U.S. DEPARTMENT OF
ENERGY

Office of
ENERGY EFFICIENCY &
RENEWABLE ENERGY

DOE Vehicle Technologies Office Freight Highlights

Austin Brown, Director
Sustainable Freight Futures Workshop
May 29, 2024

Topics

- Overview of DOE's Vehicle Technologies Office (VTO)
- Transportation Decarbonization Blueprint
- Modal Action Plan status and highlights
  - Rail
  - Marine
  - MD/HD
- National Zero Emission Freight Corridor Strategy
- Supertruck Charge

Vehicle Technologies Office

- Applied research, development, demonstration, and deployment
- 100% focused on clean transportation
- Target the “sweet spot” between science experiments (too early) and commercial technology / product development (too late)

Vehicle Technologies Office (VTO)

ON-ROAD
Light-, Medium-, Heavy Duty Vehicles

NON-ROAD

Decarbonization of Off-Road, Rail, Marine, and Aviation

Batteries & E

Material s

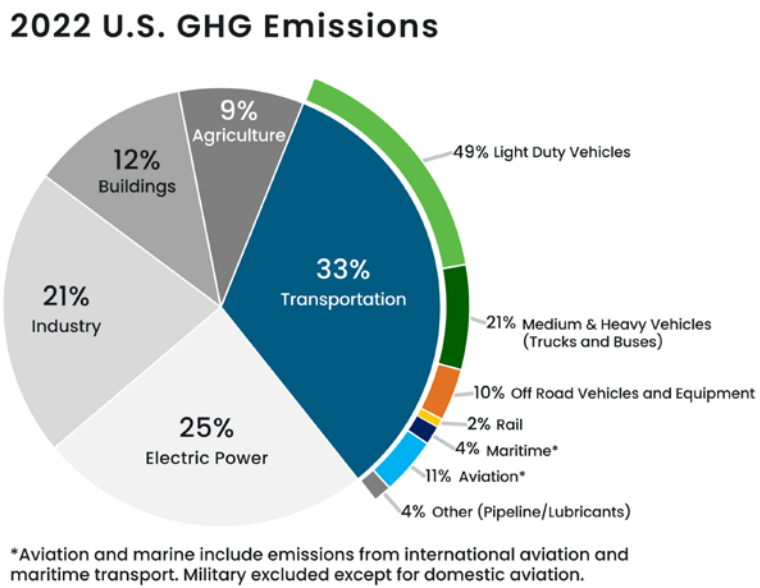
Mobility Systems

Technology Integration and Deployment

Clean Cities

H2@Scale
U.S. Department of Energy

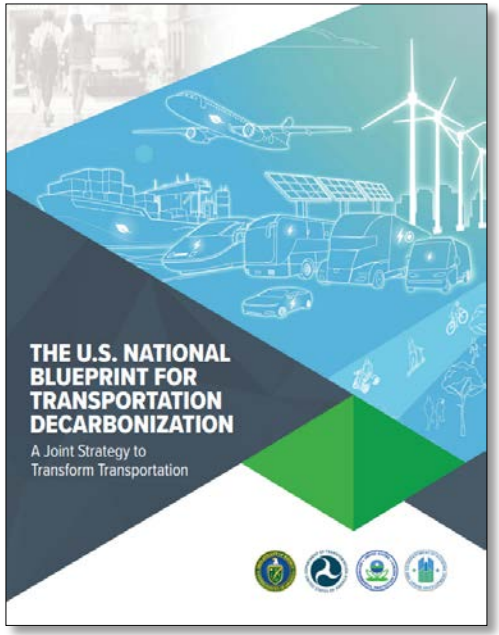
Economy-wide Decarbonization by 2050



Based on 2024 EPA data, dated 05/21/2024

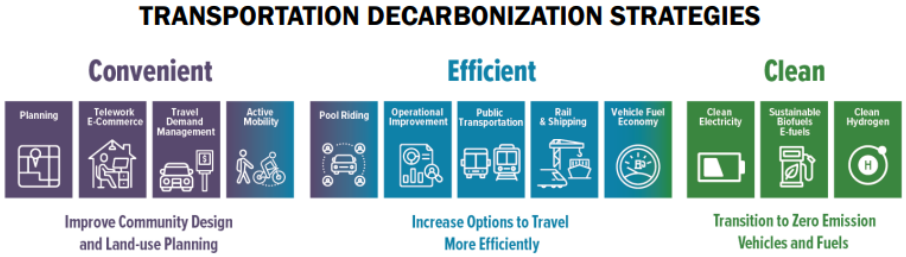
- The Biden administration has set a goal of net-zero carbon emissions economy wide by 2050
- Transportation is the largest source of GHG emissions
  - 50% of **energy expenditures and local pollution issues**
  - Significant implications for global competitiveness, trade, and domestic jobs

National Blueprint for Transportation Decarbonization



Released January 2023

- Covers all transportation modes (light-duty vehicles, medium- and heavy-duty trucks and buses, off-road, rail, marine, aviation, and pipelines) and sets up realistic, achievable pathways based on science.
- Focuses on solutions that can be incrementally deployed, delivering results by 2030.
- Addresses full lifecycle emissions and integration with the electric grid.

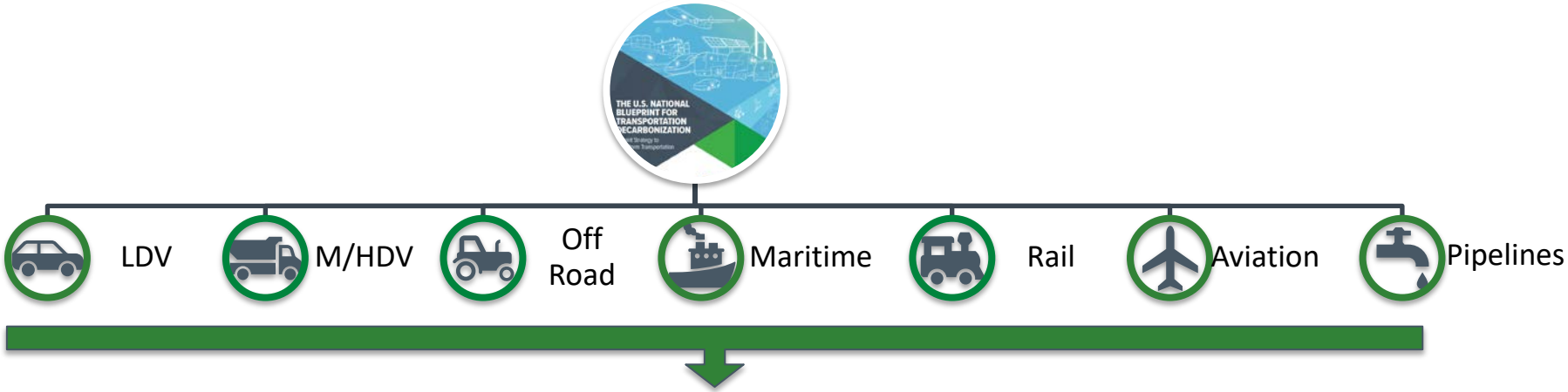


Detailed Action Plans will be developed with stakeholders to achieve the following milestones:

- **Before 2030–Turning the Tide on Transportation GHGs: Research and Investments to Support Deployment**
- **2030-2040–Accelerating Change: Scaling Up Deployment of Clean Solutions**
- **2040-2050–Completing the Transition: A Sustainable and Equitable Future**

SCAN QR CODE
to access the Blueprint

The Modal Sector Action Plans



Builds on the U.S. Decarb Blueprint- Use the US Transportation Decarbonization Blueprint as the foundation.

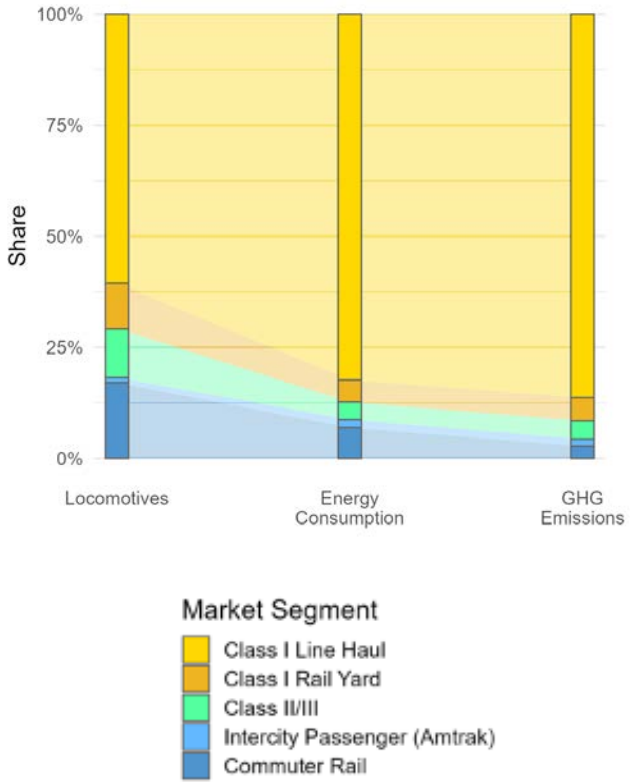
Near and Long-Term Strategies- Identifies key actions that can be taken to overcome barriers to the deployment of net-zero solutions

Notable Milestones, Targets, and Commitments- Describes proposed near and long-term nationwide milestones for the decarbonization in each mode.

Near-term actions- Recommends near-term actions to pursue now to 2030 in support of the strategies, consistent with a pathway to net-zero emissions by 2050.

Metrics and Indicators: Proposes metrics and indicators to track progress in each modal sector.

Rail Decarbonization



1 icon represents limited long-term opportunity
2 icons represents large long-term opportunity
3 icons represents greatest long-term opportunity

	BATTERY/ELECTRIC	HYDROGEN	SUSTAINABLE LIQUID FUELS
Light Duty Vehicles (49%)*		—	TBD
Medium, Short-Haul Heavy Trucks & Buses (~14%)			
Long-Haul Heavy Trucks (~7%)			
Off-road (10%)			
Rail (2%)			
Maritime (3%)		†	
Aviation (11%)			
Pipelines (4%)		TBD	TBD
Additional Opportunities	• Stationary battery use • Grid support (managed EV charging)	• Heavy industries • Grid support • Feedstock for chemicals and fuels	• Decarbonize plastics/chemicals • Bio-products
RD&D Priorities	• National battery strategy • Charging infrastructure • Grid integration • Battery recycling	• Electrolyzer costs • Fuel cell durability and cost • Clean hydrogen infrastructure	• Multiple cost-effective drop-in sustainable fuels • Reduce ethanol carbon intensity • Bioenergy scale-up

* All emissions shares are for 2019

† Includes hydrogen for ammonia and methanol

Rail Action Plan Overview

1. **Define baseline emissions**

2. **Articulate a strategy to chart a path to net-zero emissions in the rail sector by 2050:**

   - Provides transparent assessment of viable zero- and low-carbon emission technologies
   - Identify high-potential corridors and rail yards for near-term zero-emission (ZE) deployment
   - Defines a clear research agenda for the next 3-5 years for long-term ZE deployment
   - Defines supporting policies and programs to accelerate decarbonization

3. **Set feasible but ambitious targets to net-zero emissions by 2050 based on strategy**

4. **Articulate federal actions to support low and zero-emissions locomotive deployment**

5. **Highlight funding and financing opportunities to encourage adoption of low and ZE technologies**

6. **Define indicators to measure progress toward a ZE rail sector**

TRANSPORTATION DECARBONIZATION: DOE/DOT/EPA/HUD Collaboration

Three Goals of the Rail Decarbonization Strategy

- **Reduce GHG Emissions**. Deploy commercially-available low- and ZE technologies that are commercially available in the immediate term while planning for long-term infrastructure needs
  - Target market: line-haul freight
  - Target tech: catenary, low-carbon liquid fuels (near-term), HFC, battery, OCS (long-term)

- **Improve Public Health.** Deploy ZE technologies for the greatest public health benefit.
  - Target market: rail yards and short-haul operations in non-attainment areas and disadvantaged communities
  - Target tech: battery and catenary locomotives (near and long term), HFC (long term)

- **Mode Shift. Expand affordable access to rail to provide passengers and shippers more energy efficient options.**
  - Target market: short-line railroads, intercity passenger rail

Key Findings - Technologies

- Overhead Catenary Electrification
  - Highest TRL, only commercially-deployable zero-emission option available today
  - Most energy-efficient pathway
  - Reduced interoperability, and high capital and maintenance costs
  - Industry need for reliable access to high electricity demand
- Discontinuous /Intermittent Catenary with Battery Electric Locomotive
  - Reduces upfront infrastructure requirements
  - Addresses catenary clearance issues
  - Extends battery electric range

Key Findings - Technologies

- Battery Electric Technology
  - Current energy density not sufficient for line haul applications but could be readily deployed in rail yards
  - Evolution of battery technology and off-grid electricity generation could accelerate this technology
- Hydrogen Fuel Cell
  - Technically not ready for widespread deployment in line-haul rail operations but can likely meet the needs of lower-energy rail needs
  - Need to address hydrogen supply and distribution infrastructure as well as safety and maintenance

Key Findings - Technologies

- Hydrogen Combustion Engine
  - Could provide opportunity to push clean hydrogen production, storage, and distribution infrastructure to support to hydrogen fuel cell locomotives
  - Can potentially deliver significant GHG and some criteria emissions reduction
- Low GHG Liquid Fuel Engine
  - May include biodiesel, renewable diesel, methanol, ethanol, and others
  - Can potentially reduce GHG and some criteria emissions, depending on feedstock, production pathways, fuel blends, and aftertreatment
- Autonomous, Electric Rail Cars
  - High potential to facilitate modal shift from trucks to train
  - Has potential to increase rail capacity and reduce emissions

Core Actions by 2030

- Low and ZE deployment
- Safety & standards for low and ZE technologies
- Research, data, & analysis
- Workforce development
- Stakeholder engagement
- Policies for accelerating low and ZE technologies

Maritime Vessels

Maritime Vessel Goals

- Continue to support the Zero-Emission Shipping Mission (ZESM) goals to ensure that 5% of the global deep-sea fleet is capable of using zero-emission fuels by 2030. Including:
  - Deploying at least 200 zero-emission fueled shipping vessels; and
  - Ensuring that 10 large trade ports covering at least three continents can supply zero-emission fuels by 2030
- Work with countries through the International Maritime Organization to adopt a goal to achieve zero emissions from international shipping by 2050

Key Actions

- **Fund research and innovation** on viable fuels and technologies for decarbonizing the maritime sector.
- **International and domestic stakeholder engagement** to develop and implement effective decarbonization strategies and regulations.
- **Infrastructure investments and improved design and planning** in clean technologies and fuels for maritime applications.

Medium and Heavy-Duty Vehicles

Medium and Heavy-Duty Vehicle (MDHV) Goals

- Aim to have 30% of new MHDV vehicle sales be zero-emission by 2030 and 100% by 2040
- Ensure 100% federal fleet procurement is zero-emission by 2035

Key Actions

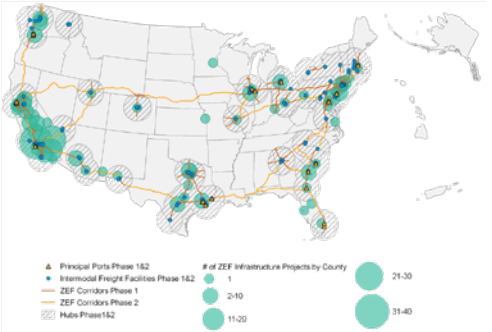
- **Fund research and innovation** to develop viable technologies to replace fossil-fuel vehicles for ALL MHDV applications.
- **Implement policy and regulation** to reduce new vehicle GHG and criteria emissions and set ambitious targets.
- **Invest in strategic demonstration and deployment** to support the build-out of interoperable electric vehicle charging and refueling infrastructure.

White House Roundtable on Zero-Emission Freight Infrastructure

Held on National Transport Day during Earth Week, April 24, 2024

Roundtable Highlights:

- **White House Fact Sheet –** Focused on a National Zero-Emission Freight Strategy across modes, funding announcements & awards, and Roundtable partnership.
- **Roundtable Stakeholder Partnership** – 100 participants representing fleets, truck OEMs, utilities, infrastructure providers (charging/H2), and environmental organizations.
- **Progress Against Phase 1** - Over 10 day-of public announcements made and 171 infrastructure deployments presented showcasing real progress against Phase 1 of the National ZEF Corridor Strategy.
- **Advancing Strategy Implementation –** Input from 5 breakout sessions informed next steps for cross-sector collaboration, tracking progress, and informing ongoing Strategy updates and improvements.



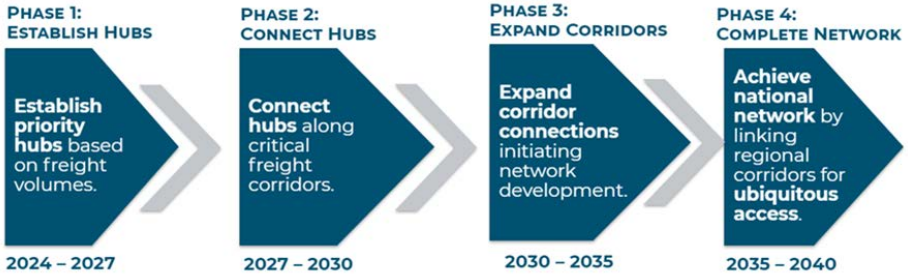
ZEF Corridor Strategy Phase	Total Investment
Phase 1 (2024-2027)	$ 914,509,365
Phase 2 (2027-2030)	$ 573,125,696
Project Schedule Undetermined	$ 52,277,680
Total	**$ 1,539,912,741**

National Zero-Emission Freight Corridor Strategy

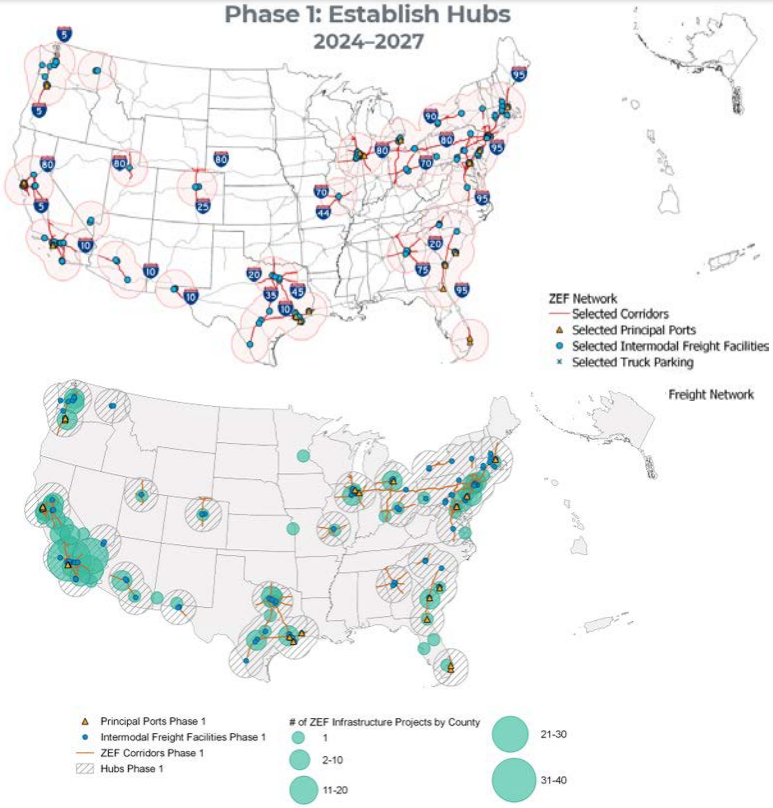
Released on March 12, 2024

The **'Whole of Government' Strategy** seeks to –

- **Prioritize investment, planning, and deployment** of zero-emission medium- and heavy-duty vehicle (ZE-MHDV) infrastructure in key freight hubs and along freight corridors.
- **Sequence market driven actions** in favorable launch areas where ZE-MHDVs are more cost effective; targets the highest truck volumes, air quality and community impact; and promotes a fully integrated energy ecosystem (electricity & hydrogen).
- **Facilitate cross-sector collaboration** to catalyze investments, mobilize market activity, coordinate utility & energy planning, track progress and anticipate industry needs.

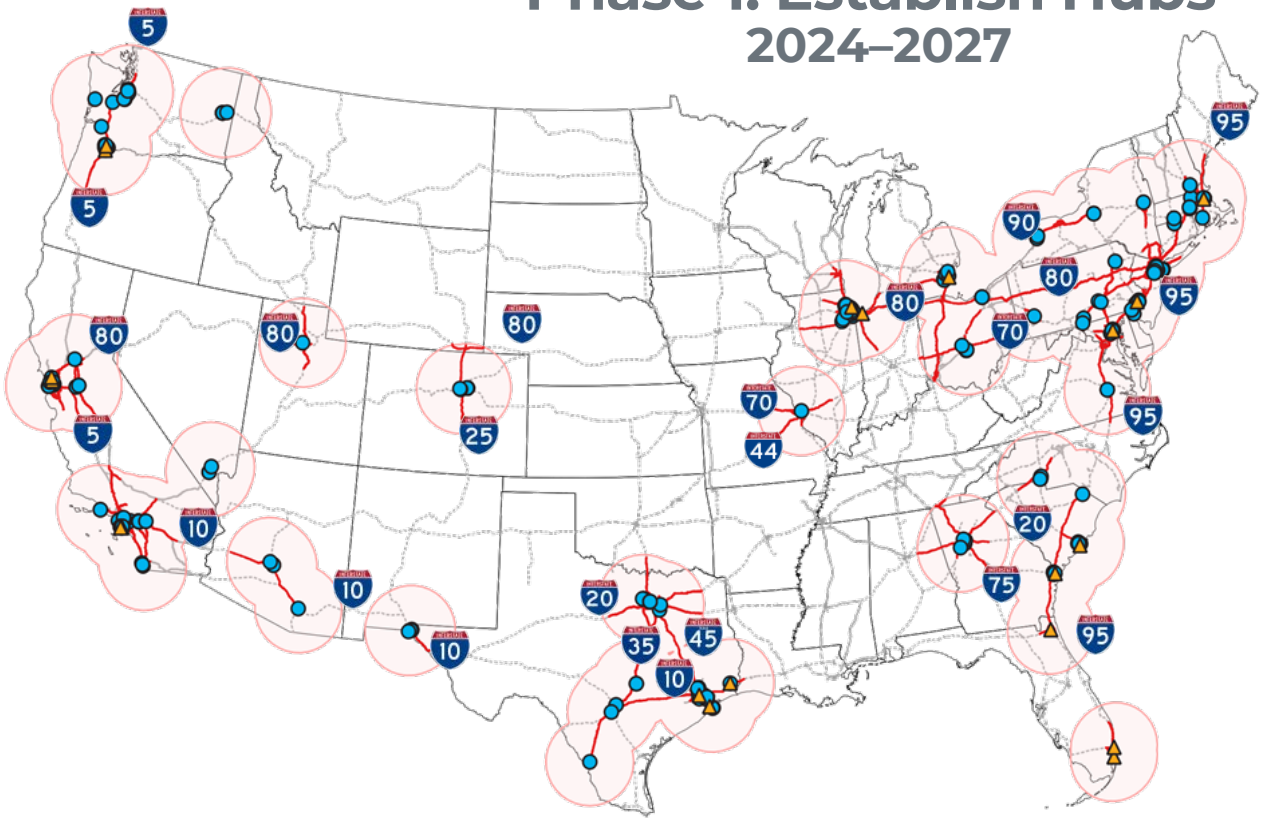


A four-phased strategy starting in 2024 leading to a complete zero-emission freight network by 2040.



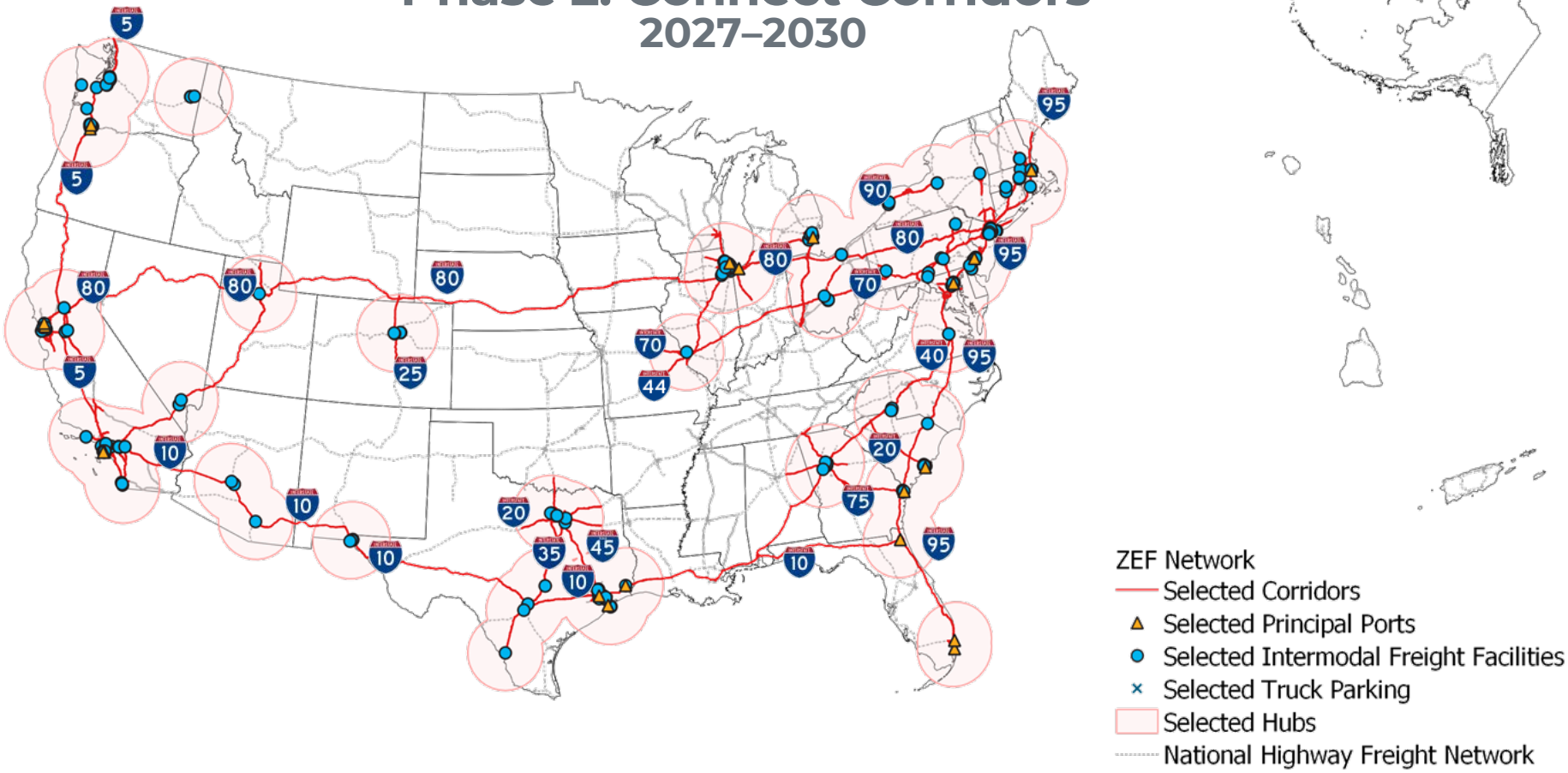
Current progress against Phase 1 [2024 – 2027] representing over 170 ZE-MHDV infrastructure deployments.

Phase 1: Establish Hubs
2024–2027

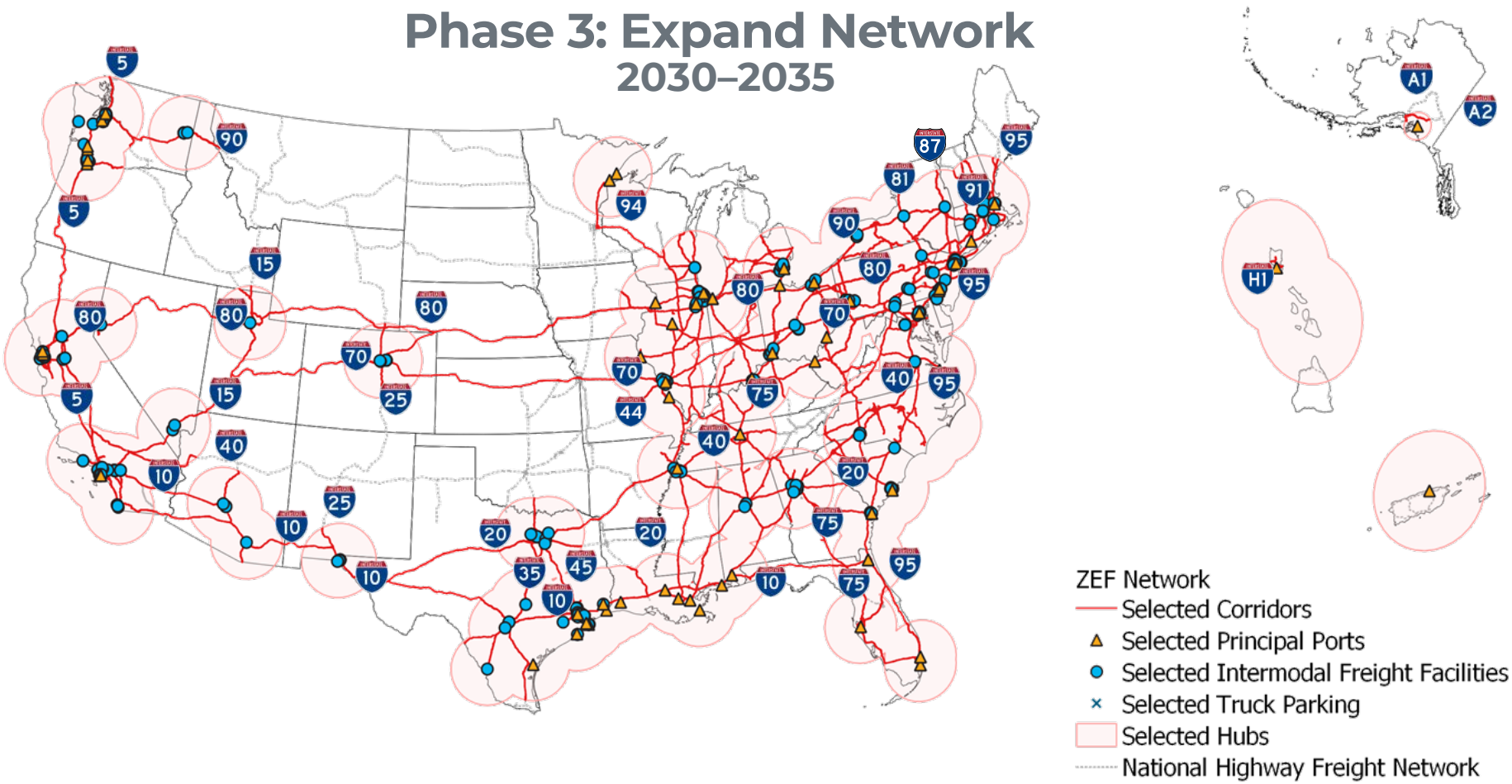


ZEF Network
- Selected Corridors
- Selected Principal Ports
- Selected Intermodal Freight Facilities
- Selected Truck Parking
- Selected Hubs
- National Highway Freight Network

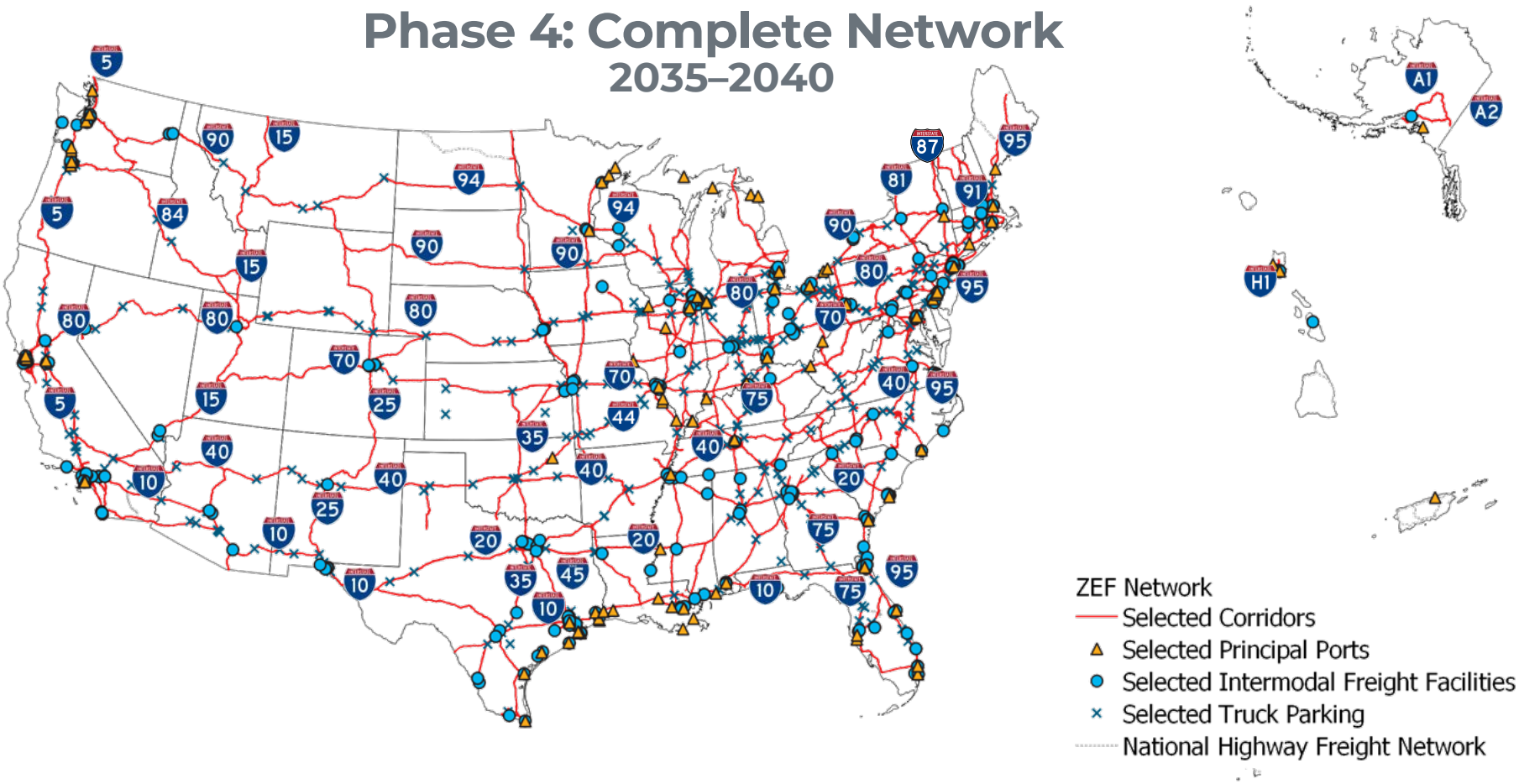
Phase 2: Connect Corridors
2027–2030



Phase 3: Expand Network
2030–2035



Phase 4: Complete Network
2035–2040



SuperTruck II and III

SuperTruck II (2016-2023)

Objective: Demonstrate 55% engine brake thermal efficiency (BTE), and greater than 100% improvement in freight efficiency (ton-mpg)

- All SuperTruck II teams are demonstrating more than 100% vehicle freight efficiency improvements from baseline truck, including engine efficiency, electrified accessories, aero, tires, and light-weighting

Cummins DAIMLER NAVISTAR PACCAR VOLVO

SuperTruck III (2022-2027)

Objective: Demonstrate 75% reduction in greenhouse gas and air pollution emissions as well as reducing the total cost of ownership when compared to a 2020/2021 model year truck

- Paccar and Volvo will develop Class 7/8 battery-electric tractor trucks.
- Daimler will develop Class 8 fuel cell tractor truck .
- Ford and GM will develop medium duty fuel-cell trucks.

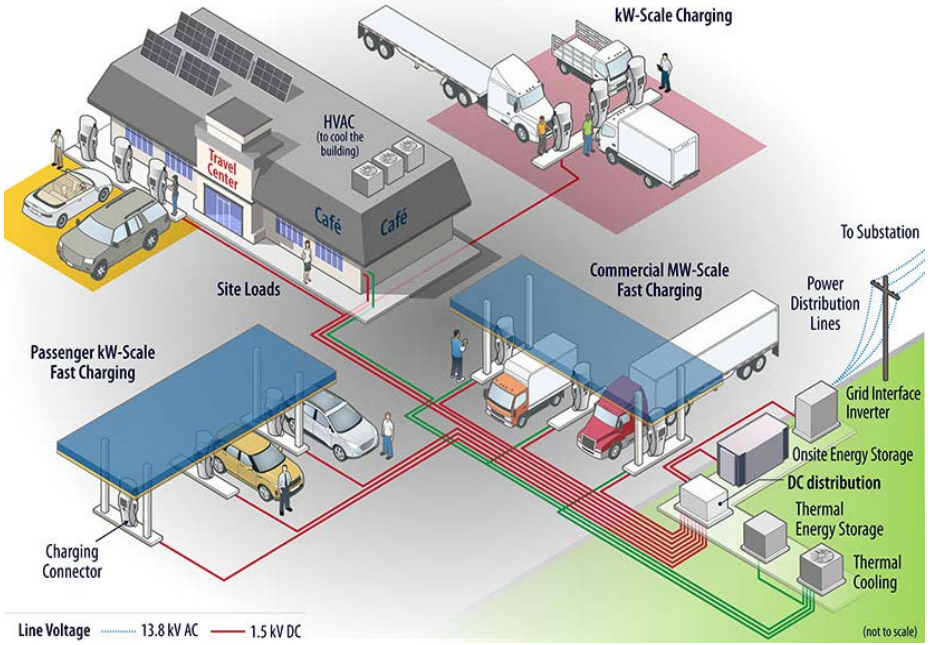
DAIMLER Ford gm PACCAR VOLVO

FY24 Appropriations Language: "Within available funds, the Committee recommends up to $35,000,000 with a 50 percent industry cost-share to continue the SuperTruck III program and further address the energy efficiency, CO_2 reduction potential, and freight efficiency of heavy and medium duty long and regional haul vehicles, including Class-8 long haul trucks and associated charging infrastructure."

SuperTruck Charge

- Demonstration program that can develop approaches to load management and delivering grid-services through optimal design and operation of electric depots and truck stops
- This will help grow truck charging infrastructure near hubs and along corridors
- Provide publicly available learning and data
- Create replicable technology/operation models will speed the uptake of Battery Electric Trucks and provide flexibility for the future grid
- Subtopic 1: Truck Hubs/Depots
- Subtopic 2: Truck Stop/Travel Center

Concentrated along corridors, interstates in non-metropolitan areas, dealing with associated constraints on the grid.



Source: Medium- and Heavy-Duty Electric Vehicle Charging | Transportation and Mobility Research | NREL

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Thank you!

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