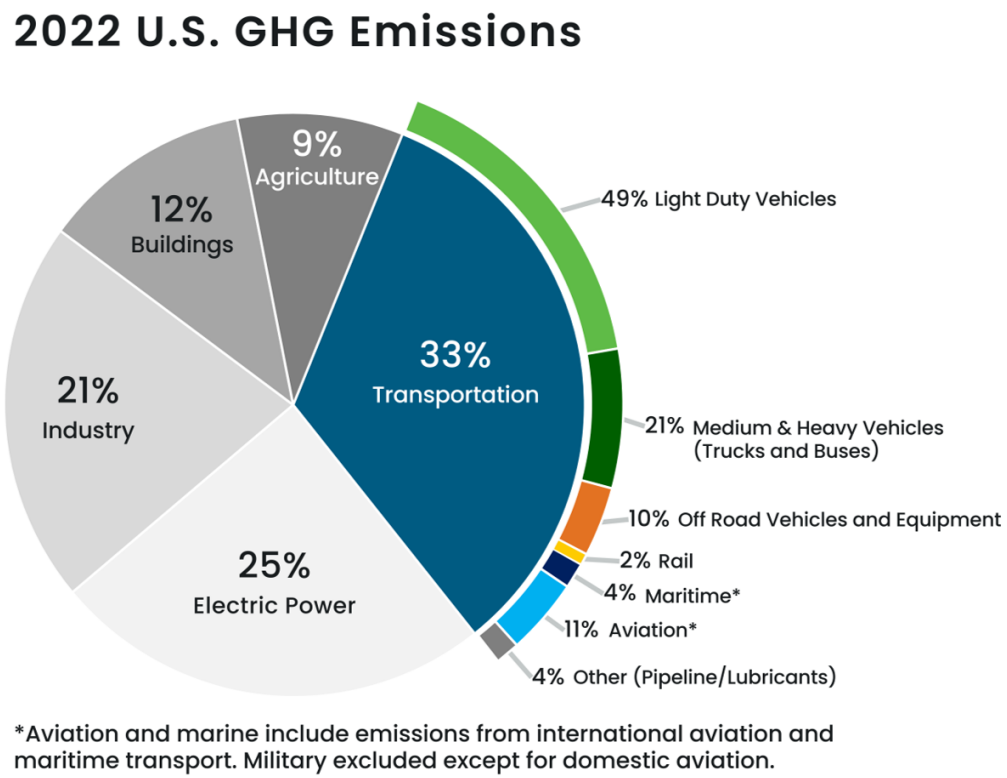
U.S. Department of ENERGY | Office of Energy Efficiency & Renewable Energy

DOE VEHICLE TECHNOLOGIES OFFICE OVERVIEW

AUSTIN BROWN
Director, Vehicle Technologies Office

ECONOMY-WIDE DECARBONIZATION BY 2050



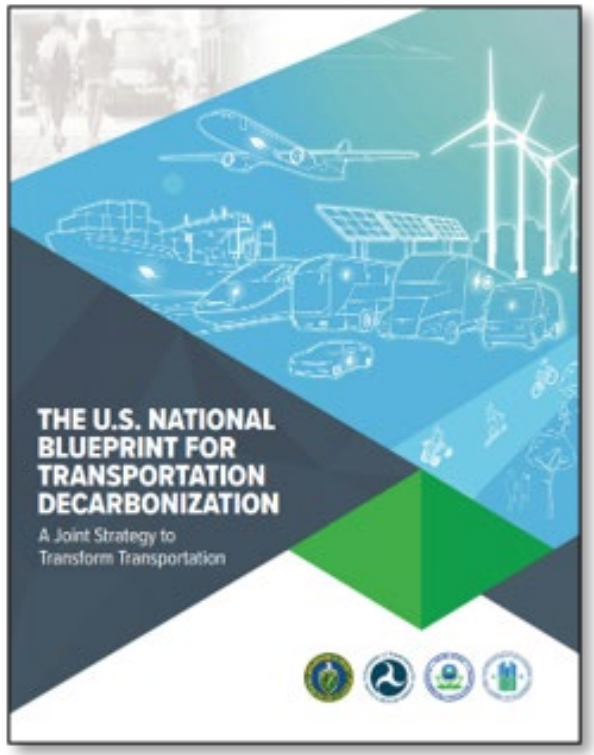
*Aviation and marine include emissions from international aviation and maritime transport. Military excluded except for domestic aviation.

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

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

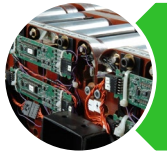

Batteries


Electrification


Materials Technology


Mobility Systems


Electrification


Hydrogen/Fuel Cells


Advanced Power Trains


Net-Zero Carbon Fuels

Off-Road, Air, Marine, Rail

In coordination with HFTO and BETO

Technology Integration

Analysis

Vehicle Technologies Office (VTO)

We fund research, development, demonstration, and deployment (RDD&D) of new, efficient, and clean mobility options that are affordable for all Americans. Our goal is realizing the U.S. National Blueprint for Transportation Decarbonization, which is a landmark strategy for cutting all transportation sector greenhouse gas (GHG) emissions by 2050.

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VTO manages RDD&D within seven complementary mobility technology areas

Batteries R&D: Improving electric vehicle core battery technology performance, environmental safety, and affordability to enable large market penetration and a secure supply chain.

Electrification R&D: Facilitating an electric vehicle charging infrastructure harmonized with a modern grid and demonstrating advanced electric vehicles and components.

Energy Efficient Mobility Systems: Creating a convenient and efficient transportation system by conducting RDD&D at the traveler, vehicle, freight, and system levels.

Decarbonization of Off-Road, Rail, Marine, and Aviation: Prioritizing R&D to reduce greenhouse gas emissions for the off-road, rail, marine and aviation sectors through hybridization, battery-electric, fuel cell, and renewable fuel applications.

Materials Technology: Accelerating advanced materials and processing technologies to improve vehicle efficiency and reduce embodied greenhouse gas emissions.

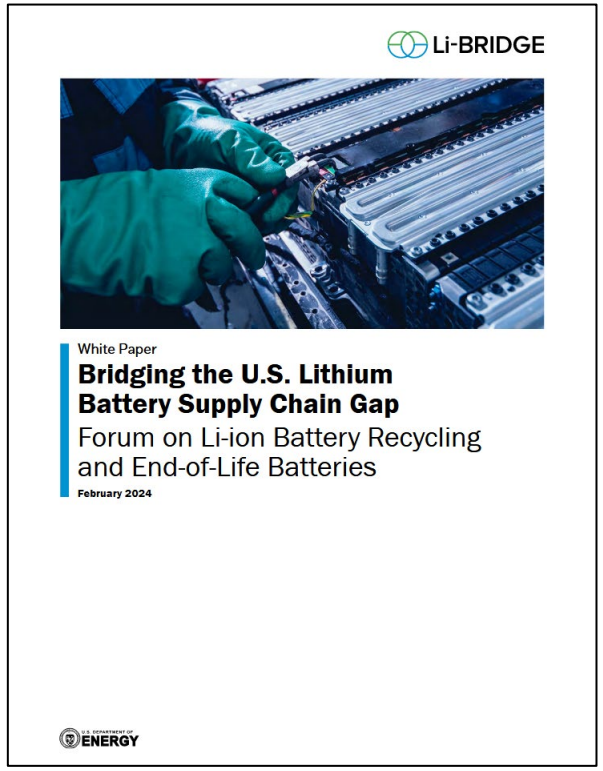
Technology Integration: Partnering with communities and companies to advance clean transportation fuels and energy-saving technologies with objective data and real-world lessons learned.

Data, Modeling, and Analysis: Employing data-driven, advanced transportation technology analysis to inform research investments and create insights about energy use, decarbonization, cost, and impact.

For more information, visit: www.energy.gov/eere/vehicles

KEY PARTNERSHIPS

Li-Bridge

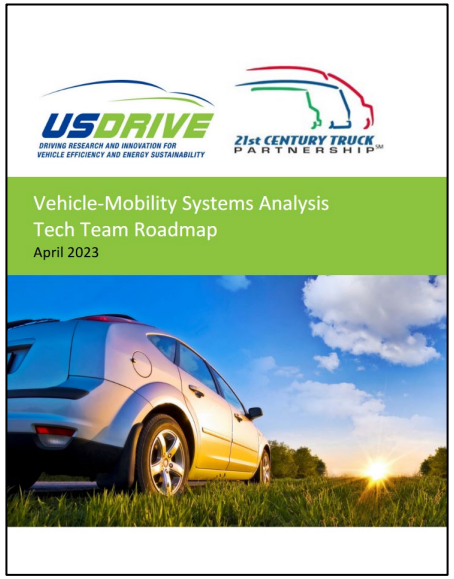


Forum for industry and government to debate and brainstorm solutions for achieving expanded domestic recycling capabilities.

Published report advising federal and state policymakers about the challenges of lithium-based recycling and ways to address the challenges.

21st Century Truck Partnership and U.S. DRIVE

Published four technical sector team roadmaps (electrification, safety, freight operational efficiency, and ICE) and the VMSATT roadmap



FUNDING ANNOUNCEMENTS

Released 6/3/2024:
Notice of Intent for FY 2024 Batteries & Electrification Funding Opportunity

Released 4/24/24: Notice of Intent:
SuperTruck Charge funding opportunity

Released 4/4/24:
Fiscal Year 2024 R&D funding opportunity—$49.8 million – Concept Papers due 6/24/2024

Released 2/12/24:
Fiscal Year 2024 Technology Integration funding opportunity-- $15 Million

Visit https://eere-exchange.energy.gov/ for more information on FOAs.

FUNDING SELECTIONS

Announced 1/8/2024:

16 project for $32.5 Million – Fiscal Year 2023 Technology Integration Funding Opportunity

Announced 1/18/2024:

- **27 projects for $71 Million – Fiscal Year 2023 R&D Funding Opportunity**
- **$60 million for an Advanced Battery R&D Consortium (USCAR)**

NEXT STEPS: WHAT TO EXPECT IN 2024+

Expanded work on **battery supply chain, vehicle-grid integration, and trucks.**

Continued **stakeholder and industry engagement** on strategy development.

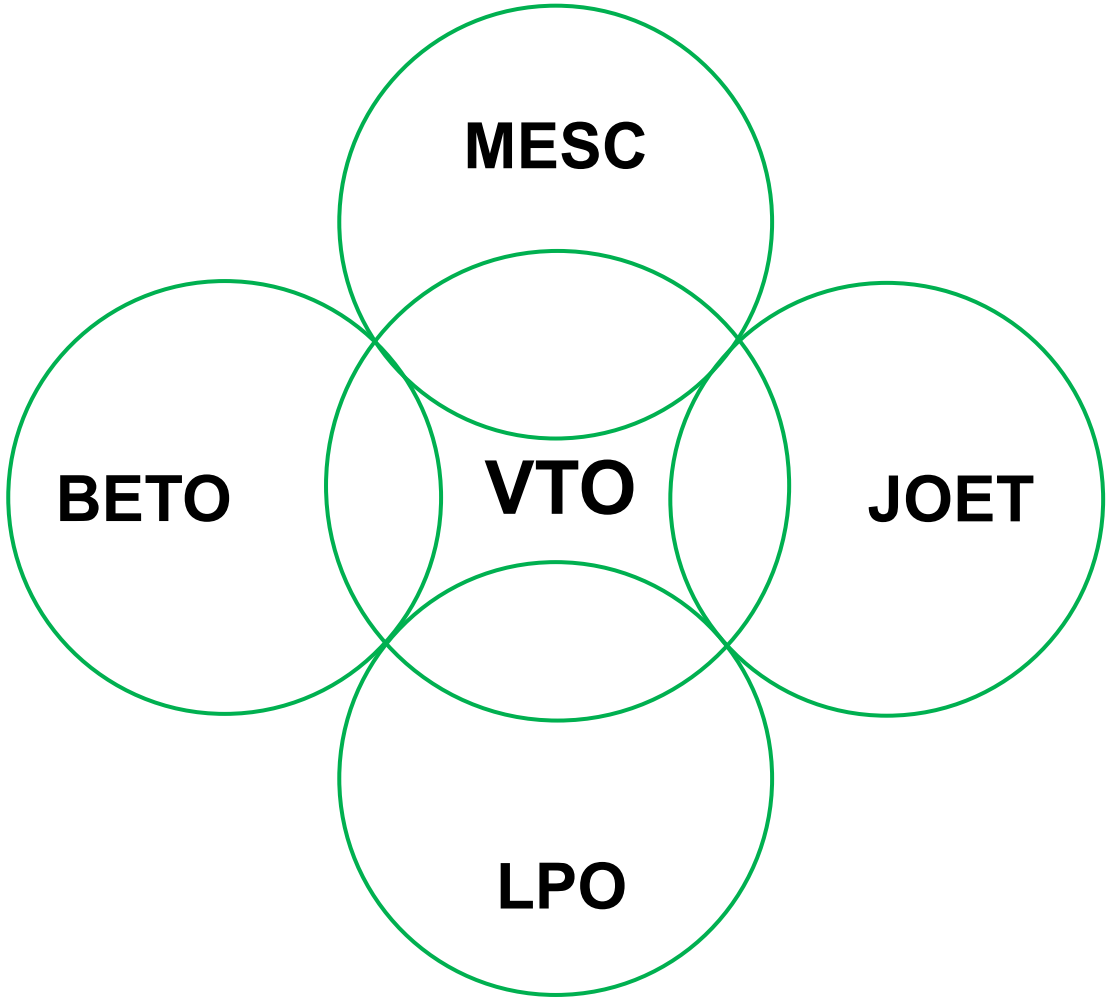
Release of **mode-specific decarbonization action plans.**

Continued **infrastructure buildout** including EV chargers through the National Electric Vehicle Infrastructure (NEVI) and the Charging and Fueling Infrastructure (CFI) programs.

Strengthened **interagency collaboration and coordination** on policy, strategy, funding, and program implementation. Specifically, on;

- Port decarbonization
- Rail
- Zero-emission freight corridors.

COORDINATION WITH OTHER OFFICES



COORDINATION WITH OTHER OFFICES

3/28/2024:

Coordination with MESC: 17 projects $62 million for Bipartisan Infrastructure Law Consumer Electronics Battery Recycling, Reprocessing, and Battery Collection Funding Opportunity

4/25/2024:

Coordination with BETO: $17.5 million funding opportunity WASTE: Waste Analysis and Strategies for Transportation End-Uses funding opportunity announcement

MESC
OFFICE OF MANUFACTURING AND ENERGY SUPPLY CHAINS

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Bioenergy Technologies Office

BATTERIES, VGI, AND TRUCKS

DOE VTO BATTERY R&D ROADMAP

Improved Li-ion
Graphite/NMC

Projected Cell Specific Energy, Cost
300 Wh/kg, $100/kWh

Current cycle life	> 1,000
Calendar life	> 10 years
Mature Manufacturing	Yes
Fast charge	Reduced cycle life
Cost positive recycling	No

R&D Needs
- Improved fast charge
- Low temperature performance
- Low/no cobalt cathodes
- Cost positive recycling

Next-Gen Li-ion
Silicon (-composite)/NMC

Projected Cell Specific Energy, Cost
400 Wh/kg, ~$75/kWh

Current cycle life	> 1,000, for ~320 Wh/kg
Calendar life	~3-5 years
Mature Manufacturing	No
Fast charge	Yes
Cost positive recycling	No

R&D Needs
- Improved calendar life
- Abuse tolerance improvement
- Low/no cobalt cathodes
- Cost effective and scalable pre-lithiation

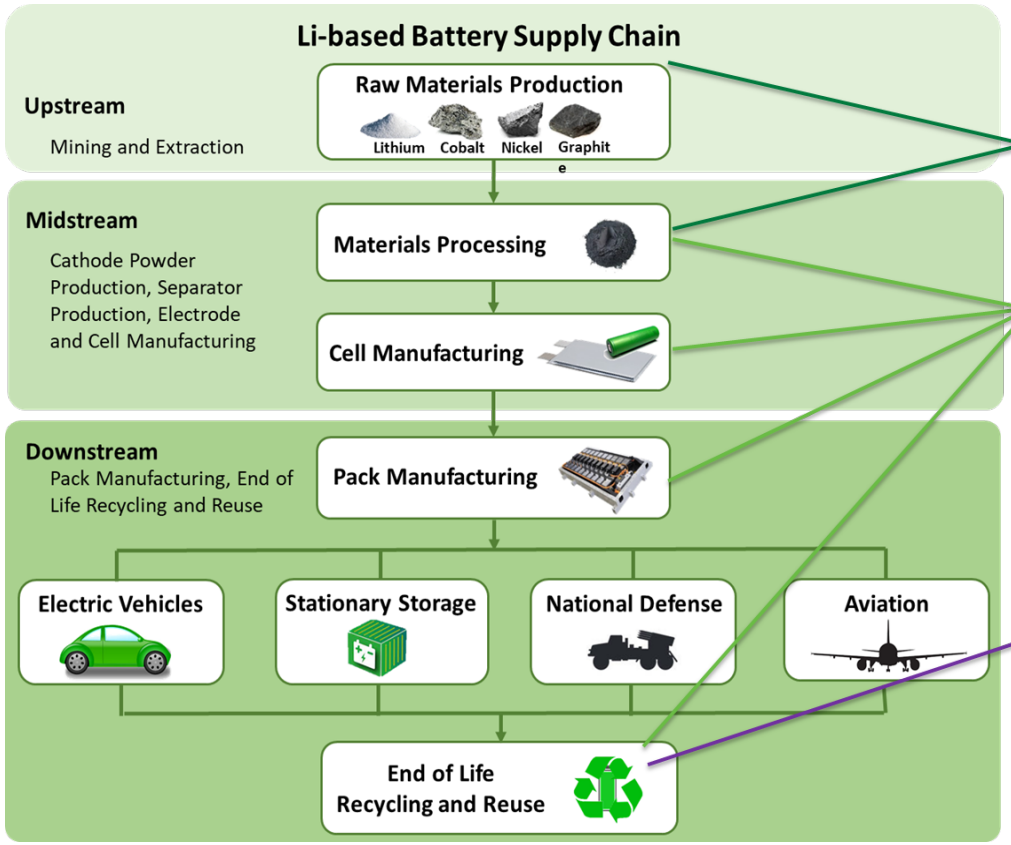
Lithium Metal
Li metal/NMC or Sulfur

Projected Cell Specific Energy, Cost
500 Wh/kg, ~$50/kWh

Current cycle life	> 400
Calendar life	TBD
Mature Manufacturing	No
Fast charge	Maybe
Cost positive recycling	No

R&D Needs
- Improved cycle and calendar life
- Protected lithium
- Dendrite detection and mitigation
- Cost effective manufacturing

BATTERY MATERIALS AND RECYCLING



Sec. 40207(b) Battery Material Processing Grants ($3 Billion Total over 5 years)

Sec. 40207(c) Battery Manufacturing and Recycling Grants ($3 Billion Total over 5 years)

Sec. 40207(e) Lithium-Ion Battery Recycling Prize Competition ($10 Million total)

Sec. 40207(f) Battery and Critical Mineral Recycling: Battery Recycling Research, Development, and Demonstration Grants ($125 Million total)

Sec. 40208 Electric Drive Vehicle Battery Recycling and Second-Life Applications Program ($200 Million Total over 5 years)

MESC-20 (BIL)	DOE-LPO (Loan)
Battery Manufacturing & Processing Section 40207(b)(c) $6 billion	**Advanced Vehicle Technology Manufacturing Loans** And **Loan Guarantees**
Battery Recycling (Sections 40207 and 40208) $334 million	

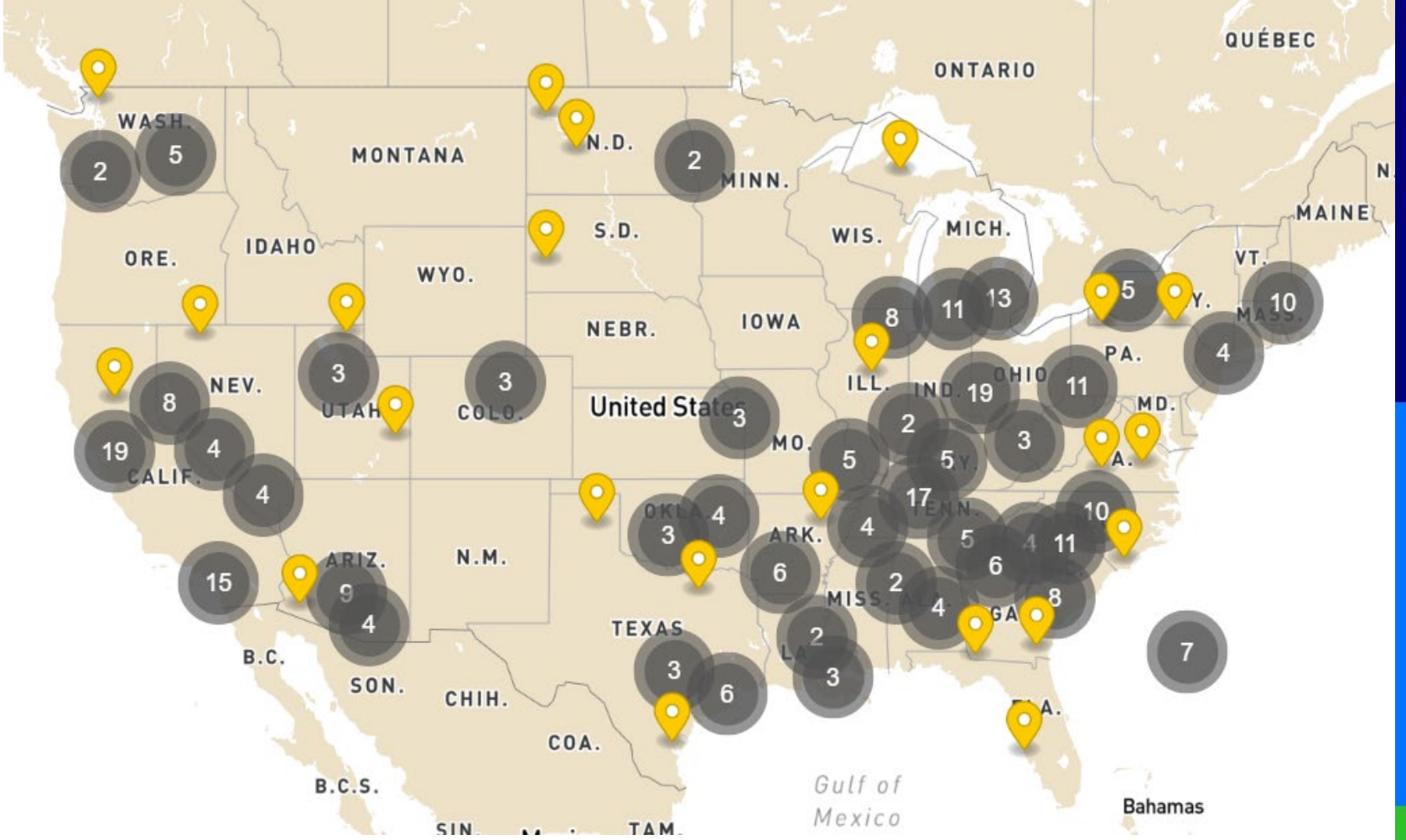
BATTERY INVESTMENT

Over $130 billion announced so far

Over 300 new or expanded minerals, materials processing, and manufacturing facilities

Announced battery cell factories could supply **10 million** new electric vehicles each year

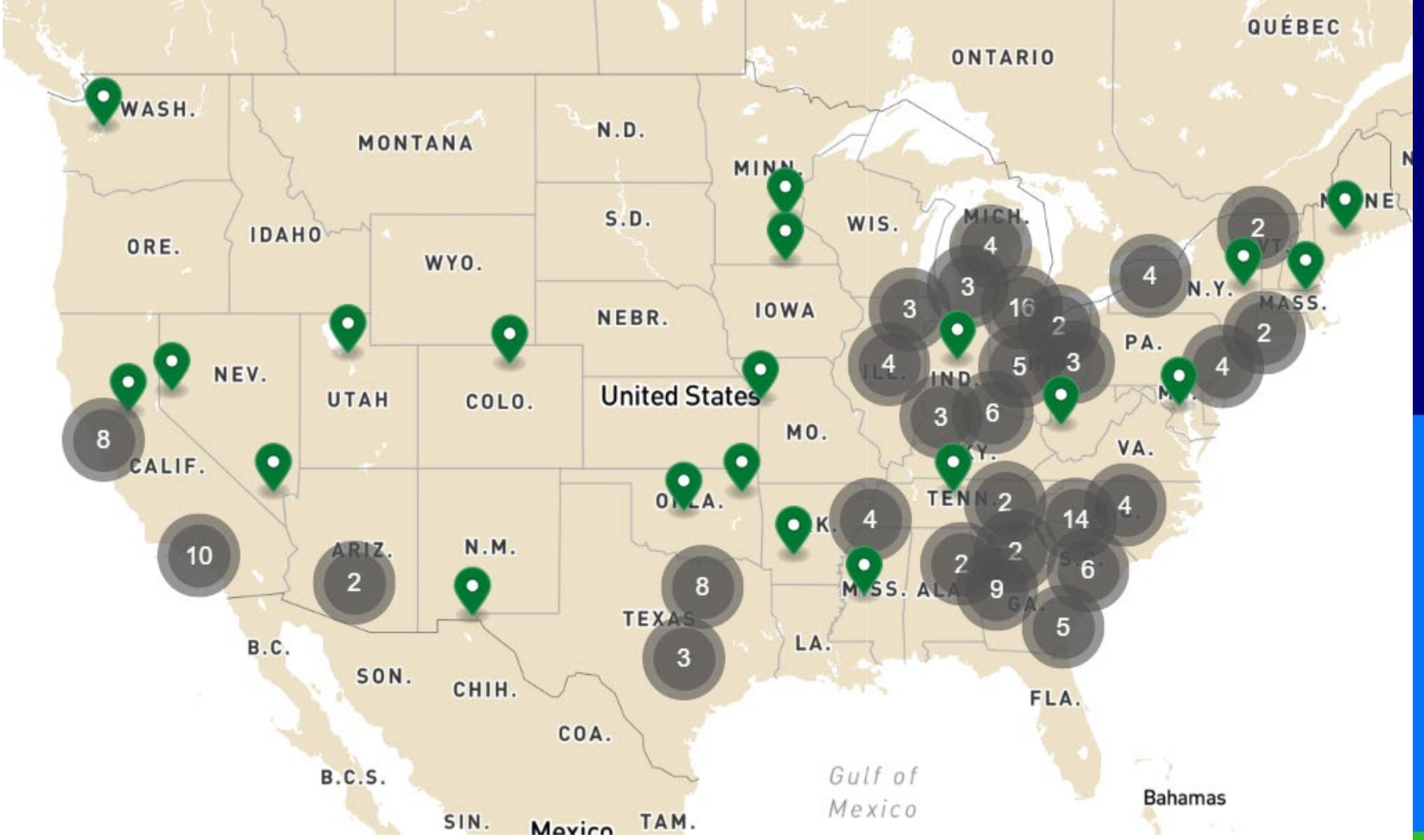
Over 90,000 potential new jobs



Data current as of October 25, 2024.
energy.gov/invest

EV ASSEMBLY, COMPONENTS, AND CHARGERS

- **Over $40 billion** in investment announced so far
- **Over 170** new or expanded sites for EV assembly and EV component or charger manufacturing
- Companies have announced U.S.-made planned production of **over 1,000,000** charging stations each year, including **60,000** fast chargers
- **Over 60,000** potential new jobs

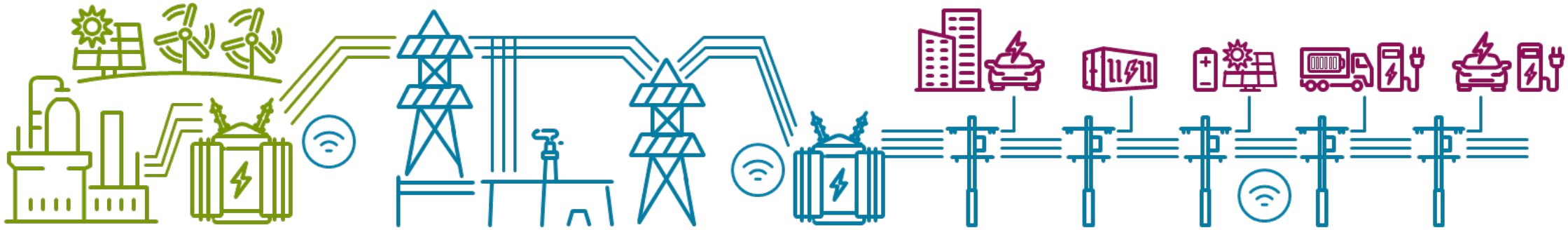


Data current as of October 25, 2024.
energy.gov/invest

WHAT IS VGI?

VEHICLE GRID INTEGRATION FOR ELECTRIC MOBILITY: INTERACTIONS AND ENABLERS

Decarbonized | Reliable | Resilient | Cost-effective



ENABLED BY

- Clean Energy Resources
- Reliable Charging
- Sufficient Capacity
- Driver Behavior
- Communications & Controls
- Technical Standards
- Cyber Security
- Retail Rates
- Grid Services Markets
- Actionable Data
- Policy and Regulation
- Transparency & Oversight
- Investment

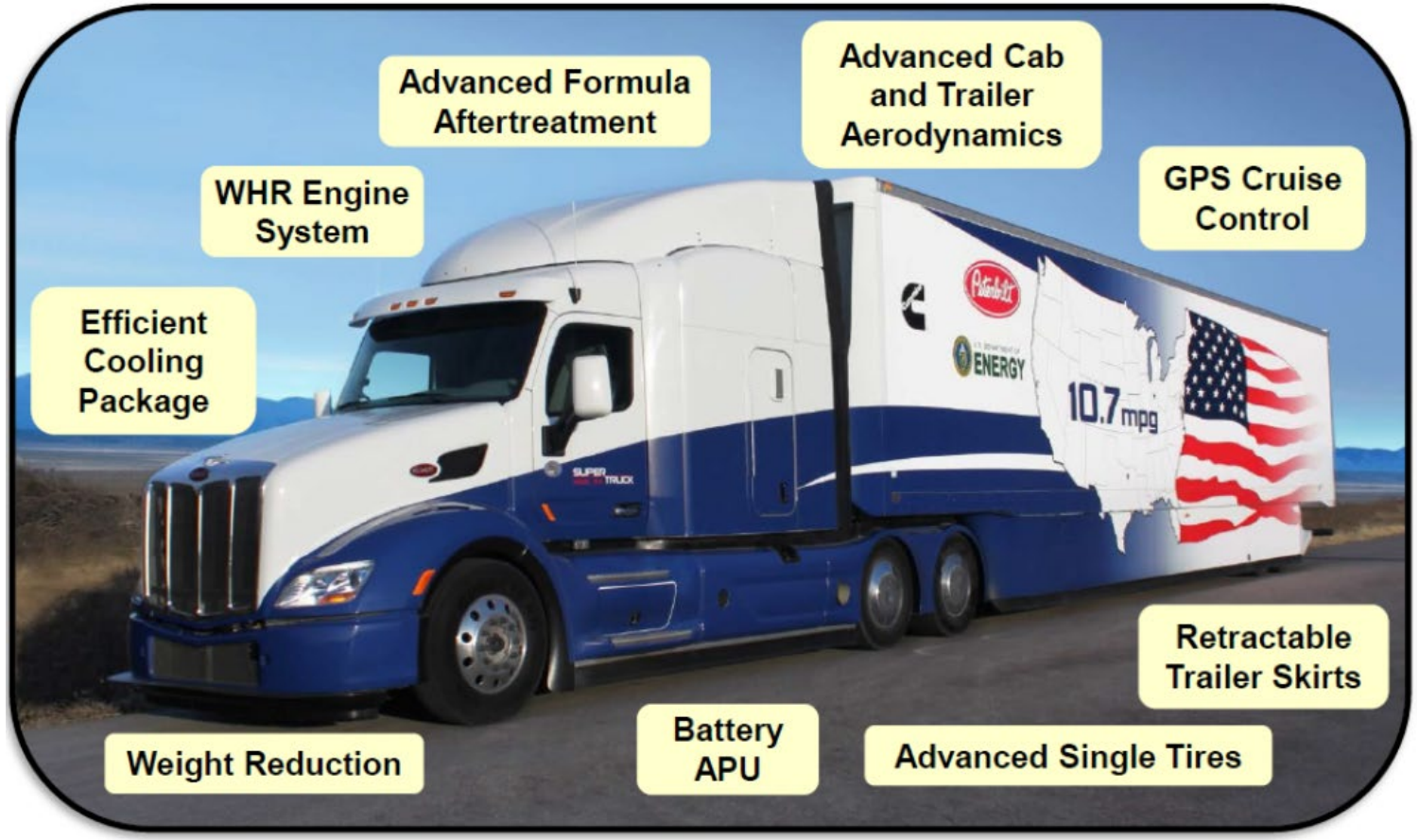
SUPERTRUCK I (2009-2015)

Volvo

Navistar

Cummins/
Peterbilt

Daimler



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SUPERTRUCK II (2016-2023)

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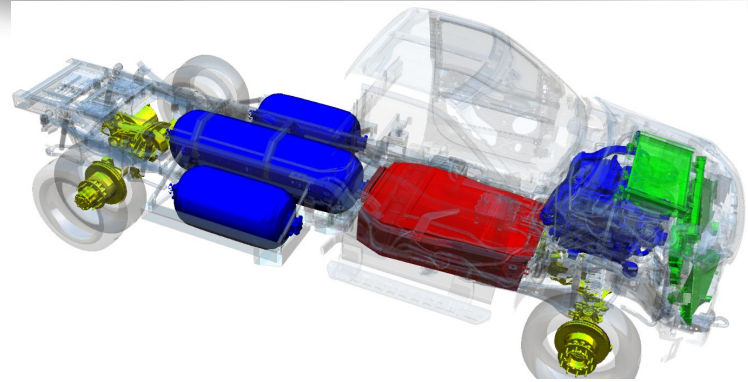
SUPERTRUCK III (2022-2027)

- Demonstrate 75% reduction in GHG and air pollution emissions
- Reduce TCO from a 2020/2021 MY truck
- 5 teams participating – Three teams are developing MD/HD FC trucks while two teams are making HD battery electric truck
- Two teams will also develop and demonstrate megawatt charging station



Ford

DAIMLER TRUCK
North America

gm

VOLVO

PACCAR

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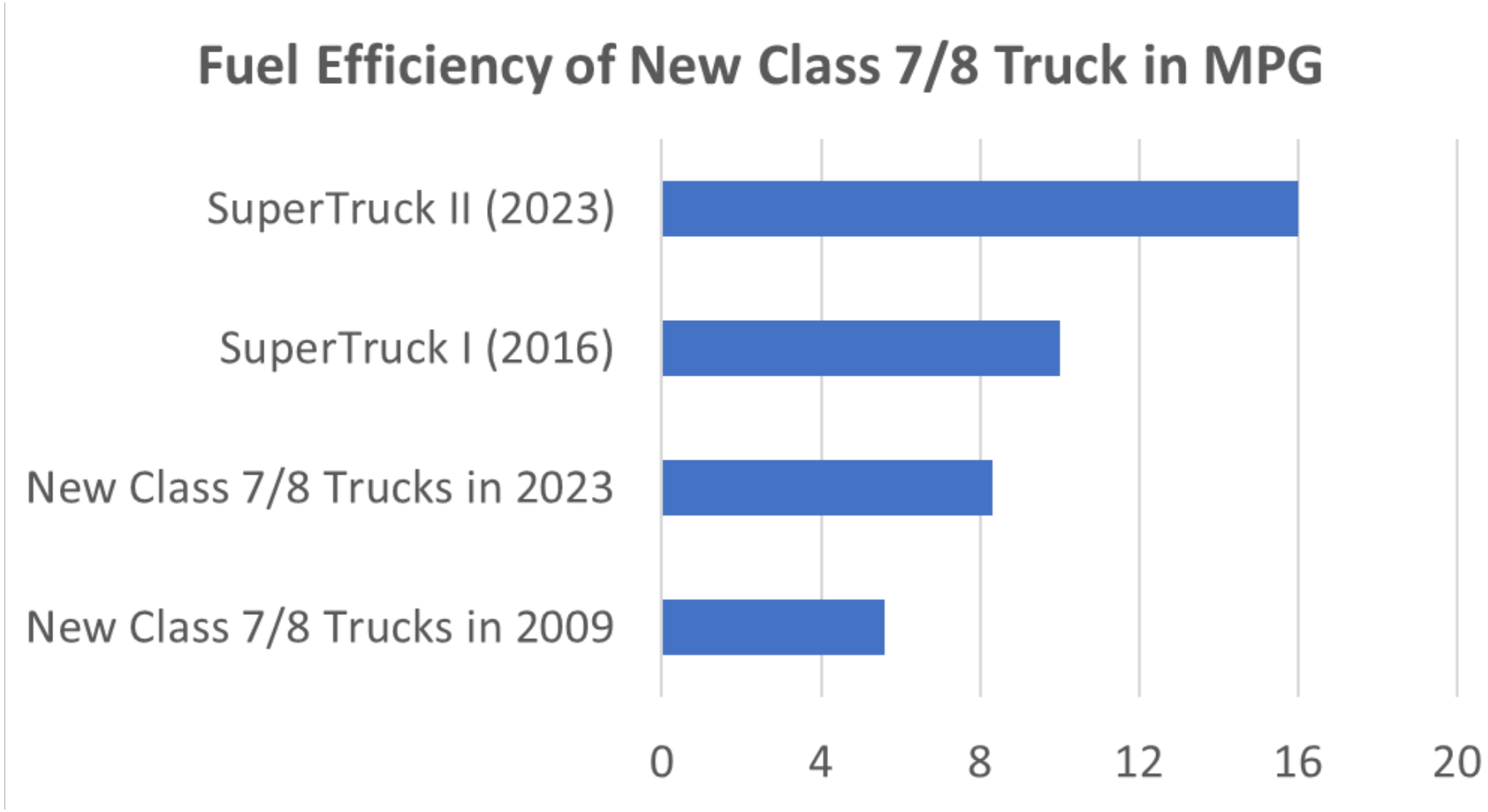
SUPERTRUCK IMPACT



2009 and 2023 MY truck MPG were taken from ANL's Vision Model

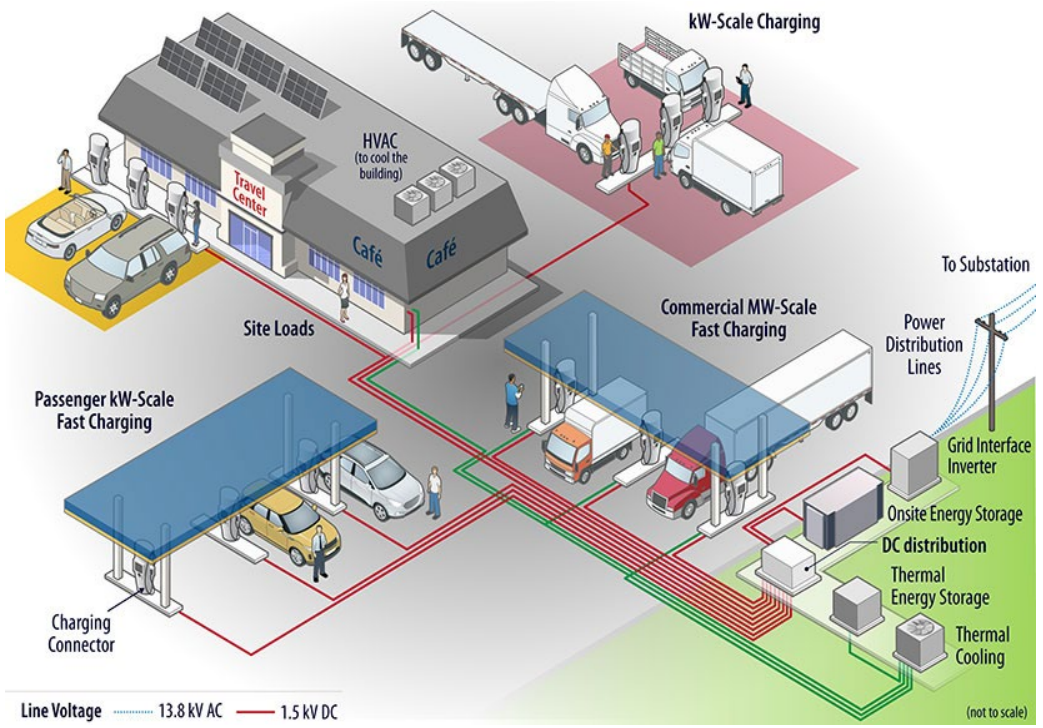
SUPERTRUCK CHARGE

Notice of intent issued 23 April 2024

Delivering high-power charging, load management, and grid services that alleviate grid capacity challenges at a large-scale charging installation for MD/HD trucks through optimal design of charging infrastructure and operations.

1. Truck Depots concentrated near hubs, ports, warehouses, and other logistics operations,

2. Truck Stops/Travel Centers along key freight corridors



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