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TRANSPORTATION RESEARCH BOARD

Public Transit as a Climate Solution

July 21, 2021

@NASEMTRB
#TRBwebinar

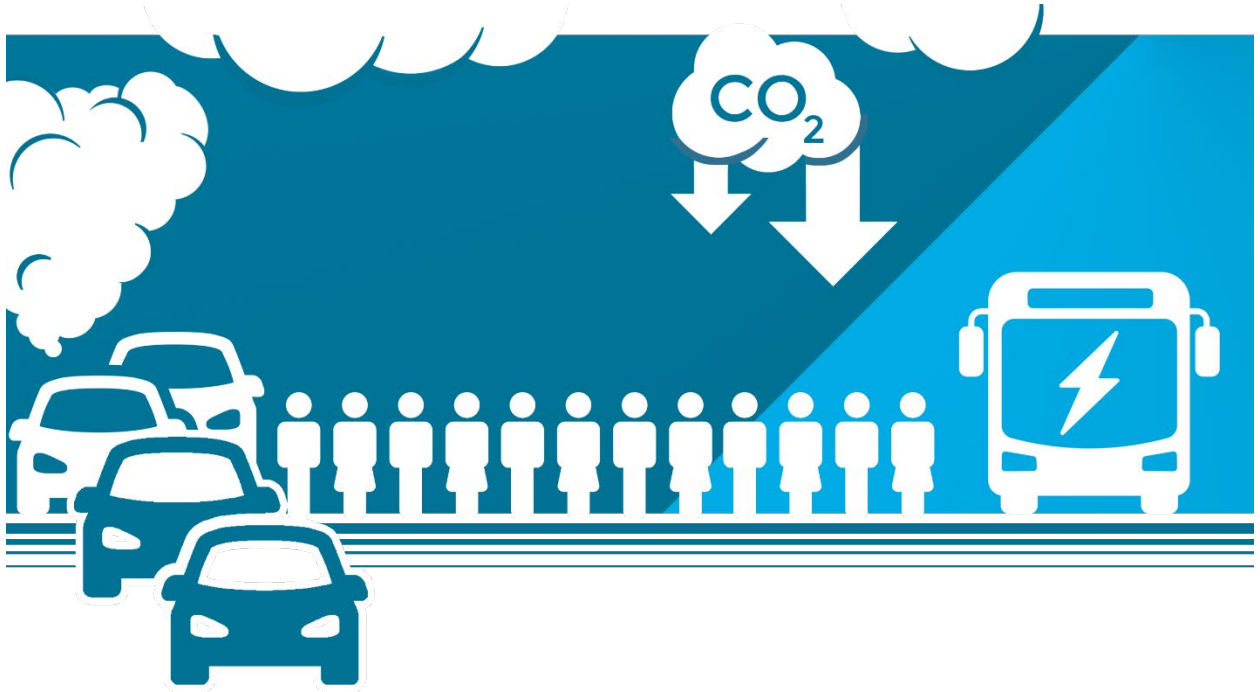
APA Credits

- This webinar is worth 1.5 AICP credits through the American Planning Association

Learning Objectives

1. Identify how to incorporate transit as a climate solution
2. Determine strategies for reducing carbon footprints and greenhouse gas emissions

#TRBwebinar



An Update on Public Transportation's Impacts on Greenhouse Gas Emissions, TCRP Report 226

TRB Webinar: Public Transit as a Climate Solution

TCRP Project J-11 / Task 36 Summary Findings

July 21, 2021

Jen McGraw, Center for Neighborhood Technology

National sustainability benefits of public transportation

Transportation represents **28% of greenhouse gas** emissions in the U.S.

Vehicle miles in 2018

were over **3.2 trillion** and have been rising

As cities seek to meet climate goals transportation emissions reductions are essential.

Public Transportation is a Climate Solution

Public Transportation in the U.S. saved **63 million metric tons of CO_2e** in 2018

Public Transportation is a Climate Solution

Public Transportation
helped avoid 148 billion miles
of auto travel in 2018.

Did you know?

The average transit vehicle had 12 passengers in 2018.

Public Transportation is a Climate Solution

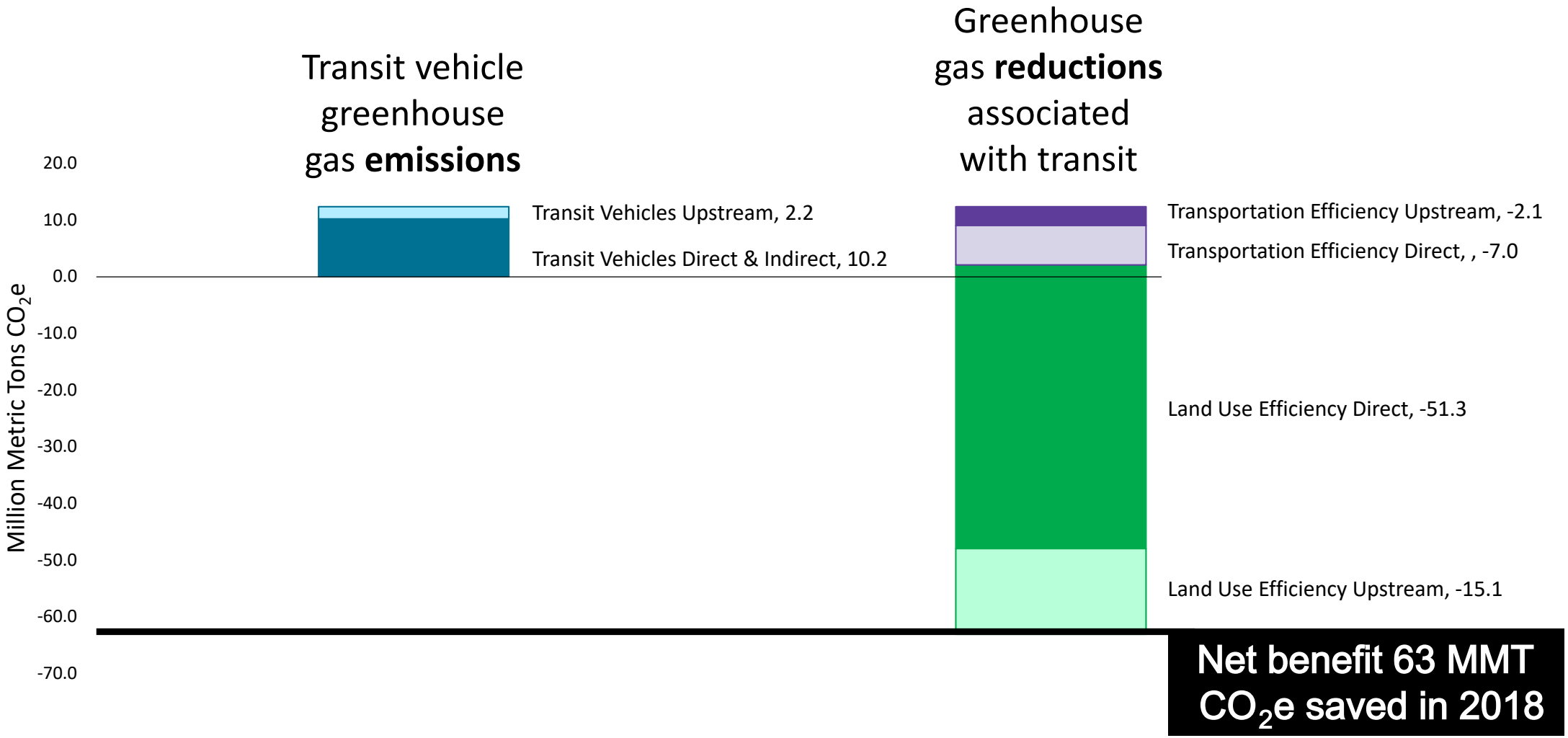
Public Transportation
helped avoid 6 billion gallons
of gasoline use in 2018.

Did you know?

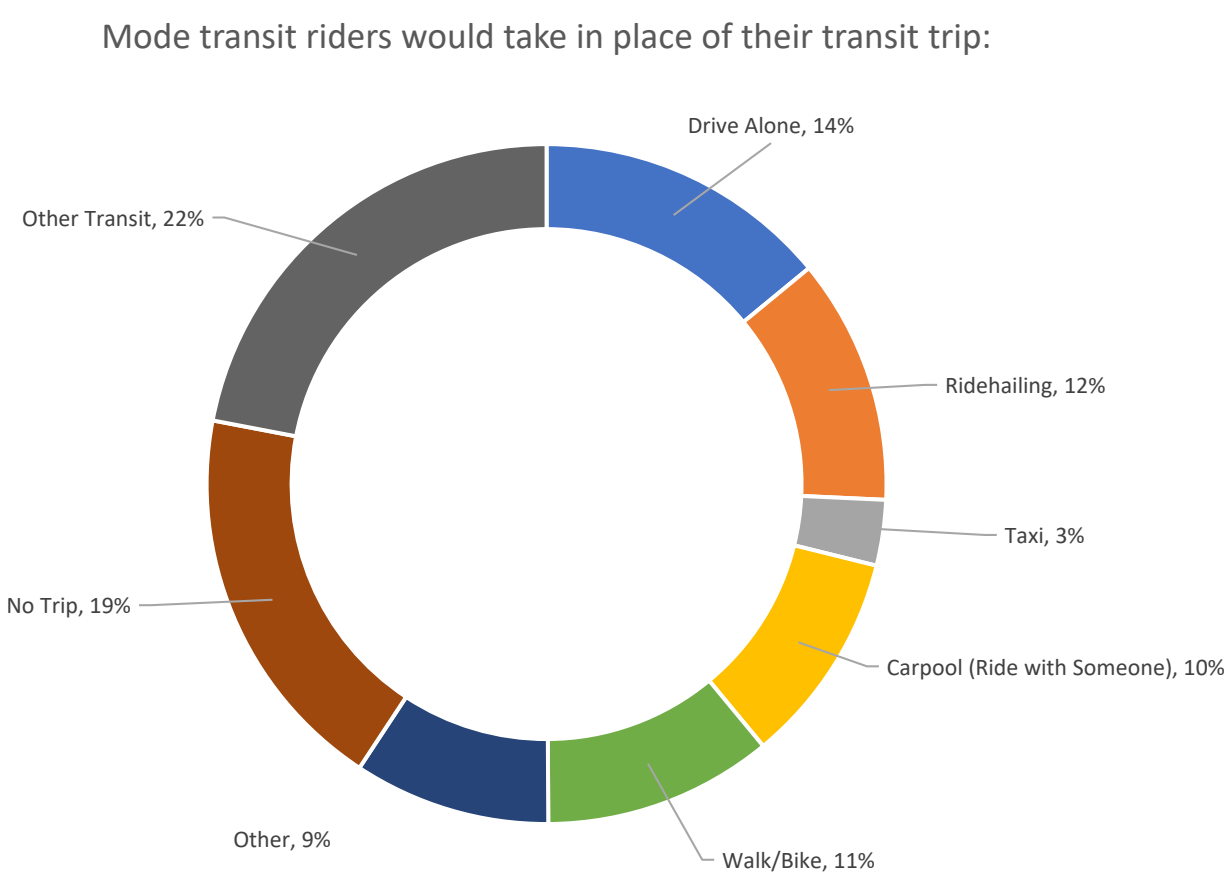
Transit riders avoided using 790 million gallons in automobiles.

Public transportation systems created land use efficiencies that saved 5.8 billion gallons of gasoline in communities.

GHG Impacts of Public Transportation 2018



Mode Shift Factor



Drive Alone	14%
Ridehailing	12%
Taxi	3%
Carpool	10% / 2.5 occupancy
Total:	33% of transit passenger miles replaced by auto miles

Source: APTA, *Economic Impact of Public Transportation Investment 2020 Update*, April 2020, adjusted to include “other transit”. Data from transit rider surveys.

Transit Multiplier

- **Direct Effect:** VMT reduction of transit passengers (also called Transportation Efficiency)
- **Indirect Effect:** VMT reduction in the community—even residents who do not ride transit themselves save VMT, such as through shorter trips & fewer driving trips (also called Land Use Efficiency)

$$\text{Transit Multiplier} = \frac{(\text{Direct Effect} + \text{Indirect Effect})}{\text{Direct Effect}}$$

Reduced carbon footprint of individuals using public transit

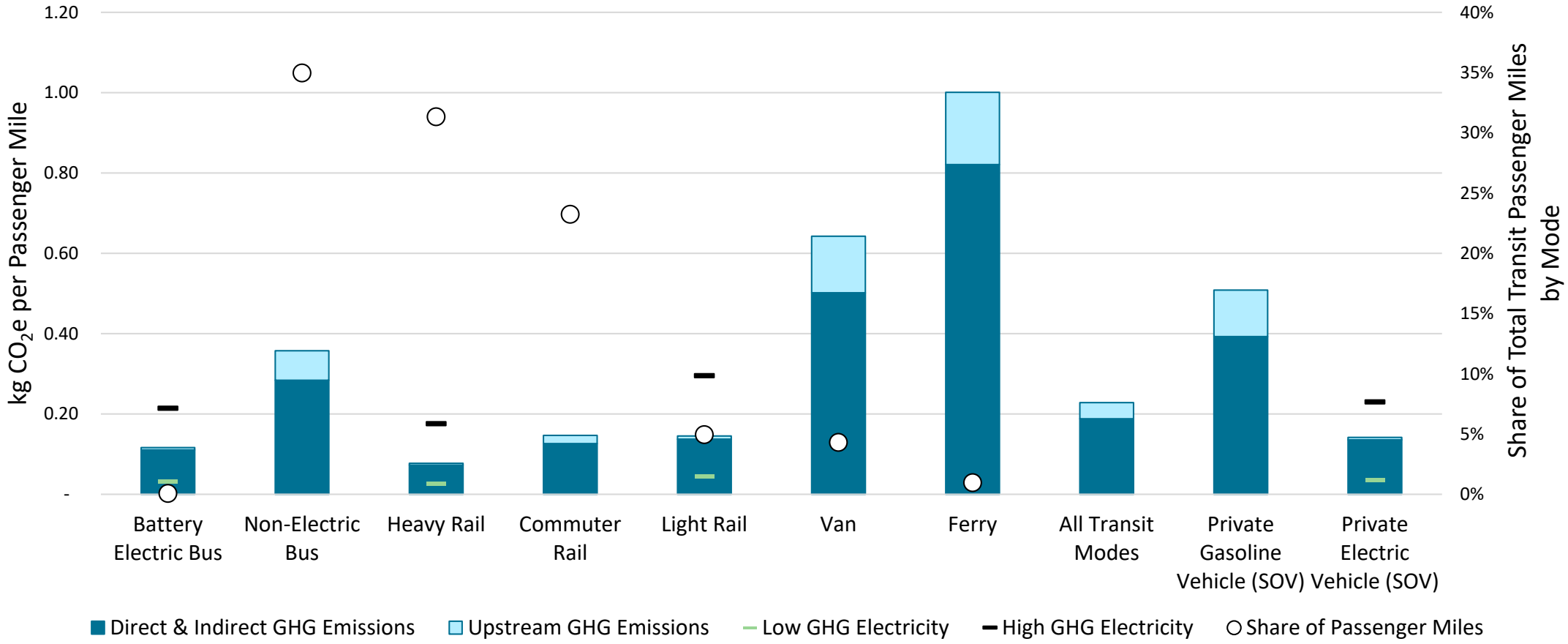
Public Transportation is a Climate Solution

A typical trip on public transit emits
55% fewer greenhouse gas emissions
than driving or ridehailing alone.

Did you know?

- Public transportation is a low-carbon solution for passengers, and it has gotten better over time.
- Emissions per passenger mile in 2018 were 26% lower than in 2005.
- Transit kept pace with auto fuel efficiency improvements over the last decade.

Average GHG Emissions per Passenger Mile



SOV is single occupancy vehicle. Average private vehicle occupancy for commute trips is 1.18 passengers, for all trips 1.67 passengers (NHTS).

Public Transportation is a Climate Solution

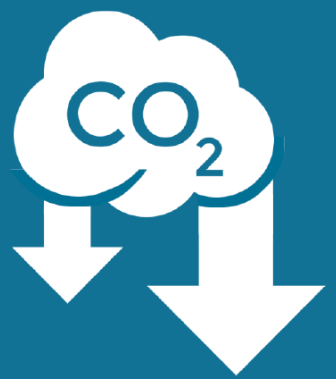
Public transportation provides multiple resiliency benefits for communities impacted by climate.

Did you know?

- GHG reduction should not be transit's only sustainability metric.
- Transit provides necessary access to school, jobs, and services and helps reduce household transportation costs.
- Public transportation creates air quality improvements that benefit public health.

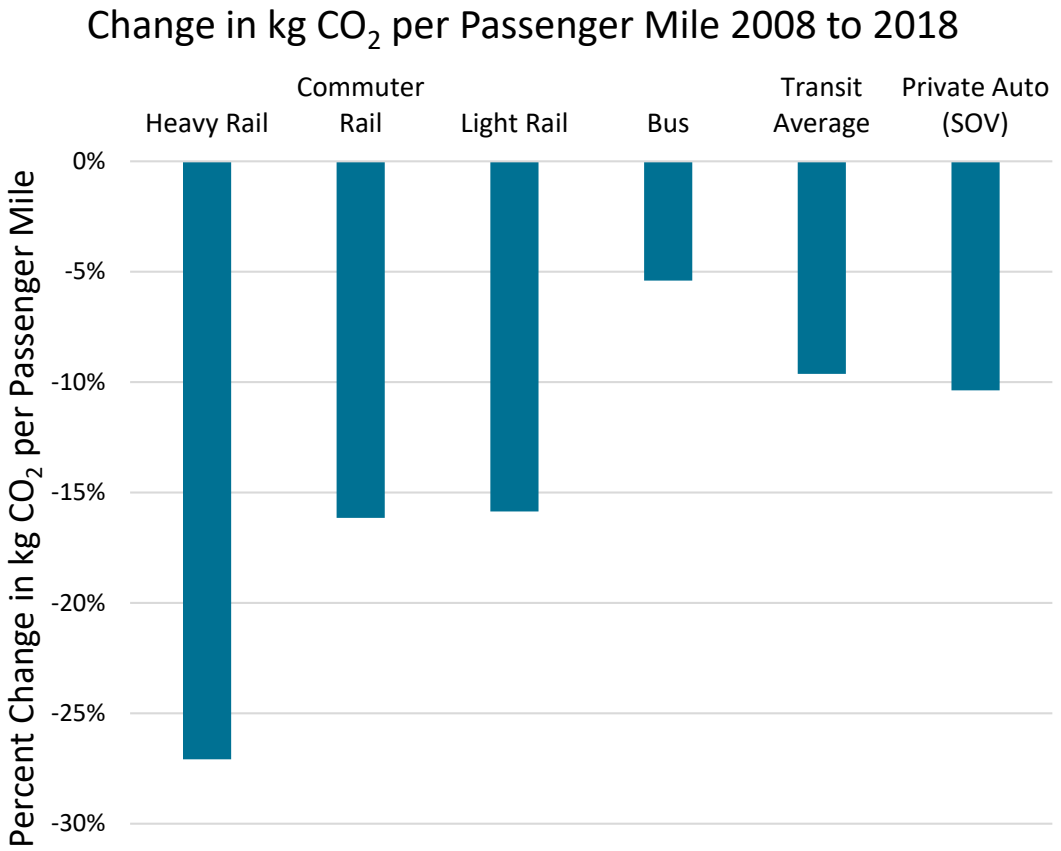
Transit agency contributions to GHG emission reduction and sustainability

Public Transportation is a Climate Solution



Public Transportation vehicles emitted **10% less CO2 per passenger mile** in 2018 than they did in 2008.

Transit vehicle CO_2 emissions have decreased & CO_2 per passenger mile has decreased over time



Values in are in CO_2 not CO_2e in this chart only for consistency with previous analyses
2008 Source: FTA, Public Transportation's Role in Responding to Climate Change, 2010.

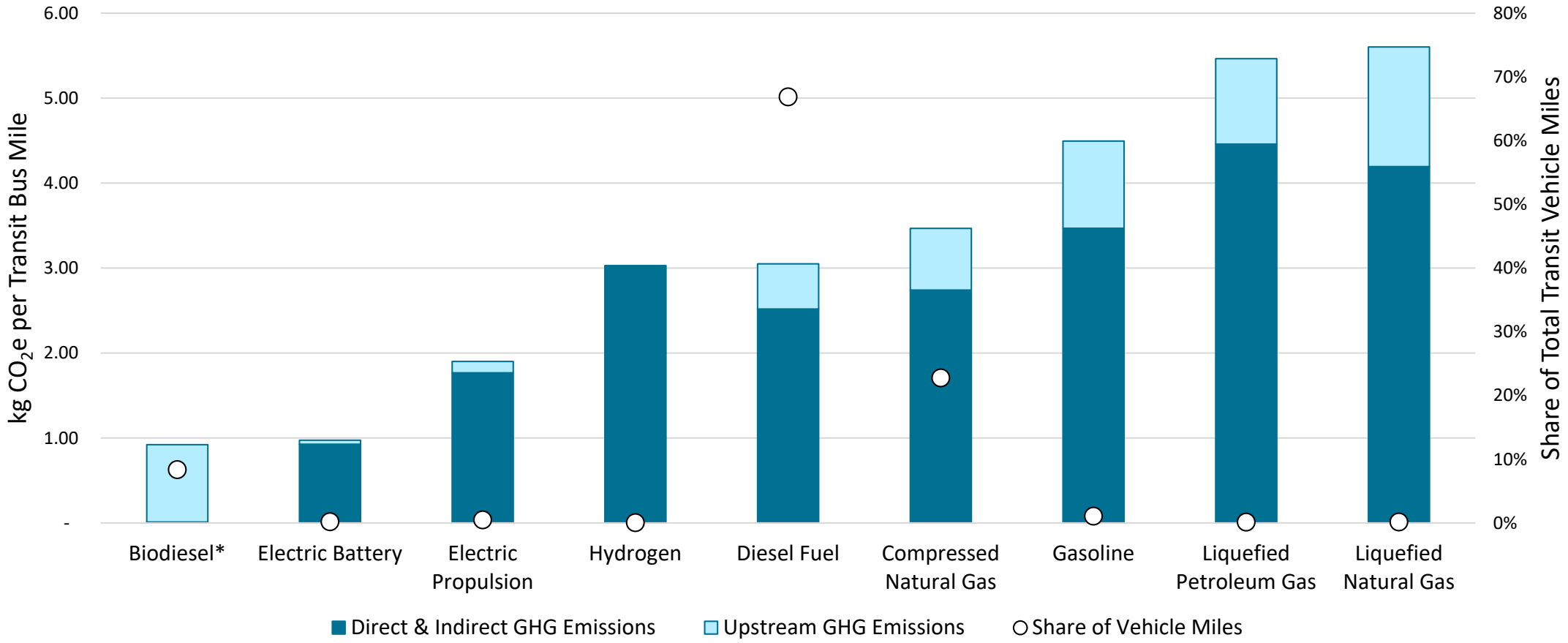
Public Transportation is a Climate Solution

A battery electric bus emits
62% fewer GHG emissions
than an average diesel bus.

Why it matters:

- Transit agencies are adopting lower-carbon fuels and technologies.
- Electricity was 29% less carbon-intensive in 2018 than 2005, on average in the U.S.
- As cities seek to meet climate goals transportation emissions reductions are essential.

Transit bus emissions vary significantly by fuel

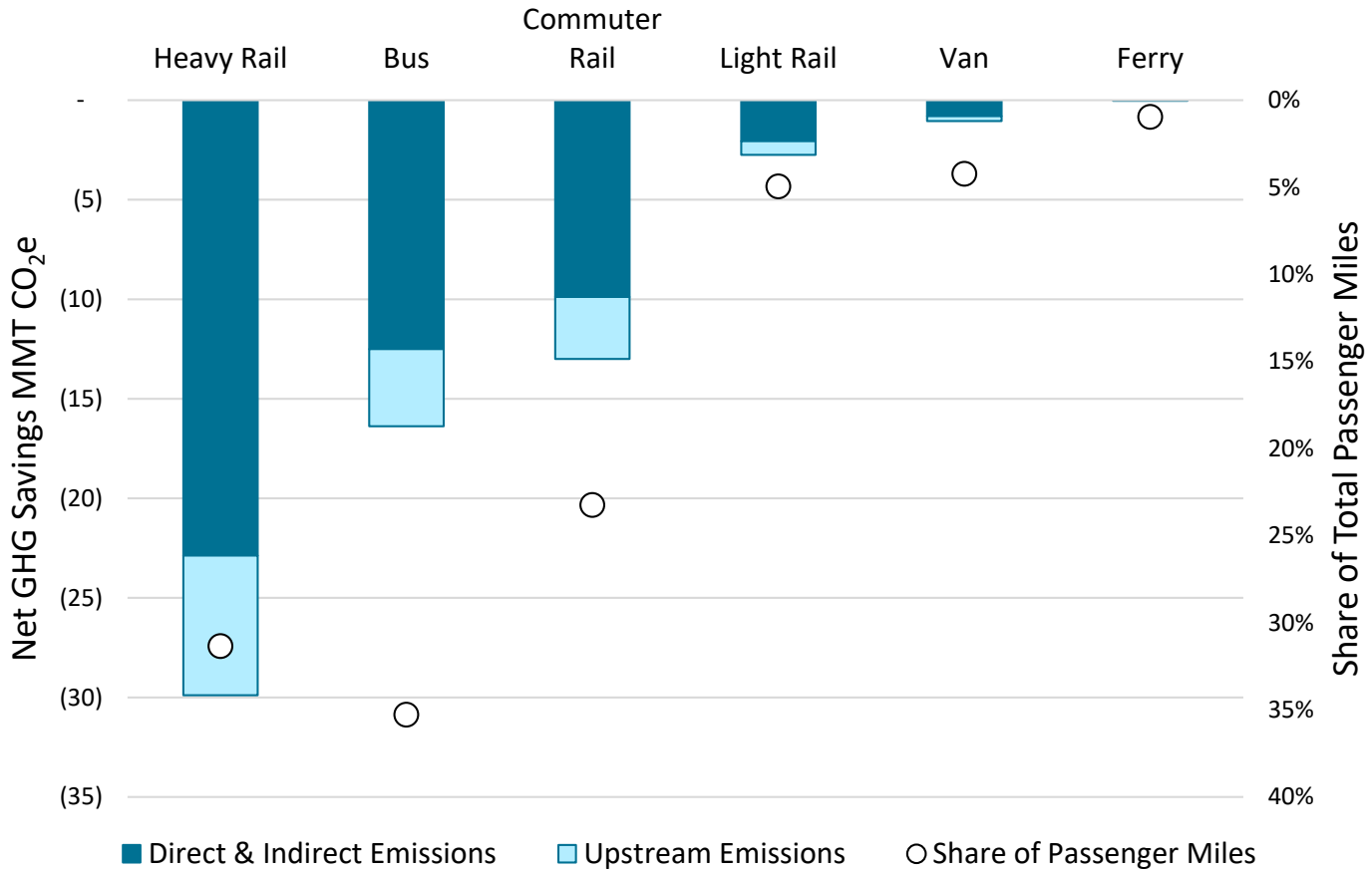


Fuel economy and fuel carbon intensity both impact this metric. *Biodiesel also generates biogenic CO_2(b) of 2.96 kg per bus mile. These biofuels are sourced from plant matter and their carbon emissions are considered part of the natural carbon cycle.

National sustainability benefits of public transportation by mode

GHG Impacts of Public Transportation 2018 by Mode

(Transit Vehicle Emissions + Transportation Efficiency + Land Use Efficiency)



Variables impacting net savings:

- Vehicle technology
- Vehicle capacity
- Fuel, including electricity sources
- Occupancy
- Ridership
- Location efficiency
- Operations
- And more

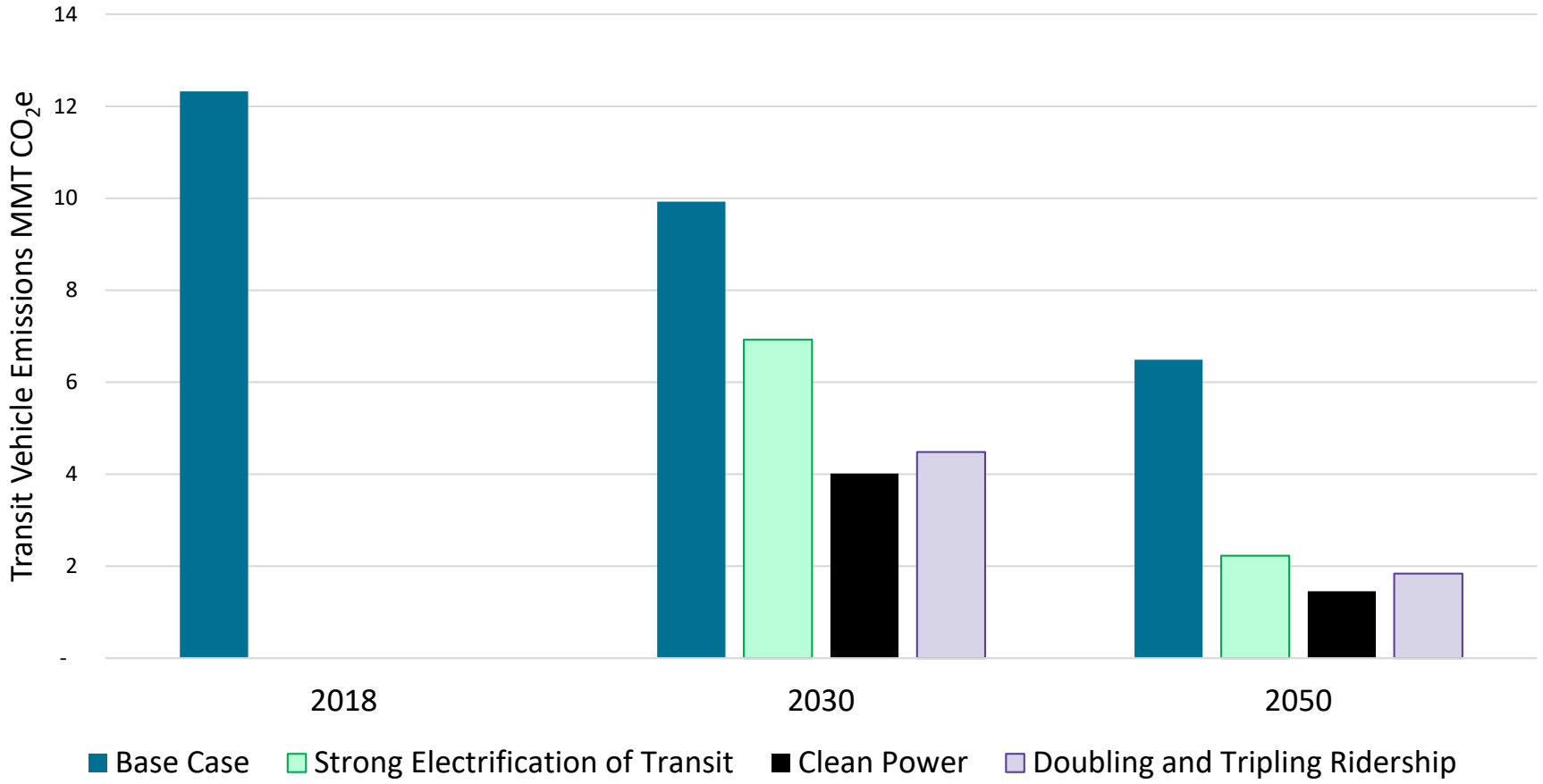
Potential future scenario

Public Transportation Scenarios 2030 and 2050

(Hypothetical for Consideration)

- Largest GHG scenario change is avoided personal vehicle travel as ridership doubles & triples.
- Avoided vehicle travel creates net savings of 120 MMT CO_2e via transportation & land use efficiency in 2050.
- Land use efficiency is expected to grow creating significant GHG savings among non-passengers.

Transit Vehicle GHG Emissions, 2030 and 2050 Scenarios



- Scenario eliminates 83% of transit vehicle emissions by 2050 even as ridership triples.
- Emissions from transit vehicles fall from 12 MMT CO_2e in 2018 to 2 MMT CO_2e in 2050.

Project tools

Scenario Tool

								Scenarios				
								A) Additional Electrification of Transit Vehicles (Select % Increase in VMT Electrified)	B) Zero Carbon Electricity (Select % of Electricity with 0 GHGs)	C) Ridership Increase (Select % Change in Passenger Miles from 2018)		
								50%	100%	50%		
								Scenario Results				
Transit Agency Name	City	State	Mode	Transit Vehicle Emissions kg CO2e	Transportation Efficiency Emissions Savings kg CO2e	Land Use Efficiency Emissions Savings kg CO2e	Transit Vehicle Emissions with Electrification (kg CO2e)	Transit Vehicle Emissions with Electrification & Zero Carbon Electricity (kg CO2e)	Transit Vehicle Emissions with Electrification, Zero Carbon Electricity and Increased Ridership (kg CO2e)	Scenario Transportation Efficiency Emissions Savings (kg CO2e)	Scenario Land Use Efficiency Emissions Savings (kg CO2e)	
Example			Light Rail	24,050,987	16,780,962	100,843,241	24,050,987	-	-	25,171,444	151,264,862	
Example			Bus	25,159,072	43,515,075	261,498,781	33,594,988	12,579,536	14,963,123	65,272,612	392,248,171	

Project tools available at http://www.trb.org/Main/Blurbs/181941.aspx

San Francisco 11am September 9, 2020.

Thank You

Jen McGraw jen@cnt.org

Center for Neighborhood Technology

cnt.org

TCRP Report 226:

http://www.trb.org/Main/Blurbs/181941.aspx

Benefits to Transit Agencies of Addressing Sustainability

TRB Webinar: Public Transit as a Climate Solution

Amy Pettine

July 21, 2021

NELSON NYGAARD

NELSON NYGAARD

We Put People First

Amy Pettine
Principal

Developing transportation systems to promote broader community goals of mobility, equity, sustainability, health, and economic development

Transit

Transit Corridors

Active Transportation and Safety

Cities and Streets

Parking and Demand Management

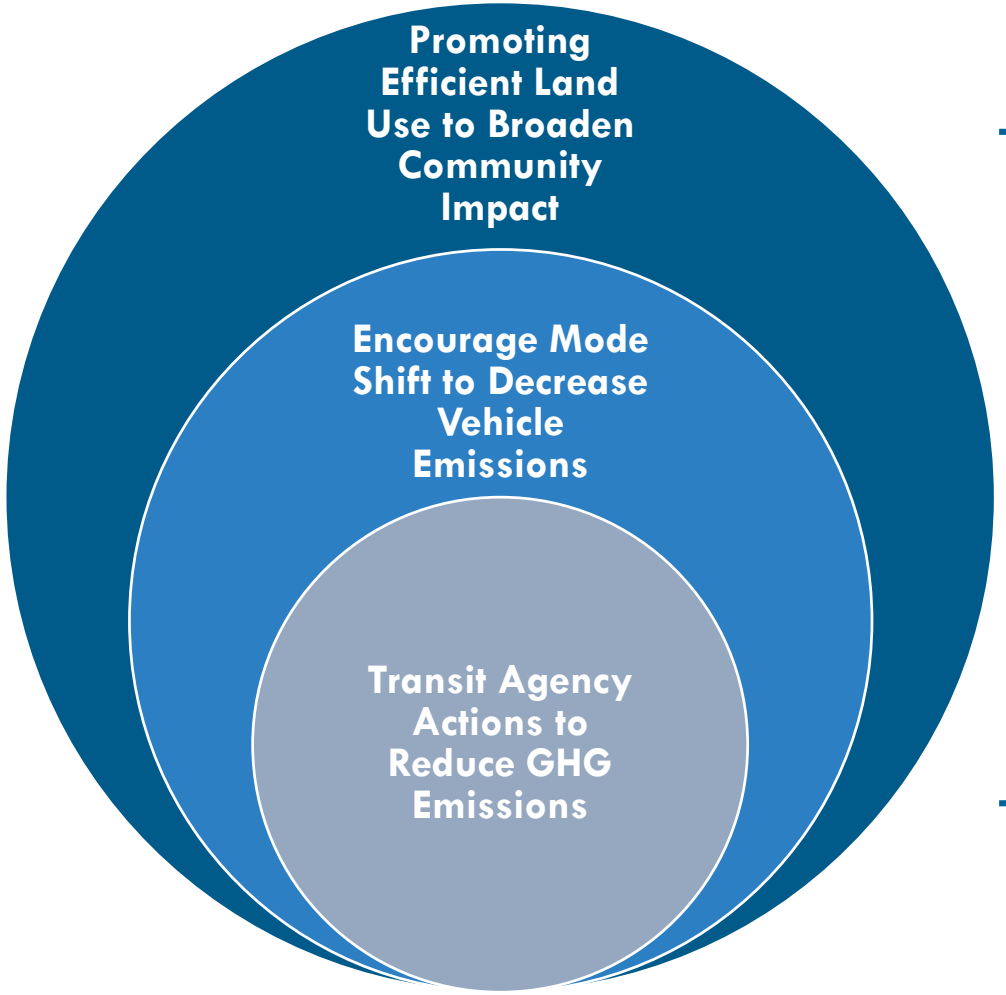
Paratransit and Community Transit

Emerging Mobility

Engineering and Design

Tackling Sustainability at All Levels

Transportation is a major source of the greenhouse gas (GHG) emissions that are causing climate change. As communities work to cut emissions and become more resilient they are looking to public transportation as a climate action strategy.



How Transit Agencies Benefit

- Key Player in Mitigating Climate Change (Transportation Sector Impacts High, Transit Sector Contributions Low (1.2% of GHG)
- Leverage New Technologies
- Workforce Development
- Mode Shift Goals Bring System Investments to Provide a Reliable Alternative to Driving
- Concrete Benefits from Agencies who have worked towards sustainability
- FTA has several grant programs that provide additional funding to shift away from diesel buses

Transit Agency Challenges

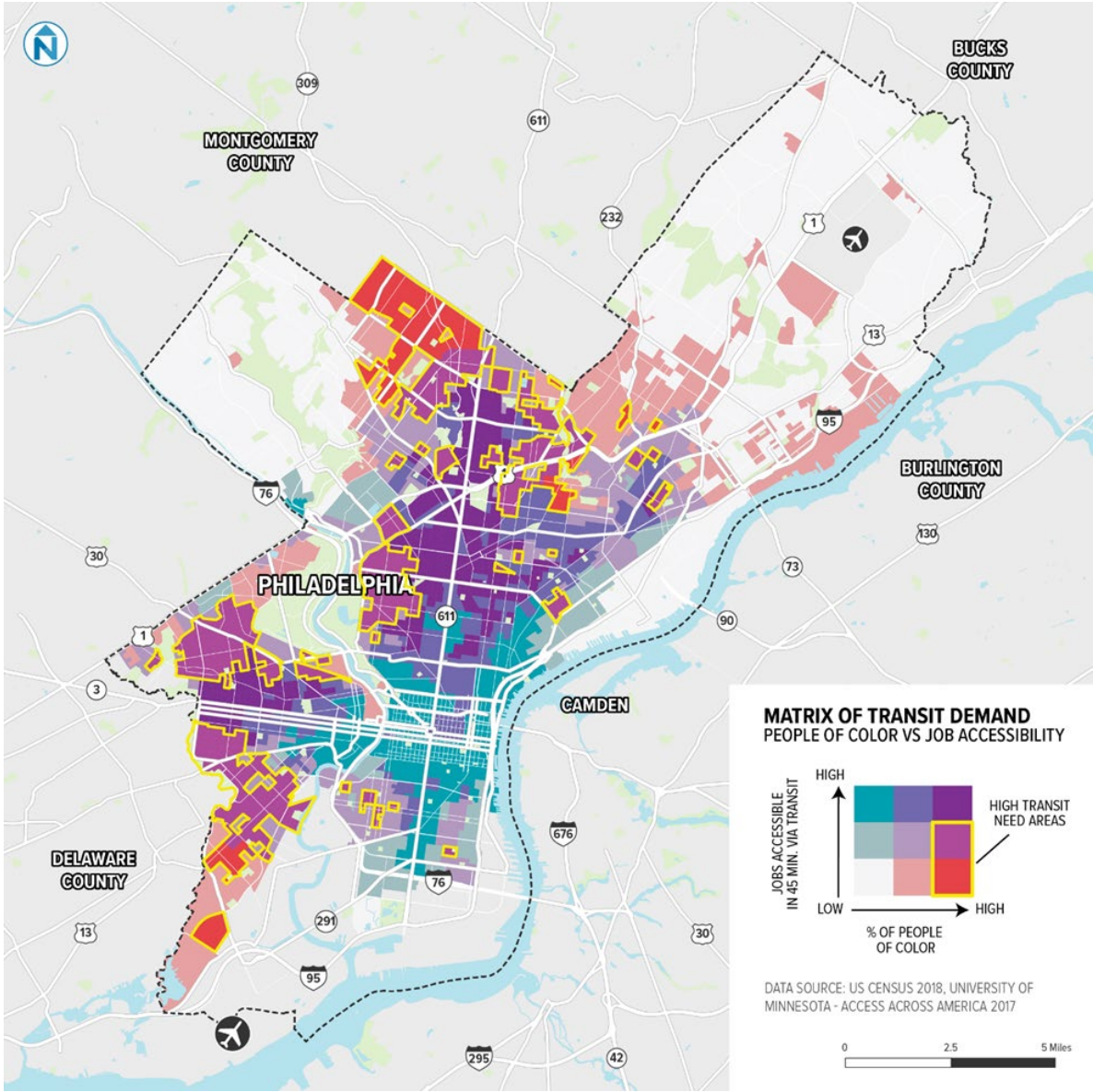
- State Plans & Mandates
- Seat at the Table

Question – where do transit agencies fit in?

- Telling a Story
- Measuring Success
- Encourage Culture Change
- Increase Funding

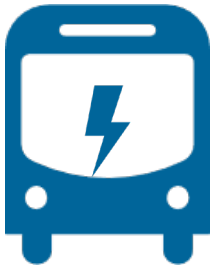
Sustainability + Equity

- Public transportation serves many essential needs. It also plays a role in:
- Reducing air pollutants
- Addressing health and safety impacts of transportation
- Reducing household transportation costs
- Increasing access



Public Transportation Impacts

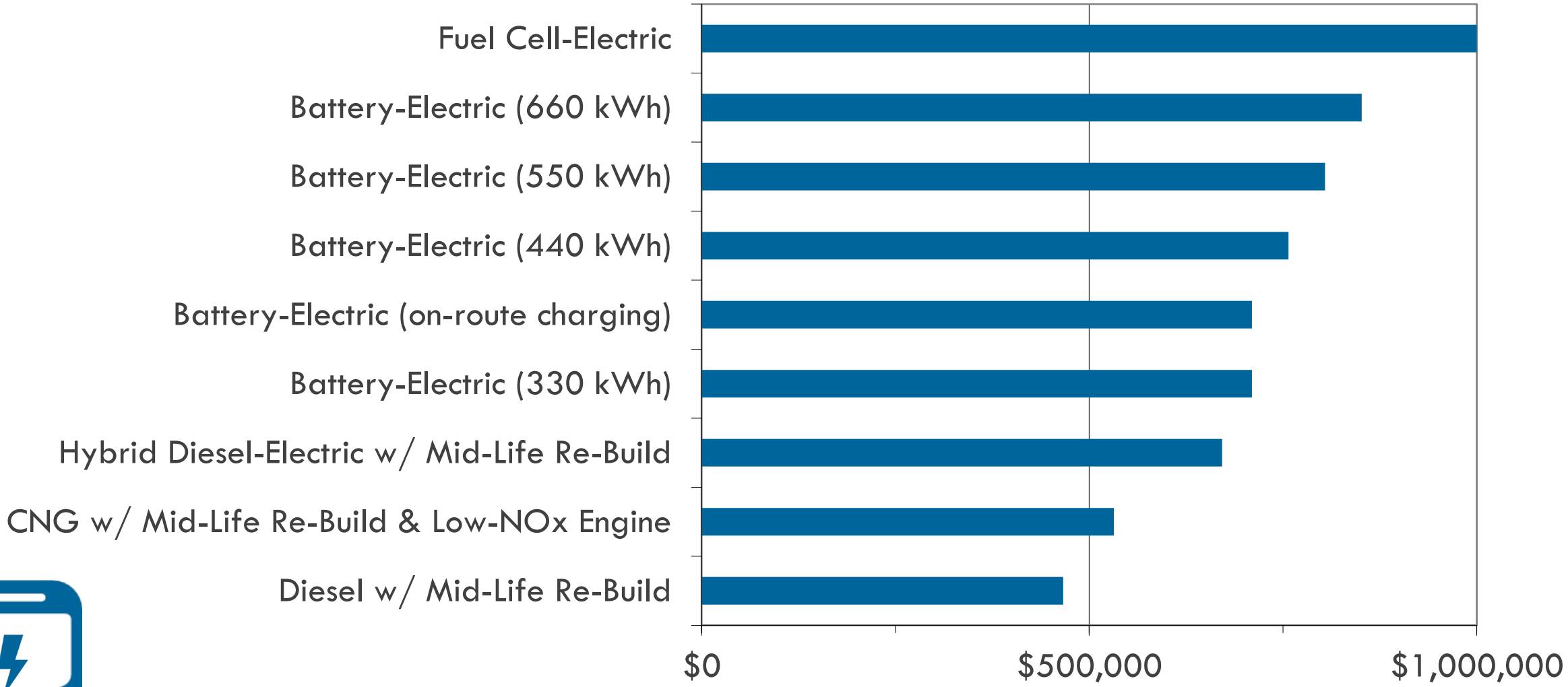
1. Transit Vehicle GHG Emissions: the GHG emissions associated with transit vehicle fuel use;
2. Transportation Efficiency GHG Savings: the GHG emissions saved by passengers riding transit rather than using personal vehicles; and
3. Land Use Efficiency GHG Savings: the GHG emissions saved by the broader impact of transit on vehicle miles traveled (VMT) in the community.



Fleet Conversion

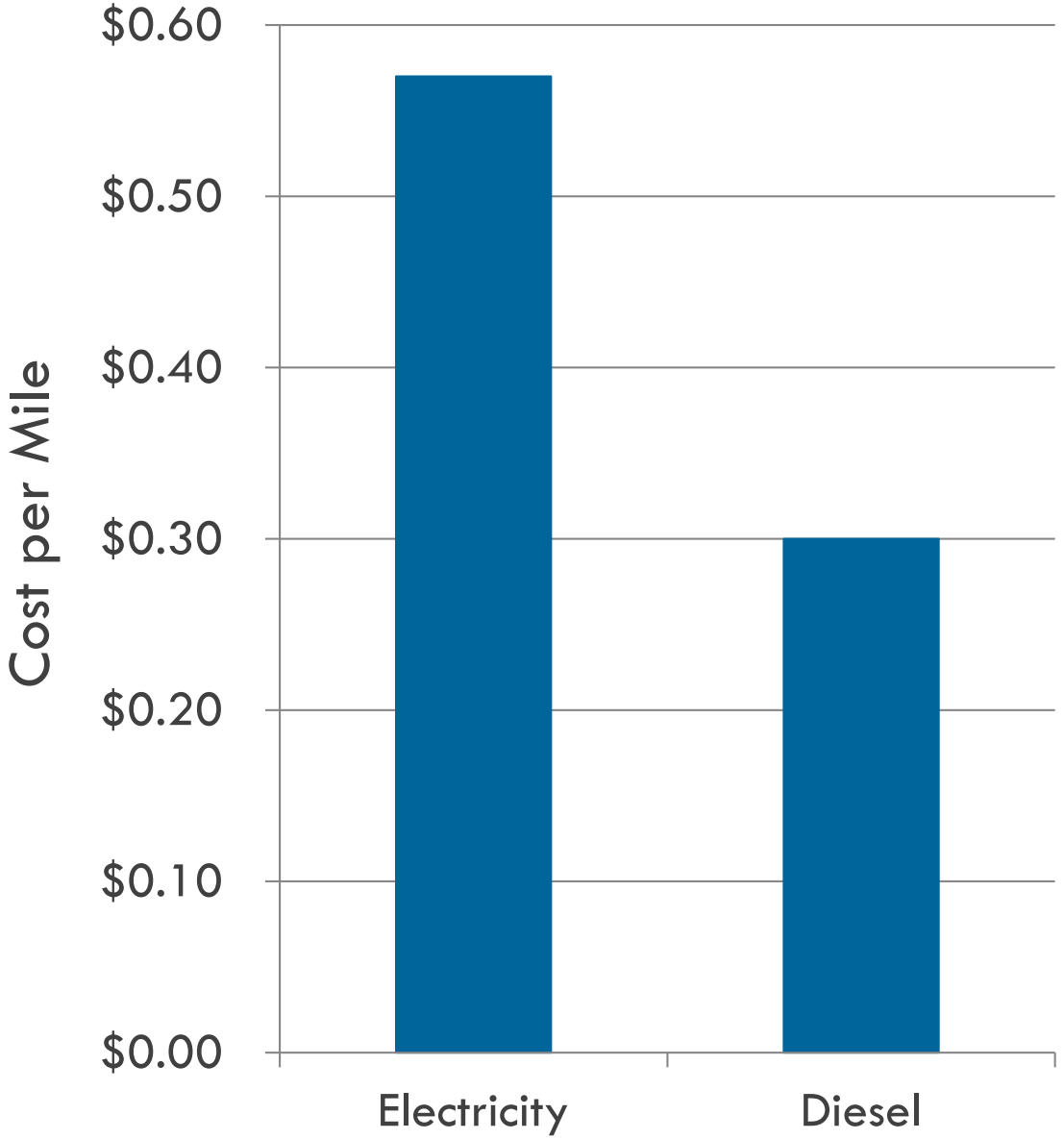
- Huge increase in electric fleet in last few years
- Upfront expense in vehicles and facilities
- Utility coordination essential
- New technology challenges
- Long-term savings possible

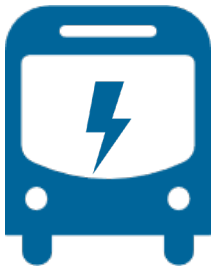
Transit Bus Costs



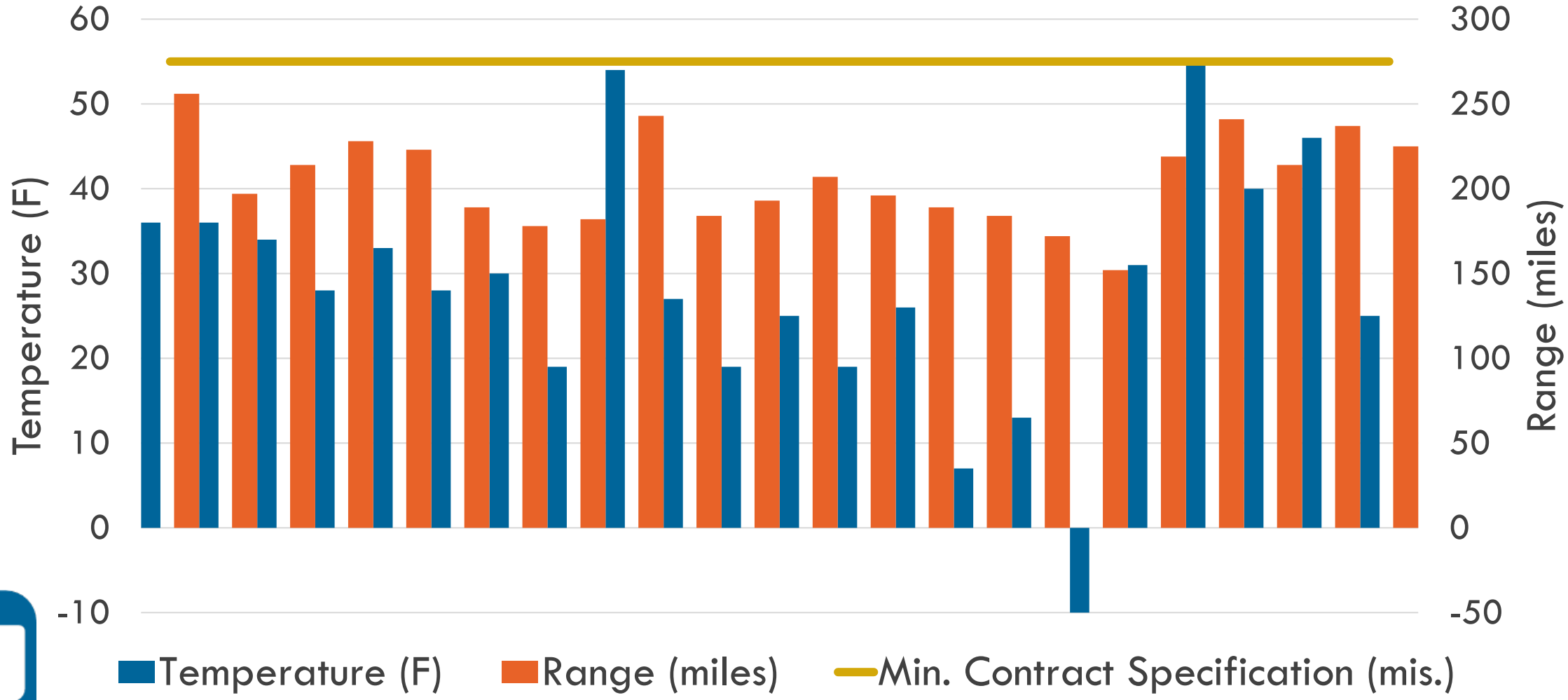
Operating Costs

- Ostensibly lower
- Fuel economy of electricity 2x to 3x that of diesel
- Problems with rate structure
  - Demand charges





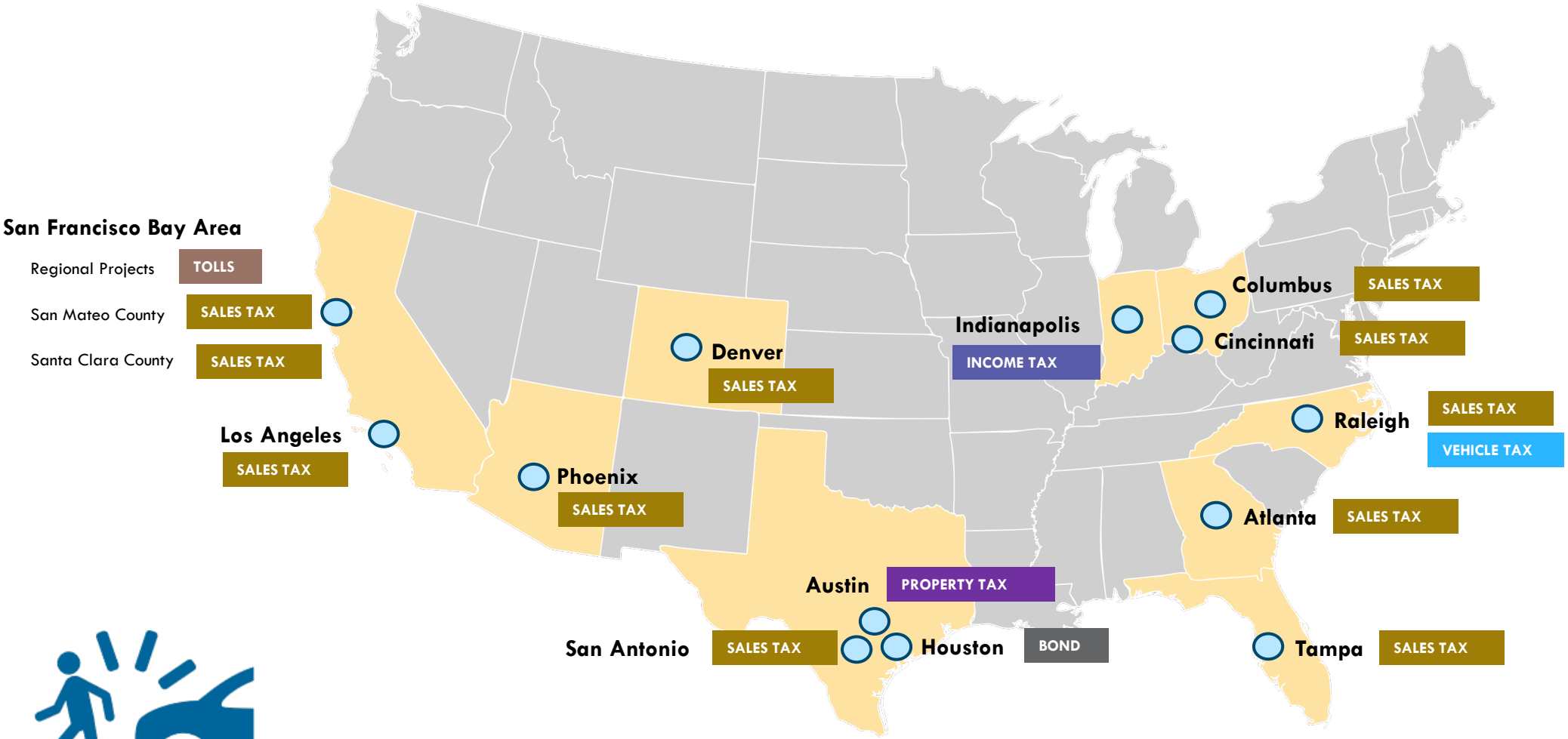
Range Anxiety



Encourage Mode Shift

- Increasing ridership is the strongest way to increase public transportation's GHG impacts in communities
- This will require additional transit service, which can increase transit vehicle GHG emissions, but this is more than offset by the GHG savings of passengers who avoid personal vehicle use and the larger land use impacts of transit.

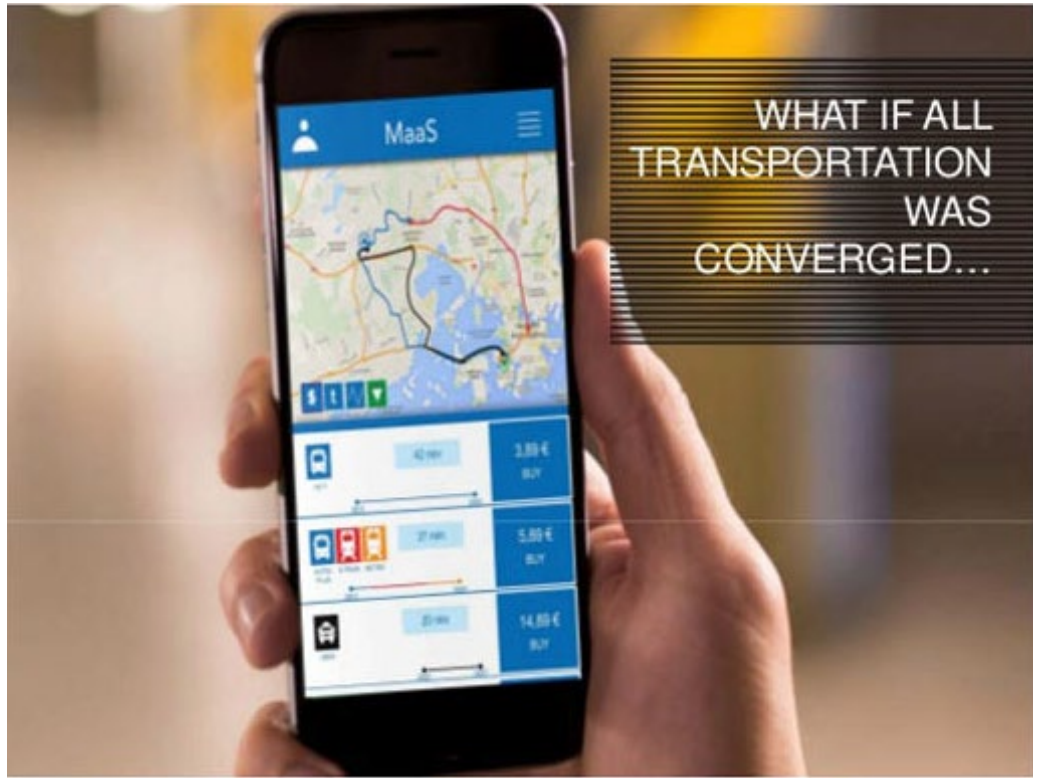
Increase Transit Funding



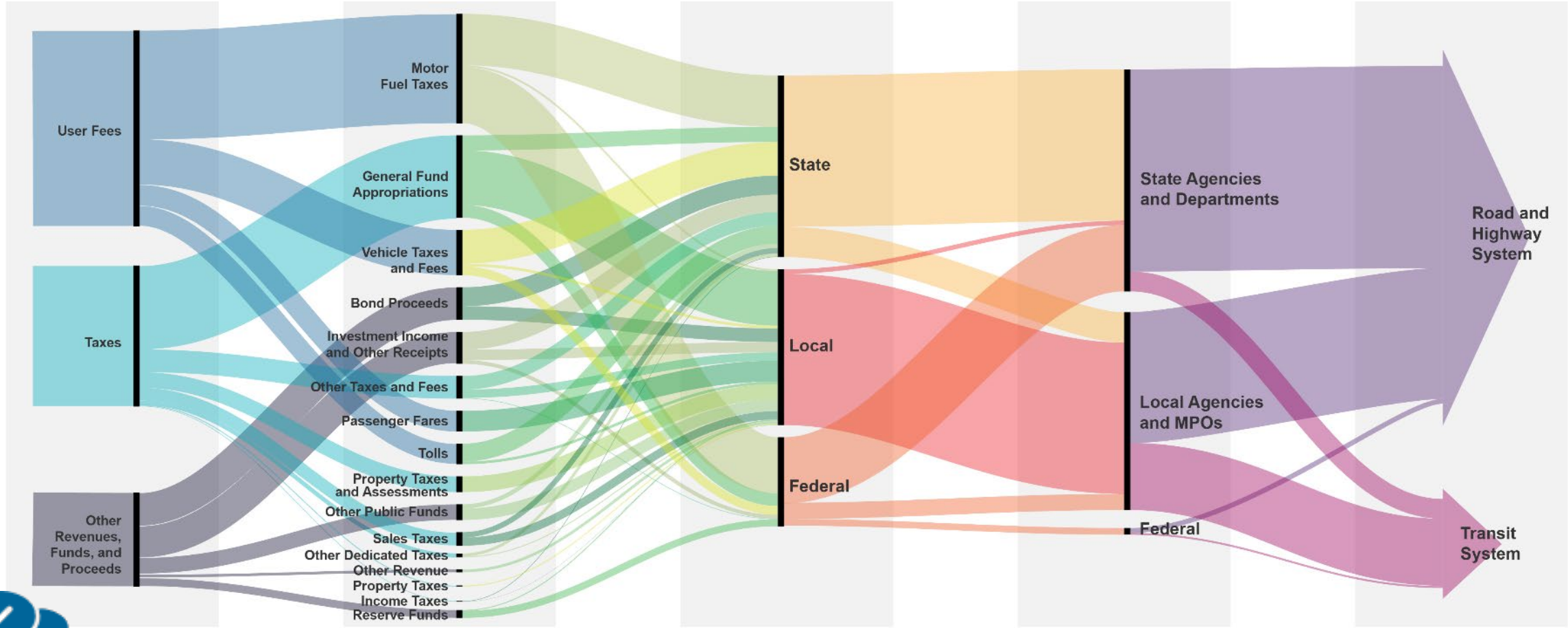
Prioritize Transit in Roadway Design

- Bus Priority
- Traffic Signal Priority
- High Quality Bus Stops
- Improved Accessibility
- Off-board Fare Payment

Transition from Mobility Provider to Mobility Manager



Align Funding with Our Values



OPPORTUNITIES

Advocate and Educate

HOW DOES TRANSIT BENEFIT THE CITY OF DENVER?

1 Supports a healthy environment.
Tailpipe emissions are the leading contributor to ozone and other air pollutants. Meeting new air quality standards will be difficult without a reduction in single occupancy vehicles, congestion, and a move to alternative fuels.

2 Attracts talent and makes Denver more competitive.
Quality transit service helps to attract and retain a talented work force.

3 Supports accessibility and affordability.
Transit reduces household transportation costs and provides access for residents who are not able or cannot afford to drive, allowing them to access work, shopping, medical appointments, and social activities.

4 Supports sustainable growth.
Denver is growing at an unprecedented rate. Transit supports growth by moving more people within the same right-of-way footprint—accommodating new residents and employees efficiently.

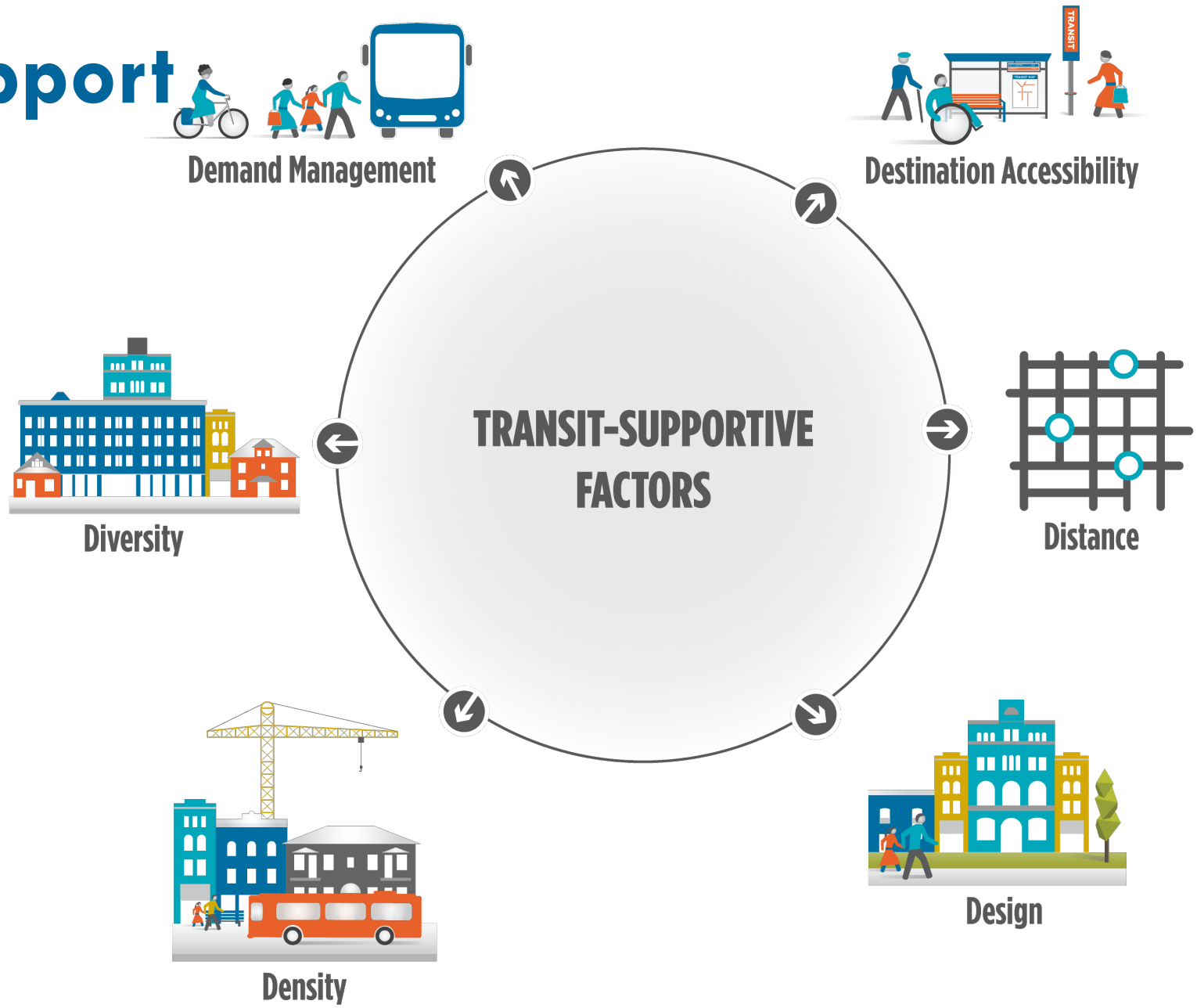
5 Contributes to active, healthy lifestyles.
Transit riders walk an average of 19 minutes per day, nearly reaching the Center for Disease Control's recommendation of 22 minutes a day of moderate aerobic activity.

6 Makes Denver a better place to visit.
Visitors expect quality public transportation to get around a world-class city.

7 Boosts the region's economy.
By 2035, Denver will add more than 190,000 jobs based on DRCOG projections. Transit can help people reach these jobs and expand economic mobility.

More Ways to Support Transit Agencies

- Add GHG calculations to the National Transit Database to measure progress.
- More FTA policies to support risk, innovation, and encourage coordination with non transportation federal programs.
- Mode shift (to any form) matters –create a mobility ecosystem.
- Visionary Board and Transit Leadership



Thank you!

Amy Pettine

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Martha's Vineyard Transit Authority

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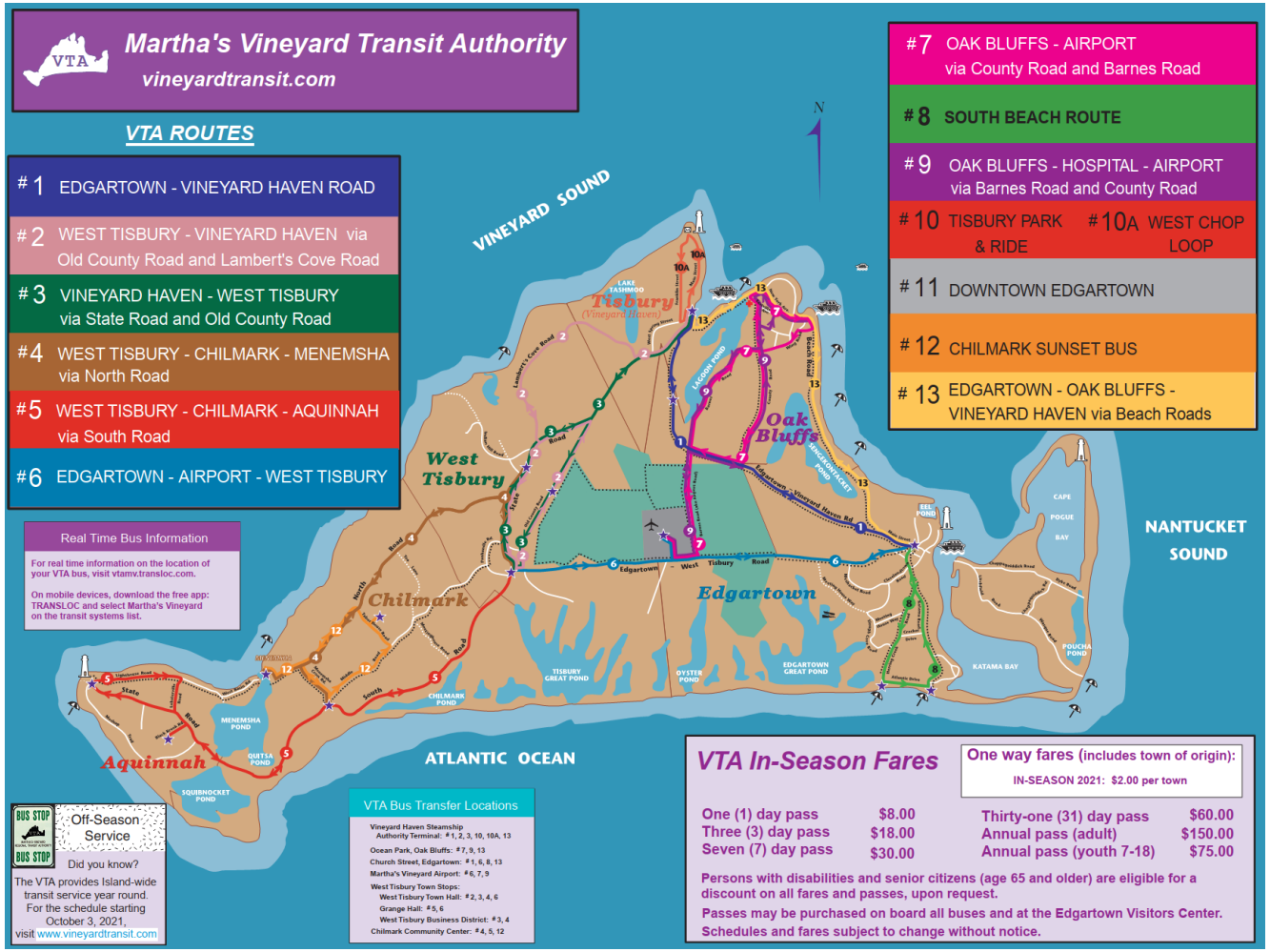
TRANSIT AGENCY PERSPECTIVE ON IMPLEMENTING SUSTAINABLE SOLUTIONS

ANGIE GOMPERT, VTA ADMINISTRATOR

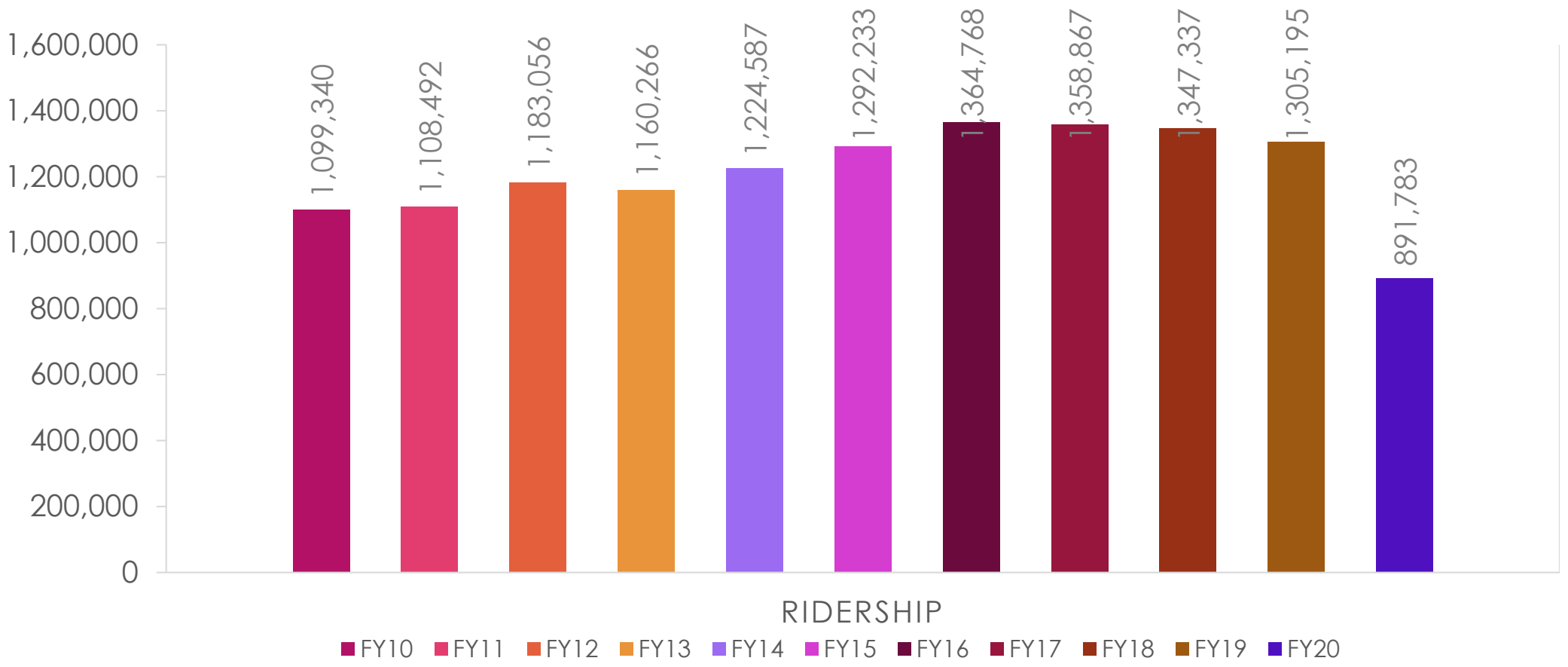
Martha's Vineyard Transit Authority

- Serves all 6 towns on the island
- 12 year-round routes
- More routes and buses in summer
- 1.4 million rides annually
- 1.2 million miles service annually
- 32 buses, including 16 electric

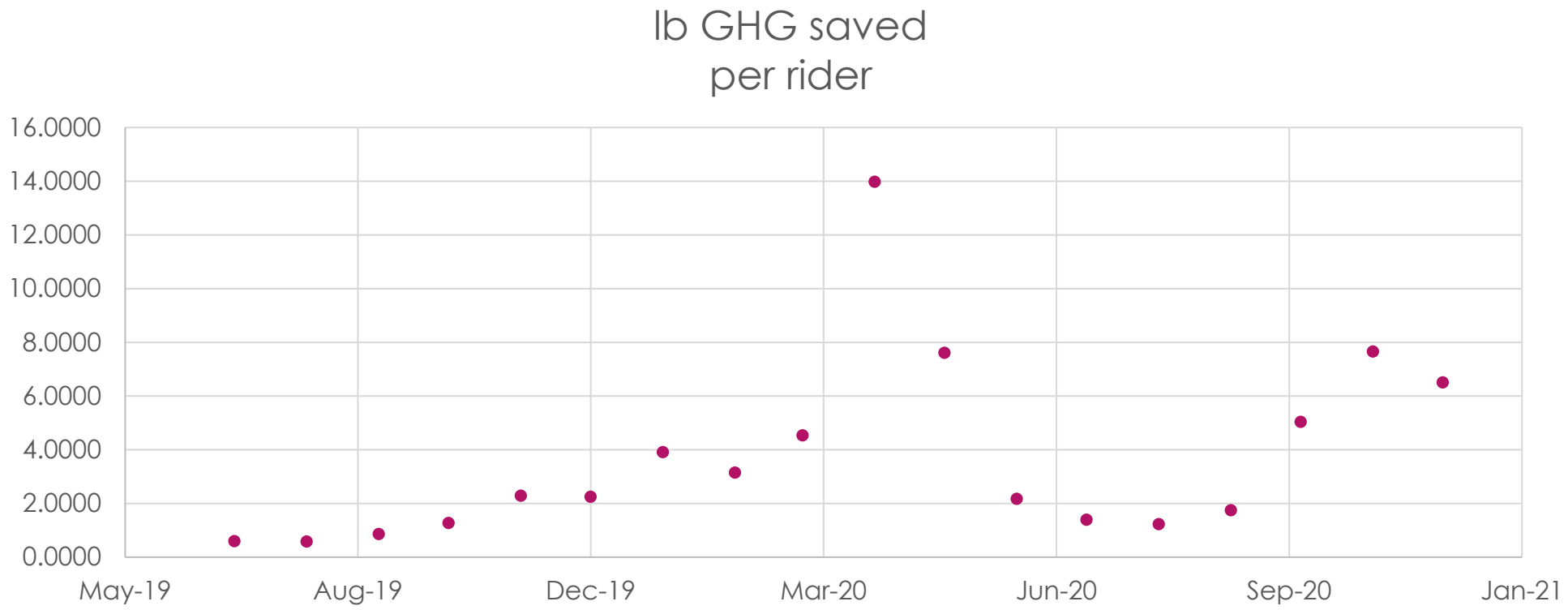



RAM
USA1

Ridership Trend



Greenhouse Gas Savings



Greenhouse Gas Savings

- Median GHG savings per rider – **2.67 Pounds (.0012 mT CO2e)**
- Over **3 Million Pounds (1,360 mT CO2e)** of GHG savings over a traditional diesel system from project to date

A Focus on the Future

- An electric fleet will serve the Island in the future and maintain relevancy
- A state-of-the-art solution that supports fuel, noise, and emissions reduction
- Removes 36,000 tons of carbon dioxide over ten years of driving 1.4 million miles annually
- Microgrid solution provides reliability and opportunity for future vehicle to grid services

VTA's Vision Future of Island Public Transit

- Electric Transit Vehicles
  - Buses, vans and service vehicles
- Charging Infrastructure
  - Plug-in vehicle chargers
  - Inductive charging
- Photovoltaic (PV) Solar
  - Generate energy for system
- Energy Storage Systems
  - Makes grid connection optional
  - Back-up source of power

Progress to Date

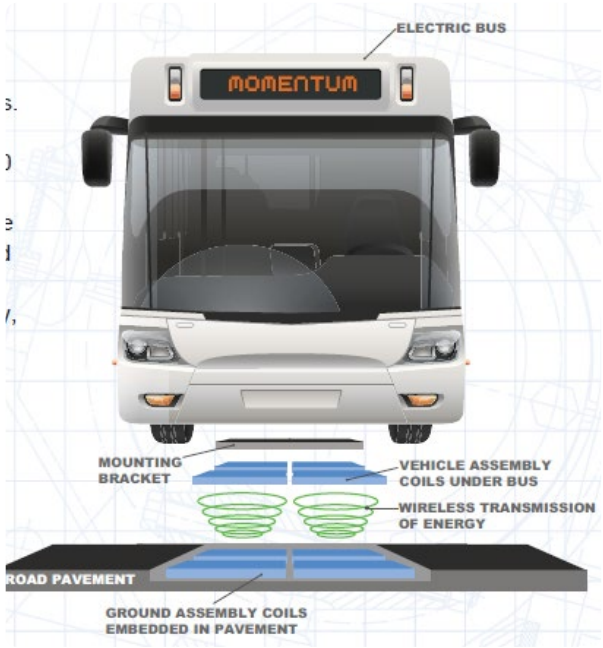
- Operating 16 all electric buses, 50% of fixed route bus fleet
- Updated our operations and maintenance facility's electrical distribution system to make it capable of handling charging for entire fleet
- Procured vendor for inductive charging units
- Secured the first on-route inductive charging site
- Installed eight solar canopies that will generate 700 kW of electricity
- Installed and began operating microgrid

Solar PV

- Provides an onsite renewable generation solution
- PPA with Borrego
- Now owned by VTA and Enel X in public-private partnership
- 16 vehicle charging stations underneath (with room for additional chargers to be added in the future)
- 700 kW system
- Power buses with clean electricity
- Challenge: limited export to 500 kW

In-Route Charging

- Inductive, fully wireless charging stations
- One in place now at base facility; another just approved
- 15 miles of range in 10 min of charging
- Provides robust commuter service without relying on fossil fuels



Energy Storage

- 1 100 kW and 2 280 kW systems
- Capture and store solar energy for use when the sun is not shining
  - Avoids electricity generated from fossil fuels
- Ability to further reduce energy costs through utility load management programs

Control Software

- **Managing load from the buses in real time**
  - All buses charging at once = 2.5 MW; Utility service capacity = 1 MW
  - Needed a smart system to ensure smooth operations
    - Operations come first - buses MUST be charged in time
    - Take advantage of PV generation to use the cleanest electricity even if the sun is not out
- **Managing the entire microgrid**
  - Controlling the system required a software package to make it all work
  - It's not just about solar, it's a coordinated system of energy production, storage, distribution, and management

VIRICITI

PXiSE Energy Solutions

VTA's Impact

- As of March 2021, electric buses have driven over 600,000 miles resulting in 1,600 short tons direct GHG emission savings
- Estimated to save 36,000 tons of carbon dioxide over 10 years
- Creating replicable process and lessons learned for other transit agencies
- Engaged key partners in problem-solving and identifying viable pathways for achieving vision
- Created infrastructure to support further fleet electrification
- Marketable mode of transportation to reduce use of personal vehicles on Island

Technical Learnings

- **Design Considerations:**
  - Bus operations and phasing
  - Pieces needed now, vs full build
- **Battery Procurement:**
  - Understanding battery functionality
  - Availability and timing spare parts delivery
- **Controls Software:**
  - Integration with all components
  - Software Updates
  - Software compatibility with microgrid components

Broad Lessons Learned

- **Strong partnerships are key**, and you need **leadership** to keep the project on task and to ensure the vision is not compromised
- **Thoughtful phasing of the project is essential** to ensure operations continue. In some cases, it would be useful for partners to have an **understanding of all aspects** of the proposed project
- **Financing will require some creativity**. Procurement constraints with federal funding may be a limitation for other transit agencies
- **Fortitude and flexibility** adopting a new fuel type fleet wide is a long process . Expect problems, delays and challenges. Every site is different, utility partners vary, as does the availability of resources.
- You can make a difference now!

Today's Panelists

Moderated by:

Jen McGraw,

Center for Neighborhood Technology

Amy Pettine,
Nelson/Nygaard

Angie Gompert,
Vineyard Transit Authority

NELSON NYGAARD

VTA
MARTHA'S VINEYARD REGIONAL TRANSIT AUTHORITY

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