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**FRONT RANGE
PASSENGER
RAIL**



COLORADO
Department of Transportation

Emissions Comparison by Travel Mode

*Lisa Streisfeld,
Sarah Grossi,
Christelle Matsuda, and
Brandon Najdovski*



HB19-1261: Climate Action Plan

Colorado Emissions Reduction Goals

▪ Reduce greenhouse gas emissions from 2005 levels by:

○ 26% by 2025

○ 50% by 2030

○ 90% by 2050



CO₂, CH₄, NO_x, HFCs, PFCs, NF₃, SF₆

Goal of Our Research

- Determine which mode of transport had lowest emissions per passenger-mile traveled:
 - Diesel trains
 - Electric trains
 - Internal Combustion Engine (ICEs) Gas-powered passenger vehicles or
 - Electric powered passenger vehicles (EVs)
 - Electric buses
 - ICE buses

What Is “Emissions Per Passenger Vehicle Mile”?

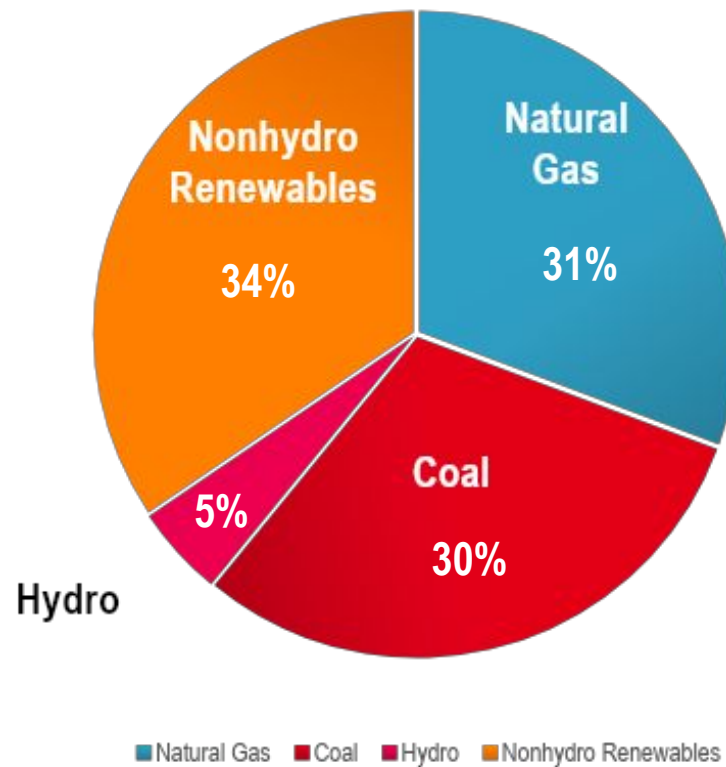
- Amount of emissions if a person took a one-mile trip.
- Compares that trip on a diesel train, electric train, gas-powered vehicle and electric vehicle.
- Easy to calculate emissions for a typical 10-mile trip or a 100-mile trip.

Research Methods

- Used data and studies from U.S. Environmental Protection Agency and from Japan, Spain, Britain and South Korea to determine average rates of emissions for different vehicles.
- Examined portfolio of energy production in Colorado, accounting for the fact that emissions for electric-powered trains and cars would go down if more renewables were used to produce electricity.
- Assumed passenger trains carry up to **300 people**, while passenger vehicles carry up to **eight people**.
- Assumed transit bus with $\frac{3}{4}$ occupancy= 38 passengers (full has 51)
- Assumed passenger vehicles carry, on average, **1.3 people**.

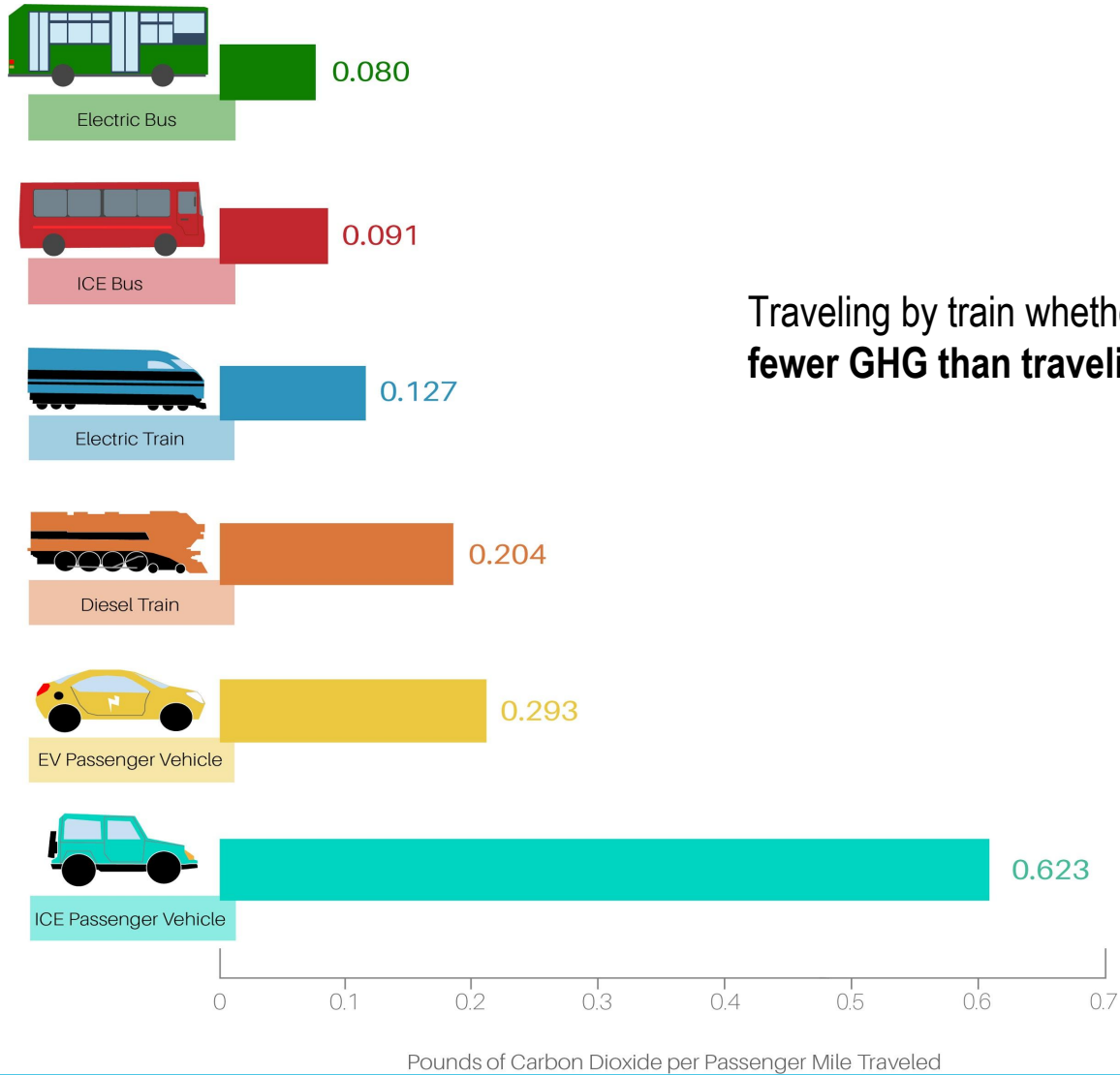
Colorado Net Electricity Generation by Source, May 2020

- Source: U.S. Energy Information Administration



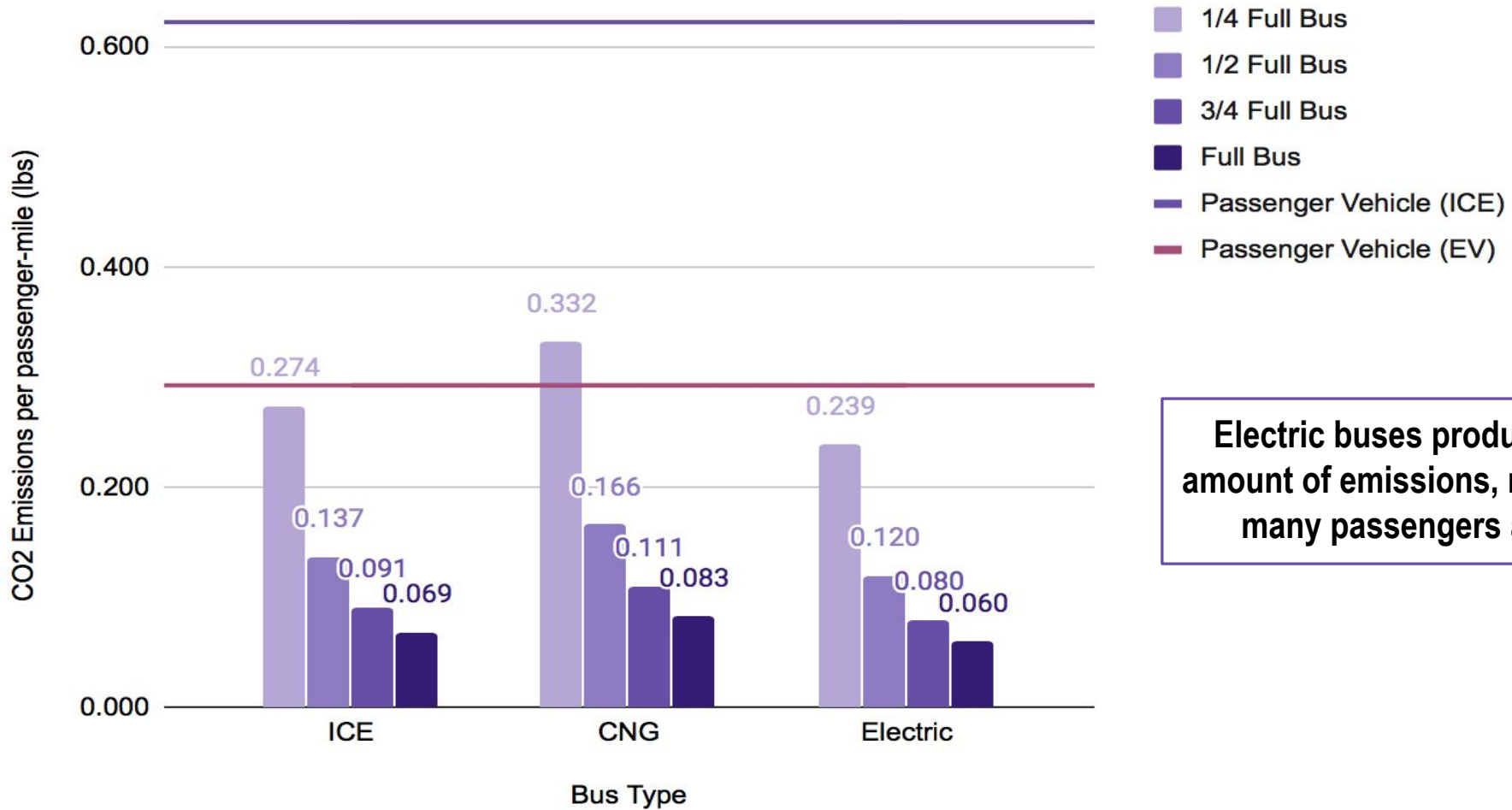
Finding: Electric Bus Produces Fewest Emissions

- Per passenger mile traveled in Colorado, a diesel-powered train produces fewer emissions than ICE-car (less than half a typical internal combustion vehicle) or an EV car.
- Electric trains and ICE buses produce less than diesel trains.
- However, an **EV Bus** produces the **lowest emissions** per passenger mile.



Traveling by train whether in a **diesel train or electric train** produces **fewer GHG than traveling in a car with typical vehicle occupancy.**

Bus Emission Comparison: Linked to Number of Passengers



Electric buses produce the least amount of emissions, no matter how many passengers are riding.

Electric Buses: Fewest Emissions, Not Widely Used

A $\frac{3}{4}$ full to a completely full electric bus still produces the least amount of emissions of all modes.



Electric Bus



Electric Train



Diesel Train



ICE and EV Cars

But charging times for electric buses result in longer travel times.

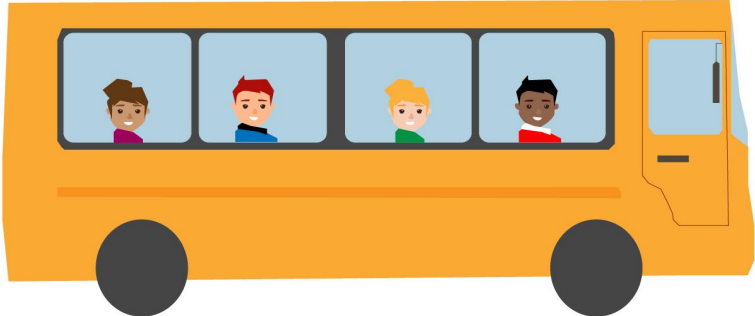
Worth Noting: ICE Vehicle Emissions Decrease with More Passengers

Car or bus travel when riding with **more passengers...**



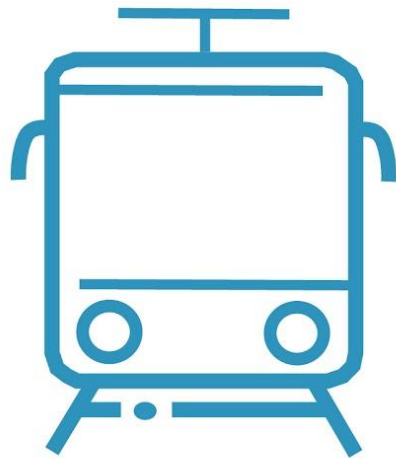
Decreases
GHG
Emissions

Improves
Efficiency



Electric Trains Produce Fewer Emissions than Diesel Trains...

On a per passenger mile traveled...



Electric Train



Diesel Train

an **electric train produces less emissions** compared to a diesel train.

... Electric Train Systems Are More Expensive to Build

- Construction costs for electric train systems can be an additional \$3 million to \$5 million per mile more to build, or up to 40 percent more than non-electrified train systems.*

*Source: CDOT Division of Transit and Rail, 2017, *Interregional Connectivity Study (ICS)*.

Worth Noting

- Assumptions based only on existing vehicle and train technology. Future technology could reduce GHG emissions more.
- Shifting to electric power generation system that use more renewable energy resources could further decrease emissions for electric cars and electric trains.

Renewable Energy Sources:

Hydro-electric

Solar

Wind

No Technology Has Been Chosen Yet

- The Front Range Passenger Rail system could use diesel-powered trains initially and at a later point switch to an electrified system.
- As the portfolio of energy production switches to more renewable sources, overall emissions will decrease with any mode.
- Criteria to be examined during NEPA will include, but not be limited to:
 - safety
 - travel time and cost
 - emissions
 - economic development
 - infrastructure capital, maintenance, and operational cost



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