U.S. DEPARTMENT OF ENERGY

Medium- and Heavy-Duty Truck Action Plan & Hydrogen and Fuel Cells Update

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U.S. Department of Energy

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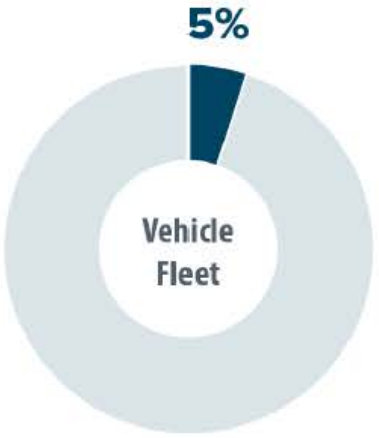
Sustainable Freight Futures Workshop

Why Should We Care About Heavy-Duty Trucks?

Heavy-Duty trucks disproportionally contribute to emissions

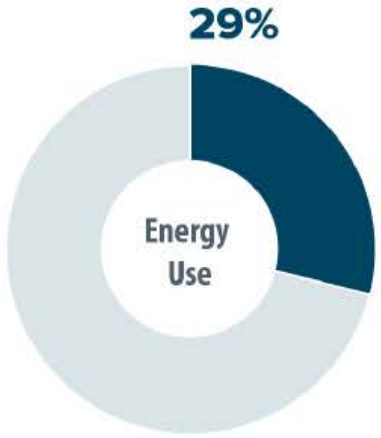
Heavy-duty vehicles (HDVs), including large trucks, constitute only 5% of the vehicle fleet, yet they are responsible for over a quarter of fuel consumption and transportation emissions in the U.S.

heavy-duty vehicles are only 5% of the entire vehicle fleet

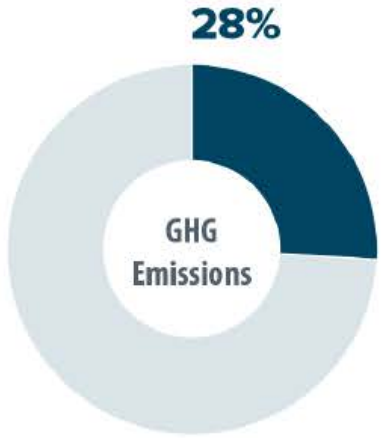


and they travel over 10% of total miles traveled

yet they consume annually 29% of the transportation fuel



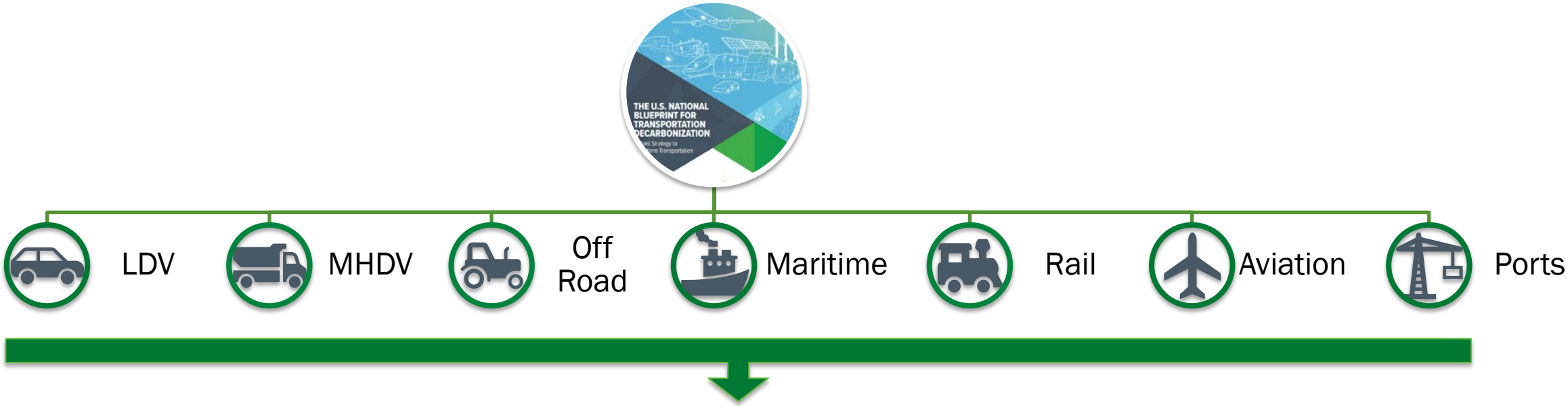
and contribute to over a quarter of transportation emissions



Source: EPA, BTS, DOT
By A. Kusoglu

MILLION MILE FUEL CELL TRUCK

To Be Released: Sector Action Plans



POLICY AND COMMITMENTS: EPA rulemaking on vehicles, industry commitments in multiple sectors

DEPLOYMENT: Installation of charging infrastructure, battery investments, supply chain development, hydrogen investments.

ENGAGEMENT: Multiple engagement sessions completed and more planned, subject matter expert and industry interviews, and regular and active interagency engagement on all sectors.

ACTION PLANS: Sector action plans started for every sector.

Medium and Heavy-Duty Vehicles Action Plan

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.

Bounding the MHDV Sector Action Plan

Covered

Vehicles
- Medium Duty (Class 3-6)
- Heavy Duty (Class 7-8)
- BEV, Fuel Cells, Internal Combustion (legacy)

Infrastructure
- Electrification
- Hydrogen

Cost Effective Clean Fuel
- Electricity
- Hydrogen
- Sustainable fuels (legacy fleet)

Regional Strategies and Workforce Development

Adjacent

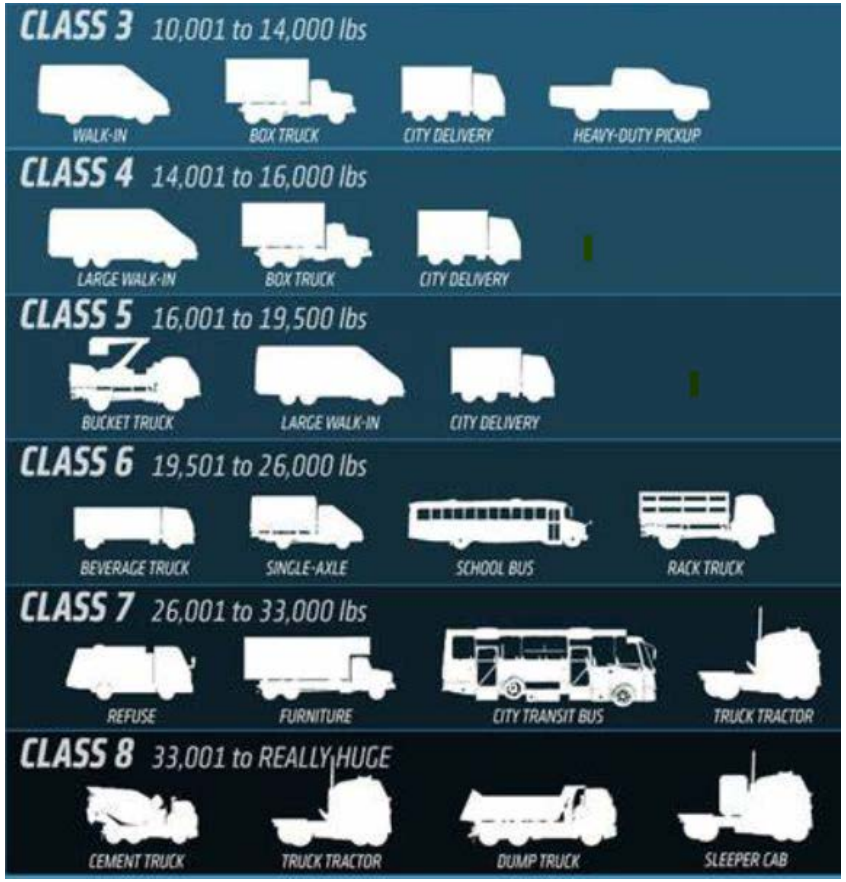
Convenience Plan

Efficiency Plan

Other Sector Action Plans
- Rail
- Maritime
- Off Road
- LDV

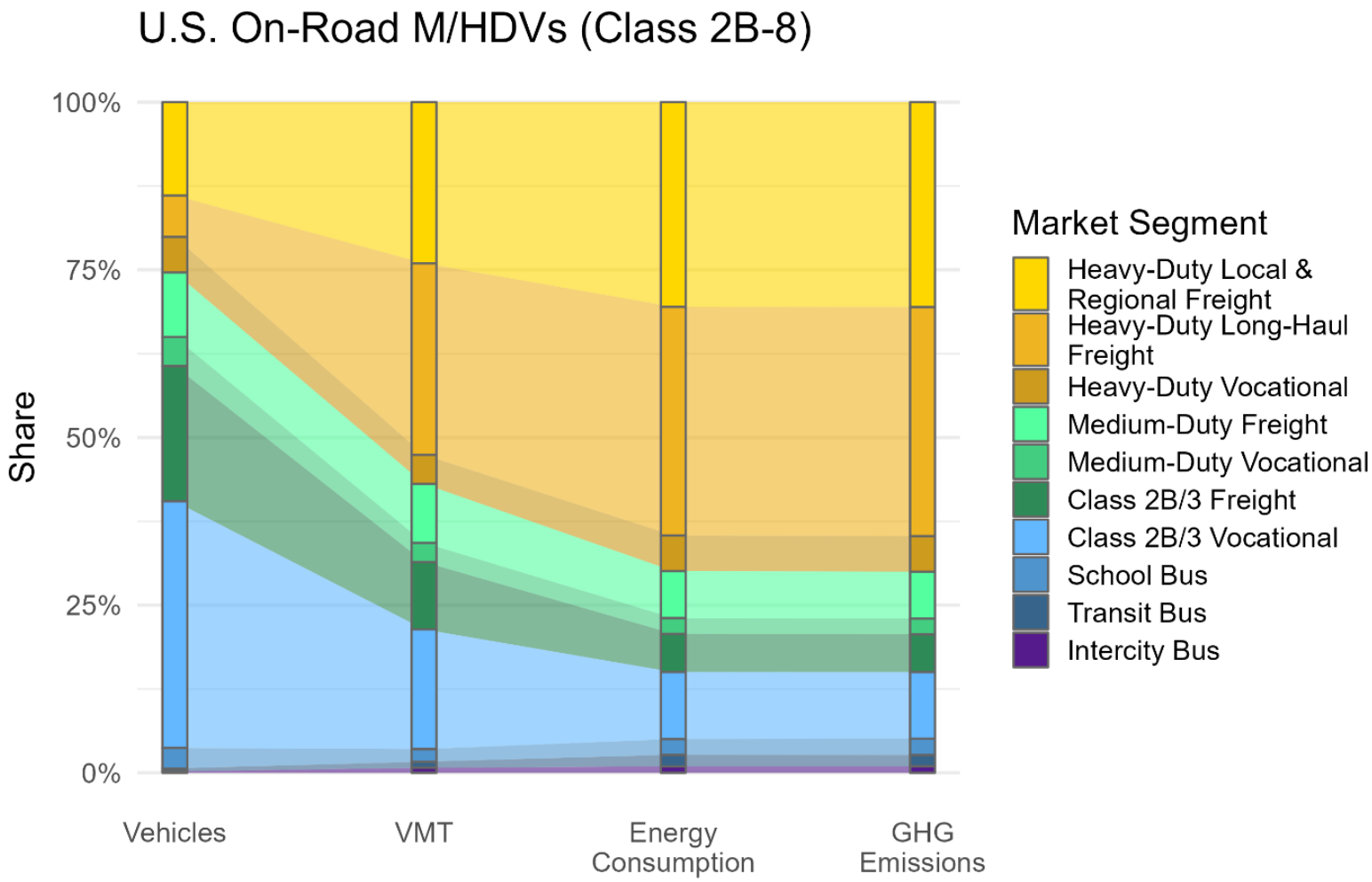
Excluded

DOD Fleet or Operations



US Emissions by vehicle type

- **Heavy-duty (Class 7-8) freight vehicles disproportionately contribute to emissions,** accounting for 22% of vehicles and 65% of GHG emissions.
- **Medium and light-medium freight vehicles (Class 2B-6)** account for 30% of vehicles and 11% of emissions in total. Class 2B-3 vehicles are 20% of vehicles and 4% of GHG emissions, while Class 4-6 vehicles are 11% of vehicles and 7% of emissions.
- **Vocational vehicles and pickups** account for 43% of commercial M/HDVs and 16% of GHG emissions.



President Biden Signs Key Bills into Law – Examples of Policies and Activities

Bipartisan Infrastructure Law (BIL) provides $9.5B for clean H_2 and Inflation Reduction Act (IRA) includes significant tax credits

President Biden Signs the Bipartisan Infrastructure Bill into law on November 15, 2021.
Photo Credit: Kenny Holston/Getty Images

BIL Required National Clean Hydrogen Strategy and Roadmap

Examples of policies & activities across the H_2 value chain

Supply	Midstream	End Use Demand
Production Tax Credit 45V, 45Q (Treasury)	Fueling Corridor Grants (DOT/JO)	Vehicle Tax Credits, Clean Fuels Credits, 48C (Treasury)
Electrolyzer RD&D BIL (DOE)	Bipartisan PIPES Act NPRM (DOT PHMSA)	State Policies (ZEV Mandates, H2 PTC)[1]
Manufacturing Tax Credit 48C (Treasury/DOE)	Manufacturing Tax Credit 48C (Treasury/DOE)	Clean Power Rule NPRM (EPA)
H2 Hubs, BIL (DOE)	H2 Hubs, BIL (DOE)	Buy Clean Standards (EOP)
		Agency offtake (DOD, USPS, USDA, DOT, EPA, etc.)
		H2 Hubs (including Demand Side Initiative) BIL (DOE)

JO: Joint Office of Energy and Transportation; EOP: Executive Office of the President, NPRM: Notice of proposed rulemaking
[1]: ZEV Mandates see: https://www.c2es.org/document/us-state-clean-vehicle-policies-and-incentives/.
State example https://leg.colorado.gov/bills/hb23-1281.

Qualifying Advanced Energy Project Credit (48C) Program

Department of the Treasury

U.S. Departments of the Treasury and Energy Release Additional Guidance on Inflation Reduction Act Programs to Incentive Manufacturing and Clean Energy Investments in Hard-Hit Coal Communities

April 29, 2024

https://home.treasury.gov/news/press-releases/jy2301?utm_medium=email&utm_source=govdelivery%20- -

Up to **$6 billion** in tax credit allocations for the second round of allocations of the **48C(e) program**.

48C – Round 2: Concept Papers Due June 21

https://www.energy.gov/infrastructure/qualifying-advanced-energy-project-credit-48c-program

Examples of DOT FHWA and EPA Funding

$90+M from DOT-FHWA Funding for H_2 Stations

North Central Texas Council of Governments
$70M
- 5 MD/HD H_2 fueling stations in TX triangle
- Created H_2 corridor from Southern CA to TX

California's Victor Valley Transit Authority
$12M
- Build a H2 fueling station and 6 DC fast charging stations for fleet and public fueling

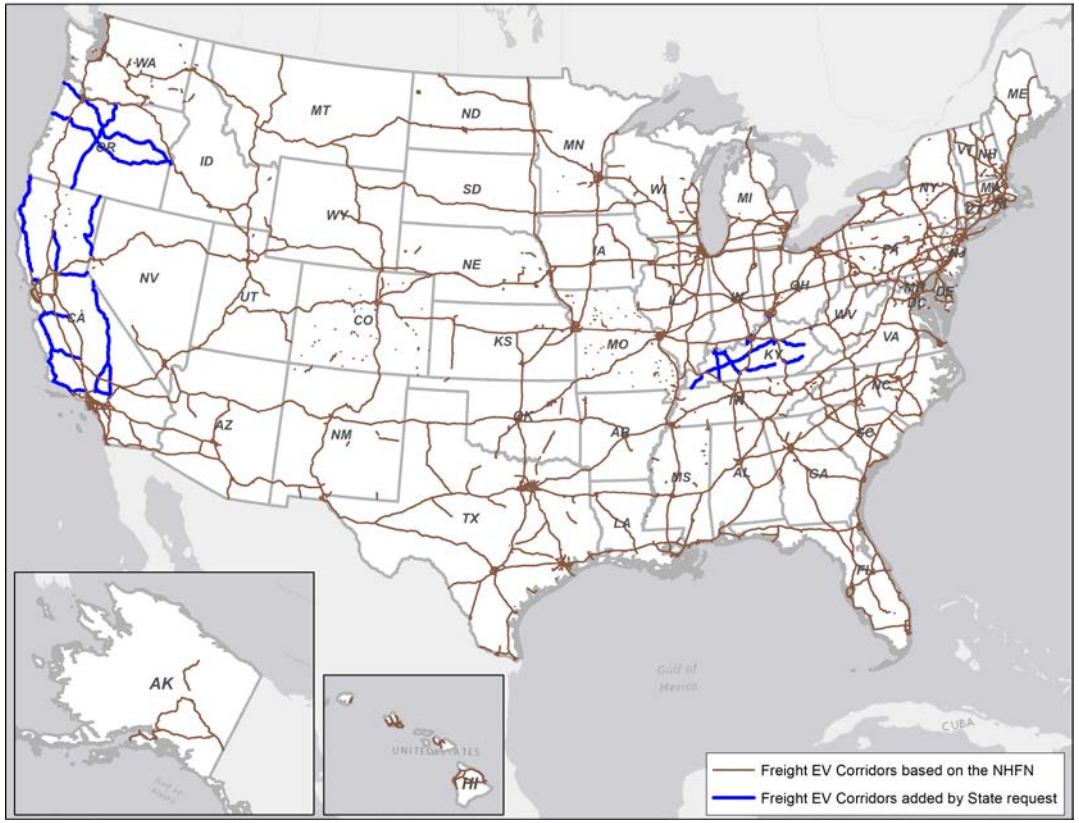
California State University, Los Angeles
$7M
- Transform H_2 Research Fueling Facility into high-capacity, multi-modal (light- to heavy-duty) H_2 fueling station

Colorado State University (CSU)
~$9M
- Build 3 public H_2 fueling stations near CSU campuses in Fort Collins, Denver, and Pueblo for truck fleets and potential vehicles along I-25

EPA Clean Ports Program: $3B for Grants

At least 25% ($750M) to be spent in nonattainment areas

Federal Highway Administration (FHWA) announced the designation of National EV Freight Corridors – includes H2 stations



https://www.fhwa.dot.gov/environment/alternative_fuel_corridors/freight_ev_corridors/

FHWA station & charging in collaboration with Joint Office of DOT, DOE

President Biden announces $7B for 7 H2 Hubs, Oct 2023

Demand side strategy for Hubs announced

DOE selects consortium to bridge demand for clean H_2 providing market certainty and unlock private capital
Jan 2024

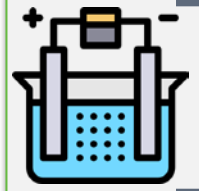
H2 Hubs managed by OCED: See https://www.energy.gov/oced/office-clean-energy-demonstrations

H2 & Fuel Cell Manufacturing Selections

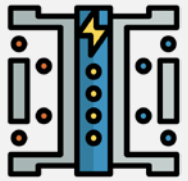
52 Projects

RD&D and manufacturing for domestic supply chain. Enables $2/kg H_2 by 2026 and $80/kW fuel cells by 2030

RD&D for domestic manufacturing and support for H2 Hubs



Electrolysis **10 GW/yr** Supports production of 1.3M metric tons of H_2/year



Fuel Cells **14 GW/yr** Capacity for 100,000 HD fuel cell stacks, corresponding to 50,000 trucks (~15% of annual sales)

$1.6B

Total Project Costs

Including **~$750M** in federal cost share and ~**$850M** in cost share

1,500+

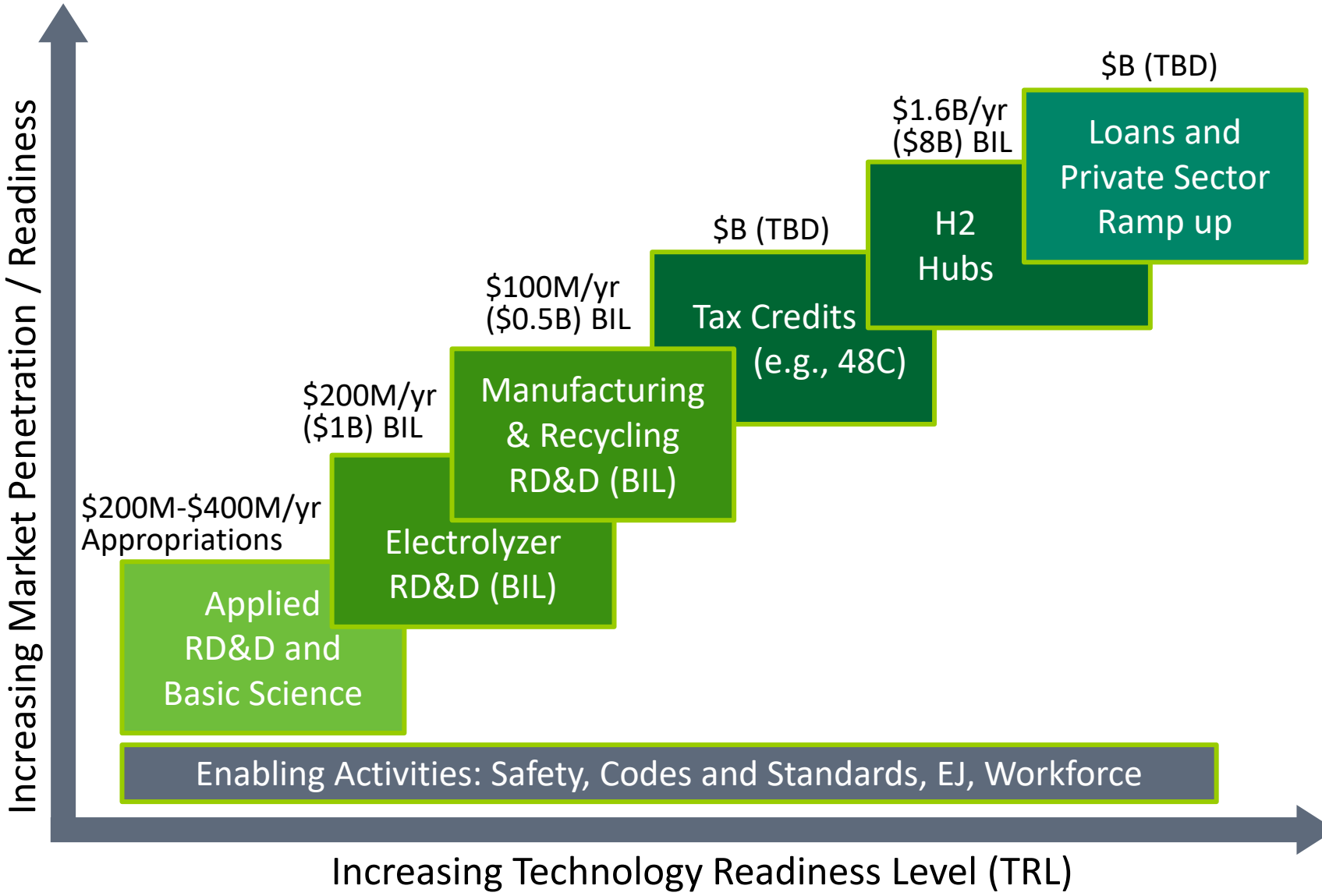
Direct jobs created

Plus, thousands of indirect jobs across the U.S.

24 States

Benefiting 32 disadvantaged communities across the U.S. with initiatives in workforce development, energy equity, and DEIA

Context: DOE Hydrogen Portfolio Activities including BIL

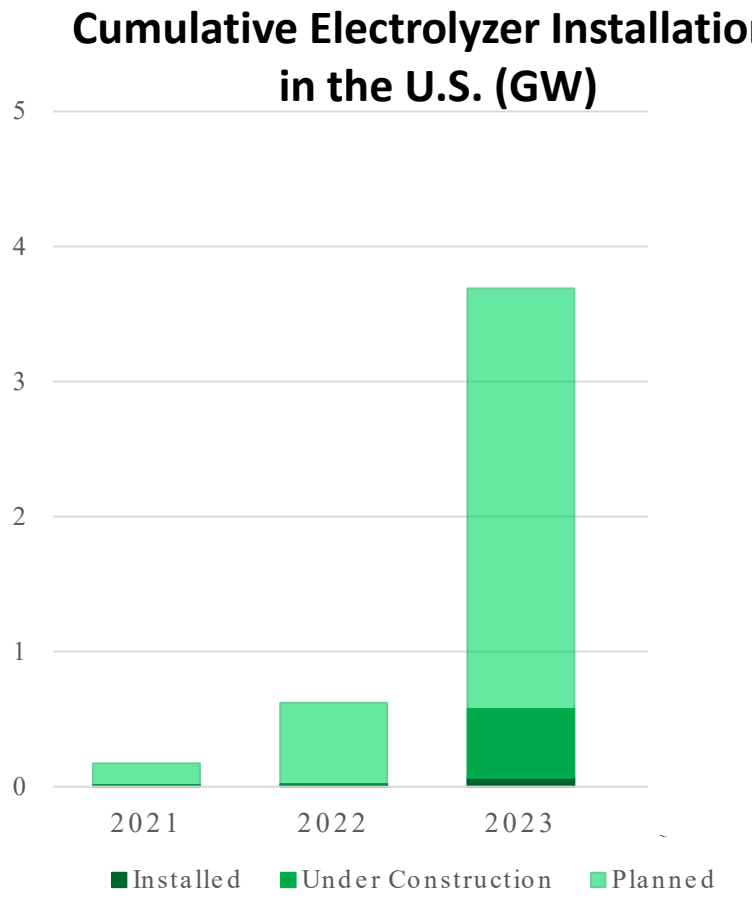


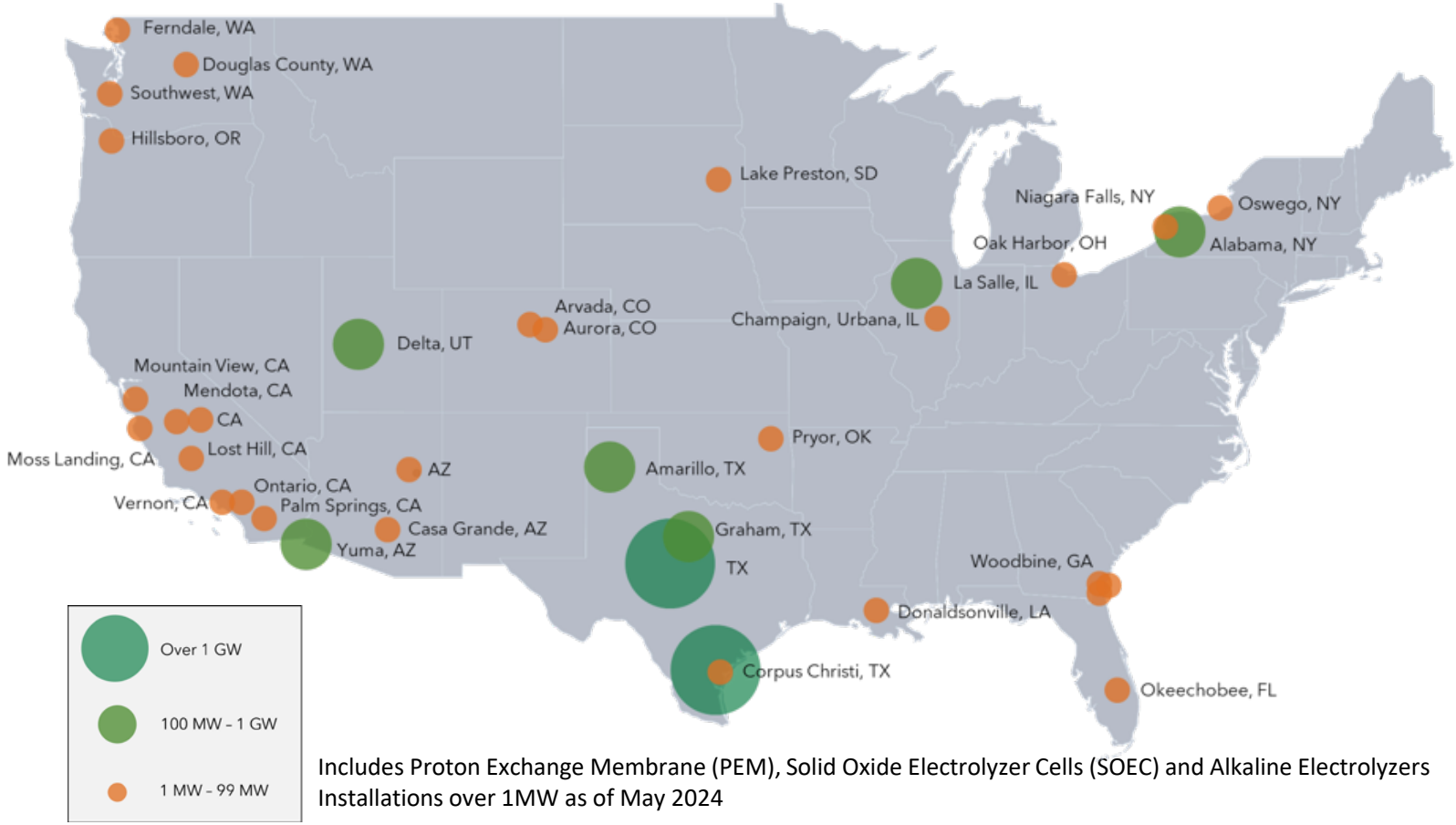
BIL Provisions:

- **$1B for Clean Hydrogen Electrolysis Program (Sec. 816)**
  - $200M/yr (FY22-FY26) to enable $2/kg H_2 by 2026
- **$500M for Clean Hydrogen Manufacturing & Recycling (Sec. 815)**
  - $100M/yr (FY22-FY26) to enable manufacturing and recycling

Planned and Installed Electrolyzer Capacity in the U.S.

Total 4.5 GW in Electrolyzer Capacity
~1 GW added since 2023 (Up by >20%)





Includes Proton Exchange Membrane (PEM), Solid Oxide Electrolyzer Cells (SOEC) and Alkaline Electrolyzers Installations over 1MW as of May 2024

Source: Hubert, M., & Arjona, V. (2024). DOE Hydrogen Program Record# 24001 https://www.hydrogen.energy.gov/library/program-records

Applications of Hydrogen and Fuel Cells - Today

Examples of Applications in Use

- >500 MW — Backup Power
- >69,000 — Forklifts
- >4.5 GW — Electrolyzers
- ~380 — Fuel Cell Buses
- ~50 — H_2 Retail Stations
- >18,000 — Fuel Cell Cars

PEM: Polymer electrolyte membrane

Photo Credit: UPS

Fuel cell delivery and parcel trucks operating in CA and NY

Increasing orders of fuel cell forklifts by warehouses and stores in the U.S.

Photo Credit: BMW Manufacturing

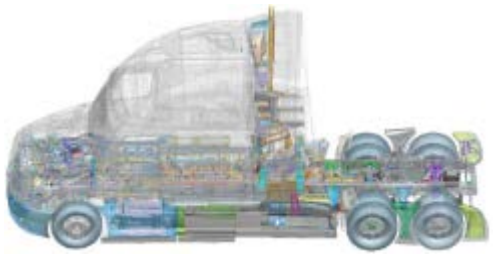
Approx. 70 hydrogen buses operating for public transit

Hydrogen Fuel Cell Heavy Duty Truck Projects

SuperTruck 3 Demonstrations include H_2 Fuel Cells (>75% GHG Reduction)

DAIMLER

Walmart, SCHNEIDER, Linde, MAHLE, MICHELIN, Argonne, NREL, Oak Ridge National Laboratory, Auburn University, Oregon State University



Goals:
- Demonstrate 2 total (Class 8) HD long-haul fuel cell electric trucks (B-sample & final truck demo)
- 6.0 mi/kg H2 fuel economy
- 600-mile range (onboard LH_2 storage)
- 65,000 pounds GVW

Fleet Operators: Schneider National, Walmart

gm general motors

Southern Company, nel, Argonne

Goals:
- Demonstrate 8 total (Class 4-6) MD trucks
  - 4 fuel cell & 4 battery electric trucks
- Fuel Cell System Goals:
  - 65% peak efficiency
  - <$80/kW system cost (100K units/yr)
  - 20K-30K hour lifetime
- Demonstrate microgrid w/ electrolyzer & fuel cell (H_2 fueling & fast charging)

Fleet Operators: Southern Co, Metro Delivery

The above image is not final product/visual and is subject to change

Ford Motor Company

FERGUSON, Consumers Energy, SoCalGas

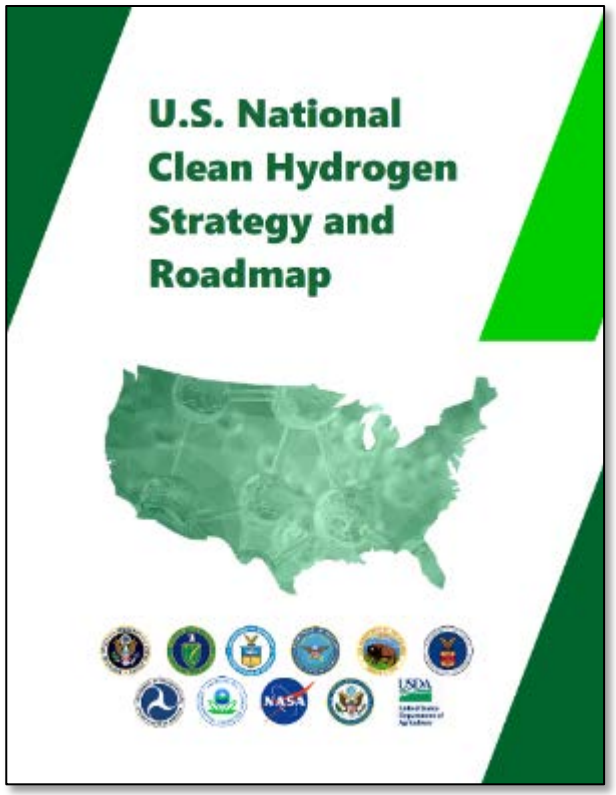
FEV, NREL

Goals
- Demonstrate 5 total (Class 4-6) MD vocational trucks
- 300+kW net vehicle power, H_2 PEM FC + Li-Ion battery
- 300-mile range (700 bar H_2 storage)
- 10K/20K pounds payload/tow capacity

Fleet Operators: Consumers Energy, Ferguson, SoCalGas

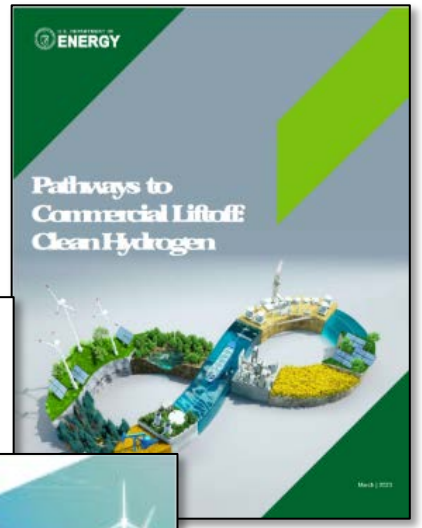
Key Publications

Analysis and guiding documents provide framework for key activities from basic science through deployment

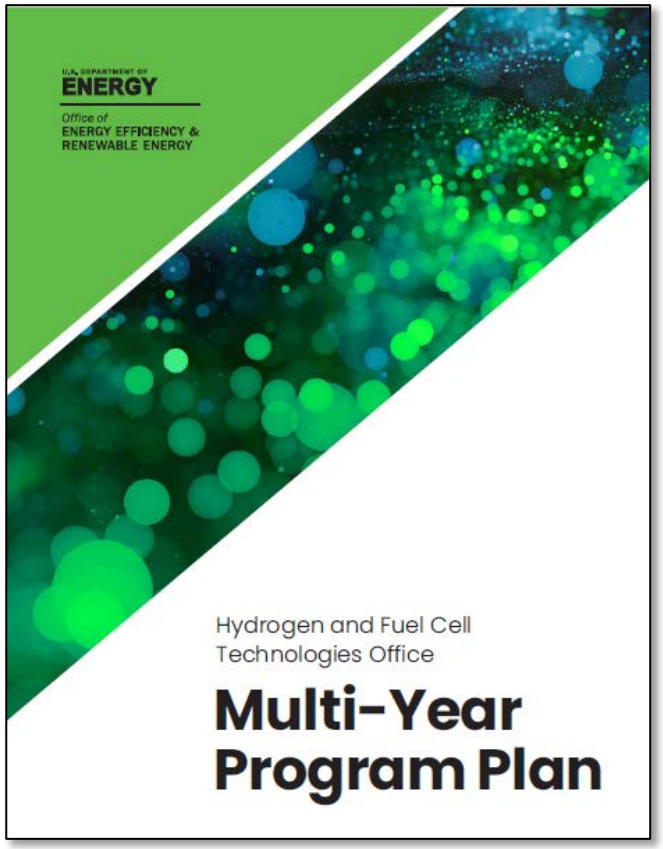


www.hydrogen.energy.gov

Modal plans underway
Rail, offroad, marine, etc.



Liftoff updates coming soon



Released May 6, 2024

www.energy.gov/eere/fuelcells/mypp

Resources and Opportunities for Engagement

HYDROGEN AMERICAS 2024 SUMMIT & EXHIBITION

11 – 12 JUNE 2024

RONALD REAGAN INT. TRADE CENTER, WASHINGTON D.C.

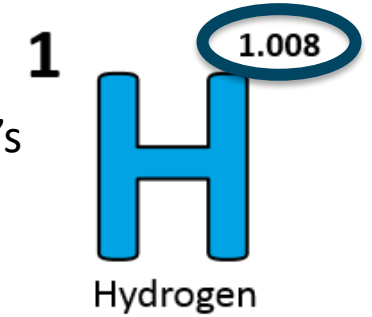
Save the date!

2025 DOE Annual Merit Review and Peer Evaluation Meeting

May 19 – 22, 2025

Hydrogen and Fuel Cells Day October 8

- Held on hydrogen's very own atomic weight-day



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www.aiche.org/CHS

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