Incentives to Support the Transition to Zero Emissions for Medium- and Heavy-duty Sectors in Oregon

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Executive Summary

Oregon's medium- and heavy-duty fleets must transition to zero emission technologies for the state to meet its climate goals. The transition will be complex and will only succeed with robust partnerships between the public and private sectors. There is a clear and significant gap in available funds to support fleets as they transition to Zero Emission Vehicles.

The Oregon Legislature tasked the Oregon Department of Environmental Quality and the Oregon Department of Transportation to explore MHD vehicle and charging infrastructure incentive programs that are needed to transition from gasoline or diesel to electricity or hydrogen. This report presents information from existing state programs, best practices from Northeast States for Coordinated Air Use Management and input from stakeholders.

The study's review of Oregon and federal incentives to speed adoption of MHD ZEV found that the existing state and federal grant programs are insufficient, offering funding in Oregon for only a few dozen vehicles and accompanying charging infrastructure each year. Recent federal legislation provides funding and incentives that will encourage the transition to ZEV particularly for school buses, transit buses, and port-related equipment. Oregon's Clean Fuels Program provides incentives to fleets that use lower-carbon fuels like electricity and hydrogen. However, more is needed.

This report's findings include feedback from fleet owners, manufacturers, non-profits and other interested parties. There is strong support for state level incentives now to reduce costs, speed adoption and meet regulatory requirements for MHD ZEV adoption. Also, since other west coast states offer ZEV MHD incentive programs to reduce ZEV vehicle and infrastructure costs, MHD manufacturers and fleets owners expressed concern that Oregon could be at a competitive disadvantage.

To increase adoption, the agencies encourage incentive programs that:

- Can be established quickly and are flexible to reflect the changing ZEV ecosystem now and in the future.
- Include dedicated sources of funding to support short- and long-term fleet and charging conversion.
- Can be stacked with other incentives as funding levels change over time.
- Emphasize outreach to all of Oregon's fleets in ways that are accessible to them.
- Promote opportunities that are equitable to all parts of the state and fleet owners.

There is broad recognition of the need for supportive state-level incentives among fleet owners, truck manufacturers, and environmental organizations throughout Oregon, and strong endorsement for creating state incentive programs. Along with greenhouse gas reductions, the transition to ZEV also reduces tailpipe air pollutants, especially important in areas that are overburdened by transportation emissions. A state-level incentive program will help truck manufacturers comply with the Advanced Clean Trucks regulation and reduce the cost barrier for Oregon fleets to convert to ZEV and fueling infrastructure.

Recommendations

Oregon cannot wait for, nor rely on, federal or private funding alone to advance the adoption rate of MHD ZEV. A sustainable revenue source should be dedicated to support incentives for the transition to MHD ZEVs. State-level incentive programs must be nimble and leverage other

efforts such as regulatory actions and responsive contract terms. This will fill in gaps between intermittent funding opportunities and be responsive to barriers for fleet transition. State-level programs should also support equity goals for specific impacted and underrepresented communities and fleet owners. Transitioning MHD to ZEV is a marathon, not a sprint. Technology is evolving quickly but it will take decades for fleets to turn over.

After considering other incentive programs around the country, best practices, and input from stakeholders, DEQ and ODOT are recommending any future Oregon incentive programs be designed to be:

Adaptable. The implementing agencies need broad authority that allows for quick program start-up and ongoing refinements that can quickly respond to changes to the fleet, regulatory environment, and market trends.

Sustainable. Dedicated sources of revenue are needed to cover the incremental up-front costs of the vehicles and fueling infrastructure now and in the future. Some sectors will be quick to convert but others will be much more challenging, and incentives must address both timelines.

Stackable. To be most effective, state-level programs must be able to leverage federal and other funding opportunities like those offered by electric utilities.

Flexible. Best practices in other states show the value of creating multiple, targeted incentive programs that leverage federal funds and enable the state's private fleets to decide which combination of incentives they need. Optimal incentive options include vehicle purchase incentives linked with infrastructure funding; separate infrastructure-only and vehicle-purchase-only incentives; and funding to support public infrastructure along highways and in communities.

Accessible. The key to successful incentive programs is targeted and funded outreach to engagement and support Oregon's fleet owners. The incentive programs should provide administrative and technical support for applicants and awardees. Many of Oregon's fleet owners are small businesses. Agency staff should ensure incentives are available to those who need them most. Outreach to women- and minority-owned fleets as well as those that are based in communities with higher levels of pollution must also be emphasized. Outreach should include the creation of a website that is easily understood by fleet owners and provides information that best fits their needs.

Equitable. New incentive programs should dedicate a percentage of the funding for fleets that serve in and benefit environmental justice communities and areas that are disproportionately impacted by high levels of air pollution. Reserved funds should also allow for direct support for historically underrepresented, BIPOC- and minority-owned fleets.

Table of contents

Purpose of the report

The 2021 Legislature directed the Oregon Department of Environmental Quality and Oregon Department of Transportation to report to the Joint Committee on Transportation, by December 2022, with an analysis of existing incentives available to support the transition to Zero Emission Vehicles (ZEV) for Medium- and Heavy- Duty (MHD) transportation sectors. The agencies were further directed to research incentives offered in other states and to provide recommendations on expanding or creating incentives to support Oregon businesses in their ZEV fleet transition. This report includes analyses on incentives for both vehicles and ZEV fueling infrastructure.

The transition to ZEV in the MHD sector is a key strategy to decarbonize transportation emissions to meet the state's climate goals. Almost as important are the improvements to local air quality and the resulting reduction in the harmful impacts of diesel emissions particularly for Oregon's overburdened communities. Transitioning to ZEV will also speed the development and technological readiness of vehicles and charging infrastructure, while lowering costs and protecting consumers from the volatility of the global crude oil market.

As identified in the Every Mile Counts Alternative Fuels Study, the high cost of vehicles and fueling infrastructure is the main challenge for Oregon fleets to transition to ZEV technologies. This report addresses the current state of incentives available to Oregon's fleets and opportunities for additional incentives, what other states are doing, and what types and levels of incentives are best for Oregon's fleets.

Background

In 2021, Oregon experienced extreme weather events, chronic heat and drought, flooding and intense wildfires as a result of climate change. Governor Kate Brown acknowledged and supported Oregon's efforts to address climate change through the reduction of greenhouse gas emissions.[1] According to the Oregon Global Warming Commission, state-wide emissions must be reduced by over 50% to meet Oregon's 2035 GHG reduction goal.[2]

In the United States, the transportation sector is one of the largest contributors of human caused GHG emissions; in Oregon, it is the largest source and accounted for at least 35% of all emissions in 2019.[3] The combustion of fossil fuels in cars, trucks, commercial aircraft, and locomotives contribute the most GHG emissions.[4] Reducing the use of fossil fuels in the transportation sector will decrease GHG emissions, including carbon dioxide, methane, and nitrous oxide. It will also reduce criteria pollutants and other toxic air pollutants such as diesel particulate matter.

Light-duty vehicles, which are predominantly cars and SUVs, account for most of the transportation related carbon emissions, while medium- and heavy-duty vehicles, which are predominantly vans and trucks, are a close second. MHD vehicles represent a small portion of vehicles on the road but contribute approximately 25% of the overall carbon emissions.[5] A report published by MJ Bradley & Associates in 2021 showed MHD vehicles in Oregon emit an estimated 9.3 million metric tons of greenhouse gases annually. The same report showed Oregon's MHD fleet emitting 70% of nitrous oxide and 64% of particulate matter.[6] The MHD

[1] EQC votes on CPP
[2] Oregon Global Warming Commission 2020 Biennial Report to the Oregon Legislature
[3] Oregon Greenhouse Gas Emissions from 1990-2019
[4] ELPA: Fast Facts on Transportation Greenhouse Gas Emissions
[5] Motor Vehicle Emission Simulator (MOVES3), US Environmental Protection Agency.
[6] Oregon Clean Truck Program, MJ Bradley and Associates, 2021.

industry is essential for moving goods throughout the country and within Oregon. Nationally, the trucking industry employs nine million workers.[7] Providing incentives for the transition to MHD ZEV will help Oregon make progress on air quality and climate goals while supporting the businesses and jobs associated with goods delivery.[8]

In 2019, the Oregon Legislature passed HB 2007 which established regulations on older model diesel trucks in the Portland Metro area and directed Oregon DEQ to allocate approximately $40 million from the Environmental Mitigation Trust Fund to clean them up. Among other actions the bill established the Joint Task Force on Supporting Businesses in Reducing Diesel Emissions to consider funding strategies to help businesses reduce emissions from diesel engines. The task force evaluated funding strategies, including new concepts for taxes, fees, and contract requirements or funding set-asides. The final report discussed strategies to reduce emissions and how to fund them. This report builds on that effort by focusing on MHD ZEV and updates the information on incentives and program design.

One of DEQ's priorities is to reduce emissions from transportation by requiring that an increasing percentage of new vehicle sales in Oregon be ZEVs. Oregon DEQ also runs the Oregon Clean Vehicle Rebate Program, the Clean Fuels Program, and several grant programs that provide incentives to reduce the costs associated with ZEVs and fueling infrastructure. The recent adoption of the Climate Protection Program ensures that greenhouse gas emissions across Oregon will need to decrease through 2050. The proposed updates to the Employee Commute Options Program should also reduce transportation emissions.

ODOT's role in transportation electrification is to convene state agencies and entities, and to facilitate the equitable deployment of electric vehicle (EV) charging infrastructure that is accessed by and/or benefits the public, including administering federal and state charging infrastructure funds. ODOT administers the National EV Infrastructure Formula Program from the 2021 Bipartisan Infrastructure Law, the Low or No Emission Vehicle Program from the Federal Transit Authority, and in 2023 will be administering an EV Community Charging Rebate program for the installation of Level 2 chargers.

The following provides a more in-depth discussion of key actions that Oregon is taking in the MHD space.

Multi-State MHD ZEV Action Plan

In 2021, Oregon joined a diverse coalition of 19 jurisdictions in the United States and Canada in signing on to a Multi-State Medium- and Heavy-Duty Zero Emission Vehicle Memorandum of Understanding.[9] The Northeast States for Coordinated Air Use Management (NESCAUM) led the MOU Action Plan development, which emphasizes an equitable transition that considers overburdened communities impacted by MHD emissions. The goal of this MOU is to reduce GHG emissions and air pollution through adoption of zero-emission trucks, vans, and buses. The plan sets targets of at least 30% of new MHD vehicle sales to be ZEV by 2030, and 100% of sales to be ZEV no later than 2050. The MOU recommended the development of an Action Plan to accelerate the deployment of MHD ZEVs.

[7] "Economics and Industry Data," ATA, accessed October 20, 2021, https://www.trucking.org/economics-and-industry-data.
[8] Oregon Global Warming Commission 2020 Biennial Report to the Oregon Legislature
[9] Multi-State Medium- and Heavy-Duty Zero Emission Vehicle Memorandum of Understanding https://www.nescaum.org/documents/mhdv-zev-mou-20220329.pdf/

Action plan strategies include the adoption of the Advanced Clean Trucks rule (ACT), developing and/or expanding incentives for vehicle purchase and installing fueling or charging infrastructure, incorporating work force development and training, and encouraging sector specific adoption. Recommendations from the action plan are summarized in this report under the section "Incentive Program Design Considerations".

Advanced Clean Trucks Rule

The Advanced Clean Trucks rule, adopted in 2021 by Oregon's Environmental Quality Commission, requires medium- and heavy-duty vehicle manufacturers to sell ZEVs as a certain percentage of total sales, beginning with the 2025 vehicle model year. The term ZEV includes battery electric vehicles powered solely by an electric motor and battery; plug-in hybrid electric vehicles powered by a combination of an electric motor and a fossil-fueled internal combustion engine; and fuel cell electric vehicles powered by an electric motor fueled by hydrogen. Manufacturers must increase their ZEV truck sales percentage over time depending upon the class size of the truck.

The ACT rule is foundational to reducing greenhouse gas emissions because it ensures the availability of medium- and heavy-duty ZEVs in Oregon. Emissions reductions as a result of the rule are expected to be between 1.8 and 2.4 million metric tons by 2040. Additionally, ZEV trucks have no tailpipe emissions which also result in a reduction of nitrogen oxide and particulate matter emissions. While the ACT rule requires manufacturers to have ZEVs available, an incentive program would support and encourage Oregon fleets to buy and use ZEV trucks.

Oregon's Clean Fuels Program

The Clean Fuels Program has made significant strides since it began in 2016, reducing approximately 6.5 million tons of greenhouse gas emissions and displacing over 1.5 billion gallons of fossil fuels. The program's success and progress thus far can be summarized in three distinct outcomes:

- Companies producing biofuels are using cleaner methods to make them and delivering them in greater volumes to Oregon. Renewable forms of diesel, natural gas, propane, and electricity have emerged as commercially viable and cost-effective replacements of their fossil versions.

- Biofuels and electricity use are reducing tailpipe pollution including carbon monoxide, nitrogen oxides, and particulate matter and improving public health of Oregonians. This is especially important for Oregon's historically overburdened communities that are located near major transportation corridors, multimodal facilities, and distribution hubs, where they encounter disproportionately high amounts of pollution.

- The Clean Fuels Program has fostered a $150-million-a-year-plus market where investments are being made to increase the production of lower-carbon fuels, spark new innovations in technology, and invest in infrastructure to deliver these fuels across the state. There has been no significant rise in fuel prices and in fact the Clean Fuels Program (CFP) has reduced the cost of low-carbon fuels and created financial incentives to decarbonize the transportation sector.

The CFP incentivizes lower-carbon fuels through the generation of credits which can be sold and used to reduce the total cost of ownership. Since electricity is a lower-carbon fuel, the owners of

the chargers are eligible to generate CFP credits. Revenue from the sale of those credits can be used to offset the cost of the electricity itself or any other capital or operating costs.

Existing incentive programs in Oregon

Current incentives are funded through three revenue streams State (including VW Settlement), Utility and Federal, described below and summarized in Table 3. Each revenue stream includes specific parameters that guide eligibility and project design. Federal funds generally come with additional restrictions, are not guaranteed, and vary in amount year by year. Federal funding streams have been separated in the table and the report.

Table 1: Oregon Funding Programs Supporting the Adoption of MHD ZEV

MHD ZEV Transportation Funding Mechanisms in Oregon (2022)									
Point Agency	**Program**	**Eligibility**	**Incentive Levels**	**Coverage for Infrastructure**	**Small/Minority-Owned Fleets/Priority Communities**	**Scrappage**	**Stacking**	**Funding Source**	**Funding Amount**
State Funding Mechanisms									
DEQ	Diesel Emissions Mitigation Grants	2010 or older diesel (Class 4-8)	25-100% of project costs	Yes	Yes	Yes	May stack with private funds	VW Settlement	~$8 million thru 2025
DEQ	Charging Pilot	Match support and commitment to ZEV Fleet	80-100% of project costs and 50-100% of planning costs	Yes	Yes	No	May stack with local or federal funds	State	$15 Million (one time)
Federal Funding Mechanisms									
DEQ	Diesel Emissions Reduction Act	2010 or older diesel vehicle (Class 4-8)	25-45% of project costs	Yes; limited to Battery Electric Vehicle charging units assoc. with vehicle replacement	No	Yes	May stack with local, private or non-VW state funds	Federal - EPA	~$530,000 per year@
DEQ/ODOT	Congestion Mitigation and Air Quality	Geographic/ Buy America Compliant/ Varies with project type	80% of project costs	Yes	Yes	Variable	May stack with State and private funds (including utility)	Federal - FHWA	$250,000 per year
ODOT	Low/No (Section 5339(c) grants)	Purchase or Lease of transit vehicles/infrastr.	80-90% of project costs	Yes	No preference indicated; ODOT or Transit agency applies	No vehicle or facility requirements	May stack with state funds	Federal - FTA	~$5.5 billion over 5 years (nationwide); varies by award
ODOT	National Electric Vehicle Infrastructure Act	Geographic/ Buy America Compliant/ Light Duty focus	80% of project costs	Yes	Justice40 communities to receive 40% benefits	Not applicable	20% non-federal match; May stack with state, local, or private funds	Federal - FHWA per IIJA	$52 million over 5 years
Utility Funding Mechanisms									

PGE	Business Charging Rebate	Installation of level 2 charger	$1,000/ charger	Yes	No	No	May stack with state, local, federal or private funds	Utility	Varies per year
PGE	Fleet Partner	Fleets adopting Electric vehicles	No incentive-technical and site assessment support	Varies	No	No	May stack with state, local, federal or private funds	Utility	Varies per year

Medium- and heavy-duty vehicles

There has been rapid progress in zero emission vehicle, charging, and fueling technology. However, the upfront cost of ZEVs and corresponding infrastructure has impeded the rate of adoption.

Oregon offers rebates to address upfront cost barriers to light-duty ZEV adoption, however there are very few state incentives to lower the purchase price of MHD ZEVs or support investment in MHD infrastructure. While MHD ZEVs are currently available in most vehicle classes, they are not yet viable for all use cases.

For example, long-haul trucking electrification is evolving slowly because there are many barriers to overcome in vehicle design and charging infrastructure. Additionally, there are few existing Class 8 ZEV models available on the market.

The adoption of Advanced Clean Trucks Rule included a one-time reporting requirement for Oregon fleets that will provide additional details beyond what registration data can provide. The ACT reporting requirement, set to be completed in 2023, will inform DEQ's understanding about MHD vehicles and sectors that are currently in use, and how to best support incentive programs as well as set target goals.

Oregon's medium- and heavy-duty fleet

For this report, the categories in Table 2 are used to define MHD vehicles. These categories are consistent with those used by DEQ in the recently adopted Advanced Clean Trucks Rule (OAR 340-257). There is variation in vehicle type and class; for instance, transit buses may be class 7 and 8 vehicles.

Table 2: MHD vehicle categories and corresponding weight ranges

Category	Gross Vehicle Weight Range
Class 2b and 3 Trucks (Light-/Medium-)	8,500 lbs. < GVWR ≤ 14,000 lbs.
Class 4 and 5 Trucks (Medium-/Heavy-)	14,000 lbs. < GVWR ≤ 19,500 lbs.
Class 6 and 7 Trucks (Medium-/Heavy-)	19,500 lbs. < GVWR ≤ 33,000 lbs.
Class 8a and 8b Trucks (Heavy-)	GVWR > 33,000 lbs.
Class 7-8 Tractors	GVWR 26,001+

The Medium and Heavy-Duty Truck Alternative Fuels Study examined data provided by ODOT's Division of Motor Vehicles and Commerce and Compliance Division. Table 3 shows the number of Oregon-based vehicles and the percent of the fleet for each class for vehicles registered in Oregon. This data shows that 84% of MHD vehicles registered with DMV fall in the Class 2b-3 category which are vehicles greater than 8,500 lbs. but less than 14,000 lbs.

Table 3: MHD vehicle categories and corresponding fleet percentages

Category	Counts	Percent of Fleet
Class 2b and 3 Trucks	322,525	84%
Class 4 and 5 Trucks	796	>1%
Class 6 and 7 Trucks	6,139	2%
Class 8a and 8b Trucks	21,500	6%
Class 7-8 Tractors	32,177	8%

This fleet data does not include vehicles that are registered in other states and travel through Oregon. About 17% of DMV vehicle records have no VIN decode (mostly pre-1981 vehicles) and therefore are not represented in these counts.

Existing vehicle incentive programs in Oregon

The Department of Environmental Quality operates multiple incentive programs for retrofitting, repowering, or replacing older MHD diesel engines. Most of the programs from DEQ focus on vehicles, but certain programs may also support installation of ZEV infrastructure. The only non-federally funded program in Oregon is the Diesel Emissions Mitigation Grant Program.

Oregon DEQ's Diesel Emissions Mitigation Grant Program
Amount: Approximately $8,000,000 per year
Focus: Reduce Diesel Emissions from MHD vehicles
Purpose: This grant program provides incentive funding from Oregon's share of the Environmental Mitigation Trust Fund (VW settlement); a $72.9 million settlement dedicated to projects that reduce diesel emissions. To date the program has provided funding for the purchase of several MHD ZEV as a part of DEQ's school bus replacement work and competitive grants.
DEQ plans to provide approximately $40 million (~$8 million per year) between 2021 and 2025 to businesses, governments and equipment owners. Grant funds will help them retrofit, repower, or replace older, more polluting diesel engines with new, cleaner alternative technologies.[10] The percentage of reimbursement funding will vary 25-100%, depending on the project type, equipment, and owner.[11]

The Diesel Emissions Mitigation Grant Program air quality goals include:

- Maximize benefits for vulnerable populations, e.g., low income, people of color, older adults, and youth.
- Prioritize pollution reductions in areas of the state with the highest emissions of nitrogen oxides and particulate matter from diesel engines.

[11] See the US EPA detailed comparison document for specific eligible projects and percentages that apply https://www.epa.gov/sites/default/files/2019-03/documents/vw-dera-option-factsheet-tribes-2019-03.pdf

- Maximize pollution reduction cost effectiveness.

This grant supports incentivizing the transition to ZEV through partnerships with Oregon cities, school districts, and businesses. DEQ partnered with Beaverton School Districts to provide $100,000 for two new electric school buses. In the competitive grant program, DEQ is currently under contract to fund $2.6 million for the City of Portland to purchase eight new ZEV heavy-duty trucks, $1.6 million with Titan freight systems to purchase 6 new ZEV heavy-duty trucks, and $1.2 million for the City of Newberg to purchase a new electric street sweeper. All of these projects require the destruction of old diesel engines and chassis in order to verify the permanent reduction of diesel emissions in Oregon.

Medium- and Heavy-duty ZEV infrastructure

MHD ZEV adoption is only possible if the infrastructure to charge or refuel electric vehicles exists. This is a key barrier to both battery and fuel cell MHD electric vehicle adoption.

Types of chargers

According to Atlas Public Policy, the U.S. will need between $100 billion and $166 billion in charging infrastructure investment this decade to support 100% electric truck sales by 2040.[12]

There are many types of MHD battery electric vehicles, and each vehicle type will have different charging needs based on vehicle size, usage schedule, and application. There are two primary types of EV chargers utilized in the MHD sector - Level 2 chargers and Direct Current Fast Chargers.

Level 2 Charging for Medium-duty Electric Trucks

Level 2 chargers typically are used by medium-duty electric trucks (Class 2b – 5 and some Class 6) and range in power from 6.6 to 19.2 kW. Medium-duty trucks with a battery capacity of 75 – 100 kW will take approximately 5 – 10 hours to substantially charge up (assuming a 10 – 11 kW charger). The precise time it will take a medium-duty battery electric vehicle to charge up will depend on the charger's power level, the state of charge of the battery at the time of refueling, the truck's battery capacity, and the vehicle's ability to accept faster charging. Medium-duty trucks charging up with a 19.2 kW Level 2 charger will be able to refuel more than twice as fast as those charging up with a 6.6 kW Level 2 charger. Vehicles with smaller batteries and/or return to the same place to charge such as urban delivery trucks or school buses may be well suited for Level 2 charging.[13]

Direct Current Fast Charging for Medium and Heavy-duty Electric Trucks

Direct Current Fast Charging ranges from 50 kW to 3 Megawatt and offers a much faster rate of charge. DC fast charging takes substantially less time to charge a battery electric truck, and how fast depends upon the DCFC power level, the truck's battery state of charge, the vehicle's ability to accept faster charging and battery capacity. Larger medium-duty battery electric vehicles (Class 6), box trucks and long-haul trucks (Class 7 and 8) will likely charge using DCFC. The power level of the DCFC will dramatically affect charging speed. According to Atlas Public Policy's analysis, a Class 8 truck (operating at an efficiency level anticipated for 2040) will take

[12] U.S. Medium- and Heavy-Duty Truck Electrification Infrastructure Assessment, Atlas Public Policy, 2021
[13] Communication with John Halliwell, Electric Power Research Institute, and Charlie Allcock, Charlie Allcock Consulting, September 1, 2022.

about 7.4 hours to charge up (to drive 545 miles) when refueling with a 350 kW charger. However, it will only take about an hour for the same Class 8 truck to charge up (to drive 545 miles) using a 2 MW charger.[12] Vehicles with larger batteries and those with a use case that incorporates less downtime, such as long-haul trucks, are expected to rely on DCFC.

Categories of infrastructure

There are three broad categories of ZEV MHD charging infrastructure ZEV: depot charging (private), opportunity charging (public) and en-route charging (public). These MHD truck charging types are represented below in Figure 2, along with the power level of charger most likely to be associated with each type.

Depot charging is akin to home-charging for light-duty vehicles; it is charging infrastructure installed at private fleet facilities. This type of charging is ideal for vehicles that return to a home base and can charge over a longer period of time. Depot charging can have either Level 2 or DCFC, depending on the size and needs of the vehicles in the fleet. Depot charging can cover much of the MHD charging needs, as 87% of U.S. MHDs operate within a 200-mile range fleet owners and operators to offer.[14]

Opportunity charging is publicly available charging most likely to be located in densely populated economic centers. It would primarily serve local commercial vehicle traffic to extend vehicle range while on break or while stopped for loading/unloading. Opportunity charging is best suited for battery electric Class 3 through 6 vehicles and will likely use DCFC ranging from 50 to 350 kW. [15,15]

En-route charging will be located along common freight routes to serve MHD ZEVZEVs that travel longer distances such as long-distance transit vehicles or long-haul trucks. En-route charging primarily serves larger vehicles, such as Class 6 through 8, and thus should use DCFC chargers (350 kW – 1 MW and above). [15,16]

Fleet considerations: quantity, capacity, costs

Quantity

Once a fleet operator chooses the type of charging infrastructure is appropriate for their fleet, they must decide on how many chargers they will need. Sometimes, there will need to be a dedicated charger for each vehicle but other times, a charger can serve multiple vehicles. The fleet operator needs to consider how many vehicles need to be charged; can a charger serve multiple vehicles; how long will it take to fully charge; and can the vehicle be topped off (take a partial charge) to complete its next route.

Capacity

Once a fleet operator determines the number and types of chargers needed, they should begin to work with their electric utility to understand whether electrical upgrades are needed, explore managed charging strategies, and assess if the utility can support these new demands within existing electrical capacity or whether upgrades are needed. [16] Other options, such as charging as a service, should be explored.

[14] Perspectives on Charging Medium-and Heavy-Duty Electric Vehicles
[15] Communication with John Halliwell, Electric Power Research Institute, and Charlie Allcock, Charlie Allcock Consulting, September 1, 2022.
[16] Jessie Lund, John Schroeder, Emily Porter, and Dave Mullaney, Charting the Course for Early Truck Electrification, RMI, 2022, https://rmi.org/insight/electrify-trucking/.

Cost

Charger capacity and installation costs can pose significant up-front costs for fleets.[17] Charger costs vary based on power level which is directly associated with how quickly a vehicle can charge the battery, enabling vehicles to return to driving. Costs for equipment for DCFC (ranging from 50 kW to 350 kW) have historically spanned $20,000 - $150,000, and installation costs have historically varied from $10,000 to $66,000 per charger plug. Today, in late 2022, additional factors have been found to raise equipment and installation costs well above historical levels, including supply chain bottlenecks and inflation. There may be additional operating costs for DCFC associated with utility demand charges depending on the type of charger and its frequency of use, as well as potentially substantial costs for upgrades to utility infrastructure in order to accommodate the increased electrical capacity needed onsite. [18]

Hydrogen refueling infrastructure

Refueling hydrogen fuel cell electric vehicles is similar to the experience of refueling conventional diesel vehicles: fuel is primarily stored onsite and pumped into a vehicle via a nozzle. Fill time is determined by the size of the vehicle's tank and the pressure at the nozzle.

There are two main types of hydrogen refueling stations: low pressure and high pressure. Lower pressure stations are more appropriate for return-to-base fleets such as transit buses and local commercial vehicles where refueling can occur overnight. Higher pressure stations are more appropriate for public refueling to serve larger vehicles with longer routes, such as long-haul trucks.

A hydrogen fueling station includes a hydrogen storage tank, a compressor, and dispensing equipment to pressurize the stored hydrogen and dispense it into a vehicle. Hydrogen can either be produced onsite or delivered from an offsite production facility in gaseous or liquid form. Large stations may also choose to store their hydrogen in liquid form and then convert the liquid hydrogen back into gaseous form for fueling purposes.[18]

Similar to the discussion about electric charging, there are three main categories of refueling infrastructure for hydrogen: depot, opportunity, and en-route. Operators must decide on what is appropriate for their fleet. For en-route infrastructure, Oregon is in the early stages of planning for hydrogen fuel cell electric vehicles. In April 2022, ODOT released its Hydrogen Pathway Study, summarizing the current landscape of hydrogen fuel cell vehicles in the U.S. and outlining a series of recommendations for preparing for their arrival in Oregon. In addition, ODOT has successfully nominated two freight corridors, Interstates 5 and 84, for "hydrogen-pending" designation under the Federal Highway Administration's Alternative Fuel Corridor program.

Hydrogen in the transportation sector is still a niche market. There is not much cost data for hydrogen fueling stations, particularly for MHD vehicles. The relatively few stations that have been built vary widely in cost and these costs have significantly changed over time. Based on three such stations operating in California, it is estimated to cost between $6 and $8 million to build a typical MHD hydrogen refueling station.[19]

[17] Perspectives on Charging Medium-and Heavy-Duty Electric Vehicles
[18] Hydrogen Pathway Study Transportation Electrification Infrastructure Needs Analysis; ODOT, Kittelson & Associates, Inc. and RMI, 2022.
[19] Perspectives on Charging Medium-and Heavy-Duty Electric Vehicles

Existing infrastructure incentive programs in Oregon

DEQ MHD Charging pilot

The 2022 Oregon Legislature passed two bills (HB 5202 and HB 4139) to establish a new incentive program supporting charging infrastructure. The first bill allocated $15 million into the Medium and Heavy-Duty Electrification Fund, and the second bill established a new grant program supporting MHD ZEV charging and fueling infrastructure projects. This one-time funding is intended to support grants to public or private entities for capital improvements and technical assistance. The competitive grant program will give priority to projects located in communities disproportionately impacted by diesel pollution or those that are connected to proposed or existing transportation corridor projects, and projects that demonstrate available matching funds. Oregon DEQ plans to fund initial charging projects in early 2023.

Oregon DEQ will use the program to support the Advanced Clean Truck Rule, identify barriers and opportunities for electrification faced by Oregon's freight industry, and benefit communities impacted by pollution. DEQ will expand Oregon's expertise planning, siting, and building MHD ZEV charging and fueling infrastructure. DEQ's goal is to ensure that this effort contributes information for long-range planning and vision for future of MHD ZEV adoption and ZEV charging and fueling in Oregon.

Utility programs

Portland General Electric Business EV Charging Rebates

PGE's pilot program provides rebates of up to $1,000 per port for commercial customers who install a qualifying Level 2 EV charger onsite.

Portland General Electric Fleet Partner Program

PGE offers free planning assistance to fleets including assessments of electric vehicle feasibility, charging analysis, site assessment, and a summary of incentives that the fleet may be able to receive. In its Fleet Partner Build program, PGE offers turnkey final design and construction of make-ready infrastructure and an incentive based on the forecasted energy use of the EV chargers installed.

Pacific Power Oregon Rebates for Business EV Chargers

PAC is providing rebates of up to $1,000 per port for commercial customers who install a qualifying Level 2 EV charger onsite.

Other support for MHD ZEV adoption

Utilities' Role in support of ZEV adoption

Oregon's electric utilities play a critical role in efforts to electrify the transportation sector. Utility programs can provide incentives and technical assistance to fleets moving to EVs as part of their outreach to their non-residential customers. But their role extends beyond that: to the EVs themselves and educating the public about the many benefits of switching to EVs. There are two primary sources of funding for utilities to conduct this work – ratepayer funds and revenue from the sale of Clean Fuels Program credits that they generate on behalf of their EV-owning customers.

Investor-owned utilities, such as PAC and PGE, are working with multiple stakeholders to create a portfolio of programs that consolidate funding sources into a single, comprehensive workplan. These transportation electrification plans are currently in the proposal stage and are scheduled to be approved by the Public Utility Commission late in 2022/early in 2023.

In the meantime, investor-owned utilities continue to implement their existing Clean Fuels Program workplans for 2022 which include PGE's Drive Change Fund and Electric School Bus Fund, and PacifiCorp's Electric Mobility Fund. These two utilities also collaborate on convening and funding the Oregoin' Electric media campaign to increase awareness about EVs.

Clean Fuels Program role in support of ZEV adoption

The Clean Fuels Program creates a market where providers of lower-carbon transportation fuels can earn credits based on switching from higher-carbon fossil fuels. Providers of higher-carbon gasoline and diesel must reduce their own emissions or purchase these credits to meet the program's carbon intensity reduction goals.

Electricity supplied to ZEVs is eligible to earn credits. Credits are generally awarded to the owner or operator of the charger. A credit is equal to one ton of greenhouse gases reduced and is calculated based on the difference between the carbon intensity of electricity and either gasoline or diesel, and the volume of electricity dispensed from the charger. The carbon intensity is either a statewide average of what is provided to the grid, or specific to a utility and can be near-zero for those that are served by the Bonneville Power Administration.

Charger owners/operators report their electricity use to the Clean Fuels Program on a quarterly basis via a web-based reporting system. The system calculates the number of credits generated and deposits them into charger owner/operator accounts.

Owner/operators can sell credits to other entities immediately. The price for the credits is market-based. The Clean Fuels Program publishes the average credit price on a monthly basis to provide participants an idea of what credits are being sold for. The sellers and buyers agree on a price and number of credits, and all financial transactions are made solely between the two parties, not through DEQ.

A growing number of MHD ZEVs are able to generate credits. In addition to traditional vans, trucks, trailers, and buses, a large variety of custom applications are becoming electrified: garbage trucks, forklifts, cargo handling equipment, transport refrigeration units, and ocean-going vessel shore power systems. The Clean Fuels Program is continuously evaluating new models of MHD ZEVs to be eligible for credit generation.

Potential federal funding

There are several federal funding mechanisms that may support MHD ZEVs: federal formula funding, such as the National Electric Vehicle Infrastructure Program (NEVI), or discretionary, competitive grants, such as the Infrastructure Investment and Jobs Act Section 11401 competitive grants. Additionally, some sector specific funding is available, such as the Federal Transit Administration's Low or No Emission grants for clean transit vehicles or the Environmental Protection Agencies' funds for clean school buses.

Each program has specific criteria for access to funds, such as compliance with Buy America steel and iron requirements, scrappage, and matching funds. Additionally, state allocations of

these funds may vary year to year. While many federal funds exist to support ZEV transitions, these programs are often highly competitive and designed for large and expensive projects. Federal funds often have significant additional requirements that many fleet applicants may not be able to meet.

US EPA Diesel Emissions Reduction Act Grant Program

Amount: Approximately $530,000 per year
Focus: Diesel emission reduction throughout Oregon – primarily focused on treating school buses.
Purpose: Since passage of the federal Diesel Emissions Reduction Act in 2005, the U.S. EPA has funded diesel emissions reduction projects through national competitive grants, direct state allocations, school bus rebates and direct tribal allocations. DEQ administers the grant program in Oregon. The focus of DERA state allocation funds has been on vehicle and equipment replacement, funding advanced exhaust control retrofits, or replacing older diesel engines with newer, cleaner-burning engines.

Between 2008 and 2018, $14.6 million was spent on DERA projects in Oregon to treat more than 800 diesel engines. In recent years, Oregon has focused its DERA funds on retrofitting or replacing older school buses (~$530,000/year). While school buses do not represent the largest source of diesel emissions in Oregon communities, the emissions that are produced by older school buses impact vulnerable populations (children) and the buses are driven near where people live. In addition, these funds assist school districts with meeting the retrofit and replacement requirements in ORS 468A.796 (2019).

US FHWA and FTA Congestion Mitigation and Air Quality: DEQ Allocation

Amount: $250,000 per year
Focus: Diesel emission reduction in non-attainment areas

Purpose: Congestion Mitigation and Air Quality Program is designed to improve air quality by reducing transportation emissions in areas in that do not meet federal air quality standards. The Federal Highway Administration and the Federal Transportation Administration implement the CMAQ program.[20] FHWA awards CMAQ funds to Oregon through the Oregon Department of Transportation.

In 2007, the Oregon Legislature directed $250,000 per year of Oregon's CMAQ funding allotment to the Oregon Department of Environmental Quality to reduce diesel emissions.[21] An example of past projects include installation of diesel exhaust control retrofit devices on older school buses in the David Douglas School District in the Portland area. DEQ is currently seeking CMAQ applications focused on reducing diesel emissions through the adoption of zero emission technologies.

Infrastructure Investment and Jobs Act

The IIJA created or added funding to several different programs that could support ZEV MHD and charging infrastructure. In addition to the NEVI formula charging infrastructure program, and

[20] https://www.fhwa.dot.gov/fastact/factsheets/cmaqfs.cfm
[21] 2007, HB5047-A, 74th Oregon Legislative Assembly: Budget Report and Measure Summary, Package 806; pg 8-9; http://olis.leg.state.or.us/liz/2007R1/Downloads/MeasureAnalysisDocument/193

the EPA Clean School Bus program, the IIJA expanded funding or created new funding programs that could be used to support MHD vehicles and infrastructure. The IIJA created the Carbon Reduction Program which funds emissions reduction and includes charging infrastructure and state fleet vehicles as eligible projects. In addition, the IIJA established a 5-year, $2.5 billion discretionary grant opportunity for EV charging as well as hydrogen, propane and natural gas infrastructure along designated alternative fuel corridors or in other locations accessible to the public. Eligible applicants include state entities, MPOs, local governments, Indian tribes and U.S. territories

FTA Low or No Emission Vehicle Program

Amount: Approximately $1.1 billion *nationally*
Focus: Support low or no emission vehicles for transit agencies
Purpose: This is a competitive grant opportunity that provides funding to state and local governments for the purchase or lease of zero-emission and low-emission transit buses as well as the acquisition, construction, and leasing of required supporting facilities. ODOT administers much of the federal funding through the FTA Low or No Emission Vehicle Program. Certain large transit agencies can apply directly for funding from this program, while the Oregon Department of Transportation assists in the applications for funding for other transit districts. In 2021, the Infrastructure Investment and Jobs Act substantially increased the total funding available under the Federal Transit Authority's Low or No Emission Vehicle Program (5339(c)). In Fiscal Year 2022, $1.1 billion was available for grants nationally, with a 10%-15% local match required, depending on project characteristics. In 2022, the Oregon Department of Transportation received over $2 million for the City of Sandy transit service to buy battery electric buses and install charging equipment, and the Corvallis Transit System received over $2.6 million to buy battery electric buses and building a charging depot with electric charging stations (administered by the City of Corvallis).

EPA Clean School Bus Program

Amount: $1,000,000,000 per year through 2026
Focus: Reduction of harmful emissions from older, dirtier school buses
Purpose: Funding under the IIJA will make $5 billion in rebates available nationally over the next five years for ZEV and low emission school buses.[22] The grants also provide limited funding for associated infrastructure improvements.

National EV Infrastructure Formula Program

Amount: $52 million over five years
Focus: Light-duty EV charging along Alternative Fuel Corridors
Purpose: Although the NEVI program is primarily focused on light-duty EV charging, ODOT will encourage its private sector partners to design charging sites to support charging for medium-duty electric trucks and vans. For example, while initial federal guidance mandates a minimum of four high-powered (150 kW) fast chargers at each location, at some sites ODOT aims to go beyond this minimum guidance and require one higher powered charger (up to 350 kW) at many locations and invest in sufficient wiring for two additional chargers (up to 350 kW) to future-proof the site. ODOT will recommend pull-through station designs in many sites to accommodate larger medium-duty vehicles or those towing a trailer. A 20% non-federal match is required creating a $65 million overall investment through this program.

[22] https://www.epa.gov/cleanschoolbus

Inflation Reduction Act

Qualified Commercial Clean Vehicles (Section 13403)

Amount: 30% vehicle purchase credit
Focus: Electric and other non-gasoline/diesel trucks
Purpose: Beginning Jan. 1, 2023, the Inflation Reduction Act's Commercial EV Tax Credit will provide a 30% vehicle purchase credit for electric and other non-gasoline/diesel trucks and a 15% credit for combustion vehicles with at least a 15 kWh battery. The credit is capped at $40,000 or the incremental cost of the vehicle - whichever is lower - and is valid through 2032. For vehicles under 14,000 lbs., the credit is capped at $7,500, Alternative Fuel Refueling Property Credit (Section 13404).

The IRA extends the existing Section 30C Alternative Fuel Infrastructure Tax Credit through 2032. Beginning in 2023, the cap per location is $100K per charger for infrastructure installed in a federally designated low-income or rural census track. A bonus is provided totaling 30% (up to $100,000) if construction and installation meet prevailing wage and apprenticeship requirements.

Clean Heavy-Duty Vehicles (Section 60101)

The IRA allocated $1 billion to the Environmental Protection Agency to create an incentive program providing funding to replace Class 6 and 7 vehicles with comparable ZEVs, build ZEV charging infrastructure, fund workforce development and training, and fund planning and technical activities to support the adoption of ZEVs. How this program will be implemented and impact states has not been determined.

MHD ZEV incentive programs in U.S. and Canada

Vehicle incentive programs

There are diverse programs to support ZEV adoption for MHD vehicles throughout North America. Below is a summary of each program. A quick comparison can also be found in Table 3: Existing Incentive Programs for Zero Emission Vehicles.

California Air Resource Board- Carl Moyer Program

The Carl Moyer Program is a grant program that provides incentive funds to private companies and public agencies to purchase cleaner-than-required engines, equipment, and emission reduction technologies. Eligible projects include those that reduce emissions from heavy-duty on-road and off-road equipment. Eligible engines may include on-road trucks over 14,000 lbs. gross vehicle weight, off-road equipment such as construction and farm equipment, marine vessels, locomotives, stationary agricultural equipment, forklifts, light-duty vehicles, airport ground support equipment, lawn and garden equipment, and emergency vehicles. The Moyer Program provides about $60 million for projects each year statewide, funded through tire fees and smog impact vehicle registration fees. The program pays up to 85% of the cost to repower engines and up to 100% to purchase an CARB-verified retrofit device. Maximum grant amounts vary for purchase of new vehicles and equipment.

The San Joaquin District administers funds from the Carl Moyer Program differently and accepts applications to replace on-road diesel trucks with alternative technology units. Truck replacement projects that will accelerate emission reductions in low income and disadvantaged communities

experiencing greater air quality impacts may receive priority through the project review and selection process. Projects funded under this program must achieve emission reductions not required by law or regulation.

California's Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project

This program supports deployment of zero-emission and near-zero-emission technologies. The HVIP program provides point-of-sale vouchers and is a model for first-come, first-served incentives that reduce the incremental cost of commercial vehicles through point-of-purchase price reductions. Vehicles that are eligible include Class 2b-8 trucks and buses and drayage vehicles. The program provides $7.5K to $240K per vehicle, depending on vehicle cost.

California CORE Project: off road incentives

The CORE program sets aside funding from the HVIP program for drayage vehicles. The program aims to accelerate the deployment of advanced technology in the off-road sector by providing a streamlined way for fleets to access funding that helps offset the incremental cost. The program provides first-come, first-served vouchers to Californians who buy or lease zero emission off-road equipment, such as large forklifts, cargo handling equipment, construction equipment, landscaping equipment and on- and off-road terminal tractors. Incentives are increased for equipment located in disadvantaged communities.

The Diesel Replacement Rebate Program

The DRR program in Hawaii provides rebates for the replacement of MHD diesel vehicles with new, battery-electric equivalents. The DRR is funded by the Volkswagen Environmental Mitigation Trust, and the Diesel Emissions Reduction Act.

Approximately $2.1M will be available for program rebates. Rebates are worth up to 45% of project cost and cover vehicle classes 5-8. Participants are required to scrap the existing vehicle. Public and private organizations are eligible to apply. Funds for eligible projects are on a first come, first served basis. Projects may include the purchase of one new charging unit per vehicle. Charging unit costs are included in the overall project total and are subject to the 45% rebate limit.

Massachusetts MOR-EV Trucks Program

The MOR-EV program is designed to reduce air pollution emissions in Massachusetts by increasing the use of medium duty/heavy duty on-road electric vehicles, including trucks, buses and vans. This program is funded through the Regional Greenhouse Gas Initiative (RGGI).

This program offers rebates for public and private purchases or leasing of qualified new vehicles registered in Massachusetts and maintained for at least 48 months. Rebates apply to both individual vehicles and fleet acquisitions. Increased funding is available if the vehicle is registered in or will operate more than 50% of the time within a designated environmental justice community census block. An additional 10% may be added to the currently available incentive value.

New Jersey Zero-Emission Incentive Program

The ZIP pilot program uses vouchers to support businesses and institutions purchasing new, medium-duty ZEVs that will operate in New Jersey metro areas. The pilot's $44.3 million in funding comes from the state's Regional Greenhouse Gas Initiative proceeds. "Phase 1" of the program provides vouchers ranging from $25,000 to $100,000.

The program reimburses grantees up to 25% of the cost of replacing non-road construction equipment, up to $100,000 per project. The program prioritizes construction equipment used on projects in urban/sensitive areas; construction equipment with the highest use; and older construction equipment. Non-road equipment powered by diesel engines, marine engine replacement equipment, and charging stations are eligible for funding under this program.

New York Truck Voucher Incentive Program

The New York Truck Voucher Incentive Program, provides vouchers, or discounts, to fleets across New York State that purchase or lease medium- and heavy-duty zero-emission battery electric or hydrogen fuel cell electric vehicles. Voucher amounts are a percentage of the incremental cost of the vehicle.. Voucher incentive amounts may differ by vehicle type, vehicle weight class, and where the vehicle is stored when not in use.

Government of Quebec's Écocamionnage Program

The Écocamionnage program aims to reduce GHG emissions of goods and service vehicles through measures to improve energy efficiency or through the use of alternative energies. This program does not apply to the passenger transport sector but does include low-speed vehicles, electrically assisted cargo bikes and light vehicles used for commercial purposes are now eligible. Class 2-8 vehicles are eligible, and the program provides up to $175,000 based on vehicle class and battery capacity.

Charging Infrastructure Incentive Programs

In addition to vehicle incentives, states and utilities are increasingly offering incentives for the ZEV infrastructure to support MHD vehicles. These programs are either standalone or paired with those that offer vehicle incentives. Some states include infrastructure in vehicle incentive programs (see above).

State Programs

California

California's EnergIIZE (Energy Infrastructure Incentives for Zero-Emission) Commercial Vehicle Project is the nation's first commercial vehicle fleet infrastructure incentive program, funded by the California Energy Commission's Clean Transportation Program[23] and implemented by the national non-profit CALSTART. EnergIIZE provides incentives for ZEV infrastructure equipment for MHD battery electric and hydrogen fuel cell vehicles operated and housed in California. There are four lanes within EnergIIZE that customize funding for specific fleet situations.

The California Electric Vehicle Incentive Project (CALeVIP)

This program provides incentives for installing Level 2 and DC fast chargers. Like EnergIIZE, the project is funded through the California Energy Commission's Clean Transportation Program and implemented by the national non-profit, the Center for Sustainable Energy. The project is currently funded for $164 million. Program details vary by region but most offer between $5,000 and $7,500 per connector for Level 2 chargers and up to $80,000 per DC fast charger, capped at 75%-80% of project costs. Extra facets of the program offer additional incentives for projects located at multi-unit dwellings or within a disadvantaged or low-income community.

[23] California's Clean Transportation Program, also known as the Alternative and Renewable Fuels and Vehicle Technology Program (ARFVTP), was created by Assembly Bill 118 in 2008 and invests up to $100 million annually in a broad portfolio of transportation and fuel transportation projects using fees collected from vehicle and vessel registration, vehicle identification plates and smog abatement fees.

California's Low Carbon Fuel Standard Infrastructure Crediting Provision

In 2018, California amended the Low Carbon Fuel Standard to include a ZEV infrastructure crediting provision designed to support the deployment of ZEV infrastructure. The ZEV infrastructure provision includes both hydrogen refueling infrastructure and DC fast charging Infrastructure.

In addition to generating Low Carbon Fuel Standard credit for dispensed fuel, the eligible hydrogen station or DC fast charger can generate infrastructure credits based on the capacity of the station or charger minus the quantity of dispensed fuel. Providing credits based on the capacity of the station rather than fuel dispensed is especially important in the early years of ZEV deployment when there are fewer EVs or fuel cell EVs to take up station capacity.

Utility Programs

New York

Joint Utilities of NY: Medium- and Heavy-Duty Make Ready Pilot

Under this Medium and Heavy-Duty Make Ready Pilot, utilities provide incentives of up to 90% of utility-side infrastructure costs to reduce the cost of developing EV charging capacity. Funds for incentives are available on a first-come, first-served basis. Projects located in or fleets operating a significant portion of time in disadvantaged communities are prioritized. Participating utilities are accepting applications through 2025 or until funding has been fully allocated. To qualify for this program, fleets must be participating in one of New York's vehicle incentive programs (NY Truck Voucher Incentive Program or NYC Clean Trucks Program).

California

Southern California Edison Charge Ready Transport Program

The Charge Ready Transport Program offers low to no cost electrical system upgrades to support the installation of EV charging equipment for qualifying MHD vehicles. Once a fleet is approved to participate in the program, SCE will design, construct and install the necessary infrastructure on both the utility-side and customer-side of the electric meter.

Pacific Gas & Electric's EV Fleet Program

PG&E's EV Fleet Program helps fleets install charging infrastructure for MHD battery electric vehicles. The program is funded through customer rates. Eligible customers must own or have a purchase order for at least two MHD electric vehicles. Both Level 2 and DC fast chargers are eligible under this program.

Through this program, PG&E will construct, own and maintain all electrical infrastructure from the transformer to the customer's meter. Fleet operators will design, build, own, operate and maintain the electrical infrastructure from the customer meter to the EV charger. In select instances, PG&E will also cover behind-the-meter infrastructure. Charging equipment rebates (from $15,000 to $42,000, depending on charger power level) are also offered for school buses, transit buses and disadvantaged communities.

San Diego Gas and Electric – Power Your Drive for Fleets

SDG&E's Power Your Drive for Fleets program connects fleets with resources, fleet-friendly charging rates and financial incentives to easily and cost-effectively design and install MHD charging infrastructure . SDG&E helps install make-ready charging infrastructure for MHD EVs,

working with fleets from the initial infrastructure planning stage through to design, construction and ongoing site maintenance.

Charging infrastructure for class 2-8 on and off-road vehicles are eligible for this program. Transit agencies, school districts and fleets located in disadvantaged communities are eligible for an additional rebate of up to 50% of the costs to purchase charging stations. For business customers currently charging a fleet of EVs, SDG&E offers a new rate structure: the EV-HP rate. This rate allows customers to choose the amount of power they need to charge their vehicles and pay for it through a monthly subscription fee, eliminating demand charges.

Table 4: Other State and Province Incentive Programs for Zero Emission Vehicles and Charging Infrastructure

North America MHD ZEV incentive Programs							
Jurisdiction	**Program**	**Eligibility**	**Incentive Levels**	**Coverage for Infrastructure**	**Enhanced Incentives for Small/Minority-Owned Fleets/Priority Communities**	**Scrappage**	**Funding Source**
CA	Carl Moyer VIP	Class 4-8 (GVWR 14K lbs-33K+)	Up to HHD: $410K, MHD: $180K	No	Only for fleets of 1-10 trucks	Yes	State and/or local funding
CA	Carl Moyer	Class 4-8 (GVWR 14K lbs-33K+)	50%-80% of eligible costs; Up to HHD: $410K, MHD: $180K	No	Higher incentive cap for fleets of 1-10 trucks	Yes	State and/or local funding
CA	HVIP	Class 2b-8 Trucks and Buses (GVWR 8.5K lbs-33K+, excluding pick-up trucks)	$7.5K to $240K depending on vehicle	No	DAC: +15% Innovative Small e-Fleets Set Aside ($25M FY 21-22); Drayage Truck Set-aside ($75M); Small fleet Set Aside ($25M for fleets with 10 or fewer trucks)	No (except for school buses in some cases)	State and/or local funding
CA	EnergIIZE Commercial Vehicles Infrastructure Program	Infrastructure for MHD ZEV vehicles; Fleets, EVSE providers	50% of eligible costs, up to $500,000 per project	Yes	Yes, 75% of eligible costs, up to $750,000 per project	N/A	CEC Clean Transportation Program
HI	Diesel Replacement Rebate Program	School buses and Class 5-8 trucks and buses	Up 45% of project costs	Yes, one charger per vehicle	No	Yes	DERA, VW funds
MA	MOR-EV Trucks Rebate Program	Class 2b -- 8	Up to $7,500 for Class 2b; up to $90,000 for Class 8); declining incentive level blocks over time	No	Yes, additional 10% if 50% of operation is in EJ communities	No	RGGI funds

NJ DEP	Equipment Modernization Program	Local government fleets; Class 2b-8	Cost differential + charging station	Yes	N/A	Yes	VW, RGGI funds
NJ EDA	NJ ZIP	Class 2b-6 Commercial, industrial, and institutional (local gov and non-profit) orgs may apply	$25,000 - $100,000 base voucher by class Bonuses for small businesses, minority/women/veteran owned businesses, NJ manufacturers		Yes. $10M set aside for small business, 25% bonus for small business, $4,000 stackable bonus per vehicle per certified qualifying criteria (e.g., female minority veteran would qualify for $12k bonus per vehicle she purchases)	No	RGGI funds
NY	NYTVIP	Class 3-8 (although Class 3 funding is not currently available)	Up to 100% of the incremental cost, up to $385,000 per vehicle based on vehicle vocation and weight class	No for school buses and trucks	No	Yes/Flexible	VW, CMAQ funds (CMAQ funding currently exhausted)
Quebec	Eco-Trucking Program	Class 2-8	Up to $175,000 based on vehicle class and battery capacity	No-separate infrastructure program	No	No	Electrification and Climate Change Fund

Prepared by the Northeast States for Coordinated Air Use Management

Incentive program design considerations

There are numerous ways to design incentive programs to support adoption of MHD ZEVs;. Program design may include tax credits, sales tax waivers, low interest loans, rebates (contracts), and point-of-sale voucher programs. According to NESCAUM, point-of-sale programs that provide “cash-on-the-hood” incentives are the most effective.[24]

NESCAUM published their Multi-State Medium- and Heavy-Duty Zero-Emission Vehicle Action Plan in 2022 which included seven recommendations to consider when designing and implementing a MHD ZEV incentive program:

- States should establish MHD ZEV point-of-sale or other equally effective fixed reimbursement vehicle and infrastructure that integrates, pays incremental cost, and supports fleet owners.
- Deliver early benefits to communities historically exposed to higher levels of air pollution in state vehicle and infrastructure incentive programs.
- Support small fleets, minority-owned fleets, and independent owner/operators.
- As a condition of receiving incentive program funding, states should consider requiring applicants to certify compliance with state and federal tax and labor laws and to ensure in-state registration for a fixed period following acquisition of the vehicle.
- States should work through the ZEV Task Force to form a workgroup to consider issues relating to the design of MHD ZEV incentive programs, including the role of scrappage and options for flexible scrappage requirements that can maximize fleet participation while securing emission reductions; performance-based incentives that reward increased electric range and/or lower electricity use; requirements for reporting charging infrastructure uptime data; stacking of incentives from multiple incentive programs; and how incentive programs could evolve to support growth of a secondary market for MHD ZEVs.
- States should strive to establish sustainable sources of funding to support vehicle and infrastructure incentive programs.
- States should consider providing exemptions (or reductions) from sales tax and registration fees for zero-emission trucks and buses until overall cost parity is achieved.

[24] Multi-State Medium- and Heavy-Duty Zero-Emission Vehicle Action Plan, NECAUM, 2022.

Roundtable discussion

NESCAUM held a roundtable discussion in July 2022 with lead staff who are implementing ZEV incentive programs. Topics included stakeholder engagement, voucher vs. rebate or grant, inclusion of vehicle size and fleet size, incentive levels and equity. Below is a summary based on topic area from that roundtable meeting.

Stakeholder outreach

One of the outcomes of the roundtable discussion was an emphasis on the importance of transparency throughout any stakeholder engagement process. Specifically, participants stressed that a good engagement plan needs to consider and prioritize ensuring the participation of small and BIPOC-owned fleets and environmental justice communities. For example, an engagement plan should be thoughtful when deciding on the ways information is being distributed, holding meetings during off hours, and engaging both public agencies and private businesses.

Roundtable participants also commented that engagement with electric and hydrogen providers is needed to discuss the short- and long-term impacts and feasibility of potential projects. Lastly, participants commented that holding feedback sessions after a program is launched can be valuable in sharing lessons learned and how to make the process better in the future

Vehicle eligibility

MHD vehicles cover a vast range of vehicles and use cases. Knowing what vehicles are eligible, and why, is an important aspect of a ZEV incentive program. Each state program has different approaches. Hawaii's program, for example, is limited to classes 5 through 8 and the Carl Moyer program limits eligibility to classes 4 through 8. Other programs include 2b-6. Some programs use the Diesel Emissions Reduction Act and Volkswagen program as their structure which includes 2b-8 classes as eligible.

Other considerations regarding vehicle eligibility had to do with availability from manufacturers to keep up with demand, cost of vehicles, and what level of infrastructure was available in a given time period.

Repowers or conversion eligibility

Repowering, or battery vehicle conversions, for MHD fleets can be less expensive than new ZEV purchases, and hence more attractive options and more available to smaller fleets.

New York allows repowers and works directly with the repower providers. This approach spurs participation in different market segments and is more inclusive of a broad range of vehicle types where new ZEV vehicles are not available or may be too costly.

Some of California’s programs also offer this option, but it has been underutilized so far. The state is working with fleets on a case-by-case basis for repowers and conversions but felt it is an important option to include.

From a technical standpoint, it can be hard to determine the feasibility of conversion and if it will work for the vehicle purpose. Another consideration is that not all funding sources allow for repowers or conversions, and vehicle warranties may be affected.

Program structure

There are different approaches to how to incentive MHD ZEV vehicles and infrastructure. On the vehicle side there are two main program options: vouchers versus contract or grant.

Vouchers are generally a set amount that is offered at the time of purchase, or “on the hood” at a set value. Sometimes voucher systems are run through vehicle dealerships.

Grants or rebates involve agency contracts that generally specify vehicle purchase, timeline and amount. Reimbursement is provided after the purchase of a vehicle. There are also tax rebates, like the federal tax rebates for light-duty vehicles. There are positive and negative aspects to each approach.

The California Carl Moyer program has two tracks: a voucher track for small fleets with 10 or fewer trucks, and a contract rebate track for larger fleets.

The vouchers track is designed to support smaller fleets through a quick and easy process, for both the applicants and on the implementation side. The voucher has specific amounts depending on vehicle replacement. However, this program must make a lot of assumptions in terms of vehicles that are being replaced and emission benefit, which means that the voucher program is limited in what vehicle type it can fund.

For other vehicles and infrastructure, California utilizes a contract approach. The contract track allows for more flexibility and project scope beyond truck replacements and includes locomotive, marine vessels, and infrastructure projects.

Fleet owner education and outreach is key to helping them navigate the different tracks and incentives.

Incentive levels

Determining the appropriate amount of incentive to increase ZEV adoption is essential. Many factors play into this decision: the difference between cost of the ZEV’s compared to the cost of diesel counterparts (differential cost); what nearby states are offering; what information is available about the market value of a base model vehicle; and cost effectiveness in reducing emissions.

Quebec's approach to incentives is to provide funding for approximately 50% of the incremental cost, based on vehicle class and battery power. Information about the vehicles is obtained from the manufacturers and then used to determine incentive levels. Other ZEV incentive programs in the U.S. take a similar approach but fund up to 100% of the differential cost. Amounts vary by weight, class and by fuel type so some programs look at each vehicle application to determine cost versus having a cap dollar amount based on vehicle specifications.

Cost effectiveness, or rather looking at how much a vehicle replacement costs and how much of an emission or GHG reduction will occur, is another consideration when determining vehicle incentive and eligibility. This additional qualification ensures that the highest benefit is being achieved by getting the most reductions per dollar. In addition, this prioritizes reducing the highest polluting vehicles. However, it can add complexity to the application process, especially for smaller fleets.

Overall, when determining incentive levels, most programs start at certain levels and adjust as they receive feedback and find solutions to barriers for fleets. Adaptability and flexibility in program design allows for responsiveness to fleet owner needs by balancing incentive levels.

Infrastructure incentives

There are many considerations when it comes to infrastructure incentives including duration or contract, long term planning, type/size of charger, and public versus private access. Overall, infrastructure incentives are newer than the vehicle incentive programs so there are more unknowns including how long projects take to assess and complete, current versus future needs, and incentive levels.

There are clear advantages to planning for higher electricity usage or “future proofing;”. That is, it is less expensive to dig once and install all the electrical capacity and conduit that might be needed in the future rather than go back and, for example, dig and break up concrete a second time to build out additional or higher-powered charging stations. However, that may mean providing incentives for vehicles and charging infrastructure needs that are not currently applicable at the outset of the infrastructure project, or that will serve vehicles with higher-power charging needs that are expected to be on the road in the future.

Infrastructure projects have many steps and milestones involved. Some programs offer reimbursement at each of those steps —rather than at the completion of the project — to increase accessibility of these projects and allow for lower initial capital investment from the applicant.

Fleet size

There are unique considerations when designing a program that targets support for ZEV adoption by smaller fleets. The technology is still new and may not be a good fit for a small fleet. Initial maintenance needs and training capacity may be lower for small fleets. ZEV vehicles, especially cutting-edge vehicles, may require down time and small fleets often do not have fleet redundancy. Smaller fleets may be at a financial disadvantage, too; they may have lower cash on hand for down payments or it may be more difficult to qualify for financing.

However, small fleets make up a significant portion of fleets in most states.[25] In Quebec, 75% of the fleets have five vehicles or fewer. Small fleets are included in their incentive program at the same incentive levels as the larger fleets. In California one of the tracks has a greater incentive for smaller fleets, offering incentives covering 80% of costs versus 50% for larger fleets.

Some large fleets are struggling with taking advantage of incentive programs that have scrappage requirements. Large fleets tend to have a much higher vehicle turnover rate, so they are constantly replacing older vehicles with newer ones, so they have no old ones available to scrap and therefore do not qualify for some of the programs.

Currently larger fleets seem to be leading in the early adoption of ZEVs, but over time as costs come down and ZEVs enter the used market, that may shift. Outreach and including small fleets in the design and stakeholder process will enable a more flexible transition to ZEV MHD.

[25] Trucking Statistics

Equity

Equity has been considered for MHD ZEV programs in many ways. One way is reaching out to community groups and overburdened populations within the stakeholder and outreach process. Some programs set aside a certain amount of funding towards vehicle and infrastructure that impact overburdened communities. Programs are working to include metrics for environmental justice for all recipients (voucher and contracted grants). Other programs use interactive maps to track vehicle deployment in environmental justice communities, and some use a similar system for scoring (contracted grants).

Providing or directing people to technical support, both for vehicles and infrastructure, is also part of the equity aspect of these programs. Engaging with small, minority and BIPOC owned fleets is important for inclusion. This type of engagement varies from program to program based on set aside funds and/or additional outreach, and the inclusion of conversions and not just new vehicles.

There are many ways to include environmental justice and all of the programs emphasize the importance of balancing it with early adoption and overall reduced emissions.

Partner listening sessions and feedback

DEQ and ODOT hosted two listening sessions to solicit comments and feedback from fleets, non-profits, and other interested parties for this MHD ZEV incentive Report.

Incentive levels

Numerous commenters praised the California HVIP program, a truck and bus vehicle voucher incentive, administered at point of sale. They supported adoption of a similar, if not identical, program in Oregon. Commenters also suggested consistency along the west coast, indicating that if other states had better incentives, it would deter new purchases in Oregon. Similarly, if Oregon had a more comprehensive program, it might not be sustainable long term.

Multiple stakeholders suggested funding the differential, or rather the difference in cost between the purchase price of a ZEV and a diesel vehicle, since the diesel vehicle cost is the one that a fleet would have to pay for regardless. Others suggested incentives based on percentage of total cost.

Infrastructure

Numerous stakeholders requested extended contract times to complete ZEV purchases and/or install infrastructure when using vehicle rebates or infrastructure incentives. Contract times in this sector are frequently 18-24 months from incentive start date to completing charging equipment installation. COVID-19 is still causing supply chain issues for vehicles and some charging infrastructure. Stakeholders say that in some cases, delivery times are double or triple delivery times from 2019. The takeaway: program incentive and/or contract mechanisms must be flexible to accommodate product availability and infrastructure installation timelines.

Commentors noted the need for infrastructure incentives. Some noted that in other states, if applicants use incentives to buy fleet vehicles, then applicants are channeled to a similar infrastructure incentive program. Other commentors specifically described the need for charging

or fueling infrastructure incentive programs that are not linked to vehicle purchases. They argued this would allow fleets enough lead time to prepare charging or refueling infrastructure in advance of future ZEV purchases, and to enable development of public charging and hydrogen refueling along highways and in communities.

Stakeholders identified that Oregon's electric utilities all provide different levels of technical support and investment in electric infrastructure and that can be a barrier. California has a requirement for all utilities to provide a "make ready" system to assess and install infrastructure in their territory more swiftly. A similar approach in Oregon may cut down installation time — which is currently anywhere from 18-24 months — once supply chain issues are resolved. Some electrical utilities in Oregon have developed such programs and others have not, meaning that the ease and cost to fleets varies throughout the state.

Multiple comments suggest fleets should be able to choose battery electric or hydrogen vehicles and fueling infrastructure. Commentors pointed out that Oregon likely needs to put more effort into making rural areas ready for infrastructure, allowing more equitable adoption of ZEVs.

Beyond readiness, space for infrastructure was mentioned numerous times. Large fleets are running out of room to add infrastructure capacity to support ZEVs, which means that they may need to purchase additional land or repurpose other areas which can be expensive and cause adoption delay. For small fleets, it is also challenging to have dedicated space for charging infrastructure, and they might prefer incentives that expand public charging options and incentives for charging that are separate from those of vehicle purchasing.

Program design

ODOT and DEQ received the most comments on program implementation. Stakeholders want flexibility in the type of fueling technology and class of vehicles that can be purchased with an incentive. This includes eligibility of smaller weight class vehicles for both on and off-road, a wide range of model year eligibility, no minimum number of vehicles being purchased, and eligibility for fleets of all sizes, and prefer no scrappage requirements.

Other comments focused on the benefits and issues with all program types including vouchers, rebates, and tax incentives. Most commenters support the "cash on the hood" style program for vehicle incentive ease of use and implementation. This can be beneficial as there is less need for upfront cash or loans, which can be more equitable for small businesses. One commentor mentioned prioritizing funding in underserved communities, then awarding remaining funding via a lottery system.

Many commenters raised a common issue: for some sectors, specifically non-road and long-haul vehicles, technology does not exist right now for them to adopt ZEV vehicles. If the vehicles are not made for the application, the load, or the range, this fact will limit who can apply and could influence incentive program design.

Stakeholders encouraged Oregon to provide flexible state funds. If state funding could be used with federal funds as match, or stacked/leveraged with utility infrastructure funding, this would help smaller fleets with less money be more competitive for federal funding. It would also lower the barrier to adoption, particularly for school bus and transit bus programs.

Stakeholders mentioned incentives for scrapping or destroying older, more polluting vehicles. Large fleets tend to cycle through vehicles at a higher rate and only keep them in service four to five years before selling them in the used market. This implies that most of these large fleets do not have older vehicles to scrap but do have money and desire to invest in ZEV vehicles. Scrappage of older vehicles guarantee emission reductions, but a scrappage requirement may slow large fleets from ZEV adoption as they would be excluded from the incentives. A commenter mentioned New York's program to address this concern; New York's program allows the applicant to buy an older used vehicle from another fleet to scrap instead of scrapping their own.

Commenters expressed interest in potential benchmarks and goals for future incentive programs. For example, programs could focus on emission reductions; greenhouse gas reductions; supporting early adoption of ZEV vehicles; equitable opportunities for small and minority owned businesses; or reducing pollution in areas with historically overburdened populations. Choosing the goals will help develop implementation strategies and metrics. For instance, ODOT and DEQ received a comment about a point-of-sale voucher program being the most equitable and potentially having the largest benefit among environmental justice communities.

Summary

Oregon will want to consider many important and relevant points from the listening sessions when designing vehicle and infrastructure incentive programs including:

- Design for both current and future ecosystems for MHD ZEV for on and off road.
- Incentives for new vehicle sales should encourage participation without regard to size of organization.
- The total number of incentives for any single applicant should be capped.
- The impact of secondary (used vehicle) market incentives.
- The need to consider scrappage requirements.

A program review is recommended every 3-5 years to assess the current ZEV ecosystem and update the program design.

Overall, it is clear that fleets, non-profits, manufacturers, and other interested parties are engaged and excited about new ZEV incentive programs in Oregon. Many stakeholders submitted additional comments specific to program design. All comments received have been kept for consideration if and when program development begins.

Recommendations and next steps

Recommendations

Oregon cannot wait for nor rely on federal or private funding alone to advance the adoption rate of MHD ZEVs. A sustainable revenue source should be dedicated to support incentives for the transition to MHD ZEVs. State-level incentive programs must be nimble and leverage other efforts such as regulatory actions and incentive contract terms. This will fill in gaps between intermittent funding opportunities and be responsive to ever-changing barriers for fleet transition. State-level programs should also support equity goals for specific impacted and underrepresented communities. Transitioning MHD to ZEV is a marathon, not a sprint. Technology is evolving quickly but it will take decades for the entire fleet to turn over.

After considering other incentive programs around the country and input from stakeholders, DEQ and ODOT are recommending any future Oregon incentive programs be designed to be:

Adaptable. The implementing agencies need broad authority that allows for rapid program start-up and ongoing refinements that can quickly respond to changes to the fleet, regulatory environment, and market trends.

Sustainable. Dedicated sources of revenue are needed to support ZEV adoption to cover the incremental up-front costs of the vehicles and fueling infrastructure. Some sectors will be quick to convert but others will be much more challenging. Incentives must address both timelines.

Stackable. State-level programs must be able to leverage funding opportunities from several sources, including federal, electric utilities, and others.

Flexible. Incentive programs should be flexible and allow private fleets to choose from several incentive options to best fit their needs. The optimal mix of incentive options include vehicle purchase incentives linked with infrastructure funding; separate infrastructure-only and vehicle-purchase-only incentives; and funding to support public infrastructure along highways and in communities.

Accessible. The key to successful incentive programs is targeted and funded outreach and engagement to support Oregon’s fleet owners. The incentive programs should provide administrative and technical support for applicants and awardees. Many of Oregon's fleet owners are small businesses. Agency staff should ensure incentives are available to those who need them most. Outreach to women- and minority-owned fleets as well as those that are based in communities with higher levels of pollution must also be emphasized. Outreach should include a website that is easily understood by fleets and provides information that best fits their needs.

Equitable. New incentive programs should dedicate a percentage of the funding for fleets that serve in and benefit environmental justice communities and areas that are disproportionately impacted by high levels of air pollution. Reserved funds will also allow for direct support for historically underrepresented communities and BIPOC- and minority-owned fleets.

Next steps

DEQ and ODOT will continue to implement their grants and programs that interact with Oregon’s MHD fleet and will use the learnings to implement program changes, where possible; to adapt to fleet need; and to identify the opportunities and challenges to transitioning to ZEV.

DEQ will also continue to analyze the data collected from the one-time fleet reporting requirement to better understand Oregon's MHD fleet (how many are there, what types of vehicles, age, where they are based, where they travel to, etc.) and determine how best to incorporate these findings into incentive program design. DEQ will also implement the Charging Pilot Program to gain insights that can be applied to future ZEV incentive programs.

ODOT will leverage learnings from its implementation of the National Electric Vehicle Infrastructure program installing public fast charging on highway corridors and its community charging rebate program launching in 2023.

DEQ and ODOT are committed to work with other state agencies, local governments and private fleets to most effectively implement these programs and support ZEV adoption. Agencies must also continue engagement with interested parties for feedback on potential program design including type and amount of incentive, community prioritization, regional accessibility, and vehicle/ fleet requirements.

Appendix 1: Cost of MHD ZEV vehicles and infrastructure

Total cost of ownership for ZEV vehicles

Currently ZEV vehicles cost more compared to conventional model equivalents that run on diesel or gasoline. According to an analysis conducted by the California Air Resources Board, model year 2024 ZEV trucks are forecasted to cost between $14,000 and $87,000 more than that of a conventional vehicle depending on class. [26]

Overall, battery costs have dropped by 87% since 2010 and continue to drop.[27] In 2019, consulting firm ICF International published a study for the California Air Resource Board evaluating total cost of ownership for MHD vehicles. They looked at data for costs of vehicles as well as maintenance comparing diesel, electric, CNG and hydrogen vehicles across the MHD classes (2b-8). The estimates provided in these tables is based on 2019 available data and projections.

Many things have changed since these tables were made. During the COVID-19 pandemic costs of vehicles have increased due to supply chain issues and current inflation rates that are not represented in these tables.

ICF: 2019 Truck initial Purchase Price Assumptions in 2019 dollars

	Diesel	Electric	Natural Gas[6]	Hydrogen
Class 2b	$27,500	$75,000 (75 kWh)	$37,500	N/A
Class 3	$39,000	$100,000 (100kWh)	$54,000	N/A
Class 4/5 Short-Haul	$48,000	$100,000 (100kWh)	$68,000	N/A
Class 4/5 Long-Haul	$48,000	$150,000 (150 kWh)	$68,000	N/A
Class 6/7 Short-Haul	$63,000	$167,000 (150 kWh)	$95,000	N/A
Class 6/7 Long-Haul	$63,000	$250,000 (250 kWh)	$95,000	N/A
Class 8 Short-Haul	$110,000	$250,000 (250 kWh)	$140,000	$400,000
Class 8 Long-Haul	$160,000	$375,000 (500 kWh)	$190,000	$480,000
Refuse[7]	$150,000	$352,500	$180,000	N/A

Comparison of Medium- and Heavy-Duty Technologies in California

[26] Comparison of Medium- and Heavy-Duty Technologies in California, ICF, 2019.

[27] Bloomberg New Energy Fiance, 2019

ICF: 2030 Truck initial Purchase Price Assumptions in 2019 dollars

	Diesel	Electric	Natural Gas	Hydrogen
Class 2b	$28,700	$40,000	$38,700	N/A
Class 3	$40,700	$53,000	$55,700	N/A
Class 4/5 SH	$51,000	$53,000	$71,000	N/A
Class 4/5 LH	$51,000	$80,000	$71,000	N/A
Class 6/7 SH	$66,000	$90,000	$98,000	N/A
Class 6/7 LH	$66,000	$133,000	$98,000	N/A
Class 8 SH	$118,000	$133,000	$147,000	$137,000
Class 8 LH	$172,000	$191,000	$200,000	$197,000
Refuse[9]	$160,000	$191,000	$190,000	N/A

Comparison of Medium- and Heavy-Duty Technologies in California

Beyond vehicle costs, there are infrastructure and installation costs to consider. Costs for installing chargers vary depending on the site, the amount of power needed and the proximity to current lines. Charger costs tend to be more consistent, but when fleets scale up to transition whole fleets, charger cost can be a major barrier. In that same study ICF looked at current and future estimate charger costs for electric and hydrogen fueling.

ICF: Electric Charger and Installation Costs in 2019 dollars

Charger Capacity	Charger Cost	Installation Cost
19 kW	$5,000	$20,000
40 kW	$8,000	$20,000
100 kW	$40,000	$48,000
200 kW	$50,000	$55,000

Comparison of Medium- and Heavy-Duty Technologies in California

ICF: Hydrogen Station Costs in 2019 dollars

Station Capacity	Total Station Cost
230 kg/day	$2,500,000

Comparison of Medium- and Heavy-Duty Technologies in California

ICF also included information on vehicle maintenance costs. Overall electric was lower for each class and hydrogen, where data was available was lower except for transit buses which had a higher cost of maintenance on average.

Projections show that by 2030 the cost of electric MHD vehicles will be comparable to current diesel costs. While 2030 is not far out, the amount of emission and GHG from diesel vehicles will be costly to the environment and to the health of Oregonians. Incentivizing adoption of ZEV now is imperative to support climate initiative and the livability of Oregon.