ANNOUNCEMENTS

- **Mute Microphone** – in order to prevent background noise that disturbs the meeting, if you aren't talking, please mute your microphone or phone.

- **Chat Box** – if you aren't being heard, please use the chat box or raise your hand to ask a question.

- **Recording Meeting** – we will record and post the board meetings (www.ctgreenbank.com/hydrogentaskforce) and you can also access meeting dates and dial-in information through Secretary of State.

- **State Your Name** – for those talking, please state your name for the record.

Special Act 22-8

Task Force to Study Hydrogen Power

September 13, 2022

Online and In-Person Meeting

Nel Hydrogen

Agenda

- **Welcome and Introduction by Nel Hydrogen** – 10 min
- **Approval of Meeting Minutes of August 9, 2022** – 5 min
- **Task Force – New Member Introductions**– 5 min
- **Update from DEEP on NE Hub Coordination** – 20 min
- **Hydrogen Fuel Cell Applications presented by LBNL** – 25 min
- **Working Group Update** – 40 min
- **Public Comments** – 15 min
- **Nel Tour** – following meeting

Welcome and Introduction by Nel Hydrogen

nel

Welcome to Nel

CT Hydrogen Task Force Meeting, September 13, 2022

500+ Employees, Listed (NEL.OL)

PEM water electrolysers

Wallingford, CT USA

Systems delivered: **3,000+**
Nameplate capacity: **50MW/year**
Experience: **25+ years**

Capacity ready for 150MW/y

Alkaline water electrolysers

Notodden/Herøya, Norway

800+
500MW/year→1 GW/year
90+ years

Expandable to 2GW/y

Hydrogen refuelling stations

Herning, Denmark

110+
300 HRS/year
17+ years

TECHNOLOGIES AT SCALE AND BEING DEPLOYED

20 MW installations for PEM and alkaline

Alkaline stack vs. PEM

Wind to Hydrogen – mobility and refining (alkaline plant)

H2Synergy 20 MW plant; Image credit: Everfuel

Solar to Hydrogen – ammonia production (PEM plant)

Approval of Meeting Minutes of August 9, 2022

Task Force Logistics

Task Force

Still Waiting on Five Political Appointee Members

Appointer	Organization	Name	Area of Expertise
President Pro Tempore			▪ EDC (Electric – 17-) ▪ CT H2 Manufacturer ▪ ENGO (RE Advocate)
Majority Leader Senate	▪ AFL-CIO	▪ Keith Brothers	▪ Building Trades
Minority Leader Senate	▪ Avangrid ▪ Avangrid	▪ Adolfo Rivera ▪ Frank Reynolds	▪ EDC (Electric – 17-) ▪ EDC (Gas – 17-) ▪ ENGO (RE Advocate) ▪ CHFCC
Speaker of House	▪ Eversource ▪ Nel Hydrogen	▪ Digaunto Chatterjee ▪ Katherine Ayers	▪ EDC (Electric – 18+) ▪ CT H2 Manufacturer
Majority Leader House	▪ Eversource ▪ Sierra Club CT ▪ Fuel Cell Energy	▪ Nikki Bruno ▪ Samantha Dynowski ▪ Anthony Leo	▪ EDC (Gas – 18+) ▪ ENGO (RE Advocate) ▪ CHFCC
Minority Leader House	▪ Eversource ▪ Dominion Energy ▪ Infinity	▪ Jennifer Schilling ▪ Mary Nuara ▪ William Smith	▪ EDC (Electric – 18+) ▪ Nuclear Power ▪ CT H2 Manufacturer

Task Force

Ex Officio Members

Appointer	Organization	Name	Title
Ex Officio	DEEP	Katie Dykes	Commissioner
Ex Officio	PURA	Marissa Gillett	Chair
Ex Officio	UCONN	Ugur Pasaogullari	Professor (Designee)
Ex Officio	CCAT	Joel Rinebold	Director
Ex Officio (Chair)	CT Green Bank	Bryan Garcia	President and CEO
Ex Officio (Co-Chair)	CT Green Bank	Sara Harari	Associate Director

Administrative Update from DEEP on NE Hub Coordination

Hydrogen Fuel Cell Applications
Presented by LBNL

BERKELEY LAB
Bringing Science Solutions to the World

Hydrogen Fuel Cells for Heavy-Duty Applications

Hydrogen Power Study Task Force Meeting

Ahmet Kusoglu
akusoglu@lbl.gov
Scientist, Lawrence Berkeley National Lab
Communications Officer, Million Mile Fuel Cell Truck

SEPTEMBER 2022

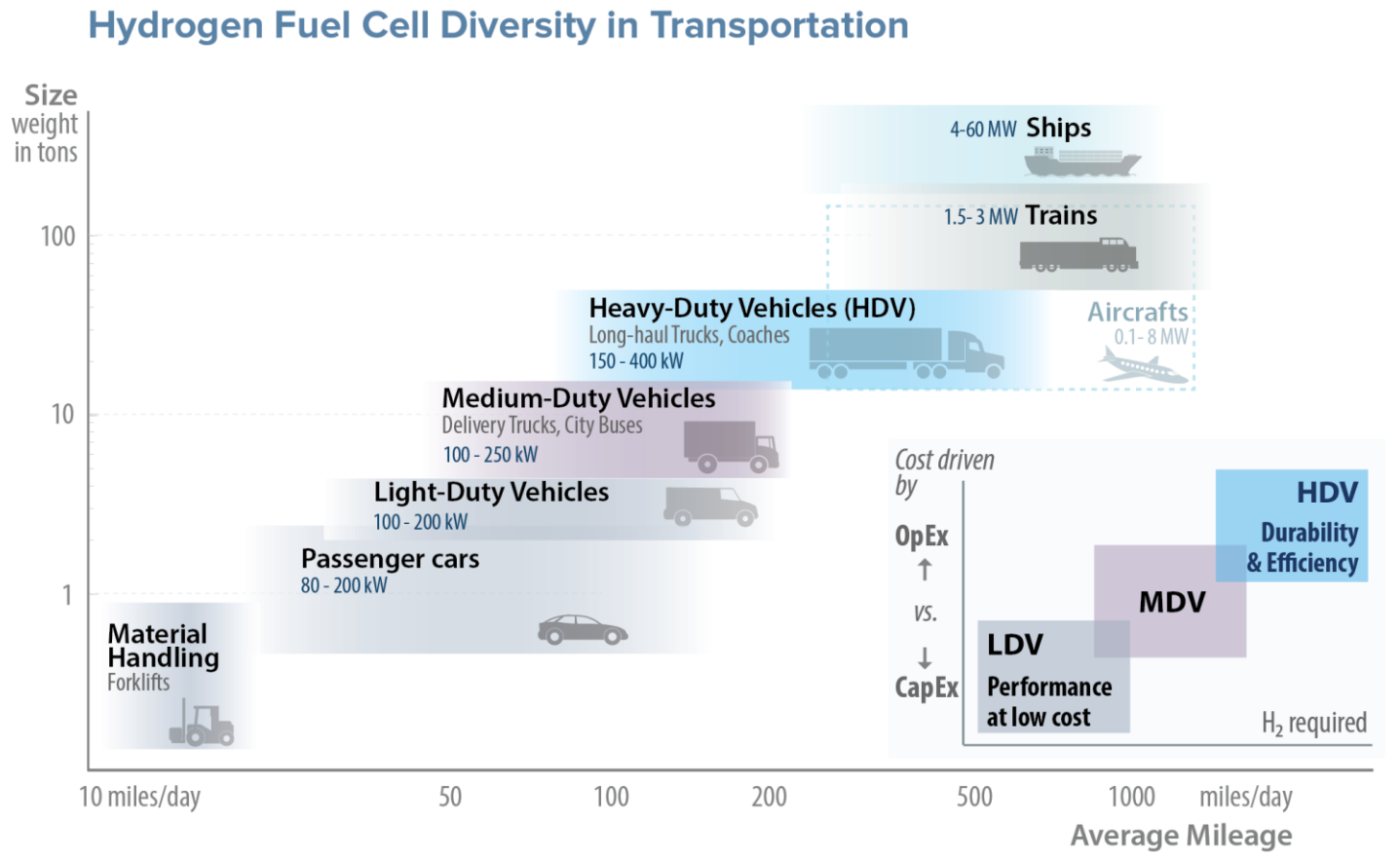
Heavy-Duty Transportation: Role of Hydrogen

Decades of development of cost-effective and durable PEM fuel cells needs to be leveraged to meet increased efficiency and durability requirements of HDV market

Fuel Cells are increasingly being examined for HDV space where there is a strong need for lowering emissions and high power without sacrificing weight (payload)

HDVs benefit from separation of energy storage and power output, the inherent strength of fuel-cells

- Factoring in short refueling time and the intrinsic power density, PEMFCs come with important performance advantages for HDVs



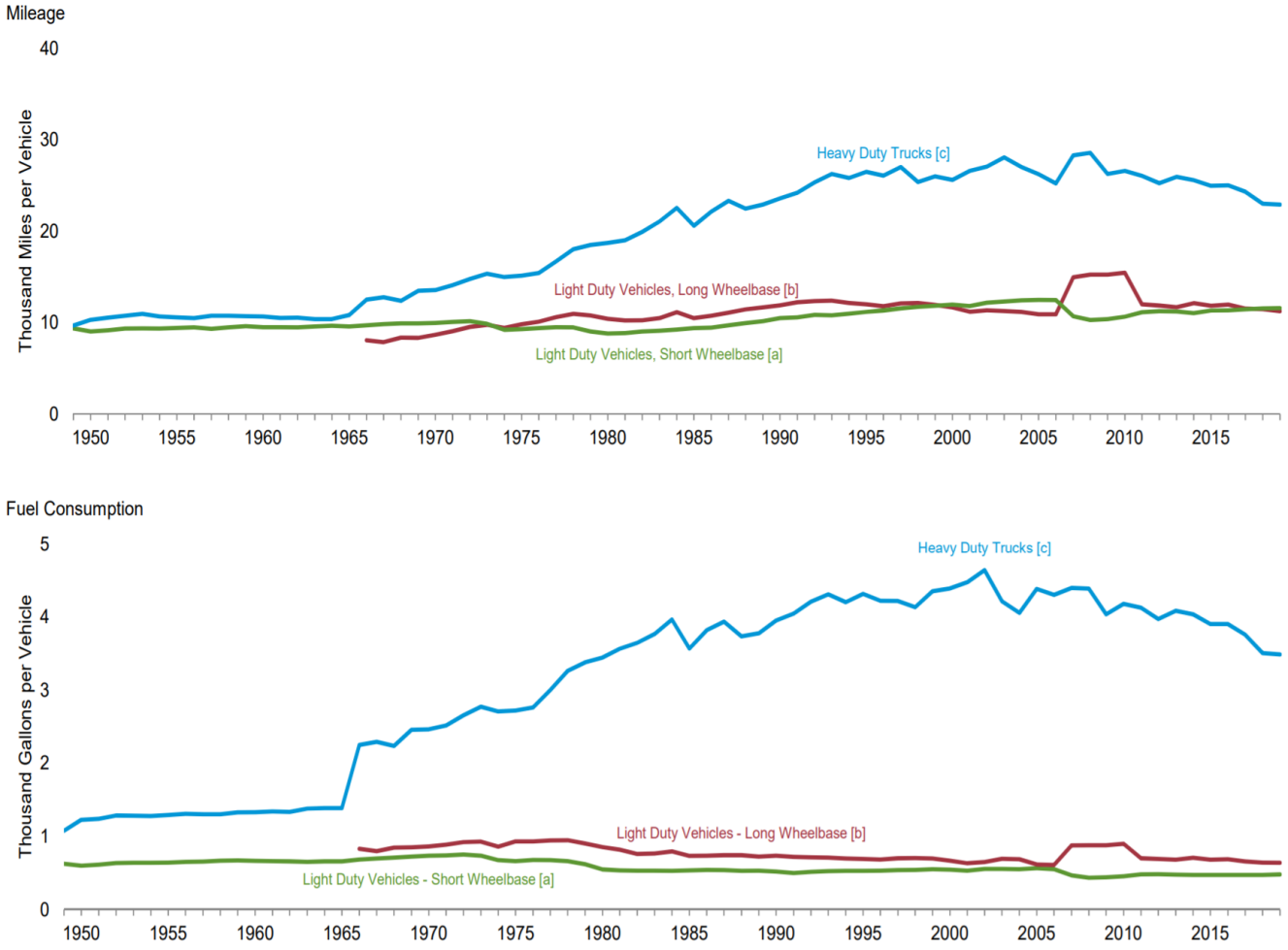
Source: Cullen and Kusoglu et al., Nature Energy (2021)

Increased Mileage and Fuel Consumption for Trucks

Longer Mileage for Trucks

- **Per-vehicle mileage is higher for HDV trucks** compared to light-duty vehicles (LDVs) and cars
- **HDV trucks consume significantly more fuel** despite comprising a smaller fraction of U.S. fleet
- **Decarbonization of heavy duty trucks will have stronger positive impact per vehicle / mile basis**

Figure 1.8 Motor Vehicle Mileage, Fuel Consumption, and Fuel Economy, 1949-2019



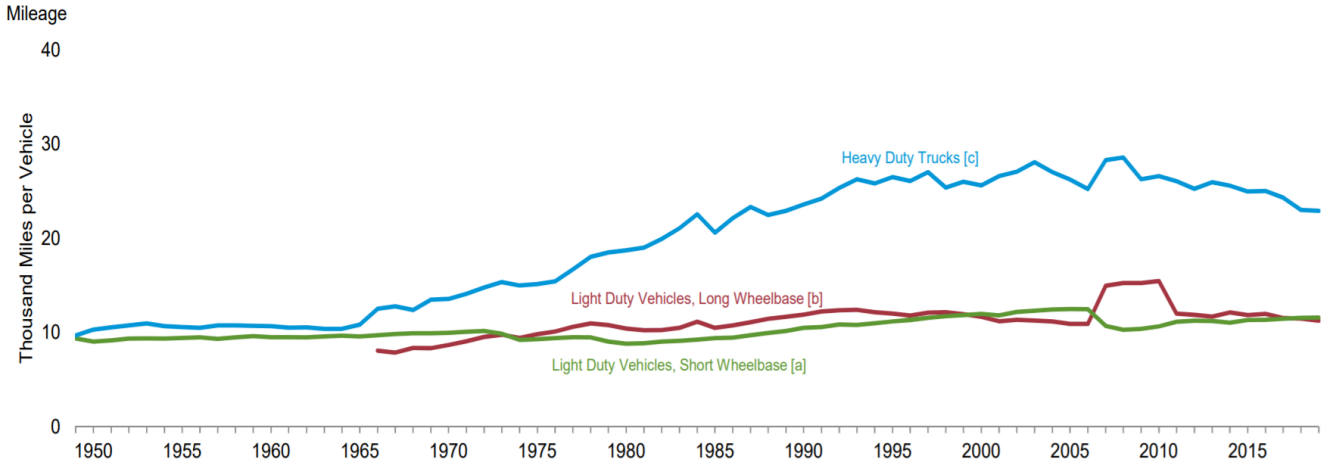
Source: EPA, EIA

Increased Mileage and Fuel Consumption for Trucks

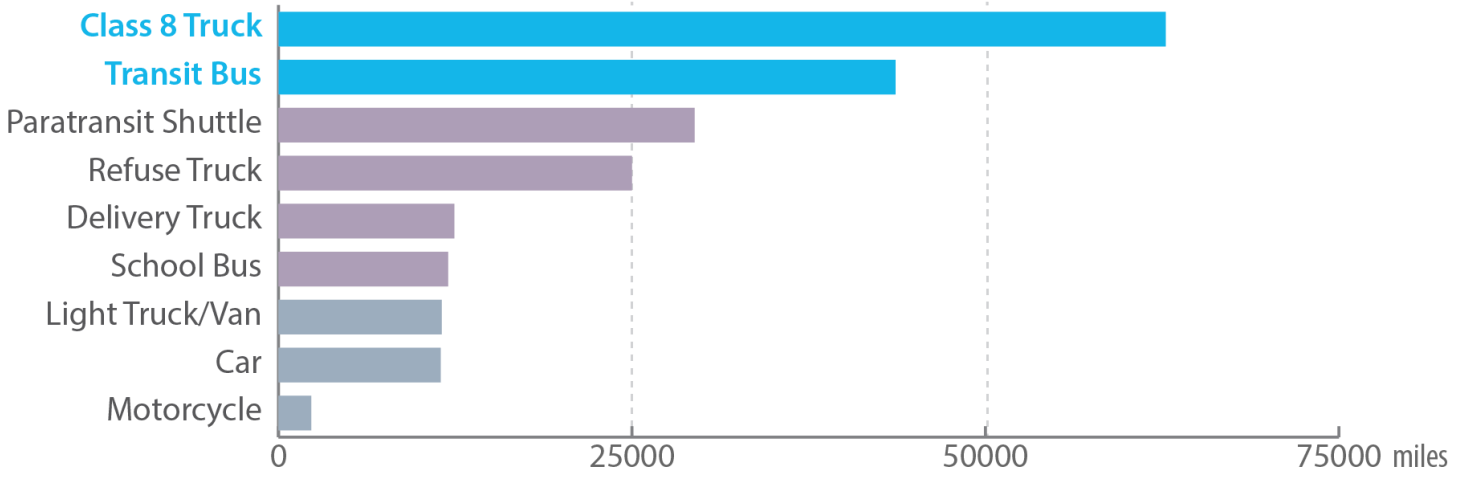
Longer Mileage for Trucks

- **Per-vehicle mileage is higher for HDV trucks** compared to light-duty vehicles (LDVs) and cars
- Annual freight truck miles traveled is projected to increase > 50% by 2050
- **Decarbonization of heavy duty trucks will have stronger positive <u>impact per vehicle / mile basis</u>**

Figure 1.8 Motor Vehicle Mileage, Fuel Consumption, and Fuel Economy, 1949-2019



Average Annual Vehicle Miles Traveled by Major Vehicle Category



Source: EPA, EIA

Transportation Emissions: A higher fraction from Trucks

Freight activity from diesel-powered trucks continues to grow, posing air-quality risks and representing an increasing share of greenhouse gas emissions. Zero-emission trucks could potentially reverse these trends (achieve net neutrality)

- By 2040, medium- and heavy-duty vehicles are expected to be the largest fraction of transport-sector emissions as freight activity grows and other sectors become more efficient and shift to alternative fuels

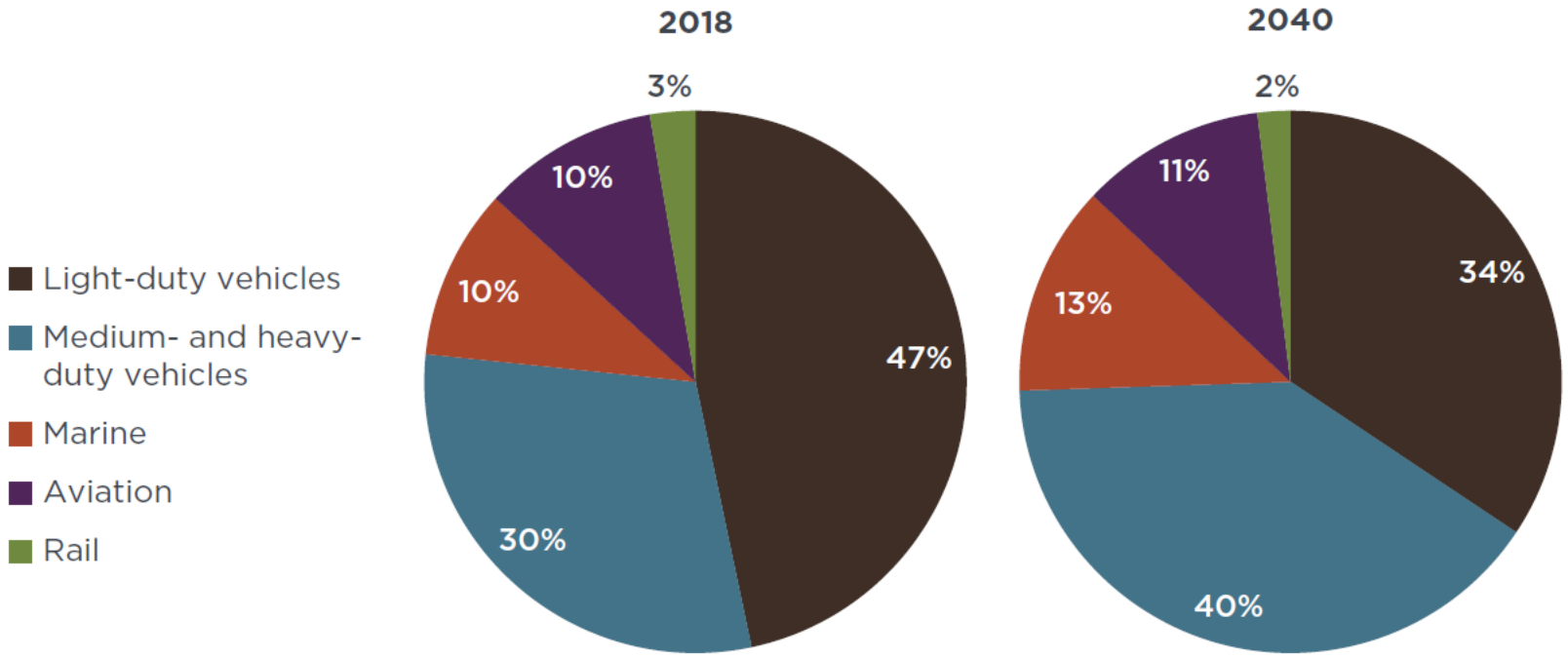


Figure 1. Global transport-sector greenhouse gas emissions by mode

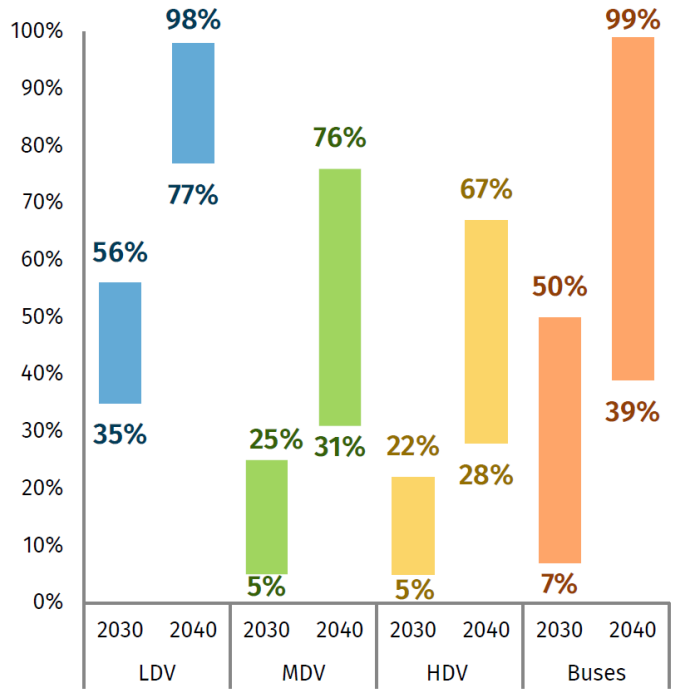
Reducing Transportation Emissions for Freight Vehicles

Electrification of Passenger Vehicles will reduce emissions – but the same progress is not projected for freight vehicles

FIGURE 6

US electric vehicle sales as a share of total sales

Percent

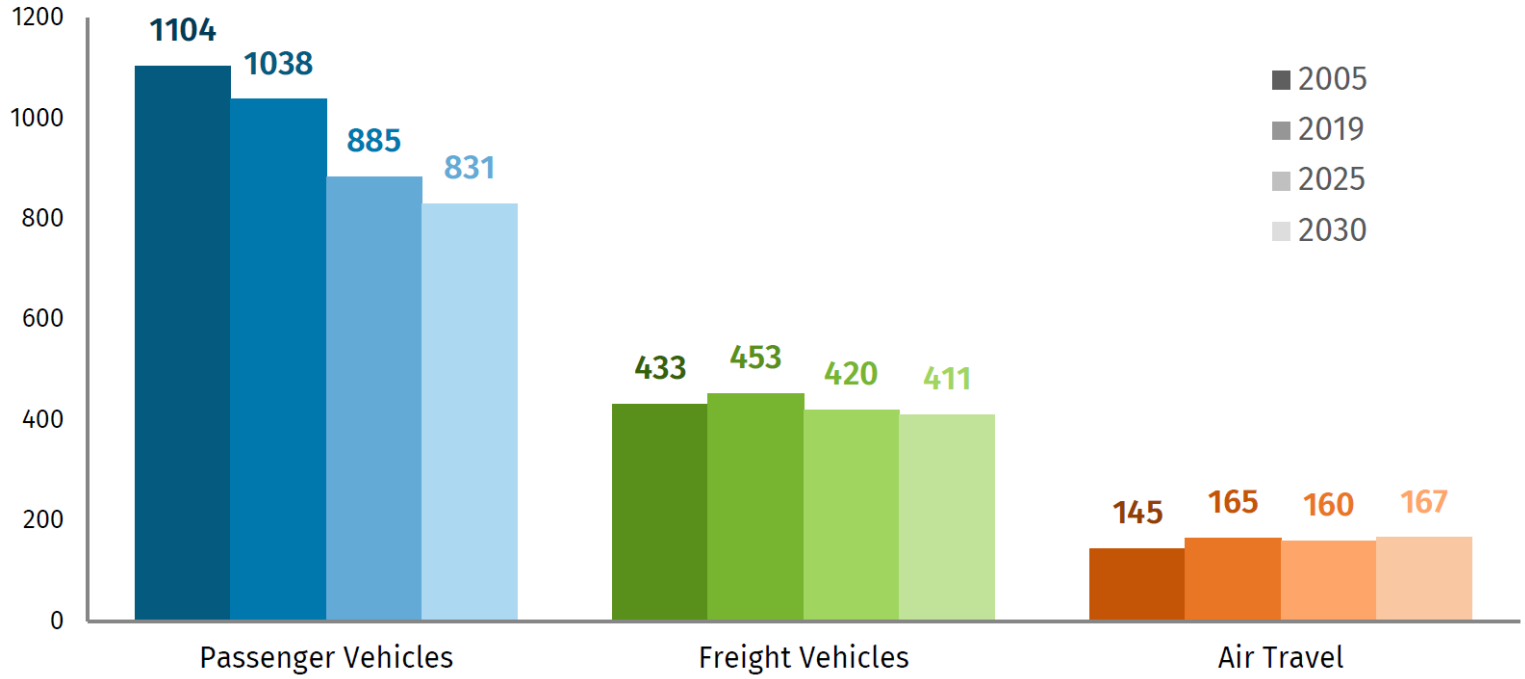


Source: Rhodium Group and EER

ES FIGURE 1

US transportation emissions by mode, 2005-2030

Million metric tons (MMT) of CO_2-equivalent (CO_2e)



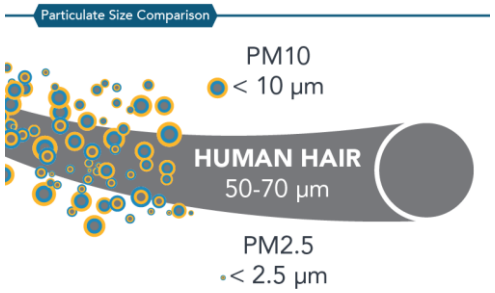
Source: Rhodium Group. Projections are from Rhodium Group's Taking Stock 2020, V-shaped economic recovery scenario.

https://rhg.com/research/closing-the-transportation-emissions-gap-with-clean-fuels/

Diesel Exhaust & Health: Diesel particulate matter (DPM)

Airborne particulate matter (PM) is not a single pollutant, but a mixture of many chemical species (e.g., SO_2, NO_X)

- Diesel engines emit a complex mixture of air pollutants, both gaseous and solid material.
- The solid material in diesel exhaust is known as diesel particulate matter (DPM).
- Over 90% of DPM is < 1 µm in diameter
  - Thus making them a subset of PM2.5; particulate matter less than 2.5 microns in diameter
  - **Most PM2.5 derives from combustion**, gasoline & diesel fuels by motor vehicles, burning of gas



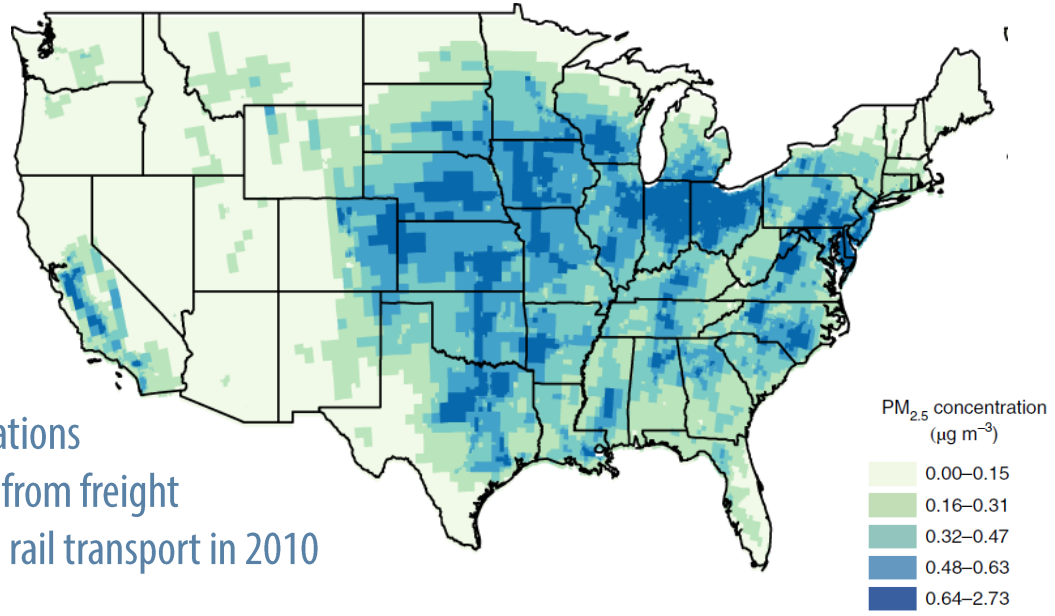
- Of all the common air pollutants, PM2.5 is associated with the greatest proportion of adverse health effects related to air pollution
  - premature mortality
  - increased hospital admissions for heart or lung causes, acute and chronic bronchitis
  - increased asthma attacks, emergency room visits
  - respiratory symptoms
  - restricted activity days
  - These health effects include cardiovascular and respiratory hospitalizations, and premature death.

Source: https://ww2.arb.ca.gov; https://ww2.arb.ca.gov/resources/overview-diesel-exhaust-and-health

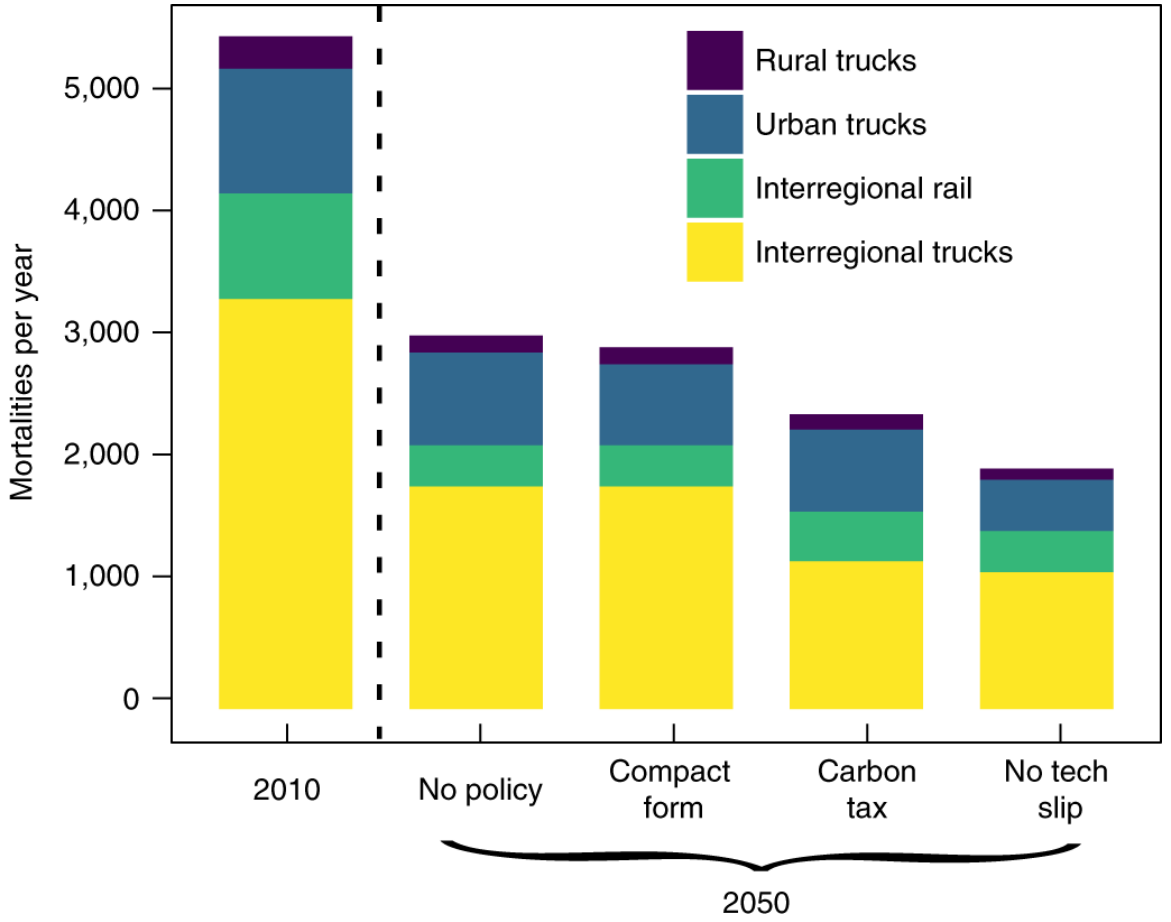
Health and Climate Impacts of Freight Transportation

Scenarios for various freight activity, macroeconomics scenarios, urban development and spatial distribution

- With improvements in clean fleets adoption and vehicle standards the mortalities are projected to decrease despite an increase in population
- Based on current trends, and in any given future scenario, long-haul freight activity still results in more adverse health impact



concentrations resulting from freight truck and rail transport in 2010



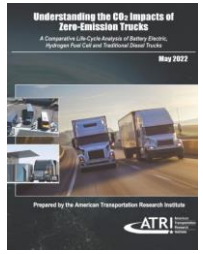
Nature Sustainability 2, 105–112 (2019)

Understanding the CO_2 Impacts of Zero-Emission Trucks

Full life-cycle emissions of class 8 trucks is the lowest when powered by Fuel-Cell with clean hydrogen

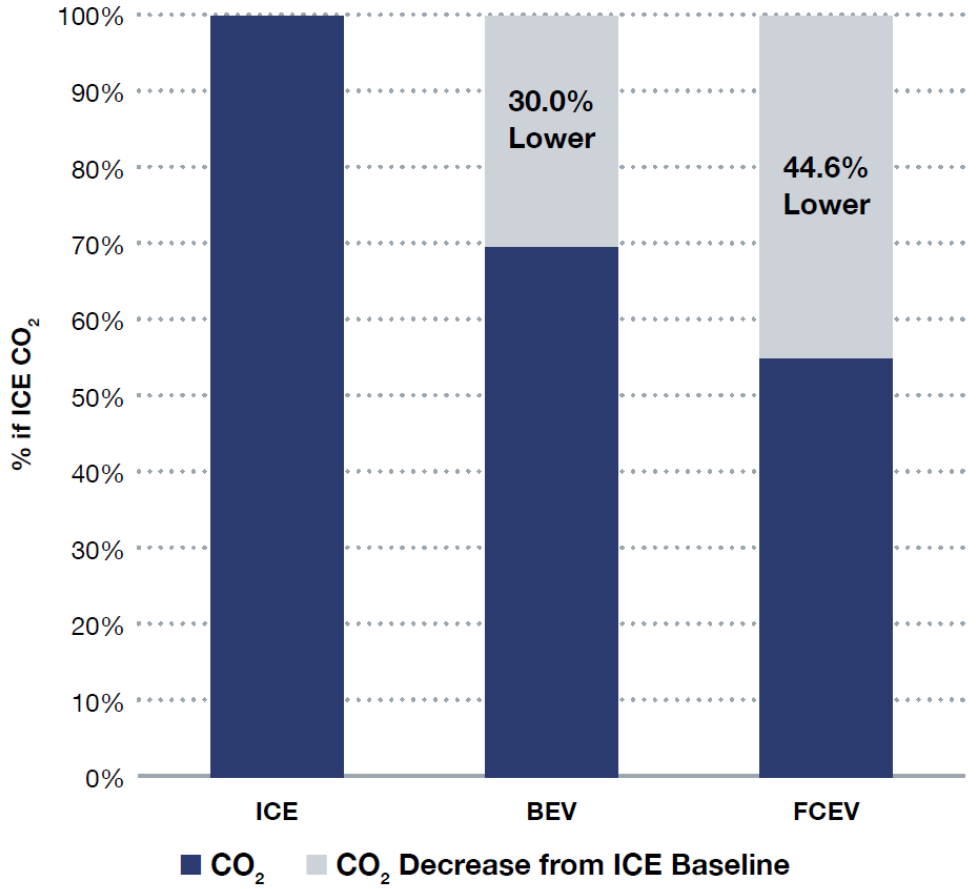
- American Transportation Research Institute analyzed **environmental impacts of Class 8** zero-emission trucks using federal & industry-sourced data to identify and compare full life-cycle emissions for a range of truck types:
  - Internal combustion engine (ICE) trucks (diesel)
  - Battery electric vehicle (BEV) trucks (electricity)
  - Fuel cell electric vehicle (FCEV) trucks (hydrogen)

- Analysis compared CO_2 emissions across the full vehicle life-cycle:
  - **Vehicle production**
  - **Energy production and consumption**
  - **Vehicle disposal/recycling**



https://truckingresearch.org/2022/05/03/understanding-the-co2-impacts-of-zero-emission-trucks/

Lifetime CO_2 Emissions for Class 8 Diesel Truck (ICE) vs BEV & FCEV

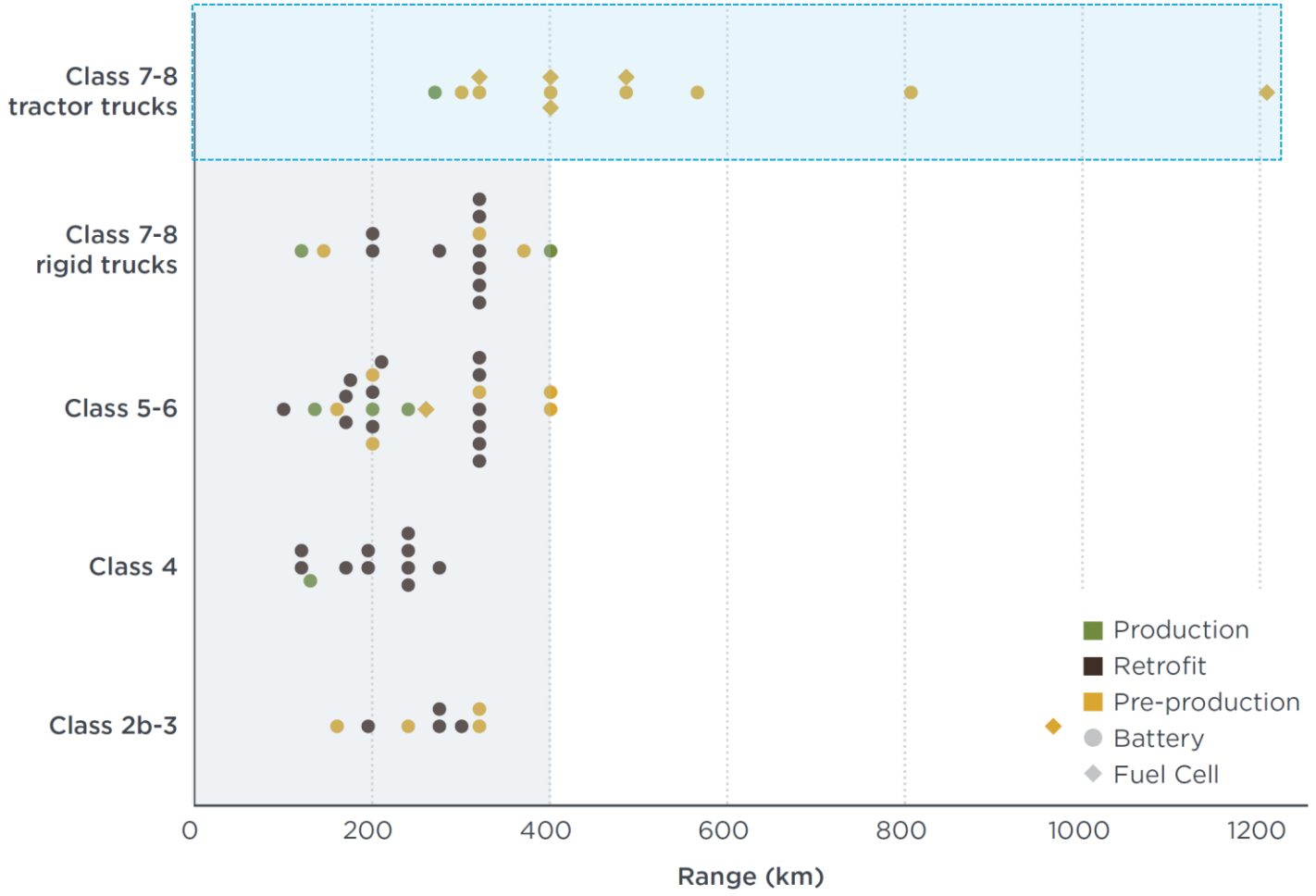


Source: The American Transportation Research Institute (ATRI)

Range of Zero-Emissions Trucks in the U.S. and Canada

Available and announced zero-emission truck models

- A large cluster of zero-emission models commercially available for Class 4 - 8 trucks.
- Nearly all of these trucks are battery powered and **max. driving ranges are between 90 – 250 miles** (150 - 400 km)
- **Fuel cell trucks with longer ranges are expected to reach the market in near future**

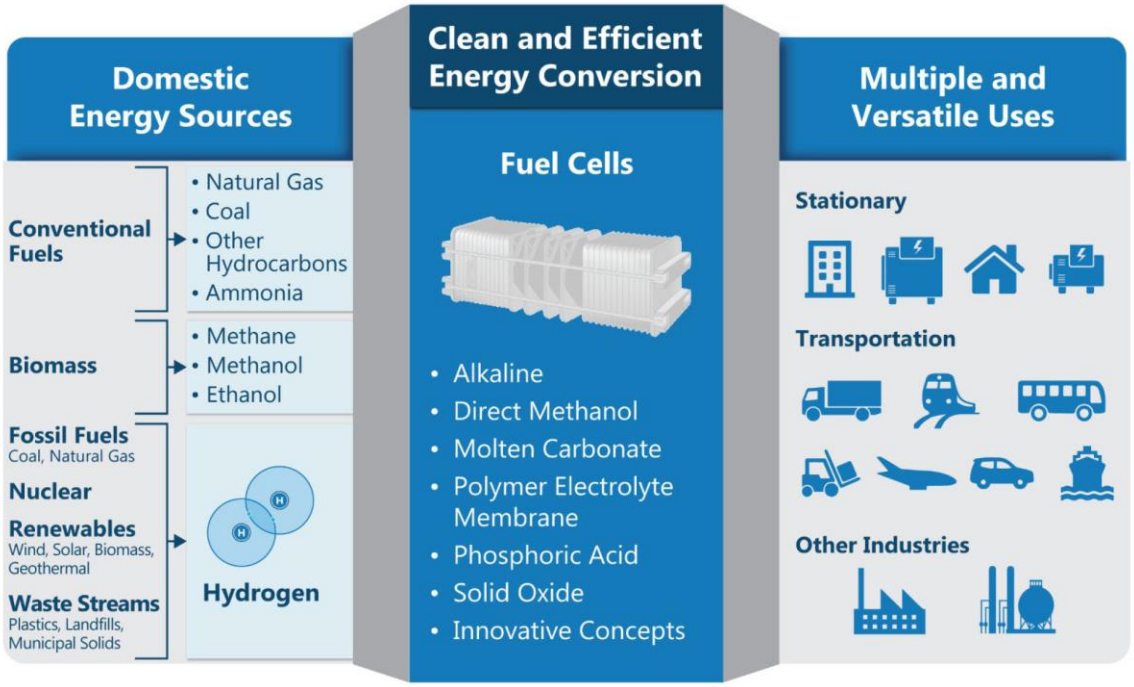


Source: ICCT (2021)

Fuel Cells for transportation: Versatility and Applications

Transportation accounts for more than a third of U.S carbon dioxide emissions

- **Ideal for applications hard to decarbonize, including long-haul heavy-duty trucks**
  - medium- and heavy-duty vehicles (HDV) that require longer driving ranges, involve heavy loads, or demand faster refueling times than may be available with battery EVs
  - MDV/HDV sector accounts for 25% of annual vehicle fuel use even though it is only 4% of the fleet
- H_2 also emerging across other sectors
  - **Marine** (clear, sulfur-free alternative to bunker fuel)
  - **Rail** (alternative where electrification lines is costly)
  - **Aviation** (weight and fueling advantage over batteries)
  - **Off-road transport, mining** (zero-emission in enclosed space)



Example: PEMFC Target for Long-Haul Trucks

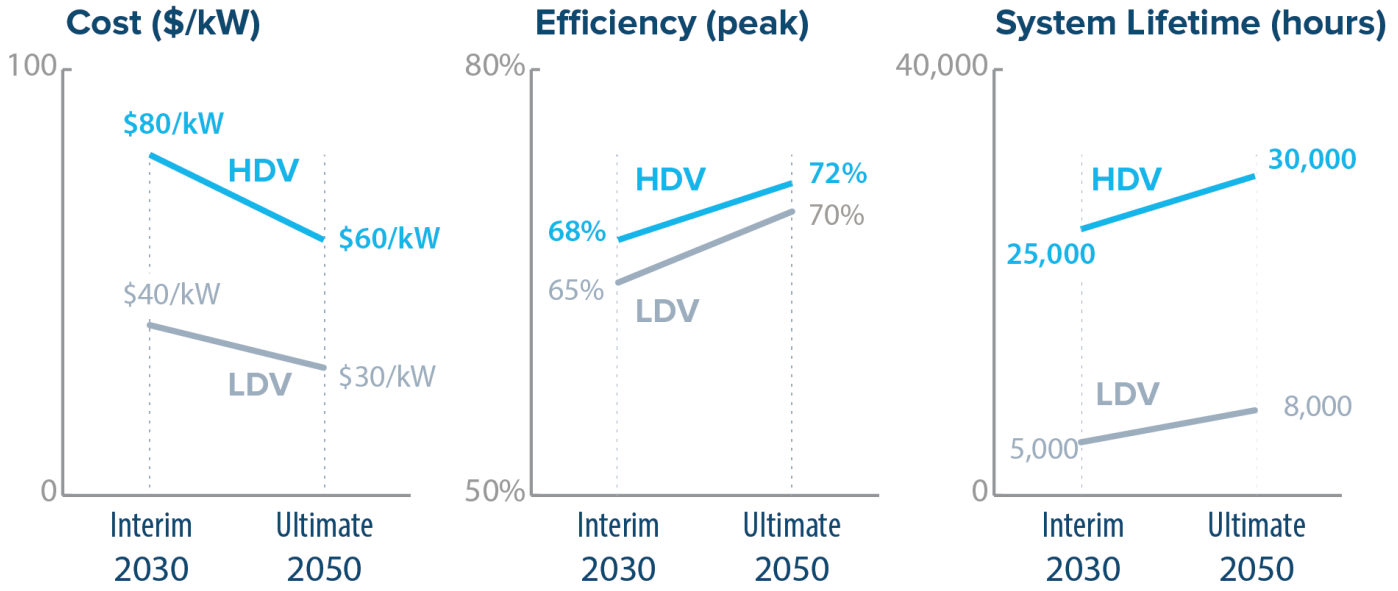
- $80/kW fuel fell system cost
- 25,000-hour durability

M2FCT will focus on fuel-cell trucks that demand a greater emphasis on system efficiency and longer lifetimes

The change in focus from light-duty (LDV) to heavy-duty vehicles (HDV) exacerbates durability and efficiency challenges for fuel cells, requiring material and system innovations that enable new classes of hydrogen vehicles that take advantage of the high efficiency, power density and scalability of this technology.

DOE Targets for Fuel-Cell Vehicles

Light Duty Vehicles (LDV) vs. Heavy Duty Vehicles (HDV)



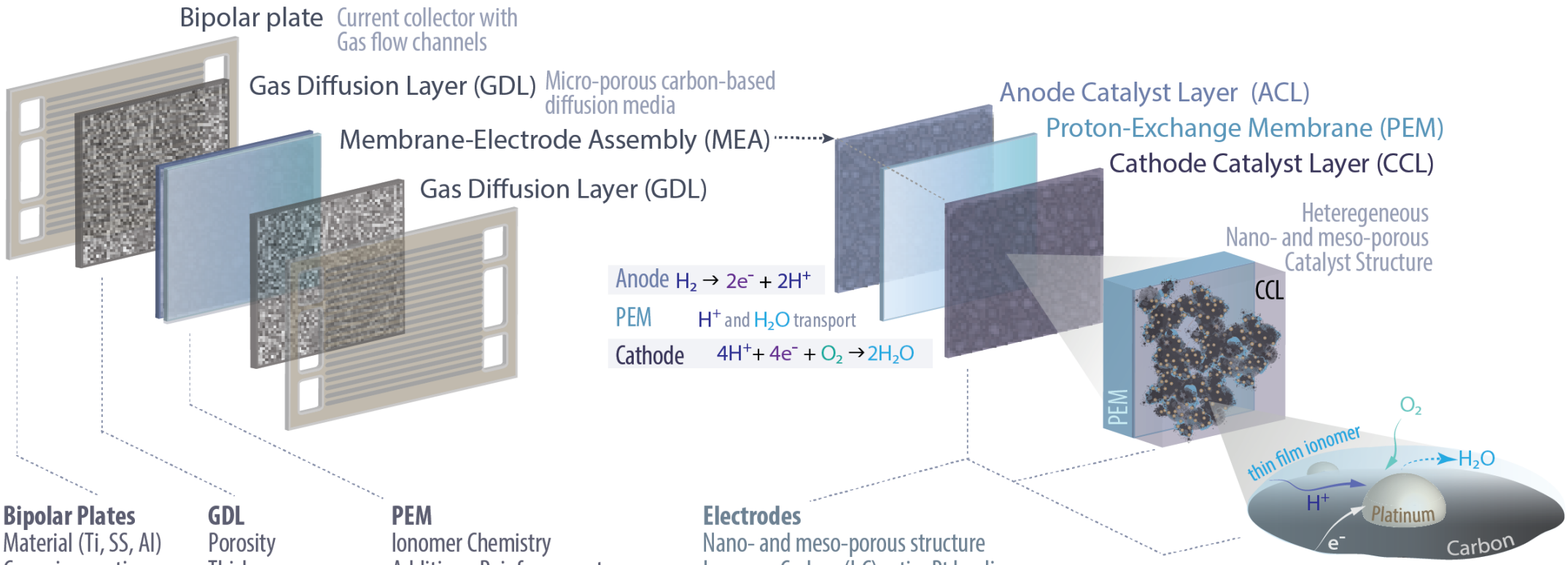
Fuel-Cell Vehicles Durability Targets

Source: DOE HFTO Program Record #19006 | Cullen,...,Kusoglu, *Nature Energy* 6, 462–474 (2021)

Notes: Current target of $50/kW for LDV is based on 100,000 units/year. HDV Targets are for Class 8 Tractor-Trailers. Ultimate targets are based on simple cost of ownership assumptions and reflects anticipated timeframe for market penetration.

Fuel-Cell Components: Design Space

Fuel Cell Components: "design space" for heavy duty stack with materials of the future



Bipolar Plates
Material (Ti, SS, Al)
Corrosion coatings
Cost and Weight

GDL
Porosity
Thickness
Carbon Type
Ionomer Coating

PEM
Ionomer Chemistry
Additives, Reinforcement
Temperature & RH dependence
Performance & Durability

Electrodes
Nano- and meso-porous structure
Ionomer:Carbon (I:C) ratio, Pt loading
Ink Formulation, Casting and Processing
Conditioning for Performance & Durability

Catalyst, Support, and Ionomers
Carbon type and structure (porosity, graphitization)
Ionomer-Electrocatalyst interactions, ionomer chemistry
Nanoparticle catalyst (alloying, ordering, monodispersity)

By A. Kusoglu

D.A. Cullen, K. C. Neyerlin, R. K. Ahluwalia, R. Mukundan, K.L. More, R.L. Borup, A.Z. Weber, D.J. Myers & A. Kusoglu, Nature Energy (2021) 462-474

M2FCT Partners: National Labs, Universities, Industry

MEA Projects

gm · Carnegie Mellon University · NIKOLA

Membrane Projects

Lubrizol · 3M · NIKOLA

Stack Projects

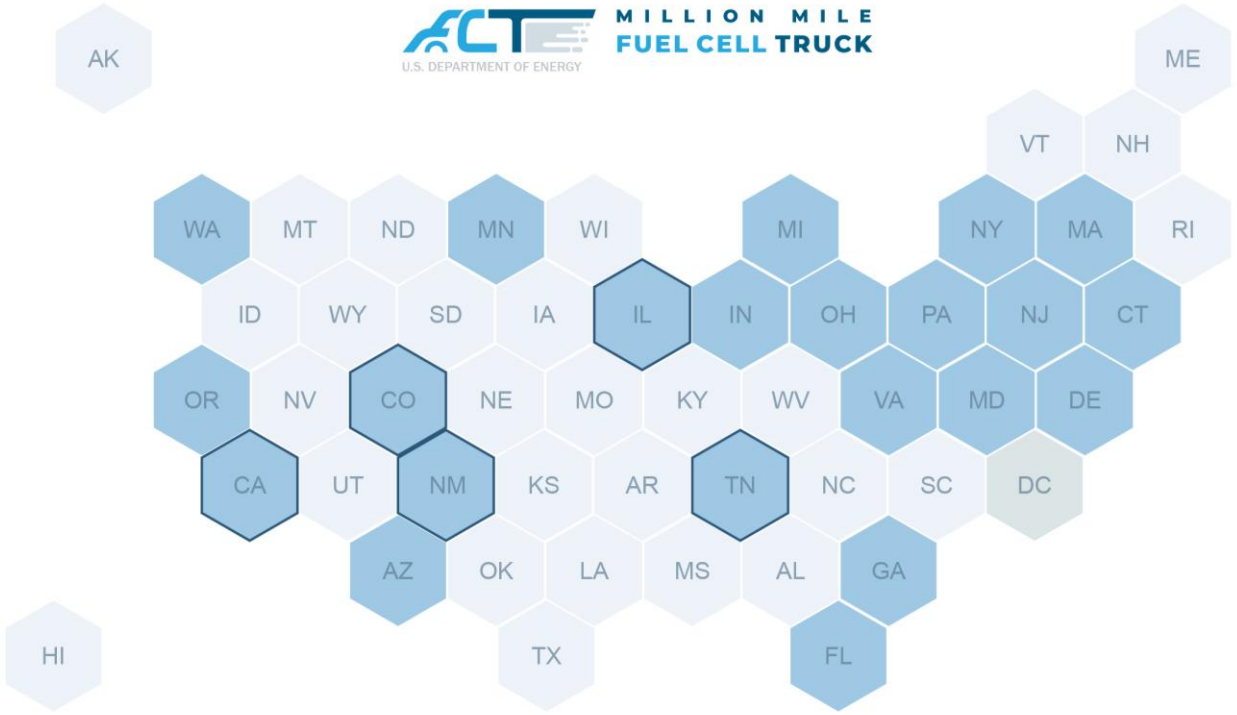
Cummins · PLUG POWER

Bipolar Plate Projects

Raytheon Technologies · NEOGRAF SOLUTIONS · TreadStone Technologies, Inc. · gm · PLUG POWER

Air Management Projects

CATERPILLAR · EATON · R&D Dynamics Corporation · MAHLE Driven by performance



LABS

Primary Labs
- LANL
- LBNL
- ANL
- NREL
- ORNL

Partners
- PNNL
- BNL
- NIST

ACADEMIA

Partners
- Cornell
- Carneige Mellon Univ.
- Colorado School of Mines
- Drexel University
- Florida International Univ.
- GeorgiaTech
- Northeastern
- UC Irvine
- UC Merced
- University at Buffalo
- University of Tennessee

INDUSTRY

Partners
- 3M Company
- Akron Polymer Products
- Ballard
- Chemours
- Cummins
- Caterpillar
- Eaton
- General Motors
- Kodak
- Lubrizol
- Mahle
- Nikola Motors
- Pajarito Powder
- Plug Power
- NeoGraf Solutions
- R&D Dynamics Corp
- Raytheon Technologies
- Strategic Analysis
- TreadStone Technologies

Main Laboratories

Los Alamos NATIONAL LABORATORY · BERKELEY LAB · OAK RIDGE National Laboratory · NREL NATIONAL RENEWABLE ENERGY LABORATORY · Argonne NATIONAL LABORATORY

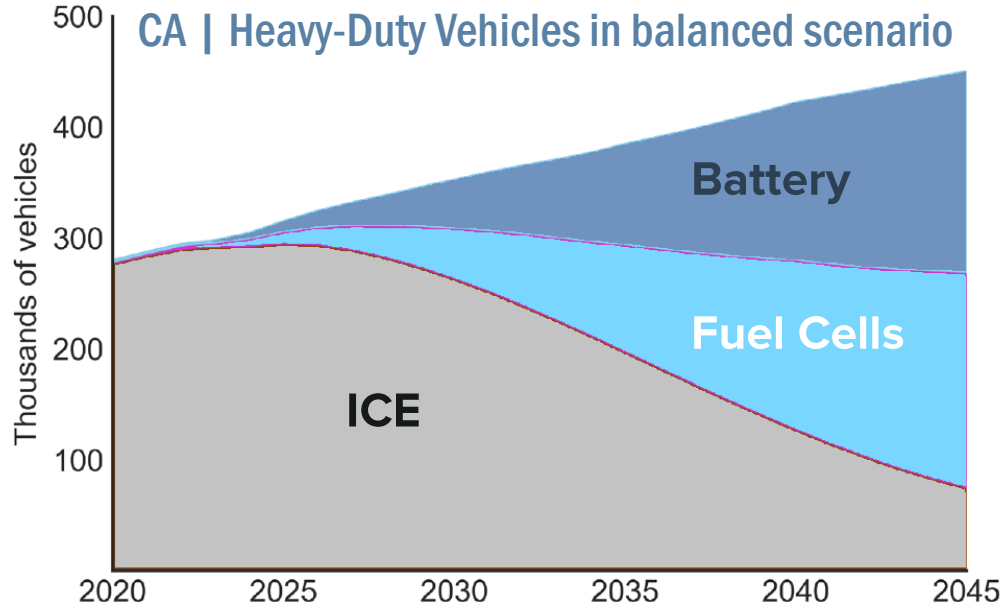
Affiliate Laboratories

Pacific Northwest NATIONAL LABORATORY · BROOKHAVEN NATIONAL LABORATORY · NIST National Institute of Standards and Technology

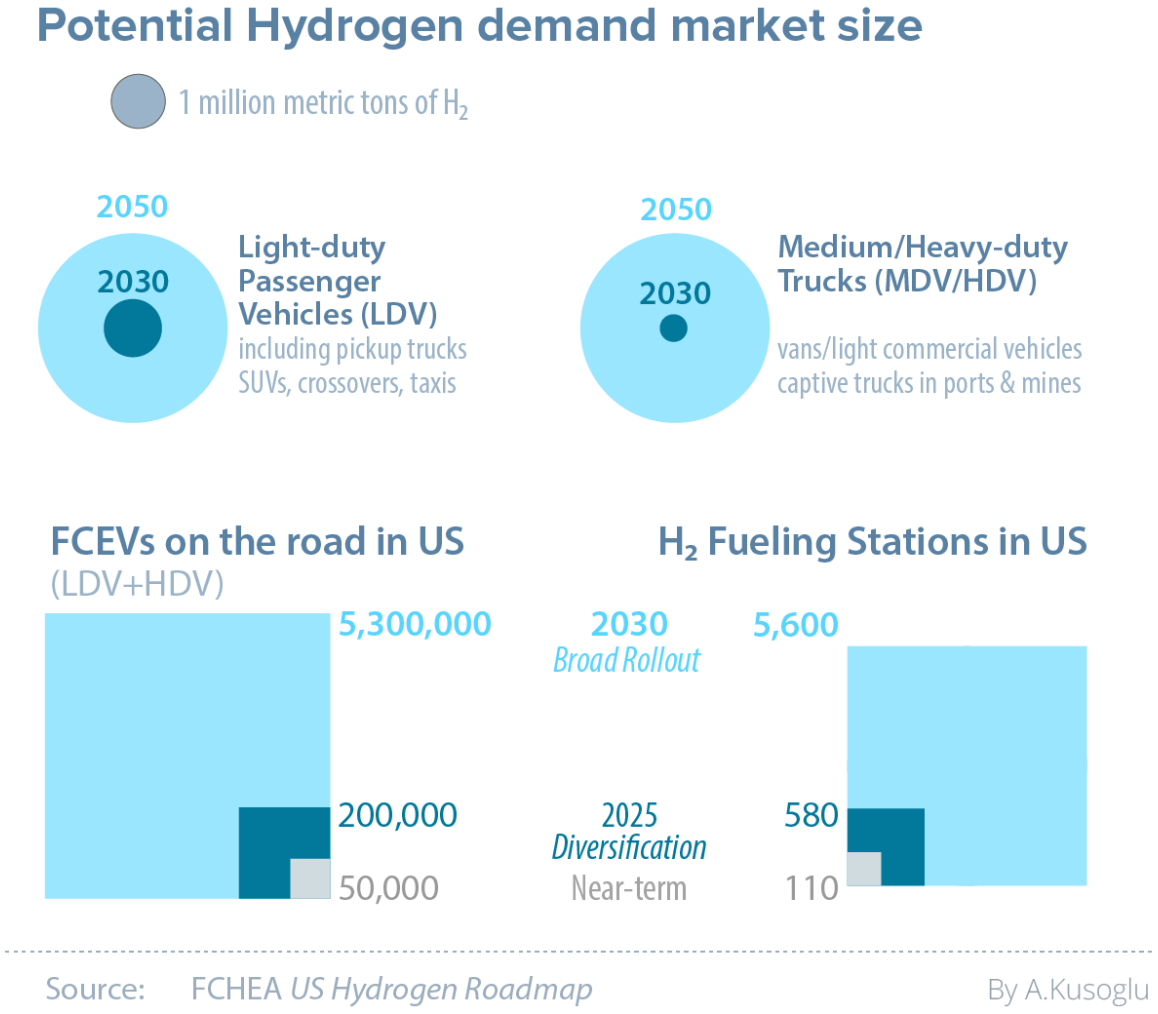
Hydrogen Roadmaps: Role of Fuel Cells

California Transportation: Heavy-Duty Fuel Cells

- A study evaluates scenarios that achieve carbon neutrality in California by 2045
  - ZEVs reach 40% - 75% of medium and heavy-duty truck sales by 2035 (depending on vehicle class), 100% of sales for transit buses by 2029.



US Hydrogen Roadmap: Fuel Cells and H_2 Stations



California's Zero-Emission Trucks Regulation

Aims to accelerate the first wave of zero-emission medium-and heavy-duty vehicles from Class 2b to Class 8

Advanced Clean Trucks

< BACK TO ALL PROGRAMS

Advanced Clean Trucks

About

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Fact Sheet

Meetings & Workshops

Regulatory Documents

Achieving California's long-term air quality, climate, and public health goals will require a transition from the conventional combustion technologies to zero emission everywhere feasible and near-zero emission powered by clean, low-carbon renewable fuels everywhere else. CARB is in the process of developing proposals for new approaches and strategies to achieve this transition. The goal of this proposed strategy is to achieve NOx and GHG emission reductions through advanced clean technology, and to increase the penetration of the first wave of zero-emission heavy-duty technology into applications that are well suited to its use.

The New York Times

New Rule in California Will Require Zero-Emissions Trucks

More than half of trucks sold in the state must be zero-emissions by 2035, and all of them by 2045.

By 2035, zero-emission truck/chassis sales would need to be 55% of Class 2b – 3 truck sales, 75% of Class 4 – 8 straight truck sales, and 40% of truck tractor sales.

Multi-State Medium- and Heavy-Duty Zero Emission Vehicle Memorandum of Understanding

Recognizes the role of heavy-duty vehicles in GHG emissions, acknowledge it as an environmental justice problem disproportionally impacting the disadvantaged communities located near freight corridors, ports, distribution centers

strategies to accelerate adoption of MHDVs as ZEV options for public transit buses and a growing number of high-mileage trucks and vans

MULTI-STATE MEDIUM- AND HEAVY-DUTY ZERO EMISSION VEHICLE

MEMORANDUM OF UNDERSTANDING

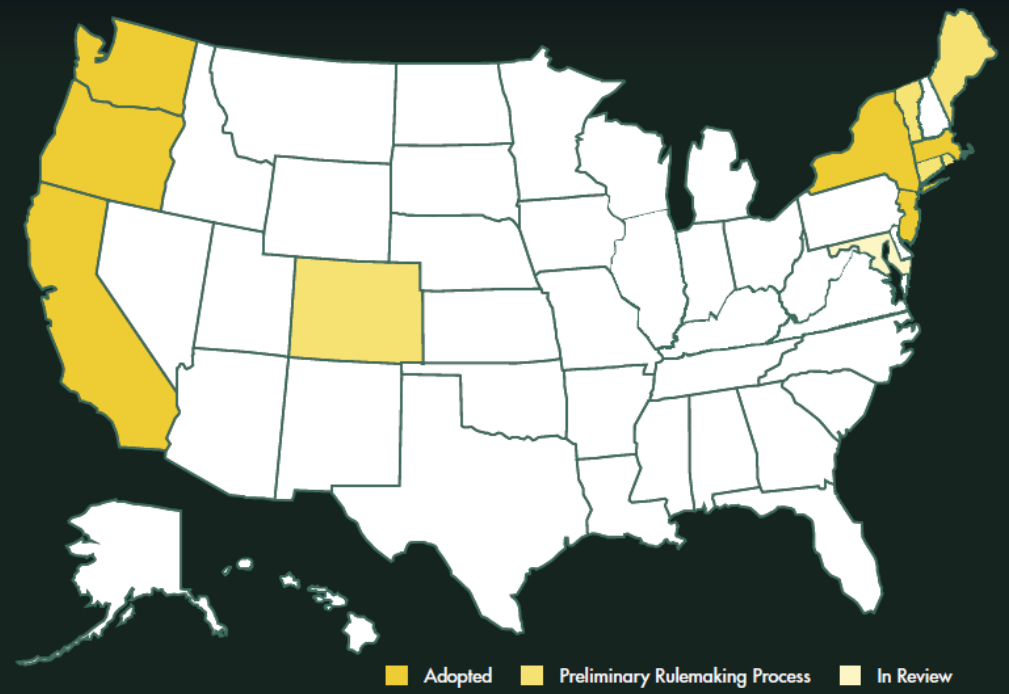
1. OVERALL COMMITMENT

- **The Signatory States agree to work together to foster a self-sustaining market for zero emission medium- and heavy-duty vehicles through the existing Multi-State ZEV Task Force**, which will serve as a forum for state coordination, collaboration and information sharing on market enabling actions, research, and technology developments.
  - Electric vehicle, as used in this document, means a battery electric (BEV), plug-in hybrid (PHEV), or fuel cell electric vehicle (FCEV).

Advanced Clean Trucks Regulations

Advanced Clean Trucks Rule Progress

Current Status of ACT Rulemaking Across the U.S.



State	Status	Beginning MY	Fleet Reporting Date
California	Adopted	2024	April 1, 2021
Oregon	Adopted	2025	June 30, 2022
Washington	Adopted	2025	Not required
New Jersey	Adopted	2025	April 1, 2023
New York	Adopted	2025	April 1, 2023
Massachusetts	Adopted	2025	Not required
Connecticut	Preliminary Rulemaking Process	-	-
Rhode Island	Preliminary Rulemaking Process	-	-
Colorado	Preliminary Rulemaking Process	-	-
Maine	Preliminary Rulemaking Process	2026	Not required
Vermont	Preliminary Rulemaking Process	-	-
Maryland	In Review	-	-
DC	In Review	-	-

Current ACT rulemaking status as of April 2022

Source: https://ww2.arb.ca.gov/news/15-states-and-district-columbia-join-forces-accelerate-bus-and-truck-electrification

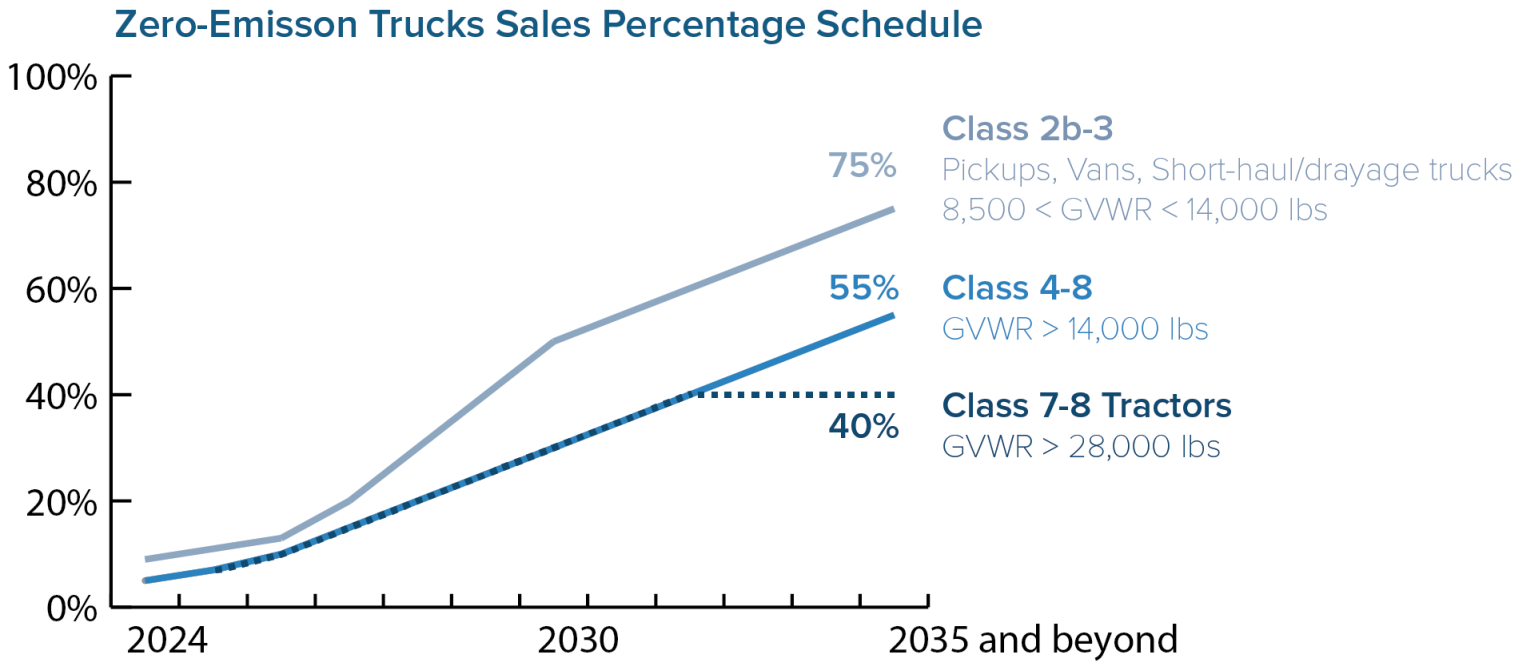
California Advanced Clean Trucks (ACT) Regulation

ACT regulation is a manufacturers ZEV sales requirement and a one-time reporting requirement for large entities/fleets

- The regulation has two components including a manufacturer sales requirement, and a reporting requirement:
  - **Zero-emission truck sales:** Manufacturers required to sell ZET as an increasing percentage of their annual California sales from 2024
  - **Company & fleet reporting:** Large employers are required to report about their existing fleet operations

https://ww2.arb.ca.gov/, https://theicct.org

- The Advanced Clean Truck Regulation is part of a holistic approach to accelerate a large-scale transition of zero-emission medium-and heavy-duty vehicles from Class 2b to Class 8.



Source: California Air Resources Board (CARB) | Visualization By A. Kusoglu

A 2022 Survey of Clean Fleets: Key Findings

A tech-neutral analysis of key insights and critical trends for today's leading on-road clean vehicle technologies

A fundamental shift away from gasoline- and diesel-based transportation has begun

- California is the market starter, but clean transportation funding and policy is spreading nationally.
- CNG and propane no longer need funding for adoption, though both still benefit from many incentives.
- Battery-electric vehicle demand is ramping up despite supply chain delays and persistently high costs.
- Renewable diesel and renewable natural gas experience record growth with support from clean fuel programs.
- **Hydrogen fuel cell vehicles edge ever closer to reality, with grant-awarded vehicles and planned stations more than doubling**

www.stateofsustainablefleets.com

Zero-Emission Buses: “5x5” technology comparison

Side-by-side evaluation of technologies operated by the same agency, in the same service environment, from the same ZEB bus manufacturer and compare that to conventional fleets.

- The first publication of the Zero Emission Transit Bus Technology Analysis report
  - Presents results of the data collected on energy, cost, performance used to populate statistics in a set of common metrics such as cost, mileage, reliability, and availability.

Figure 1: 5x5 Vehicle Matrix

FLEET	DIESEL (BASELINE)	DIESEL HYBRID	FUEL CELL ELECTRIC (FCEB)	BATTERY ELECTRIC (BEB)	LEGACY FUEL CELL
Series Grouping	1600	1550	7000	8000	FC
Technology Type	Diesel	Hybrid	Fuel Cell	Battery	Fuel Cell
Bus Qty	5	5	5	5	5
Manufacturer	Gillig	Gillig	New Flyer	New Flyer	Van Hool
Year	2018	2016	2019	2019	2010
Length	40’	40’	40’	40’	40’
Data Summary (July - December 2020)					
Fleet Mileage	110,293	95,383	112,233	64,648	82,710
Cost/Mile	$0.93	$1.11	$1.51	$1.39	$2.84
Cost/Mile (w/ credits)	$0.88	$1.09	$1.11	$0.78	$2.84
Emissions (CO_2 Metric Tons)	275	183	0	0	0
Fleet Availability	94%	85%	90%	57%	84%
Reliability (MBCRC)	15,226	8,033	10,406	8,109	3,024

Fuel cells: heavy-duty performance with zero-emissions

Mining and Construction: Why Fuel Cells

- Compared to battery-powered vehicles, fuel cell powered vehicles offer:
  - **More uptime: fuel cell trucks are refueled in minutes** (vs. 2-5 hours recharge time)
  - **Higher power output: fuel cells pack greater energy density** (far higher payload capacity than battery electric vehicles).
  - **More refueling infrastructure options**: **can be refueled at central depots or remotely** — whereas installing battery recharging infrastructure is complex and costly.

Source: Ballard

500-mile Fuel-cell truck by Hyundai in California

Largest deployment of hydrogen Class 8 trucks in the U.S is announced on July, 2021

- Hyundai will test its Xcient Fuel Cell Class 8 semi trucks in California for two projects
  - NorCal Zero project funded by CARB and CEC
  - 2 FC Trucks operate in SoCal warehouses
- 30 trucks with fleet operators beginning in mid 2023. Hyundai claims this will thus far be the largest deployment of hydrogen Class 8 trucks in the United States

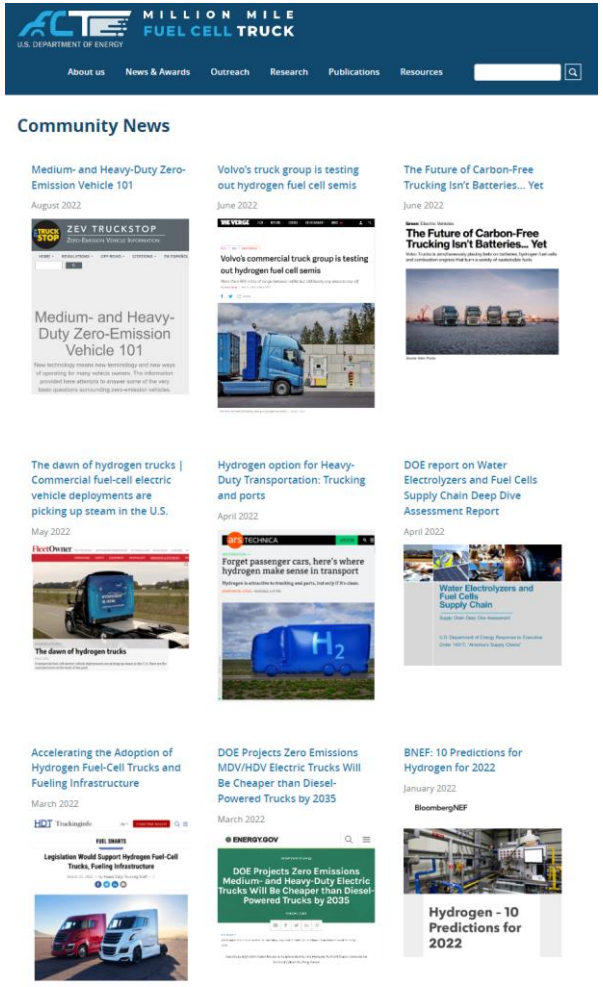
https://www.greencarreports.com/news/1133014

- **Hyundai Fuel Cell Truck Demo Pictures**
  - Bay Area, California (Dec 2021)

Photo Credit: Bay Area Air District

Million Mile Fuel Cell Trucks: Website and Resources

m2fct.org



Resources

All | Roadmaps | Hydrogen & Fuel Cells | Environmental Impact | Heavy-Duty Transportation | Tools and Analysis

Net Zero by 2050: A Roadmap for the Global Energy Sector
May 2021
Topics: Environmental Impact, Heavy-Duty Transportation, Hydrogen & Fuel Cells, Roadmaps
By IEA

Alternative Fuel Life-Cycle Environmental and Economic Transportation (AFLEET) Tool
Jan 2020
Topics: Heavy-Duty Transportation, Tools and Analysis
https://greet.es.anl.gov/afleet_t...
By ANL

Road Map to a US Hydrogen Economy
Oct 2020
Topics: Hydrogen & Fuel Cells, Roadmaps, Heavy-Duty Transportation
By FCHEA

Decarbonizing road transport by 2050
Dec 2021
Topics: Heavy-Duty Transportation, Environmental Impact
By ICCT

Zero-Emission Movement: Fuel Cell Truck Fact Sheets
Jun 2020
Topics: Heavy-Duty Transportation, Hydrogen & Fuel Cells
By CHBC

Outlook| Fuel Cell Electric Vehicles
Jun 2021
Topics: Heavy-Duty Transportation
https://www.stateofsustainable...

Fuel Cell Electric Trucks | An analysis for regional freight transport
Jun 2020
Topics: Heavy-Duty Transportation, Hydrogen & Fuel Cells
North American Council for Fre...
By NACFE

Impacts of Heavy-Duty Diesel Truck Emissions
Jan 2020
Topics: Environmental Impact, Heavy-Duty Transportation
By LBNL

Future Heavy-Duty Emission Standards: An opportunity for International Harmonization
Nov 2019
Topics: Environmental Impact, Heavy-Duty Transportation
By ICCT

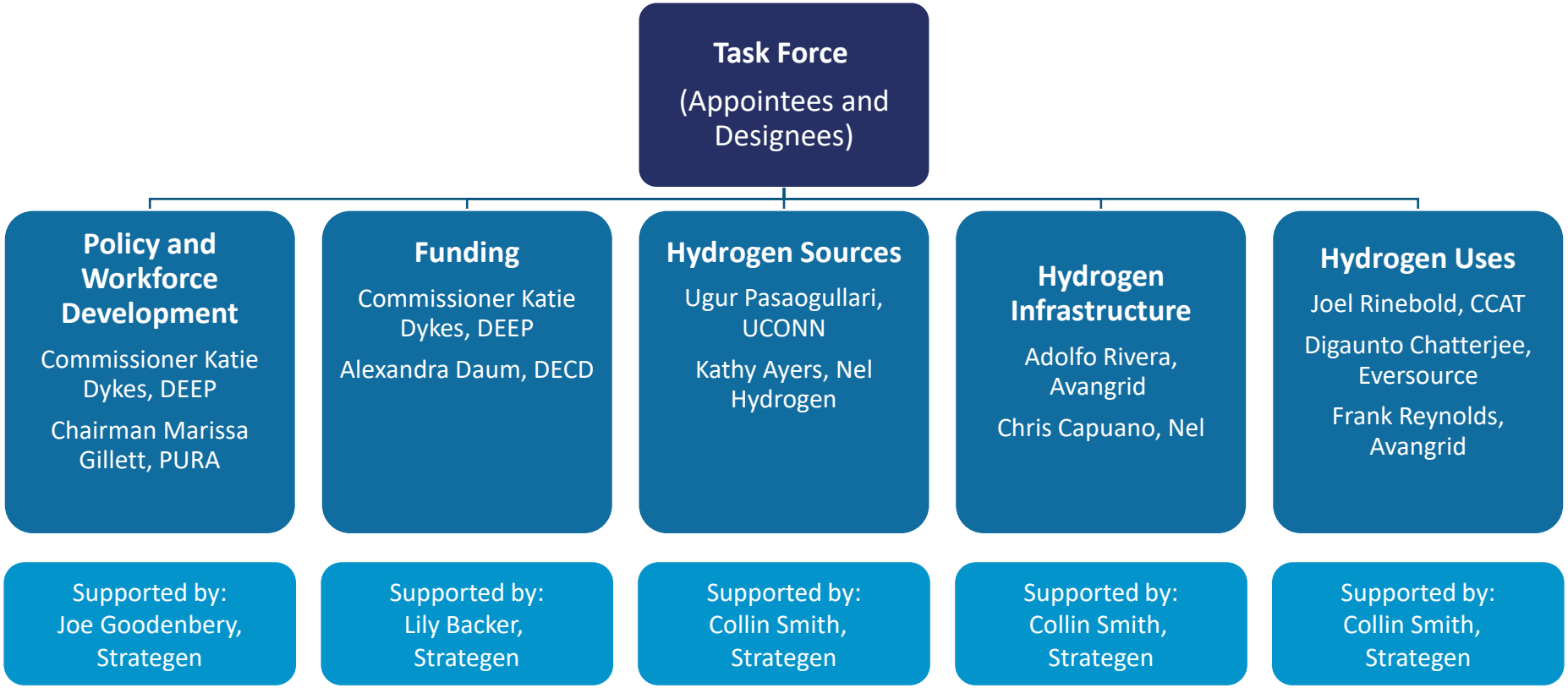
Closing the Transportation Emissions Gap with Clean Fuels
Jan 2021
Topics: Environmental Impact, Heavy-Duty Transportation
By Rhodium Group

Fuel Cell Electric Trucks: A Vision for Freight Movement in California —and Beyond
Aug 2021
Topics: Heavy-Duty Transportation, Hydrogen & Fuel Cells
By CaFCP

Business Cases for Fuel Cells and Hydrogen Applications in Europe
Oct 2017
Topics: Heavy-Duty Transportation, Hydrogen & Fuel Cells
By FCH JU (Europe)

Working Group Updates:
Review of Proposed Deliverables

Working Groups will be coordinated and supported by Strategen



The Policy & Workforce Development, Funding, Sources, and Infrastructure Working Groups are all accepting additional co-chairs.

Sources Working Group

+ **Co-Chairs –** Ugur Pasaogullari (UCONN), Kathy Ayers (Nel)
+ **Strategen Support –** Collin Smith
+ **Proposed Deliverables**

1. Proposed definition of clean hydrogen *(in collaboration with the Policy and Workforce Development Working Group)*.
2. Total production potential of clean hydrogen within Connecticut, developed across at least 3 scenarios (e.g. High, Medium, Low).
3. Impact on local manufacturing potential and industry in each of the hydrogen production scenarios identified above *(in collaboration with the Policy and Workforce Development Working Group)*.
4. *(If not addressed by other state agencies)* Comparison of Connecticut's hydrogen production potential to other Northeast states in the Regional Clean Hydrogen Hub (e.g. NJ, NY, MA).
5. Scenario-based production curves for clean hydrogen, identifying the amount of hydrogen that could be produced at different price points based on cost of underlying energy feedstocks.

Uses Working Group

+ **Co-Chairs –** Joel Rinebold (CCAT), Digaunto Chatterjee (Eversource), Frank Reynolds (Avangrid)
+ **Strategen Support –** Collin Smith
+ **Proposed Deliverables**

1. Structured framework to prioritize hydrogen end use applications relevant for Connecticut.
2. Total demand size of priority hydrogen end uses identified through the framework, developed across at least 3 scenarios (e.g. High, Medium, Low).
3. Scenario-based demand curves for each hydrogen end use, identifying:
    a. Price points at which hydrogen would become competitive for different end uses.
    b. Expected demand at those price points.
4. As appropriate, coordination with DEEP's efforts to develop project concepts for clean hydrogen use in a Regional Clean Hydrogen Hub that would be accepted by stakeholders in a regional proposal.

Infrastructure Working Group

+ **Co-Chairs –** Adolfo Rivera (Avangrid), Chris Capuano (Nel)
+ **Strategen Support –** Collin Smith
+ **Proposed Deliverables**

1. Geographic analysis detailing the locations of existing infrastructure and proximity to hydrogen production and offtake sites.
2. High-level assessment of needed infrastructure and associated costs.
3. Identification of priority areas for hydrogen infrastructure development, taking into account environmental justice and economic development objectives.

Policy and Workforce Development Working Group

+ **Co-Chairs –** Commissioner Katie Dykes (DEEP), Chairman Marissa Gillett (PURA)
+ **Strategen Support –** Joe Goodenbery
+ **Proposed Deliverables**
  1. A set of policy guiding principles that can be used by stakeholders and other workgroup chairs to align their research and recommendations with existing state policy and processes on clean hydrogen.
  2. A hydrogen policy readiness assessment that will identify the current status of hydrogen policy, regulation, and oversight in Connecticut.
  3. Coordination with other working group efforts that may impact expected hydrogen policy development.
  4. Hydrogen policy best practices assessment, potentially including flags of specific hydrogen policies that could be most relevant for Connecticut's regulatory framework.
  5. An assessment of hydrogen job creation opportunities, based on existing literature, Connecticut-specific opportunities, and best practices on workforce development and transition.

Funding Working Group

+ **Co-Chairs –** Katie Dykes (DEEP), Alexandra Daum (DECD)
+ **Strategen Support –** Lily Backer
+ **Proposed Deliverables**
  1. Recommended actions for the state to position itself competitively for funding opportunities.
  2. Provide an assessment of regions and resources that can utilize the funding available through the Targeted Brownfield Development Loan Program and make recommendations for tax advantaged opportunities.
  3. Outline a potential toolkit of incentives or other compensation mechanisms to advance the development of hydrogen infrastructure and use in Connecticut.

Working Group Updates:
Approval of Charters

Working Group Updates:
Schedule and Logistics Update

Working Group Schedule

	September	October	November	December
Funding	9/27 4-5pm	10/26 10:30am-12 pm	11/18 10:30am-12 pm	12/15 10:30am-12:00 pm
Infrastructure	9/28 2-3pm	10/24 2-3pm	11/17 3-4pm	12/19 3-4pm
Policy & Workforce Development	9/26 3-4pm	10/20 12-1pm	11/29 12-1pm	12/15 12-1pm
Sources	9/27 1-2pm	10/25 2-3:30pm	11/17 11am-12pm	12/20 1-2:30pm
Uses	9/27 12-1pm		11/22 12-1pm	

Public Comment

Engage

Organizing Tours of Various Facilities

FuelCell Energy

C2E2 Center for Clean Energy Engineering

PROTON PART OF nel ON SITE

Dominion Energy

Next Meeting – October 11, 2022

Fuel Cell Energy

Dial-In	**Webinar**	**In Person**
(949) – 346 – 4134	Click here to join the meeting	Fuel Cell Energy
ID: 781 548 359#	Meeting ID: 276 913 467 857	539 Technology Park Dr
	Passcode: QgeLuG	Torrington, CT 06790

FuelCell Energy

For access to Task Force materials, visit:

www.ctgreenbank.com/hydrogentaskforce

Thank You

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