, Colorado’s residents will save on vehicle operating costs as a result of increased travel options and the need to travel less by personal vehicle. The other social benefits resulting from the rule are also expected to result in economic impacts that may affect different sectors of the economy in a variety of ways. For example, reduced traffic crashes and air pollution will reduce spending in the health care sector, but provide consumers with correspondingly more money to spend on other goods and services that are of greater value to them. These various indirect effects are not quantified in this analysis.

Jobs Impact

Generally speaking, research shows that state and local infrastructure investment, along with other forms of government purchase of goods and services, rank[7] amongst the highest categories of spending in terms of yielding a “fiscal multiplier” -- with that multiplier ranging between 0.4 and 2.5. The macroeconomic impact of

[7] https://www.brookings.edu/wp-content/uploads/2019/05/AutoStabilizers_framingchapter_web_20190506.pdf

infrastructure spending, particularly when considering its impact as part of fiscal stimulus, does not tend to differentiate between the mode of transportation investment, largely because these impacts tend to be measured in terms of jobs created through fields like construction, engineering, and trucking which have more to do with the amount of work done than the substance of the end product. To that end, a rule that results in some shifting between project types should not have a significant net impact on jobs or the fiscal multiplier.

To the extent that there could be some shift in terms of how the modality of transportation spending impacts jobs, this might reflect in the breakdown between capital and operating expenses. For instance, if some portion of programmed transportation dollars shift to transit spending, that would likely entail a larger percentage of dollars spent on operating expenses relative to capital expenses -- as the analysis below shows. This might entail some shift in job type or classification, but should not result in a significant net change in jobs because, much like capital expenses, operating expenses translate directly into jobs in fields such as equipment operation (e.g. bus drivers), repair of both infrastructure and rolling stock (e.g. construction and mechanical work), technology operations (e.g. software and logistics and mapping systems, etc). Notably, there is significant overlap between the job types associated with capital versus operations. In sum, job impacts, much like the fiscal multiplier, are assumed to be strong and consistent so long as they are invested in transportation and irrespective of the specific type of transportation project that they support.

Table 4
NAICS Job Classifications for Transportation

NAICS Job Classifications[8]	NAICS CODE
Heavy and Civil Engineering Construction The Heavy and Civil Engineering Construction subsector comprises establishments whose primary activity is the construction of entire engineering projects (e.g., highways and dams), and specialty trade contractors, whose primary activity is the production of a specific component for such projects. Specialty trade contractors in Heavy and Civil Engineering Construction generally are performing activities that are specific to heavy and civil engineering construction projects and are not normally performed on buildings. The work performed may include new work, additions, alterations, or maintenance and repairs.	237
Highway, Street, and Bridge Construction	2373
Other Heavy and Civil Engineering Construction	2375
Transit and Ground Passenger Transportation Industries in the Transit and Ground Passenger Transportation subsector include a variety of passenger transportation activities, such as urban transit systems; chartered bus, school bus, and interurban bus transportation; and taxis. These activities are distinguished based primarily on such production process factors as vehicle types, routes, and schedules.	485
Urban Transit Systems	4851
Other Transit and Ground Passenger Transportation	4859
Interurban and Rural Bus Transportation	4852

5. At least two alternatives to the proposed rule or amendment that can be identified by the submitting agency or a member of the public, including the costs and benefits of pursuing each of the alternatives identified.

Two alternative implementation scenarios for the rule were considered, including:

[8] https://www.bls.gov/iag/tgs/iag_index_naics.htm

Alternative 1: A lower level of pollution savings based on modeling assumptions that only factored in savings associated with travel choices: Programs to encourage non-work travel by non-single occupancy vehicle modes; programs to support and encourage tele-travel (e.g., on-line health care, education, and shopping) as a substitute for physical travel; investment in bicycle and pedestrian infrastructure and micromobility services; and reduction of transit fares. Essentially, this regulatory alternative achieves the lowest cumulative pollution reduction targets and assumes fewer illustrative choices by agencies to meet them.

Alternative 2: A pollution reduction scenario at a level where the model assumed an illustrative set of actions including travel choices and expanded transit service. Notably, since most of the costs assumed in the rule relate to the ongoing cost of transit operations, this scenario would reflect most of the costs associated with the current proposal.

In contrast to the illustrative package of policy choices used to evaluate the proposed rule, these alternatives do not include additional land use policies to reduce vehicle travel. As a result, they are less likely to achieve the required greenhouse gas reduction targets and therefore to support overall state goals for GHG reduction and climate change.

The economic benefits (reductions in social costs) from these alternatives are presented in Table 5. The “travel choices” alternative (Alternative 1) achieves the lowest greenhouse gas emission reductions. The “travel choices + transit” alternative (Alternative 2) results in additional social cost savings and greenhouse gas reductions. The proposed alternative for this rule (which includes travel choices, transit, and land use policies) results in a further increase in greenhouse gas benefits. These considerations resulted in proposing this alternative to analyze the effects of the final rule. As with the base alternative, the net costs of implementing the rule to the public sector would assume similar levels of overhead (staffing) at implementing agencies but would otherwise assume that topline funding remains the same with some portion shifted from planned highway expansion into other, emissions-reducing modes and services.

Table 5
Net Present Value of Economic Benefits (Cost Savings) for Alternatives ($millions)

Scenario	Alternative 1: Travel Choices	Alternative 2: Travel Choices + Transit
2022 - 2025	$(1,527)	$(1,644)
2026 - 2030	$(6,776)	$(7,268)
2031 - 2040	$(14,852)	$(16,102)
2041 - 2050	$(10,603)	$(11,397)

Appendix A. Detailed Analysis of Economic Benefits and Costs

This appendix provides detailed information and assumptions supporting the estimates of economic benefits and costs for the proposed Colorado transportation greenhouse gas (GHG) reduction rule. Information is presented for each of the illustrative measures that are assumed to be implemented to achieve the targets set forth in the rule. This information includes a description of the measure and how it is expected to affect economic benefits and costs; a table showing the various estimated costs and benefits of the measure; and additional details about the key assumptions and data sources.

Some effects of the measures will show up as economic benefits to one party and costs to another party. For example, reduced transit fares are an additional cost to the public sector (lost fare revenue), but a benefit to consumers.

The social benefits were estimated based on the estimated reductions in vehicle-miles traveled (VMT) and GHG emissions from each measure. VMT and GHG reductions, and the associated economic benefits, were estimated cumulatively for the entire set of measures anticipated to be implemented under the proposed rule and its two alternatives, rather than individually for each measure. VMT, GHG, and associated cost changes are discussed in a separate section following the discussion of public sector implementation costs.

Analysis Timeframe

Implementation of measures is assumed to start in 2022 or 2023 depending on the measure. The year in which measures are assumed to be fully implemented varies depending upon the measure.

The analysis considers impacts of the proposed rule in four timeframes: 2022-2025, 2026-2030, 2031-2040, and 2041-2050. Economic benefits and costs were estimated based on a time-stream of costs incurred between 2022 and 2050, expressed as net present values (NPV) for each timeframe. Costs are expressed in 2021 dollars.

Public Sector Costs

<u>Travel Choices: Household-Based Trip Reduction</u>

This set of measures includes programs combining information, incentives, and services to encourage non-work trip reduction and mode shifting away from SOV travel. Trips may include school trips, shopping, personal business, recreation, etc. This set of measures includes what are sometimes called “individualized marketing” programs and incentive-based rideshare or trip reduction apps.

Individualized marketing programs and similar information/incentive-based programs were piloted in a number of cities in the early 2000’s and some continue to be implemented today, with some evolution of the programs (for example, to a focus on app-based incentives). One example is the Portland (OR) SmartTrips program, operated by the Portland Bureau of Transportation since 2003. In recent years this program has pivoted to focus on new households moving to the city and is now known as SmartTrips New Movers. Other agencies implementing programs have included Bellevue and King County, WA; Cambridge, MA; Chicago; Salt Lake City; San Francisco, and the Southern California Association of Governments. Washington State has proposed to create a voluntary “all trips” grant program funded at $10 million per year that would expand on the success of the state’s Commute Trip Reduction program to address non-work trips.

These types of measures entail public sector investment in the form of staff time and materials for marketing, information, and outreach. The program may also provide consumer cost savings as a result of reduced VMT and associated vehicle operating costs, although consumers may also incur some additional costs for expenditures on transit fares, bikeshare services, etc. All of these examples are illustrative of what implementing agencies might select as part of their implementation strategies. Importantly, as noted above, this rule does **not** require any employer-based trip reduction programs that would have been required by a proposed rule that was recently withdrawn by the Air Quality Control Commission (AQCC).

Table A.1 shows the estimated public sector implementation costs for this measure.

Table A.1
Costs for Household-Based Trip Reduction Programs (millions of 2021 dollars)

Description	$ Value per Unit	2022-2025	2026-2030	2031-2040	2041-2050
Program costs	$30 per HH per year	$2.9	$6.2	$13	$13

Basis for cost estimates:

- Programs that have been in operation in the U.S. have typically reported administrative costs of around $15 to $30 per year per household targeted. The Portland SmartTrips New Movers program is funded at $250,000 per year at a cost of just under $30 per household.[9]
- The total cost is based on the assumed participation of 3.2 percent of Colorado households (77,300 households in 2030) as described in the discussion of VMT reduction estimates for this measure below.

Travel Choices: Tele-Travel

This set of measures includes programs to encourage the substitution of “virtual” travel for commute trips as well as for non-work activities such as shopping, medical appointments, and education. Examples of state and MPO policies and actions to support virtual travel may include but would not be limited to programs to encourage and support employers in developing work from home policies; revision of health care regulations, if needed, to permit or encourage remote services to the degree feasible and appropriate; and directives to publicly funded post-secondary educational institutions to support distance learning.

Tele-travel will also be supported by investments to expand broadband infrastructure to cover all households in the state. The Colorado Broadband Office is already supporting broadband expansion with the aid of Federal grant programs as well as state funds. In the long run to maximize broadband use by all residents of Colorado, support may also be needed for low-income households that cannot afford service even if it is available. For this analysis it is assumed that additional state costs beyond ongoing infrastructure investment measures are minimal and limited to program support to encourage tele-travel and broadband adoption.

Table A.2 shows the estimated public sector implementation costs for this measure.

Table A.2
Costs for Tele-Travel Programs (millions of 2021 dollars)

Description	$ Value per Unit	2022-2025	2026-2030	2031-2040	2041-2050

[9] Portland Bureau of Transportation, “About Smart Trips”, https://www.portlandoregon.gov/transportation/

Program administration costs	$131,000 / staff person	$0.7	$0.8	$0.6	$0.5

Basis for cost estimates:

- Program administration - Two additional full-time staff people through 2030 including fringe and overhead for development and implementation of tele-travel programs, one staff person after 2030.

Travel Choices: Bicycle, Pedestrian, and Micro-Mobility Facilities, Policies, Initiatives

This set of measures includes bicycle and pedestrian infrastructure investment as well as incentives to support micro-mobility services such as shared or privately owned electric bicycles and scooters.

Public sector costs include infrastructure costs for pedestrian and bicycle facilities, and subsidies for low-income households to increase their participation in electrified micromobility options.

The costs for consumers who choose to purchase equipment like bicycles is subtracted from what those consumers might be expected to save by not operating vehicles. Importantly, though, micro-mobility options do not in any way require specific individuals to use those options; they merely expand the universe for personal choice. It is also assumed that the public sector provides an income-targeted subsidy in order to increase participation by low-income households.

Table A.3 shows the estimated public sector implementation costs for this measure.

Table A.3
Costs for Bicycle, Pedestrian, and Micro-Mobility Facilities, Policies, Initiatives (millions of 2021 dollars)

Description	$ Value per Unit	2022-2025	2026-2030	2031-2040	2041-2050
Infrastructure costs – sidewalk	$170,000 / mile	$100	$112	$187	$32
Infrastructure costs – bicycle	$25,000 / mile of lane $250,000 / mile of special facility	$46	$50	$84	$15
Maintenance	10% of capital	$46	$145	$496	$566
Electric micromobility equipment subsidy	$250 / HH / year	$0.4	$1.5	$5.9	$8.4

Basis for cost estimates:

- Data from the Denver region was used to estimate that there are about 18,800 miles of sidewalk in this region. The DRCOG regional travel demand model includes data on sidewalk density for each traffic analysis zone (TAZ). The model includes six area types, from central business district (CBD) to rural. The number of miles of sidewalk in each area type was estimated by multiplying the sidewalk density in each TAZ by the area of the TAZ, as shown in Table A.9, totalling nearly 19,000 existing miles. For illustrative purposes, it is assumed that 1,900 new or improved miles of sidewalk are added by 2030 and 4,700 new or improved miles of sidewalk are added by 2050 in metro areas and smaller communities across the state. These values represent 10 and 25 percent of the Denver region supply, respectively. It is assumed that this work may include upgrading deficient sidewalks as well as constructing new sidewalks where none are currently provided. It is further assumed that this work occurs over a 20-year period (2022 – 2041) at a cost of $170,000 per mile based on Florida DOT data.[10]

Table A.4
Existing Sidewalk Estimates, Denver Region

Area Type	Sidewalk Miles
1 = Denver CBD	51
2 = CBD Fringe & Outlying CBD (ex. Boulder CBD)	448
3 = Urban Neighborhood	3,031
4 = Suburban Neighborhood	15,004
5 = Rural Area (Non-Mountainous)	224
6 = Rural Area (Mountainous)	37
Total	**18,795**

- Bicycle facilities: Construction is assumed of 2,500 linear miles of new bike lanes at $25,000 per mile and 2,500 linear miles of new separated bike lanes and shared-use paths at an average cost of $250,000 per mile, over a 20-year period, based on cost estimates from Cambridge Systematics (2020).[11] The estimate of the added length of facilities is described in the section on VMT reductions below and would occur in metro areas and smaller communities across the state.
- Sidewalk and bike facility maintenance: 10 percent annually of cumulative construction costs, based on industry estimation rules.
- Cost per e-bike: eBikesHQ.com (2019), assumed to decline from $2,000 in 2019 declining to $1,500 by 2025. Bicycle lifetime of 6 years from ITF (2020).[12]
- Number of new e-bikes purchased: Change in annual bike-miles traveled based on e-bike speed increase as described in the section on VMT reductions below, divided by 1,500 miles per bike per year (1 round-trip, 3 days a week, average length 5 miles, or per ITF (2020)).
- To estimate a subsidy value (public sector share of e-bike costs), it is assumed that 11 percent of households purchasing an e-bike are low-income (per statewide model) and receive a purchase voucher from the state.

Transit – Expansion of Service Coverage, Frequency, and/or Hours

This measure includes expansion of transit service, including fixed-route and demand-responsive buses as well as rail transit. It is also assumed that buses are electrified over time. However, the costs and benefits of bus electrification are not considered here, since bus electrification is not a VMT reduction measure. The costs shown in this section represent the incremental costs of adding service using existing technologies.

[10] Florida DOT (n.d.). "Cost Per Mile Models for Long Range Estimating",
https://www.fdot.gov/programmanagement/estimates/lre/costpermilemodels/cpmsummary.shtm.
[11] Cambridge Systematics, Inc. (2020) "Transportation and Climate Initiative - 2019/2020 TCI Investment Strategy Tool Documentation." Prepared for Georgetown Climate Center.
[12] International Transport Forum (ITF). (2020). "Good to Go? Assessing the Environmental Performance of New Mobility."

The public sector costs include additional operating costs for the expanded service, as well as additional capital investment for vehicles to provide the service. These added costs are partially offset by added fare revenue resulting from increased ridership (shown as a negative cost).

Travelers may incur some additional costs in the form of fares paid for new trips taken. These are subtracted from the vehicle operating cost savings for this measure.

Table A.5 shows the estimated annual public sector implementation costs for this measure.

Table A.5
Costs for Transit Service Expansion (millions of 2021 dollars)

Description	$ Value per Unit	2022-2025	2026-2030	2031-2040	2041-2050
Vehicle costs	$435,000 per bus	$38	$136	$394	$452
Operating costs	See below	$200	$718	$2,083	$292
New transit fare revenue	$0.75 per trip	($68)	($243)	($706)	($809)

Basis of cost estimates:

- It is assumed that vehicle revenue-miles (VRM) are increased by 6 percent annually statewide between 2022 and 2030, with an annual increase of 2 percent between 2030 and 2050.
- Vehicle costs – $435,000 per new bus (NREL, 2017); An average of 3.11 buses are needed per 100,000 VRM of service, the average for the “motor bus” mode for all Colorado operators, from the 2019 National Transit Database (NTD).
- Operating costs – Average operating costs are assumed to be $5.96 per VRM. This is the average cost for “rapid bus” service operating in Colorado as of 2019 according to reporting for the 2019 NTD. For comparison, the cost per VRM for regular motor bus service is in the range of $3.89 to $6.28 for the state’s smaller MPOs and is $9.20 for the Denver region. It is assumed that funds for additional transit expansion under this rule would be directed into services such as bus rapid transit that are more cost-effective from a GHG reducing perspective.
- New transit fare revenue/expenses – Public agencies recoup some of their operating costs through increased fare revenue. The estimate is based on an average fare per trip of $0.75 based on 2019 NTD data for all Colorado operators. Transit ridership is assumed to increase in proportion to service levels, meaning that higher quality and frequency service results in more individuals choosing to use transit.

Transportation-Efficient Land Use

This measure includes policy changes and incentives, such as funding for planning and potential changes to transportation project selection criteria, to encourage transit-supportive land use and walkable neighborhoods that reduce vehicle-travel per household.

Land use measures are assumed to be achieved mainly through the operation of market forces responding to market demand for mixed-use neighborhoods that are supported by changes to local plans and zoning regulations. Therefore only minimal costs to the public sector are assumed for making administrative changes to plans and zoning.

Table A.6 shows the estimated annual public sector implementation costs for this measure.

Table A.6
Costs for Land Use Measures (millions of 2021 dollars)

Description	$ Value per Unit	2022-2025	2026-2030	2031-2040	2041-2050
Administrative costs	$50,000 per municipality	$7	$8	$13	$11

Basis for cost estimates:

- Administrative costs – 272 municipalities in Colorado at an average of $50,000 in planning costs per municipality per five-year period for updating and revising plans and zoning.

Reduced Investment in Adding Additional Roadway Capacity

This analysis assumes a reduction, but by no means an elimination, in spending on roadway capacity expansion relative to the "baseline" scenario of what is forecasted in long range regional transportation plans (RTPs) over the next several decades. That investment is anticipated to shift to other public investment in transportation mobility, illustrating a "net revenue neutral" implementation of the rule.

Table A.7 shows the estimated annual public sector implementation costs saved as a result of implementing fewer highway capacity expansion projects. These costs saved are assumed to be re-directed to other investments that reduce GHG and help offset the inclusion of other roadway capacity expansion projects remaining in the plans.

Table A.7
Assumed Cost Reduction for Roadway Capacity Expansion (millions of 2021 dollars)

Description	$ Value per Unit	2022-2025	2026-2030	2031-2040	2041-2050
Construction costs	$5 million per lane mile (freeway) $1.5 million per lane mile (arterial)	$418	$985	$2,656	$2,692

Key assumptions in this analysis include:

- Freeway and arterial expansion costs average $5.0 million and $1.5 million per lane-mile, respectively.
- Mix of investment is 75 percent for freeway capacity and 25 percent for arterial capacity (on a dollar basis).
- There is a lag of 2 years (for freeways) and 1 year (for arterials) between "spending" the funds and realizing the benefits (i.e., roadway open to service).

Economic Benefits (Social Cost Savings)

The various social cost savings estimated in this document rely on estimated changes in vehicle-miles of travel, traffic delay, and person-miles of walking and bicycling as a result of each measure. General modeling tools used in this analysis are first discussed, followed by a discussion of assumptions specific to each measure. The social cost savings analysis also draws on key assumptions documented above in the assessment of public sector implementation costs.

Modeling Tools

To estimate VMT reductions, the Colorado Department of Transportation statewide travel demand model and the Colorado implementation of the Energy and Emissions Reduction Policy Analysis Tool (EERPAT) were used, along with off-model spreadsheet-based analysis where needed to prepare model inputs and process model outputs.

The Colorado statewide travel demand model is a network-based model that predicts changes in traffic flows by mode and location based on future changes in demographics, job locations, costs, transportation networks, and other factors. At the time of the analysis the statewide model was set up for 2015, 2030, and 2045. Results from 2030 and 2045 runs were interpolated to obtain 2040 estimates. Results from 2045 runs were extrapolated to represent 2050.

EERPAT is a tool developed by the Federal Highway Administration and designed specifically for analysis of greenhouse gas reduction measures. EERPAT models policies at the regional level. In the Colorado application of the model, five regions are defined corresponding to the state's MPOs:

- DRCOG (Denver Regional Council of Governments) – Greater Denver area.
- GVMPO (Grand Valley MPO) – Grand Junction area.
- NFRMPO (North Front Range MPO) – Fort Collins area.
- PACOG (Pueblo Area Council of Governments) – Pueblo area.
- PPACG (Pikes Peak Area Council of Governments) – Colorado Springs area.

The statewide model and EERPAT each have strengths for evaluating different measures, so the best model for each measure was selected and the results then combined. Only personal light-duty vehicle travel within Colorado is considered, along with emissions from bus service that changes as part of the scenarios. To ensure a consistent baseline of VMT, percent VMT reductions from EERPAT for measures modeled in EERPAT were applied to total VMT from the statewide model.

GHG emissions were modeled using the U.S. Environmental Protection Agency Motor Vehicle Emission Simulator (MOVES3) emission factor model, based on VMT changes from the statewide model and EERPAT. The GHG modeling was conducted by the Colorado Department of Public Health and Environment – Air Pollution Control Division. The MOVES model accounts for Colorado-specific factors such as the age of the vehicle fleet, the distribution of VMT by different vehicle types and road types, and the speeds at which vehicles travel. MOVES provides GHG emissions in carbon dioxide equivalents (CO_2e) considering tailpipe emissions of CO_2, methane, and nitrous oxide. VMT changes for each measure, estimated as described below, were summed for all measures and used to revise MOVES inputs.

Travel Choices: Tele-Travel

This strategy is evaluated using adjustments to statewide travel demand model inputs and outputs assuming that through incentives and voluntary options, more telework becomes feasible. Note that the model does not assume a policy that requires businesses to limit employee trips.

- Telework is modeled by increasing the fraction of workers choosing to telework compared to the base

year level.
- Tele-school is modeled by adjusting the mode-specific constant for higher education trips so that home schooling meets a target percentage.
- Other tele-travel is modeled by making adjustments to model output VMT to reflect an assumed market size of households reducing their travel and percent reduction in “personal business” travel per household.

The assumed effects of tele-travel policies are as follows:

- Telework (telecommuting): The percentage of workers teleworking at least part-time is increased by a factor of 3, from 6.3 percent to 18.9 percent, compared to baseline levels, reflecting a continuation of trends observed during the COVID pandemic.[13]
- Online participation in postsecondary education: The statewide model includes school trips. It is assumed that higher education students “tele-commute” 40 percent of the time, or on average about 2 days a week for a full-time course load. This is applied as a post-model adjustment to the statewide activity-based model (ABM) trip roster. The model would reflect similar values from an emissions perspective if students walked to class rather than participating virtually.
- Other substitution of travel: Other types of trips (medical, retail, etc.) are not individually modeled but are included as part of a personal business trip type. The number of households reducing their “personal business” travel is estimated using the following assumptions:
    - Expansion of broadband infrastructure – The Colorado Broadband office tracks broadband coverage and supports programs to expand coverage, including tracking Federal grant programs. An overlay of 2021 broadband coverage on household data from the 2019 American Community Survey (ACS) estimates that 1.97 million of 2.39 million households in Colorado (82.6 percent) currently are in broadband service areas.[14] It is assumed that infrastructure expansion by 2030 will reach nearly all (97 percent) of the state’s households with broadband access, or an additional 344,000 households.
    - It is also assumed that an additional 5 percent of Colorado households already served by broadband expand their use of teletravel in the future.
- Newly participating households are estimated to take 10 percent fewer “personal business” trips as a result of tele-travel options.[15] This is applied as a post-model adjustment to the ABM trip roster.

Travel Choices: Bicycle, Pedestrian, and Micro-Mobility Facilities, Policies, Initiatives

This strategy is evaluated using a variety of adjustments to the statewide model, including increasing intersection density to represent expanded/more connected pedestrian networks; increasing walk and bike speeds to represent improved transit access and increased use of e-bikes and e-scooters; and adjusting various model parameters to reflect overall conditions that encourage walking and biking by all demographic

[13] During the height of the pandemic (May 2020), work-at-home rates were as high as 35 percent. More recently (October 2020 to January 2021), the rate stabilized around 22 percent. Source: Data from Bureau of Labor Statistics, Current Population Survey Supplement, as analyzed by University of Colorado Leeds School of Business and presented to Denver Regional Transit District, April 13, 2021.
[14] Per the Colorado Broadband Office, broadband is defined as a minimum of 25 megabits per second (Mbps) download and 3 Mbps upload. See https://broadband.co.gov/ for a map of broadband coverage. The overlay was done at the Census block group level, assuming that households are evenly distributed within a block group.
[15] While the statistics will vary for Colorado, the 2017 National Household Travel Survey shows an average annual VMT per U.S. household of 19,642, of which 31.8 percent is for shopping or other personal business (McGuckin and Fucci 2018, Table 6a). A 10 percent reduction in personal business travel would be a 3.2 percent reduction in overall travel for these households or 642 VMT per year. The Colorado statewide model may show different results, as changes in personal business travel may affect other types of travel.

groups. The model was adjusted so that the increase in bicycling matched a target estimate of total bicycle-miles of travel based on increasing bicycle travel related to additional bicycle infrastructure (new annual bike-miles traveled per new lane/path mile) as observed in other U.S. cities.

Pedestrian and Bicycle Improvements

To model improved pedestrian conditions, intersection density was increased 10 percent in 2030 over the baseline, or 25 percent in 2050, in the “suburban” area type, representing the application of policies to increase street network connectivity. Numerically this is equivalent to an increase of 16 four-way intersections in each zone. This was applied only to area types 2 (outlying CBD & fringe), 3 (urban), and 4 (suburban). While the statewide model does not include data on sidewalk density, the relative increase in intersection density is consistent with the increase in sidewalk density assumed for cost estimation above. Intersection density was increased by 5 percent in 2030 and 15 percent in 2050 for the “urban” area type, with the smaller increase reflecting the generally more connected nature of streets in urban areas.

The total miles of bicycle facilities needed to achieve a complete network in all of the urbanized land area of Colorado (census-defined urbanized areas) was estimated by assuming a build-out of separated bike lanes or shared-use paths at one-mile intervals, along with on-street bike lanes every ½ mile in between. Previous research, considering literature and models on the effectiveness of bike investment in the U.S., has estimated the number of new bicycle-miles of travel per year per mile of new facility in urban and suburban neighborhoods of various densities (Cambridge Systematics, 2020). The values used in that analysis are shown in Table A.8. These are applied to the proportion of land in CBD or “CBD fringe”, “urban”, and “suburban” area types as defined in the statewide model. Values from that study are multiplied by the required length of facilities to build out a network.

Table A.8
New Bicycle Travel per New Facility-Mile

Area Type:	Core/High Urban	Medium Urban	Suburban	
Statewide Model Area Type:	**CBD (1) or CBD Fringe (2)**	**Urban (3)**	**Suburban (4)**	**Average**
New annual bike-miles per new facility mile	146,000	82,000	26,000	64,000
% of urban land area in Colorado MPO areas	14%	39%	48%	

To estimate the extent of bike network added, a build-out of bike lanes and paths is assumed at ½ mile spacing for the entire urbanized area within Colorado (1,256 square miles) over a 20-year period between 2022 and 2041. This corresponds to 5,000 new miles of facility or 250 new miles per year. This is assumed to be split equally between on-street bike lanes and specialized facilities including physically separated bike lanes, bike boulevards, and off-street paths. The resulting increase in bicycle-miles of travel (BMT) compared to baseline conditions as estimated by the statewide model for years 2030 and 2045 is shown in Table A.9.

Table A.9
Bicycle Travel Increase From Facility Investment

Year	Baseline BMT (millions)	New Facility-Miles	Additional BMT (millions)	Total BMT (millions)	% Over Base

2030	346	2,250	144	474	37%
2045	405	5,000	320	717	77%

Additional statewide model adjustments to estimate the effects of improved walking and bicycling conditions included:

- Gender-specific constants for walking and biking: zeroing out negative terms for females; transferring positive coefficient for males to the bike or walk constant.
- Zeroing out negative terms for under age 20 other tour purposes.
- Reduction of disutility (negative interaction term) equivalent to 1.5 miles for rural area type term for bike to school tours.
- Walking interaction terms related to age 35 and age 50 thresholds changed to age 75 for work walk tours, other walk tours, other bike tours, and walk trip mode.
- Vehicular speed reduction of 2 to 11 mph, typically 6 mph, for access-oriented (versus mobility-oriented) facility types. Only applied in non-rural area types; applied to facility types 3 (principal arterial), 4 (minor arterial), and 5 (collector & local); peak and off-peak input speeds also adjusted if they would exceed the new free-flow speed.
- Walking speed (through perception of walking time) on transit access links increased to 5 mph from a base of 3 mph.
- Biking speed on transit access links increased from 12 to 13 or 14 mph.

Electric Bicycles

It is assumed that with a connected network of infrastructure in place to serve walk and bike trips, electric bicycle (e-bikes) will become more widely used. To represent electrification, the average speed of bicycling in the statewide model was increased by 33 percent.[16] The share of bikes that are e-bikes was assumed to be 25 percent in 2030 and 50 percent in 2050, so the average speed increase across all bicycle trips is modeled as 8 percent in 2030 (from 12 to 13 mph) and 16 percent in 2050 (from 12 to 14 mph).

<u>Transit: Expansion of Service Coverage, Frequency, and/or Hours</u>

The VMT effects of transit expansion are modeled in EERPAT using the following inputs:

- **Transit_growth.csv**: Ratio of future transit revenue miles to base year transit revenue miles, as well as proportion of transit revenue miles that are electrified rail transit.

In 2019, based on data reported by Colorado's transit operators to the National Transit Database, 81 million vehicle revenue-miles of service were provided by all modes in Colorado's five metro areas. For this measure it is assumed that transit revenue-miles will increase by 6.0 percent per year between 2022 and 2030 (69 percent total growth between 2019 and 2030), and by 2.0 percent a year between 2030 and 2050 (151 percent total growth between 2019 and 2050) compared to base year (2019) service levels. This compares with a statewide growth in transit VRM of 2.9 percent annually (76 percent) between 2000 and 2019 (3.1 percent for the Regional Transit District, 1.2 percent average for other operators in the state).

[16] On average, e-bikes require 24% less total EE (kcal/kg/min) than conventional bicycles - Langford, B. C., Cherry, C. R., Bassett, D. R., Jr., Fitzhugh, E. C., & Dhakal, N. (2017). Comparing physical activity of pedal-assist electric bikes with walking and conventional bicycles. Journal of Transport & Health, 6, 463–473. 1/(1 – 0.24) ~= 1.33.

The VMT reduction percentage was carried over into the statewide model by reducing the ABM trip roster by the same percentage for trips by residents of MPO zones.

Transportation-Efficient Land Use

This strategy is modeled in EERPAT using the following input:

- **metropolitan_urban_type_proportions.csv**: proportions of households in urban mixed-use areas.

Urban mixed-use areas are defined for this analysis as statewide model TAZs categorized as “urban” or higher area type (*AreaType* = 1, 2, or 3) with a population density of at least 2,000 per square mile and a retail/service job density (*Entertainmentemployement* + *Retailemployement* + *Restaurantemployement*) of at least 500 per square mile. This was the density threshold used in the Carbon-Free Boston study (Cambridge Systematics, 2019) which was based on evaluation of different thresholds and qualitative comparison against community characteristics such as walkability.

The base year (2015) number and percent of households in mixed-use urban areas was estimated using statewide model estimates of households and the mixed-use variable. This calculation was repeated for 2030 and 2045 to estimate the number of households in mixed-use areas under baseline forecast growth conditions in the future. The 2015 and 2030 data were interpolated to estimate 2023 values as the start year for additional land use policy implementation.

The 2023 percent of households in mixed-use areas ranges from 11 percent in the GVMPO region to 33 percent in the Denver region. Between 2023 and 2030, the fraction of growth in mixed-use areas ranges from 10 percent in the NRFMPO region to 43 percent in the Denver region. Under the policy scenario, this is assumed to increase to 75 percent in the Denver region and to 50 percent in other MPO regions between 2023 and 2050.

It is also assumed that some areas of existing households redevelop over time into mixed-use areas, through infill commercial development in neighborhood business districts. It is assumed that 4 percent of existing households per decade are in areas that change from non-mixed use to mixed-use. The resulting values of baseline and scenario projections for the percent of households in mixed-use areas, including new households and redeveloped areas, are shown in Table A.10..

Table A.10
Households in Mixed-Use Areas

	Households in Mixed-Use Areas					% of 2023-2030 Growth in Mixed-Use Areas		% of 2030-2045 Growth in Mixed-Use Areas	
MPO Region	2023	2030 Base	2030 Scenario	2045 Base	2045 Scenario	Base	Scenario	Base	Scenario
DRCOG	32.5%	33.5%	38.5%	33.8%	47.1%	42.9%	75.0%	35.7%	75.0%
GVMPO	11.2%	12.4%	18.7%	16.8%	29.9%	20.3%	50.0%	34.7%	50.0%
NFRMPO	18.3%	17.1%	25.5%	16.2%	36.8%	10.0%	50.0%	13.4%	50.0%
PACOG	14.5%	16.0%	20.5%	14.7%	29.6%	28.9%	50.0%	6.1%	50.0%
PPACG	21.6%	20.9%	26.4%	21.9%	34.5%	13.9%	50.0%	27.3%	50.0%

The VMT reduction percentage was carried over into the statewide model by reducing the ABM trip roster by the same percentage for trips by residents of MPO zones.

Reduced Investment in Roadway Capacity

Capacity additions can increase GHG emissions and other social costs related to vehicle-travel in the long term as a result of induced demand effects. Reducing spending on these capacity projects is likely to provide social benefits in the form of reduced GHG emissions, air pollution, vehicle operating costs, and crash costs associated with vehicle-travel. However, it is likely to increase costs related to travel time and delay. It is important to note that the alternative investments provided by funding made available for other projects will help offset the impacts of any roadway travel time increases.

Key assumptions to estimate the social costs and benefits of reduced road capacity investment include:

- Expanded roads have a base VMT of approximately 20,000 VMT per lane-mile for freeways and 10,000 VMT per lane-mile for arterials. This assumes a freeway lane capacity of 2,000 vehicles per lane per hour with 10 percent of daily traffic in the peak hour. Arterial capacities are reduced by half to account for intersection delay. Analysis of modeling conducted by Cambridge Systematics for a hypothetical freeway widening project in Virginia confirms that 20,000 VMT per lane-mile is a reasonable value.
- The long-run demand elasticity is assumed to be 0.67 for freeways and 0.5 for arterials. This elasticity represents the ratio of percent growth in VMT to percent growth in lane-miles. An elasticity of 0.5 means that a 10 percent increase in lane-miles in a given area would result in a 5 percent increase in VMT in that area. The value of 0.67 is consistent with recent modeling of corridor highway expansion projects conducted by Cambridge Systematics and is at the low end of recent values reported in a literature review, which found values ranging from 0.67 to 1.06 in the U.S.[17] That report also estimated that induced demand elasticities for arterials are 75 percent those of freeways. Since some of the induced demand in corridor studies may be due to growth being shifted from other locations in the same state, it is likely that overall induced demand for a statewide program of investments (such as is being evaluated in the Colorado analysis) is lower than levels found in corridor-specific studies.
- It is assumed that it takes five years to reach full response to induced demand, with effects in years 1-4 scaled up linearly between 0 and the final value.
- Delay savings (minutes saved per base VMT) are estimated based on modeling conducted by Cambridge Systematics. The value is 0.20 minutes per VMT at a demand elasticity of 0.67, which corresponds to a 3 mph average speed increase compared with a base speed of 30 mph. The delay savings are scaled to be zero at an induced demand elasticity of 1.0, and to increase in inverse proportion to the elasticity.
- Fuel savings per hour of delay are estimated at 0.44 gal/hour (mixed traffic – autos and trucks) for 2012 vehicles based on data from the 2012 Texas Transportation Institute Urban Mobility Report. These are scaled for 2022 and future vehicles based on actual and projected changes in fuel efficiency (mpg) and levels of fleet electrification. Energy use and GHG emissions from EVs are assumed not to be sensitive to the level of congestion or delay.

[17] Volker, J.M.B., and S. L. Handy (2021). The Induced Travel Calculator and Its Applications. University of California Institute of Transportation Studies, UC-ITS-2021-04.

- Delay reduction from highway expansion is valued at $16.50 per hour per the 2016 U.S. DOT benefit-cost analysis guidance and is calculated after induced demand effects.

Total VMT and Vehicle Operating Cost Savings

Table A.11 shows baseline forecast VMT emissions for light-duty vehicles and the total projected VMT reductions for the illustrative implementation of the proposed rule and the two alternatives considered.

Table A.11
VMT by Year, Light-Duty Vehicles

	Vehicle-Miles of Travel (millions)		
Scenario	**2030**	**2040**	**2050**
Baseline VMT Estimate	63,551	71,069	78,587
Change from Baseline			
Proposed Rule Implementation: Travel Choices + Transit + Land Use	(6,943)	(8,378)	(9,814)
Alternative 1: Travel Choices	(5,876)	(6,197)	(6,146)
Alternative 2: Travel Choices + Transit	(6,633)	(7,593)	(8,138)

Vehicle operating costs are based on gasoline and electricity consumption rates (miles per gallon equivalent) for conventional and electric vehicles from NREL (2017)[18] and fuel and electricity costs from the U.S. Department of Energy Outlook Annual Energy Outlook (AEO) 2021 Reference Case. For conventional and electric vehicles, a "weighted average" fuel efficiency is estimated based on the split of light duty vehicles and light duty trucks. Vehicle maintenance costs are also sourced from NREL (2017) and weighted by the LDV/LDT split. Table A.12 displays fuel prices, energy efficiency, and fuel and maintenance cost per mile for both conventional and electric vehicles from 2020 through 2050.

Table A.12
Light-Duty Vehicle Operating and Maintenance Costs (2021 $)

Operating Cost Inputs	2020	2025	2030	2040	2050
Gasoline Price ($/gge)	2.22	2.37	2.58	2.91	3.06
Electricity Price ($/gge)	3.91	3.80	3.69	3.60	3.31
Conventional Energy Efficiency (mpgge)	32.9	33.7	33.4	33.6	34.1
EV Energy Efficiency (mpgge)	104.7	109.7	111.6	116.9	125.2
Conventional Vehicle Cost – Fuel ($/mi)	0.067	0.070	0.077	0.087	0.090
EV Cost – Fuel ($/mi)	0.037	0.035	0.033	0.031	0.026
Conventional Vehicle Cost – Maintenance ($/mi)	0.036	0.038	0.040	0.041	0.041
EV Cost – Maintenance ($/mi)	0.029	0.030	0.032	0.033	0.033

To calculate total per-vehicle operation and maintenance costs, an annual VMT of 10,450 per vehicle is assumed. This is based on the number of vehicles forecast in 2030 (vehicles growing from current levels in

[18] Wood, E., et al. (2017). National Plug-In Electric Vehicle Infrastructure Analysis. National Renewable Energy Laboratory.

proportion to population) multiplied by miles per vehicle to match the VMT estimates provided by the statewide model.

The total electrified light duty fleet each year is estimated based on state targets, including around 940,000 vehicles in 2030 and 100 percent EV sales by 2040. Using projections from the AEO 2021 Reference Case on vehicle stock growth through 2050, as well as a vehicle turnover model, the EV vehicle stock for 2025, 2030, 2040, and 2050 is estimated alongside vehicle sales, as shown in Table A.13.

Table A.13
Light-Duty Vehicle Electrification Projections

Vehicle Category	2020	2025	2030	2040	2050
All Light-Duty Vehicle Stock	5,090,968	5,585,484	6,080,000	6,546,667	7,590,000
EV Stock	39,908	221,357	943,318	3,739,278	6,290,115
EV Sales %	5%	17%	50%	100%	100%
EV Sales	17,818	66,858	21,800	458,267	531,300
EV% of Stock	1%	4%	16%	57%	83%

GHG Emission Reductions and Social Cost of Carbon Savings

Table A.14 shows projected total GHG emissions from on-road sources for the rule and alternatives, while Table A.15 shows the expected GHG reductions in 2025, 2030, 2040, and 2050 respectively, for the rule and alternatives. As noted above, the results assume a high level of electrification of the future vehicle fleet. As a result, the absolute GHG reductions from VMT measures are substantially lower in 2050 than in 2030, even though the cumulative effects of the measures on VMT will increase over time and be greatest in 2050.

Table A.14
GHG Emissions by Year and Alternative, All On-Road Vehicles

	GHG Emissions (million metric tons)		
Scenario	2030	2040	2050
Proposed Rule Implementation: Travel Choices + Transit + Land Use	18.1	12.5	7.9
Alternative 1: Travel Choices	18.4	12.8	8.1
Alternative 2: Travel Choices + Transit	18.2	12.6	8.0

Table A.15
GHG Emissions Change from Baseline Forecast by Year

	GHG Emissions Change in Year (million metric tons)		
Scenario	**2030**	**2040**	**2050**
Proposed Rule Implementation: Travel Choices + Transit + Land Use	(1.70)	(1.20)	(0.70)
Alternative 1: Travel Choices	(1.43)	(0.88)	(0.44)
Alternative 2: Travel Choices + Transit	(1.62)	(1.09)	(0.59)

To estimate the social cost of carbon savings, greenhouse gas emissions in years between 2030 and 2050 were interpolated, and annual emissions savings before 2030 were ramped up from zero in 2022 to the 2030 level. The social cost of carbon value in each year was then applied to the greenhouse gas emissions in that year. The values used for the social cost of carbon based on the Biden administration guidance are shown in Table A.16 (The White House, 2021).

Table A.16
Social Cost of CO_2, 2020-2050 (in 2020 dollars per metric ton of CO_2)

Emissions Year	2.5% Discount Rate
2020	76
2025	83
2030	89
2035	96
2040	103
2045	110
2050	116

Other Social Benefits

Other social benefits were valued based on the following data sources and key assumptions.

Air Pollution

These costs are associated with human health impacts – including mortality and morbidity – as well as crop and forest damage, ecosystem damage (e.g., from acid deposition, ozone damage, and particulate matter deposition), damage to buildings and materials, and reduced visibility. The costs of air pollution are primarily driven by human health.

Changes in emissions of particulate matter (PM) and oxides of nitrogen (NOx) were estimated based on tailpipe emission rates (grams per mile) in each future year, multiplied by changes in light-duty vehicle VMT. Emission rates for internal combustion engine vehicles were sourced from runs of the U.S. EPA MOVES2014 model conducted by Cambridge Systematics in June 2021 for years 2032 and 2040. Emission rates for years prior to 2032 were interpolated with 2017 rates from analysis for the Carbon Free Boston study (2019) conducted by Cambridge Systematics. Emission rates for 2033-2039 were interpolated between 2022 and 2040 rates, and the 2040 rate was used for years after 2040. Tailpipe emissions from electric vehicles were assumed to be zero.

Damage values ($/kg) are based on the U.S. EPA regulatory impact analysis for light-duty vehicle fuel economy and GHG standards (U.S. EPA, 2010), as reviewed by CS in 2012 for use in the Federal Transit Administration (FTA) New Starts Environmental Benefits Template. Table A.15 shows the damage values used. The damage values are the same as used by FTA in its most current (FY 2021) version of the New Starts and Small Starts reporting templates, with the exception that 2010 dollars have been converted to 2016 dollars using a consumer price index multiplier of 1.1. The EPA values are based on nationwide modeling using county-scale data on emissions, air pollution, and population exposure. The EPA and FTA sources list different damage values for mobile vs. electricity generation sources; the mobile source values are used here. The values used are an average of those provided by FTA for years 2025 and 2035.

Table A.17
Pollutant Damage Values ($/kg)

Pollutant	Damage Value ($/kg)
$PM_{2.5}$	$976
NO_x	$17.69

Safety

Safety costs represent costs associated with crashes resulting in fatalities or injuries. To estimate safety benefits, fatality and injury motor vehicle crashes are assumed to be reduced in proportion to VMT reduced. Average rates of 0.013 fatalities and 0.195 injuries per million vehicle-miles are used, based on Fatality Analysis Reporting System (FARS) fatality data from 2000-2009 and injury rates reported by the Bureau of Transportation Statistics (BTS) in National Transportation Statistics (Table 2-17: “Motor Vehicle Safety Data”). These rates were recommended by Cambridge Systematics for the FTA in 2012 and are still being applied by FTA for use in New Starts and Small Starts project evaluation.[19]

Crash reduction benefits are valued at $9.6 million per fatality based on the latest (2016) U.S. DOT guidance on value of a statistical life. Disabling injuries are valued at $490,000 based on the value provided in FTA’s latest (FY 2021) New Starts and Small Starts reporting templates. The injury value has been inflated by FTA since the original 2012 work (when it was $323,000) and is applied to the fatality and injury rates stated in the previous paragraph.

Traffic Delay

[19] See: Federal Transit Administration, New Starts Environmental Benefits Template, available at http://www.fta.dot.gov/12304.html.

Hours of traffic delay reduced per VMT reduced are derived from data in the Texas A&M Transportation Institute (TTI) 2012 Urban Mobility Report (UMR). This report estimated potential nationwide reductions in VMT due to shifting to transit, and associated savings in travel delay. These values were used to estimate an average delay savings of 0.015 hours per mile of vehicle-travel reduced, representing a weighted average across metro area sizes. Delay savings were valued at $16.50 per hour based on U.S. DOT 2021 Benefit-Cost Analysis Guidance.

Physical Inactivity

A lack of physical activity is associated with increased mortality and other negative health outcomes. investments in walking and bicycling infrastructure and transit services increase physical activity, reducing those associated costs. Physical inactivity is valued based on health care cost savings of $0.21 per mile of walking and bicycling activity based on Gotschi (2011). Gotschi analyzed three investment plans in Portland, Oregon. Bicycle health benefits are estimated using a per-capita health care costs of $544 annually attributable to inactivity (i.e., less than 30 minutes of activity per day), which he derives from three literature sources, with values adjusted for inflation. New bicyclists are assumed to realize these benefits by increasing physical activity from 15 to 45 minutes daily. Gotschi also cites the World Health Organization's Health Economic Assessment Tool (HEAT) for cycling, which uses a relative risk estimate for all cause mortality of 0.72 for 3 hours of bicycling to work per week, from a large Danish cohort study. Gotschi's resulting estimates of cumulative bike miles and cumulative health care savings between 1991 and 2040 equate to about $0.18 in benefit per additional bike mile of travel, which was inflated to $0.21 per mile for this study.[20]

An alternative estimate of physical activity benefits was conducted using estimates of deaths prevented and the value of a statistical life based on U.S. Department of Transportation guidance. Output from the HEAT developed for a study done by Cambridge Systematics in Massachusetts was used to estimate the benefits of increased bicycling and walking, along with additional analysis by Cambridge Systematics for use of this information in the Transportation and Climate Initiative Investment Strategy Tool.[21] HEAT provides estimates of benefits in terms of reduced mortality based on the daily increase in walk or bicycle person-kilometers traveled or walk or bicycle person-hours traveled.[22] The walk and bike PMT increases and deaths prevented were used to estimate an overall rate of 1.7 deaths prevented per million new walking PMT, and 0.5 deaths prevented per million new bicycling PMT. These factors were applied to the estimated increases in walking and bicycling due to active transportation and public transportation investments. (Due to data limitations the current analysis only includes new bicycle travel, as shown in Table A.7). Deaths prevented by physical activity were valued at the same $9.6 million value of a statistical life used in the safety analysis.

[20] Gotschi, T. (2011). "Costs and Benefits of Bicycling Investments in Portland, Oregon." Journal of Physical Activity and Health, 2011, 8(Suppl 1).
[21] Cambridge Systematics, Inc. (2020), *ibid.*
[22] The HEAT tool and documentation are available at: https://www.who.int/gho/health_equity/assessment_toolkit/en/

DENVER REGIONAL COUNCIL OF GOVERNMENTS

Executive Committee

[redacted]

October 7, 2021

Colorado Transportation Commission
2829 W Howard Pl
Denver, CO 80204

VIA EMAIL SUBMITTAL to dot_rules@state.co.us

Dear Chair Hall and Commissioners,

I am writing on behalf of the Denver Regional Council of Governments' Board of Directors to provide comments on the proposed revisions to 2 CCR 601-22 to establish greenhouse gas (GHG) reduction transportation planning requirements.

As the designated Metropolitan Planning Organization (MPO) for the Denver region, DRCOG, in a cooperative process with CDOT and RTD, is responsible for transportation planning in the metropolitan area and is the venue for effective transportation decision making. Under federal law and regulation, DRCOG must:

- prepare and adopt a fiscally constrained, long-range, multimodal Regional Transportation Plan (RTP) that identifies specific transportation investments in projects, programs, and services to meet future needs and provide a safe and efficient transportation system that provides mobility while not adversely impacting the environment;
- prepare, adopt, and maintain a near-term Transportation Improvement Program (TIP) that identifies specific transportation investments in projects, programs, and services consistent with the RTP; and
- ensure the regional plans comply with all federal requirements, including air quality conformity, to maintain the region's eligibility to receive and expend federal transportation funding.

DRCOG and its partners must consider 10 specific planning factors throughout the transportation planning process. These factors include economic vitality, safety, security, accessibility and mobility of people and freight, protecting and enhancing the environment, transportation system connectivity, system management and operation, system preservation, system resiliency and reliability, and travel and tourism.

Beyond federal requirements, DRCOG supports the goal of reducing surface transportation GHG emissions. The unanimously adopted Metro Vision states that "We're working toward a future where the region has clean water and air, and lower greenhouse gas emissions," supported by objectives and initiatives to "[i]mprove air quality and reduce greenhouse gas emissions," with progress regularly measured against DRCOG's latest travel and air quality modeling results. Improving air quality is also one of the six overarching investment priorities identified in the 2050 RTP.

The following comments are offered in the spirit of clarifying and improving the proposed rule, maximizing the opportunity for the rule to help achieve state and region goals to reduce GHG emissions, and balancing the rule with DRCOG's federal responsibilities. The comments are organized by section with specific suggestions and supporting discussion points.

Section 8.01 Establishment of Regional GHG Transportation Planning Reduction Levels

- Remove the Baseline Projections from Table 1 and adopt baselines in a Transportation Commission policy directive and reference them in the Rule to allow refinement based on MPO modeling and more frequent updates.

  There should be a reasonable mechanism outside of a formal rulemaking process to review and update the baseline projections to which the reduction levels will be applied. The baseline projections have been developed using the CDOT statewide travel model and then "allocating" GHG emissions to areas based on share of statewide VMT. The relationship between VMT and GHG emissions using this distribution method may not reflect the relative fleet mix or operating characteristics that also influence GHG emissions. Further, DRCOG is required by federal law to adopt a new Regional Transportation Plan every four years and must align growth expectations with the most recent available population and employment forecasts from the State Demography Office, which are updated annually. These annual changes in population and employment forecasts can have a significant impact on travel model results and represent just one example of myriad changes to model inputs and internal model improvements that can change regional baseline measurements.

- Include 2025 Reduction Level (MMT) Values for PPACG, GVMPO and PACOG in Table 1.

  All five MPOs should be subject to demonstrating compliance with the rule for the 2025 horizon year to give the state the best chance of achieving the overall GHG reduction targets.

Section 8.02 Process for Determining Compliance

- Revise §8.02.1 to state "Such analysis shall include the existing transportation network, ~~implementation of~~ <u>future completed</u> regionally significant projects, <u>and all non-regionally significant transportation system investments included in the Plan."</u>

  §8.02.5.1 states that the required GHG Transportation Report contain a "GHG emissions analysis demonstrating that the Applicable Planning Document is in compliance with the GHG Reduction Levels in MMT of CO2e for each compliance year in Table 1…" Since these Applicable Planning Documents also include non-regionally significant program and project investments that have impacts on travel demand and GHG emissions, the required analysis should include the full set of investment priorities in order to fully assess the plan's estimated total CO2e emissions.

- Revise §8.02.1 to state that "The emissions analysis must estimate total CO2e emissions in million metric tons (MMT) for each year in Table 1 and compare these emissions to the ~~Baseline specified in Table 1~~<u>value derived by subtracting the Reduction Level from the Baseline Projection for that same year</u>."

  A comparison to the Baseline Projections by themselves is not meaningful in the context of the Rule. Determining compliance should be based on an assessment of the estimated GHG emissions of the Applicable Planning Document against reduced GHG emission value.

[redacted]

- Revise §8.02.1 to add the following before the last sentence of the section. "When adopting a TIP, the required emissions analysis will apply to one horizon year corresponding with the last year of the TIP, using interpolation between Table 1 horizon years if the last year of the TIP does not correspond to a designated horizon year in Table 1."

  Federal regulations require TIPs to be consistent with Regional Transportation Plans and represent a near- term investment plan for those priorities established in the RTP. TIPs shall "reflect the investment priorities established in the current metropolitan plan…" (CFR 450.326(a)) and "each project or project phase included in the TIP shall be consistent with the approved [regional] transportation plan." (CFR 450.325(i)). Further, since TIPs represent a near term investment strategy, there is no meaningful result from analyzing those investments against longer term horizon years well beyond the term of the TIP since such analysis will have been completed for the Regional Transportation Plan.

- Add §8.02.2.1 MPOs and CDOT shall prepare and publish a calibration and validation report for their respective travel model. The report shall document model components and key parameters and should address how models account for induced travel demand associated with changes to the transportation system.

  As part of the required modeling assumptions agreement in §8.02.2, the MPOs and CDOT should document and make publicly available the travel model components and parameters.

- Revise §8.02.3 to state "By April 1, 2022, CDOT shall establish an ongoing administrative process and guidelines, through a public process and in consultation with MPOs, for selecting, measuring, confirming, and verifying GHG Mitigation Measures.~~,~~ ~~so that~~ CDOT and MPOs ~~can~~ may incorporate one or more GHG Mitigation Measures into ~~each of~~ their plans in order to reach the Regional GHG Planning Reduction Levels in Table 1. Such a process and guidelines shall include, but not be limited to, how CDOT and MPOs should determine~~ing~~ the relative impacts of GHG Mitigation Measures, and measure~~ing~~ and prioritize~~ing~~ localized impacts to communities and Disproportionately Impacted Communities in particular. The mitigation credit awarded to a specific solution shall consider both aggregate and community impact.

  §8.02.3 states that CDOT shall establish an ongoing administrative process…for selecting…GHG Mitigation Measures…" A statewide process may not reflect that some measures may be more appropriate in one area or another and their relative impact will likely differ depending on the context. The Rule should allow flexibility for MPOs to select appropriate mitigation measures, through their decision-making processes, with guidance developed by CDOT.

- Revise §8.02.5.1.2 to state "In MPO areas that are in receipt of federal suballocations pursuant to the CMAQ and/or STBG programs, the MPO utilizes some or all of those funds on ~~projects or approved~~ GHG Mitigation Measures that reduce GHG emissions, and CDOT utilizes some or all 10-Year Plan funds anticipated to be expended on Regionally Significant Projects in that MPO area, on projects that reduce GHG emissions as necessary to achieve the GHG Reduction Levels in MMT of CO2e for each compliance year in Table 1.

  The language in §8.02.5.1.2 is not clear about whether all CMAQ and STBG funds would have to be used on "projects or approved GHG Mitigation Measures…". In addition, specific federal requirements and regulations apply to the use of CMAQ funds. Restricting the use of all CMAQ funds as proposed in the Rule may limit nonattainment areas from meeting current federal air quality standards. Likewise, restricting the use of all STBG funds to projects that reduce GHG emissions may limit the ability of DRCOG to invest in important safety, operations, reconstruction, and other non-regionally significant projects necessary for the RTP to address all required federal planning considerations. The provisions in §8.02.5.1.2 should allow flexibility for the MPO to specify only those funds that are to be spent on additional mitigation measures necessary to achieve the GHG emissions levels.

Section 8.03 GHG Mitigation Measures

- Add a provision to require sponsors of regionally significant roadway capacity projects to identify and include GHG Mitigation Measures when including the project in a TIP or the STIP.

  Many of the what the Rule calls GHG Mitigation Measures are planned investments already identified in the DRCOG 2050 RTP. And in the context of a 30-year RTP, these investments are not "mitigations" and should not be reported annually. Mitigations are actions that are taken to avoid, minimize, or compensate for the impacts of a specific action (project). Therefore, the more appropriate application of many mitigation measures is in the context of a specific roadway project and should be documented and tracked as part of the project's implementation through the TIP or STIP.

Section 8.05 Enforcement

- Revise §8.05.2 to state "If the Commission determines, by resolution, the requirements of Rule 8.02.5 have not been met, the Commission shall restrict the use of all CMAQ, STBG, and 10-Year Plan funds anticipated to be expended on Regionally Significant Projects in the area ~~funds pursuant to Rules 8.02.5.1.1 or 8.02.5.1.2, as applicable~~, to projects and ~~approved~~ GHG Mitigation Measures that reduce GHG.

  This clarification is necessary so that these funds are only fully restricted if compliance is not demonstrated under §8.02.5 are not met. If, however, the MPO demonstrates that it is using some CMAQ and/or STBG funds on mitigation measures as necessary to achieve the GHG reduction levels, then there should be no further restriction on the remaining funds.

- Revise §8.05.2 to state ~~"Prior to the enforcement of such restriction, an~~ An MPO in a Metropolitan Planning Area, or CDOT and/or a TPR ~~in a non-MPO~~ outside a Metropolitan Planning Area ~~area~~, may, within ~~thirty~~ sixty (~~30~~60) days of Commission action, ~~issue one or both of the following opportunities to~~ seek a waiver or ~~to~~ ask for reconsideration as provided for in Rule 8.05.2.1 or Rule 8.05.2.2. Enforcement of such restriction shall not begin until the Commission has taken action on such requests under Rule 8.05.2.3. ~~accompanied by an opportunity to submit additional information:"~~

  The language in §8.05.2 is unclear about whether CDOT on its own can seek a waiver for a project within an MPO area. We believe the intent is that waiver requests for projects within MPO areas must go through the MPO process prior to submittal. We also believe that 60 days is a more appropriate timeframe in which an MPO can deliberate and decide whether to seek a waiver or reconsideration.

[redacted]

- Revise §8.05.2.1 to state "Request a waiver from the Commission imposing restrictions on specific Regionally Significant projects not expected to reduce GHG emissions. The Commission may waive the restrictions on specific projects on the following basis:"
  The Rule as written requires a waiver for any "specific project not expected to reduce GHG emissions" (e.g., safety, operations, reconstruction, multimodal corridor planning, TDM, etc.). MPOs should not be required to seek a waiver from the Transportation Commission to invest federal CMAQ or STBG funds in otherwise eligible projects or programs that are not regionally significant, would not have an adverse impact on GHG emissions, and are important for the MPO to achieve other important transportation objectives.
- The Rule should either clarify the meaning of "substantial increase" in §8.05.2.1.2 or CDOT and the Transportation Commission should provide guidance that clarifies how "substantial increase" will be evaluated when considering waiver requests.
  The term "substantial increase" is vague. The Rule or guidance should provide clearer direction to ensure fair and equitable evaluation of waiver requests.
- In §8.05.2.3, strike "If no action is taken within this time period, the waiver or reconsideration request shall be deemed to be denied."
  The full consideration of these requests should be documented and acted upon by the Transportation Commission through a vote on the record. A default denial of a request should not be the result of no action by the Commission.

DRCOG appreciates the state's leadership in addressing climate change and air quality challenges. We also want to thank CDOT staff for the outreach efforts to the MPOs during the development of this proposed rule.

DRCOG acknowledges that meeting the ambitious targets set by the rule is predicated on a partnership with the state on several critical issues that are largely outside of an MPO's authority to directly implement. The feasibility of achieving the targes will require the state to take meaningful action through supportive policies and direct funding within the DRCOG region to fully achieve the desired GHG reductions. We stand ready to continue working with the state to identify and implement relevant policies and funding initiatives.

Respectfully,

[redacted]

c: DRCOG Board of Directors
Doug Rex, DRCOG Executive Director
Shoshana Lew, CDOT Executive Director
Herman Stockinger, CDOT Deputy Director
Rebecca White, CDOT Director, Division of Transportation Development

STATE OF COLORADO

Rules - CDOT, DOT_ <dot_rules@state.co.us>

Colorado Proposed Greenhouse Pollution Reduction Standards for Transportation Planning

1 message

[redacted] Sun, Oct 10, 2021 at 9:31 AM
To: dot_rules@state.co.us

Dear Madam or Sir,

Thank you for the opportunity to comment on the captioned rules on greenhouse gas reduction. We have lived North of Durango by Purgatory Ski Resort for about 10 years and have vacationed in Durango since the early 1970s.

We will not recount all the cience ba ed data upporting climate change in the world and e pecially here in Southwe t Colorado (and the devastating and costly effects thereof which we are all living with and which have been exponentially amplified by our inaction). We sincerely appreciate the Rules that have been thoughtfully put together to combat climate change.

Although we have had our net zero solar home and EVs since 2012, and 2013, respectively, it truly takes a village to combat this formidable foe. And our window to successfully have a meaningful effect on climate change is ever-shrinking. Here in the SW corner of Colorado, there are many things that could be done and incorporated into the Regional Tran portation Commi ion' plan for the Southwe t Tran portation Planning Region (a well a other the other regions in Colorado). These include but are certainly not limited to:

1) Implement a statewide vehicle emission testing program for all cars, trucks, and motorcycles. So many vehicles (e pecially pickup truck) have e hau t y tem that have been modified by removing the catalytic converter and other pollution control devices. There are so many older vehicles that have high mileage and create significant pollution that should be removed from the transportation grid by offering owners incentives to retire them. See #5 below.

2) Unlike the Gunni on Valley, A pen Valley, and many other re ort area that are ble ed with impre ive ma   tran it, La Plata County literally has no mass transit that runs from the edge of Durango to the La Plata County line in any direction. Housing in Durango is prohibitively expensive for most residents so they need to live in outlying areas and commute into Durango. Resultingly, La Plata County residents must own a car to do anything - including traveling to Durango to work, hopping for grocerie in Durango, etc We all know that vehicle emi ion (e pecially in SW Colorado that has no emission testing requirements) are the #1 contributor to greenhouse gases. It's imperative that La Plata County develop a basic mass transit system to serve outlying residents - which system would also include transportation to Durango's regional airport and Purgatory Ski Area, neither of which currently are served by any regularly cheduled/daily ma   tran it y tem open to the public

3) The road roads within Durango (and especially those roads leading into Durango) suffer from a dearth of bike lanes making it dangerous and difficult for one to commute on a bike (or E-bike) to and from Durango. That lack of bike lanes force re ident to again get in their polluting car to perform countle   ta k that could be done an a non polluting bike or E-bike. The growth of E-bikes has been explosive (240% versus traditional bicycle growth of 15% for the 12 month period ending 7/31/21). See npd.com. We must give residents options (such as developing a robust bike lane network by paving shoulders on arterials feeding Durango) so they can get out of their cars to travel to their jobs, perform errands, etc A CDOT bid out their contract for road work, developing and e tending houlder   hould be a core requirement of every bid.

4) Finally, as another way to reduce the #1 source of greenhouse gases (vehicles), Colorado and La Plata County should incentivize internal combu tion engine vehicle owner to purcha e both new and u ed EV by offering rebate , di count to annually register the EV, etc. Our governments have unfortunately supported and propped up the oil and gas industry for decades with billions of dollars in subsidies which has in part created our current climate change crisis. It's time for government to support the transition away from oil and gas and to more environmentally benign forms of transportation.

Thank you for taking the time to read our letter and hopefully give it consideration as you finalize these rules.

Yours very truly,

[redacted]

[redacted]

Sent from my iPad