COLORADO
Department of Transportation

# State Benefits and Opportunities Study for Rapid Speed Transportation

May 29th, 2019
Collaborative Effort Meeting
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Colorado Department of Transportation

# Why this Study?

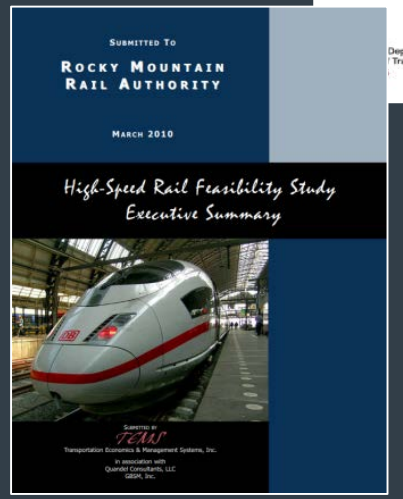
- Focus on Rapid Speed Feasibility in Colorado
- Multiple technology types evaluated
- Need to understand paths to implementation
  - Planning and Environmental
  - Safety Certification
  - Governance and Policy
  - Financial and Legal
  - Procurement and Partnerships
  - Project Oversight and Management

# Builds Upon Previous Studies

- State Freight and Passenger Rail Plan (2018)
- Statewide Transit Plan (2015)
- Advanced Guideway System Study (2014)
- Interregional Connectivity Study (2014)
- High Speed Rail Feasibility Study (2010)

*Above studies are available at https://www.codot.gov/programs/transitandrail/plans-studies-reports





# FRA Rail Passenger Service Development Plan
## Next Steps: Planning & Environmental

- **Complete Request for Proposals; Hire Consultant for FRA Rail Passenger Service Development Plan and Environmental Work**
  - Determining the timing and level/type of environmental analysis (NEPA)
  - Evaluating the right blend of Consultant and CDOT staff
  - Proposed Schedule: RFP Release May 2019 → Notice to Proceed August 2019

- **Elements Required in FRA Rail Passenger Service Development Plan**
  - Purpose and Need for Front Range Passenger Rail Service
  - Corridor options/potential feasible alignments, including possible connections to RTD's Passenger Rail Corridors
  - Potential speeds/technology: Ridership forecasting based on speed/technology
  - Levels of service (number of trains per day)
  - Stations/Mobility Hubs/transit connections
  - High level environmental analysis
  - High level cost estimates for Pre-construction, Construction, Equipment, Operating, etc.
  - Potential Service operator (Amtrak, host freight railroad, Private Rail/Transit Company, etc.)
  - Governance (Special District, Regional Transportation Authority [RTA], etc.)

# Key Findings

- Rapid speed technologies have the potential to transform the way we move in Colorado, and could help advance our mobility goals alongside other modes/systems.
- Application of new technologies is a complex process; the partnerships will vary.
- **Technologists*** need clarity and speed; creative partnerships and streamlining strategies need to be advanced.

*Technologist is defined as the company that develops the technology under consideration (i.e. Virgin Hyperloop One).

# High Speed Rail Case Studies

# Brightline

- Miami to Orlando (Florida)
  - 240 Miles/125 mph max speed
  - Phase 1: Operation
  - Phase 2: Planning/Design
- Project Sponsor: All Aboard Florida (Subsidiary of Florida East Coast Industries) is the private developer of the project.
- Brightline is privately owned and operated project
- $3.7 billion (estimated Phase 1 and 2)
- ~$15 million/mile

# Texas Central Railroad

- Dallas to Houston (Texas)
  - 240 miles/205 mph max speed
  - Planning/Design
- Texas Central Partners (TCP) is an investor-funded company that has proposed the project.
- The Central Japan Railway Company (JRC) acts as technical advisor to TCP
- $12 billion
- ~$50 million/mile

# California High Speed Rail

- Los Angeles to San Francisco (California)
  - 520 miles/200 mph (max Speed)
  - Central Valley Segment: Construction (119 miles)
  - Remaining Segments: Planning/Design
- California High-Speed Rail Authority (CHSRA) is a California state agency established to develop and implement high-speed intercity rail service.
- $77.3 billion (Phase 1)
- ~$148 million/mile
- (Current Phase Under Construction: $10.6 billion [~$89 million/mile])

# Rapid Speed Technologies Overview

| Rapid Speed Technology | Overview of Technology | Potential in Colorado |
|---|---|---|
| **Vactrain ("Hyperloop") Technologies**<br>  | Vactrain, or Hyperloop, technologies are **elevated guideways** that propel vehicles using magnetic levitation via electric propulsion. Passenger or cargo "pods" in an evacuated (airless) or partly evacuated (low-pressure) tube **can travel at airline speeds, up to 700 mph**, for long distances due to ultra-low aerodynamic drag.<br>• Representative companies include *Virgin Hyperloop One (VHO)*, *Hyperloop Transportation Technologies (HTT)*, and *TransPod*, among others.<br>→ **Range**: Inter-city & Regional (Appropriate for long-distance travel options ) | If constructed in Colorado, it is **likely in a greenfield alignment**, as the curve radii for these speeds would be larger than that of conventional railroad, highway, or utility corridors. |
| **Automated MagLev Technologies**<br>  | Automated MagLev technologies are **at-grade guideways** that move "sleds", operating in exclusive barrier-separated lanes. Sleds can carry personal automobiles, pallet sized freight, or technology-specific vehicles, and **can travel up to 200 mph**.<br>• *Arrivo* is a representative company that has developed this technology. As of December 2018, however, the company had announced its closure.<br>→ **Range**: Regional & Intra-city (appropriate for medium-distance travel options ) | If constructed in Colorado, it is **likely within highway rights-of-way**, as travel pattern would likely be within one defined area/region. |
| **Underground Tunnel Technologies**<br>  | Underground tunnel technologies are **below grade guideways** that transport passengers on autonomous electric "skates" **traveling at speeds up to 125-150 mph**. Skates can carry personal automobiles, cargo, or technology-specific vehicles.<br>• *The Boring Company*, founded in 2016 by Elon Musk, is the only company known to date developing this type of rapid speed technology.<br>→ **Range**: Intra-city & Metro (appropriate for medium- to short-distance travel options). | If developed in Colorado, it is **likely underground largely within highway, railroad, or other public rights-of-way**. |
| **Personal Rapid Transit (PRT) Technologies**<br>  | PRT technologies are **aerial guideway networks ("podways")** transporting passengers on suspended, ultralight, automated electric vehicles ("pods"). Pods are typically sized for individual or group travel, **traveling at speeds between 30 to 45 mph**.<br>• Representative companies include *SkyTran* and *TransitX*.<br>→ **Range**: Intra-city & Metro (appropriate for medium- to short-distance travel options). | If constructed in Colorado, it could be **part of a first or last mile solution** in a business park or retail power center. |

# Vactrain (“Hyperloop”) Technologies

*Sample Companies: VHO, HTT*

- Technology
  - Passengers or Cargo in "pods" floating above the track using magnetic levitation via electric propulsion through a low-pressure tube.
  - Both Maglev and vacuum tube technologies have been implemented in various applications, but not together.
- Status
  - Since 2013, many companies working to advance various aspects of technology.
  - Virgin Hyperloop One (VHO) has constructed a ½ mile full-scale test track in North Las Vegas.
  - In 2017, Hyperloop Transportation Technologies (HTT) began construction of the first full-scale passenger capsule.


# Automated MagLev Technologies

*Sample Company: Arrivo*

- Technology
  - System focuses on Maglev technology using sleds to transport passengers and freight. Speeds up to 200 MPH.

- Status
  - Arrivo considered the potential for a test track in the Metro Denver area. However, in December 2018 (near completion of this study), Arrivo announced it’s dissolution.

# Underground Tunnel

*Sample Company: The Boring Company*

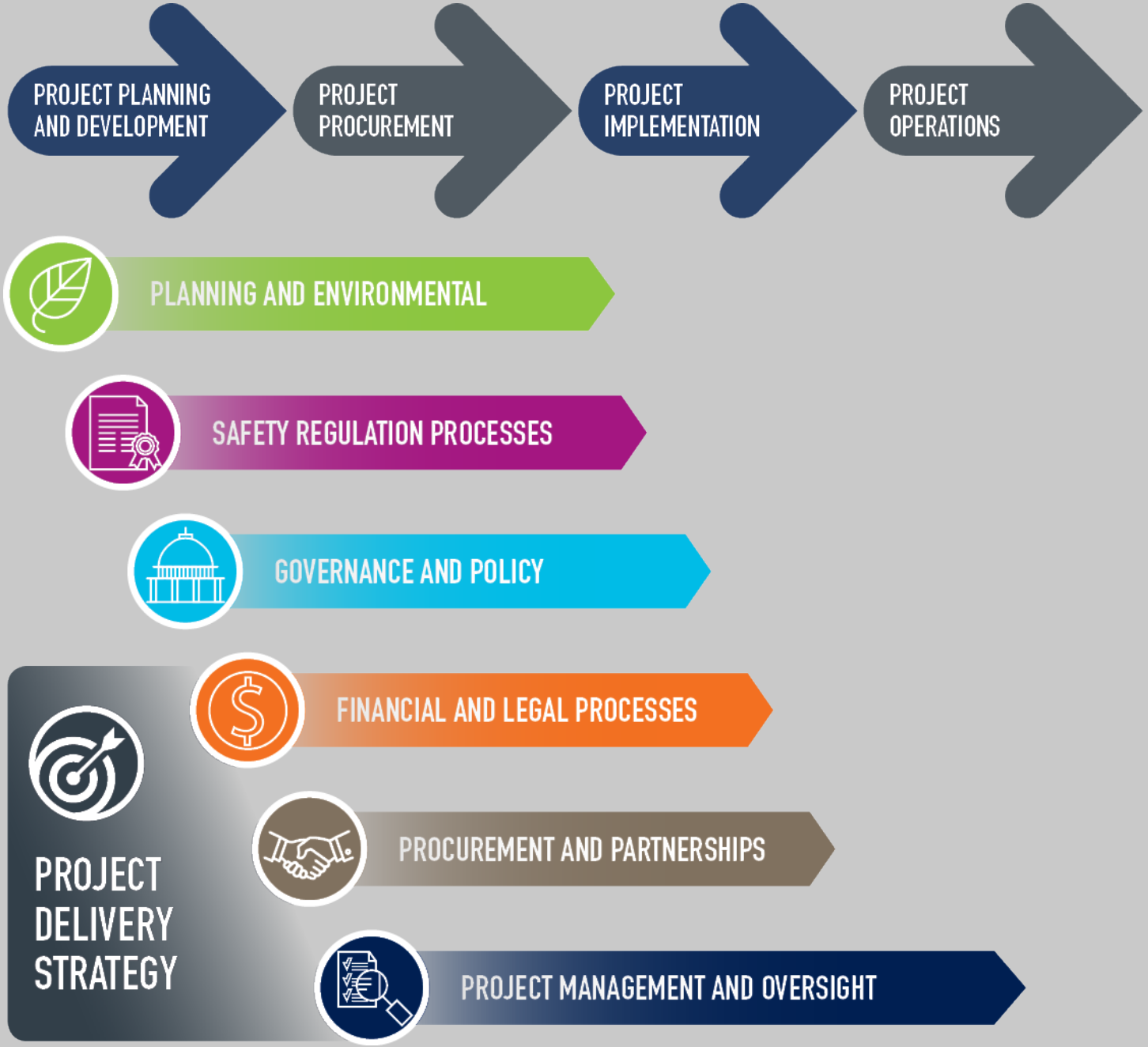
- Technology
  - Infrastructure and tunnel construction company founded by Elon Musk.
  - Selected by the Chicago Infrastructure Trust, on behalf of the City of Chicago, to design, build, finance, and operate O'Hare Express service (Chicago Express Loop, 17 miles), traveling on autonomous electric skates at up to 150 mph.
- Status
  - Tunneling for mass transit has been around since the late 1800's; high cost technology.
  - Musk believes smaller tunnel boring machines will cut capital costs significantly.
  - Not yet considered in Colorado.


# Personal Rapid Transit (PRT) Technologies

*Sample Companies: Transit X/SkyTran*


- Technology
  - Proposed as a suspended, ultra-narrow gauge rail network with ultralight pod vehicles.
  - High capacity, automated network would provide non-stop, single-seat travel from origin to destination on an exclusive right-of-way.
- Status
  - Pods are proposed to be ADA compliant and at each stop, vertical lifts would provide easy access to the platform above.
  - There is currently no funding to advance this technology within Colorado.

# Implementation Framework


PROJECT PLANNING AND DEVELOPMENT
PROJECT PROCUREMENT
PROJECT IMPLEMENTATION
PROJECT OPERATIONS
PLANNING AND ENVIRONMENTAL
SAFETY REGULATION PROCESSES
GOVERNANCE AND POLICY
FINANCIAL AND LEGAL PROCESSES
PROCUREMENT AND PARTNERSHIPS
PROJECT MANAGEMENT AND OVERSIGHT
PROJECT DELIVERY STRATEGY

# IMPLEMENTATION ELEMENTS UNDER CONSIDERATION

## PROJECT PLANNING AND DEVELOPMENT

## PROJECT PROCUREMENT

## PROJECT IMPLEMENTATION

## PROJECT OPERATIONS

### APPROVALS & MILESTONES

- FEASIBILITY STUDY COMPLETE
- RAPID SPEED BUSINESS CASE (VfM Report)
- PROJECT DELIVERY STRATEGY SELECTED
- ENVIRONMENTAL CLEARANCE
- ROD ISSUED
- SAFETY CERTIFICATION
- ROW ACQUISITION
- AWARD/ NEGOTIATION
- COMMERCIAL CLOSE
- FINANCIAL CLOSE
- PROJECT AGREEMENT FINALIZED
- PS&E DOCS (Final Design)
- SUBSTANTIAL COMPLETION
- PROJECT ACCEPTANCE
- OPERATION CERTIFICATE

### PLANNING & ENVIRONMENTAL

**EARLY PLANNING STUDIES**
- Route Alignment/ Stations Analysis
- Travel Demand & Ridership Studies
- Economic Benefits Study
- ROM Cost Analysis

FEASIBILITY STUDY REPORT

CDOT ROW? (YES / NO)

Gov't ROW? (YES / NO)

**ENVIRONMENTAL CLEARANCE PROCESS**
- Built/Greenfield Terrain on CDOT/Hwy ROW
- Built/Greenfield Terrain on Other Entity ROW
- Built/Greenfield Terrain on Private ROW

NEPA DECISION DOCUMENT

Potential Lead Agency
- FHWA
- FRA
- FTA
- USACOE
- STB
- Other

**Phased Implementation of Cargo**
→ Passenger: Launch NEPA for both Cargo and Passenger (in same documentation).

### SAFETY REGULATION PROCESSES

Anticipated Speeds:
- (up to 125 mph)
- (up to 150 mph)
- (up to 220 mph)
- (over 220 mph)

FRA Certification

Safety Certification Process

External Certification

**FRA OFFICE OF SAFETY CERTIFICATION PROCESS**
- Tier I Safety Standards (Conventional / Emerging HSR)
- Tier II Safety Standards (HSR Mixed Operations)
- Tier III Safety Standards (HSR Express)
- Tier IV Safety Standards ("Other Technology-Specific HSR")

**SAFETY DOCUMENTATION PROCESS**
- Third Party Validator
- Notice of Proposed Rulemaking

**EXTERNAL SAFETY CERTIFICATION PROCESS**

- Rule of General Applicability (RGA)
- Rule of Particular Applicability (RPA)
- "System Safety" Approach Certification

**Phased Implementation of Cargo**
→ **Passenger:** Is separate safety process needed for cargo only? Initiate safety certification for passenger early-on (concurrent with NEPA)

### GOVERNANCE & POLICY

Governance Strategy

**GOVERNANCE STRATEGY**
- CDOT Owns Land; Developer Owns and Operates System
- Other Public Entity Owns Land; Developer Owns and Operates System
- Private Developer Owns Land and Operates System

New Authority Formation; Potential Districts or Partnerships at Station(s)

**ROW / EMINENT DOMAIN PROCESS**
- Public Sponsor(s) Acquires ROW
- Authority Acquires ROW
- Public-Private Lead ROW Process

Who owns the land? Who owns the transportation asset?

**FLOWCHART SYMBOLS KEY**
- Approval
- Milestone
- Predefined Process
- Decision
- Document or Deliverable

**KEY PROCESS LEAD DESIGNATIONS**
- Project Sponsor(s) (State and/or Local)
- Federal Sponsor(s) (FHWA/FTA/FRA)
- Public Authority
- Public-Private Agency
- Private Developer
- Technologist / Designers
- Third Party Stakeholders

### FINANCIAL & LEGAL PROCESSES

**EARLY FINANCE STUDIES**
- Revenue/Commercial Viability Studies
- Funding Gap Analysis
- Initial Finance Plan

RAPID SPEED BUSINESS CASE

**PROJECT DELIVERY PLAN**
- Statutory Compliance Review
- Project Risk Analysis

Project Delivery Selection

**PROJECT DELIVERY STRATEGY**
- Traditional Strategy
- P3 w/out Private Financing
- P3 w/ Private Financing
- Fully Privatized / Unsolicited

**PROCUREMENT PROCESS**
- Final Finance Plan
- Proposal Evaluation & Selection
- Alternative Technical Concepts Process

**MANAGEMENT AND OVERSIGHT OF PROJECT AGREEMENT**
- Financial & Legal Advise

**MANAGEMENT AND OVERSIGHT OF PROJECT OPERATIONS**
- On-Going Reporting of Operations
- Review Financial Plan Updates for Performance Reports
- Revenue Collection Process

### PROCUREMENT & PARTNERSHIPS

Agency Coordination

Project Feasible?

**STAKEHOLDERS ENGAGEMENT PROCESS**
- Industry Engagement & Feedback

Private Financing?

**PREPARE PROCUREMENT DOCUMENTS**
- Prepare Solicitation Docs (RFI, RFQ, RFP)
- Prepare Financial Docs & Requirements
- Prepare Contract Docs

RFP DOCUMENT

Contract Awarded/ Negotiated

PROJECT AGREEMENT

### PROJECT MANAGEMENT & OVERSIGHT

**CONCEPTUAL DESIGN AND ENGINEERING PROCESS**
- Conceptual Engineering & Design

**PRELIMINARY DESIGN AND ENGINEERING PROCESS**
- CDOT Leads
- CDOT Leads/Tech Support
- Technologist Leads
- Private Developer Leads

Technical Requirements

LEVEL OF PRELIM. ENGINEERING CAN VARY GIVEN PROJECT DELIVERY STRATEGY

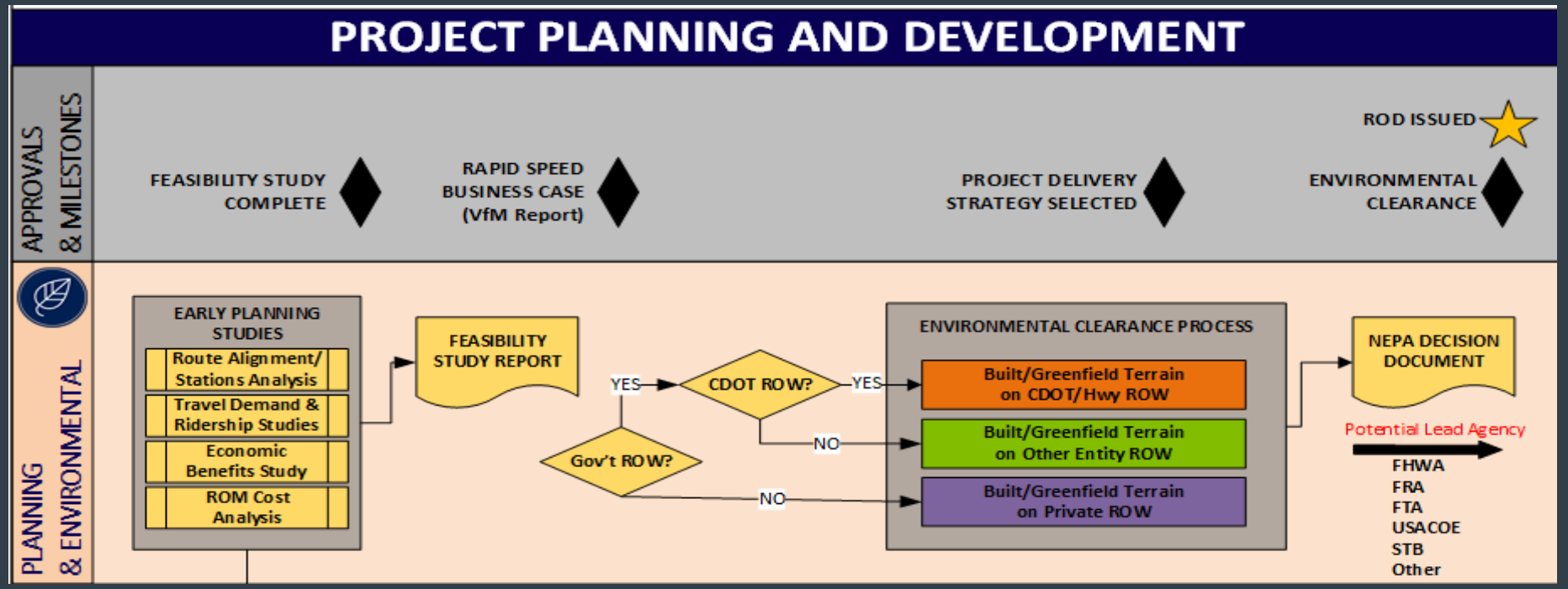
**DESIGN & CONSTRUCTION PROCESS**
- CDOT Leads
- CDOT Leads/Tech Support
- Technologist Leads
- Private Developer Leads

**TESTING & COMMISSIONING PROCESS**
- Federal Agency Leads
- Third Party Leads

**O&M PROCESS**
- CDOT Leads
- CDOT Leads/Tech Support
- Authority Leads
- Private Developer Leased

# Planning and Environmental

- Is NEPA required for these technology applications?
- Which agency would act as the lead Federal agency?
- Are there strategies to streamline the planning process?



# Planning and Environmental

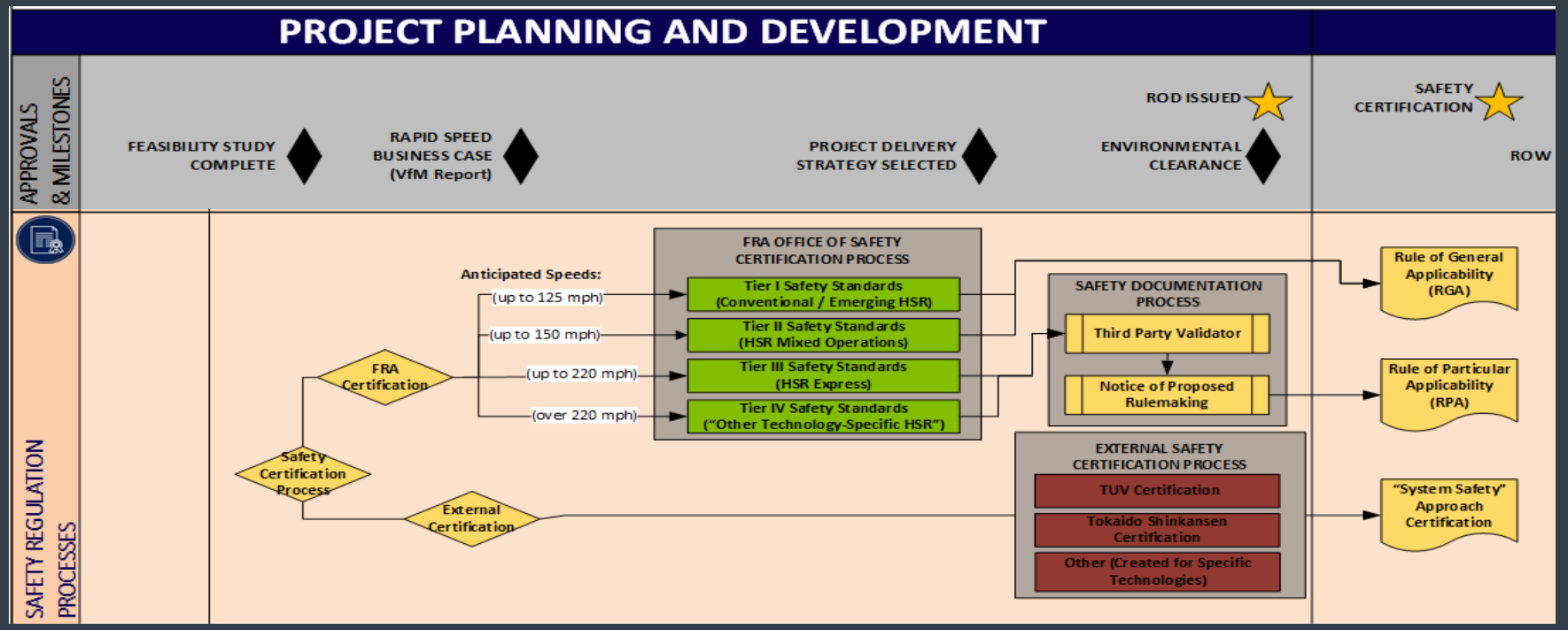
- New rapid speed technology will likely require NEPA.
  - Safety Certification requirements
  - Use of Federal Funding (including federal loan programs)
- Lead agency dependent on alignment right-of-way
  - FHWA likely if built in Highway right-of-way, and non-rail based
  - FRA likely if rail technology in railroad right-of-way (most experience with NEPA in High Speed transportation projects)
  - Surface Transportation Board (STB) may be involved

# Planning and Environmental

- Other environmental considerations for rapid speed technologies may include:
  - Human Health
  - Electromagnetic effects
  - Vibration
  - Emergency management
  - Energy use and sources
  - Secondary or induced growth
  - Farmland and wildlife impacts (particularly for greenfield alignment)
  - Visual resources (particularly for greenfield alignment)

# Safety Certification

- Which agency or entity certifies for system safety?
- Will a new entity need to be formed to certify these new technologies?
- How does the safety process overlap with planning and environmental?



# Safety Certification

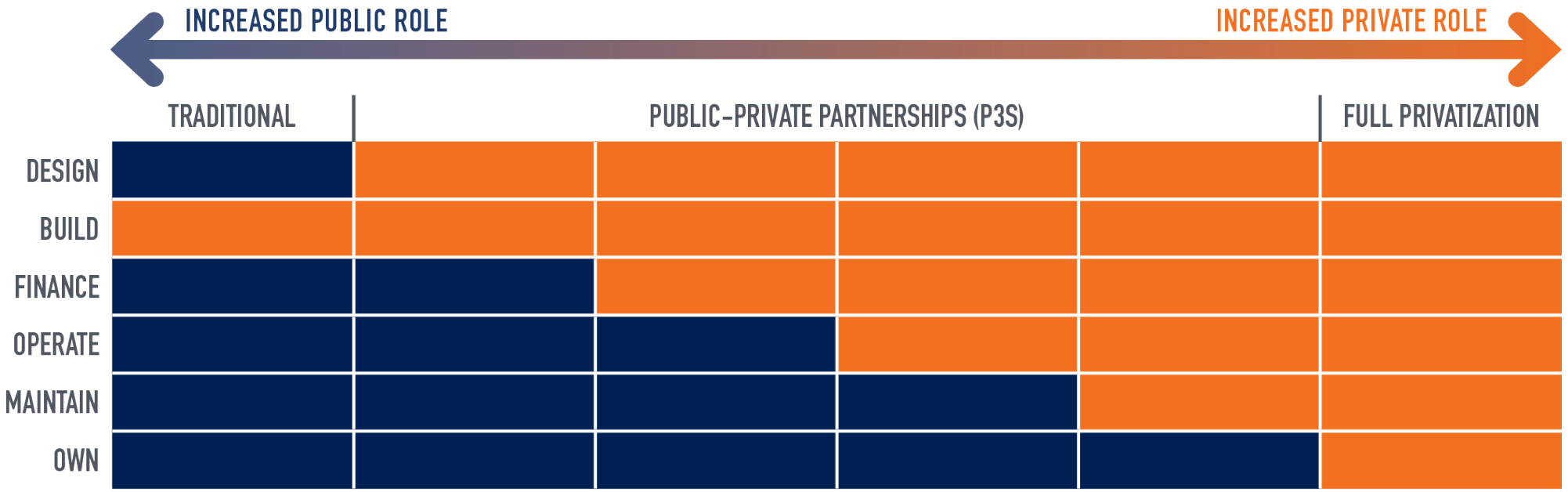
- To-date, the safety certification for high speed rail in the U.S. has been through FRA in the form of Rules of Particular Applicability (RPA)
- National Highway Traffic Safety Administration (NHTSA) enforces many standards in the auto industry (safety)
- Agencies certify high speed rail in other countries (European TÜVs - Technical Inspection Association, Railway Bureau of the Ministry of Land, Infrastructure, Transport, and Tourism for the Japanese Shinkansen System)

# Governance and Policy

- Who owns the right-of-way? Who operates the technology?
- Could a technologist authorize eminent domain?
- How does governance overlap with financial?

- System Governance Options:
  - CDOT owns land/Technologist owns and operates system
  - Other public entity owns land/Technologist owns and operates system
  - Technologist owns land and operates system

# Project Delivery Strategy




**TRADITIONAL MODEL**

- Risks retained by public sector
- Multiple procurements
- Fragmented team
- First-cost focus
- Payment by percent complete
- Public facing

**INTEGRATED DELIVERY MODEL**

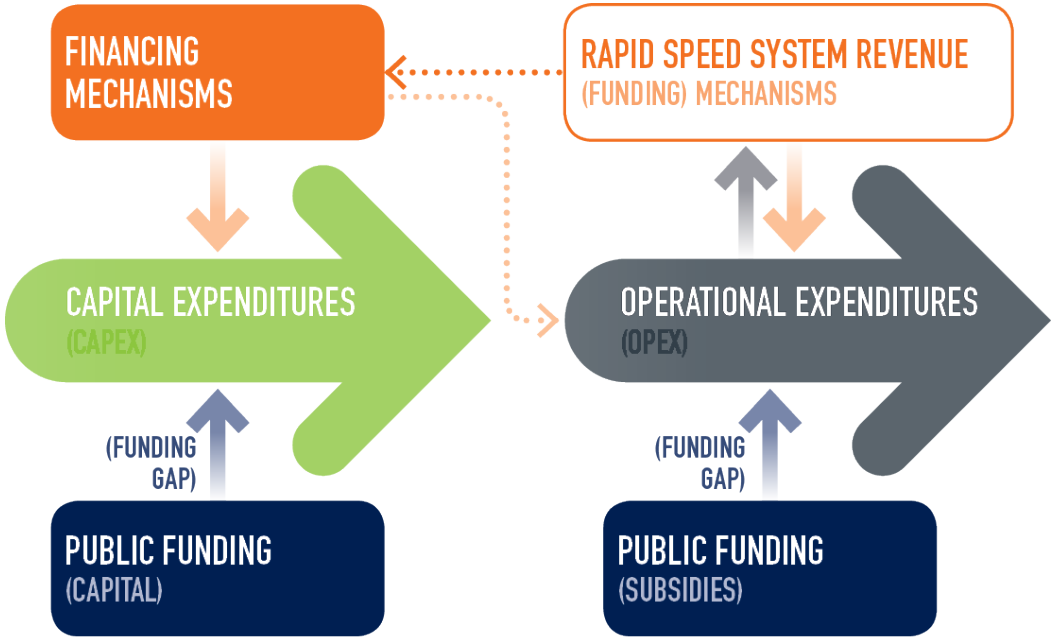
- Risks transferred/mitigated
- Integrated procurements
- Collaborative unified team
- Full life cycle cost focus
- Payment on delivery
- Private third-party financing

# Financial and Legal

- How would the implementation of a new technology be funded?
- How does funding overlap with planning?
- What would CDOT's role be (including HPTE) in the financial and legal processes?
- Complexity and Challenges
  - It is assumed that a Rapid Speed endeavor will require "megaproject" funding levels with significant private investment
  - Build America Bureau administers federal transportation credit programs

# Financial and Legal

- **Possible Sources of Funds**
  - **Public Funds** (state and local funding, federal discretionary funds, value capture opportunities)
  - **Service or Asset-Related Revenue-Generating Funding Mechanisms** (passenger and freight fares, commercial property development, ancillary revenues)
  - **Public Innovative Financing** (federal credit assistance, bonding and debt instruments [i.e. TIFIA, RRIF, and PAB])
  - **Private Financing** (private lenders, corporate bonds, mezzanine debt, private equity)




Conceptual Overview of Funding and Financing Dynamics

# Procurement and Partnerships

- Public-private partnership (P3) approach to procurement of a Rapid Speed system in Colorado
  - Enhanced by vetted Project Delivery Selection processes
- Colorado's P3 Delivery and Innovative Financing experience is demonstrated by a proven track record.

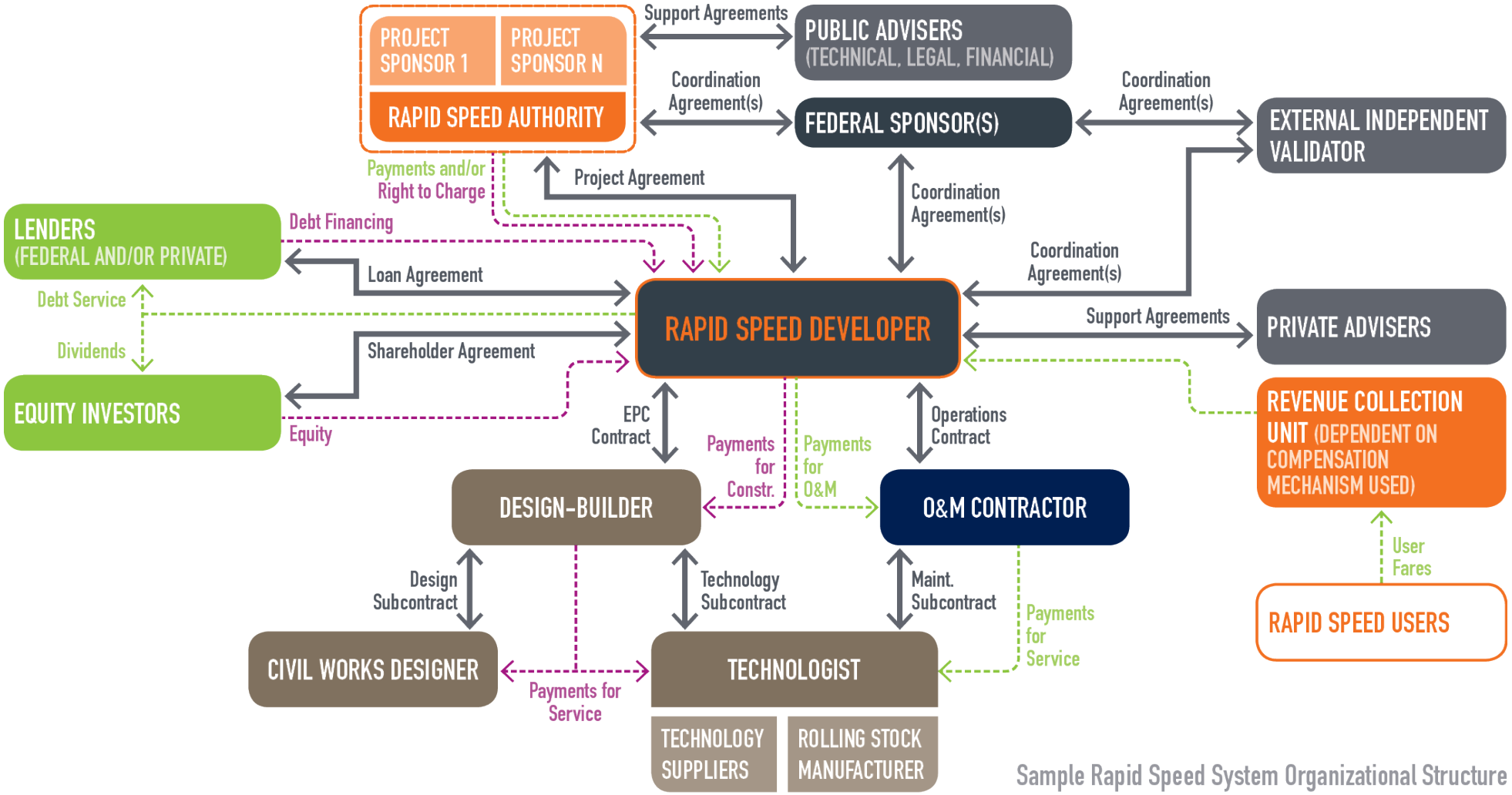
| PROJECT | COST | DATES | DELIVERY METHOD | MARKETS SERVED |
|---|---|---|---|---|
| E-470 (47 mi) | $1.21B | 1991 – 2003 | Design-Build, CM/GC | Highway |
| T-REX (20 mi) | $1.67B | 2001 – 2006 | Design-Build | Highway, Transit |
| EAGLE P3 (36 mi) | $2.2B | 2011 – 2016 | P3 | Transit |
| Union Station | $375M | 2012 – 2014 | Design-Build | Transit |
| US36 Express Lanes (18 mi) | $497M | 2012 – 2016 | Design-Build, P3 | Highway, Transit |
| Central 70 (10 mi) | $2.2B (est.) | Ongoing | P3 | Highway |

# Rapid Speed Related Revenue Generation

- **Value Capture**
  - Tax Increment Financing
  - Special Assessments Districts
  - Transit-Oriented Development
  - Transit Joint Development (partnered with developers)

- **Potential Utility Partnerships**
  - Leveraging funding by selling or leasing access to utility providers to utilize planned ROW
    - Fiber Optic (telecommunications)
    - Water and Sewer (drinking and wastewater)
    - Oil and Gas (pipeline)
    - Power (electricity and natural gas)

# Project Oversight and Management




Sample Rapid Speed System Organizational Structure

# Summary

- Rapid speed technologies have the potential to transform the way we move in Colorado, and could help advance our mobility goals alongside other modes/systems.
- CDOT will likely play a key role in advancing these technologies, in coordination with other local, state, and federal agencies.
- Technologists need clarity and speed; creative partnerships and streamlining strategies need to be advanced.

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# Thank you

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# EXTRA SLIDES