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

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Oregon Department of Transportation

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DEQ Department of Environmental Quality

This document was prepared jointly by the
Oregon Department of Environmental Quality
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# Executive summary

*To be added after second stakeholder listening session*

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# Purpose of the report

During the 2021 legislative session the Oregon Department of Environmental Quality and Oregon Department of Transportation were given direction from the Legislature to report back to the Joint Committee on Transportation by December 2022, with an analysis of existing incentives available to support the transition to Zero Emission Vehicles for Medium- and Heavy-Duty transportation fleets. 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 the transition. This report includes analyses on incentives for both vehicles and electric charging or other fuel infrastructure.

The transition to ZEV in the MHD Transportation Sector is a key strategy to decarbonize transportation emissions to meet the state's long-term climate goals. In addition to greenhouse gas reductions, there are several co-benefits associated with the transition to ZEV that will benefit Oregonians including: improving local air quality and reducing the harmful impacts of diesel emissions on environmental justice communities. Incentivizing the early adoption of ZEVs in the MHD sector will also speed the development and improve technological readiness of advanced vehicles and charging infrastructure, as well as lowering the future cost for Oregon's MHD fleets to transition to ZEV.

As identified in the EMC Alternative Fuels Study, the high cost of vehicles and infrastructure are one of the main challenges for Oregon fleets to transition to ZEV technologies. This report addresses options for future incentives - what exists already, what other states have done, what level and type of incentive is best for Oregon's fleet.

# Background

In 2021, Governor Kate Brown stated that Oregon has experienced more extreme weather events, chronic heat and drought, flooding and more intense wildfires as a result of climate change. The Governor also acknowledged and supported Oregon's efforts on addressing 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 percent 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 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 ($CO_2$), methane ($CH_4$), and nitrous oxides (NOx). It will also reduce criteria pollutants and other toxic air pollutants, including diesel particulate matter.

Light-duty cars account for most of the transportation related carbon emissions, while medium- and heavy-duty vehicles, which are predominantly trucks, are a close second. MHD vehicles

[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

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 NOx and 64% of particulate matter.[6] The medium and heavy-duty truck industry is essential for moving goods throughout the country and within Oregon. Nationally, the trucking industry employs 9 million workers.[7] Providing incentives for the transition to zero emission medium- and heavy-duty vehicles will help Oregon make progress toward future air quality and climate goals while still supporting the businesses and jobs associated with these vehicles.[8]

In 2019 the Oregon Legislature passed HB 2007, regulating older model diesel trucks in the Portland Metro area and directing Oregon DEQ to allocate approximately $40M in VW Settlement grant dollars. Among other actions the bill established the Joint Task Force on Supporting Businesses in Reducing Diesel Emissions. The Task Force was directed to consider funding strategies to help businesses reduce emissions from diesel engines. The Task Force evaluated funding strategies for this effort, including new concepts for taxes, fees, and contract requirements or funding set-asides. Their final report included discussions of Environmental and Public Health Effects of Diesel Engine Exhaust, a summary of House Bill 2007, Diesel Engine Emissions in Oregon, Strategies to Reduce Emissions, Existing Incentive Programs in Oregon, Evaluation of Revenue Options, and Considerations for Incentive Program Design. This report is building on that effort by updating information on existing incentives and program design both in Oregon and beyond to support adoption of ZEV MHD vehicles.

The Oregon Department of Environmental Quality's primary role in transportation electrification is to implement the regulations that require ZEVs to be brought to Oregon and to provide incentives to advance their adoption. The recent adoption of the Climate Protection Program and the Clean Trucks Rule (Advanced Clean Trucks and Low NOx Omnibus regulations); the expansion of the Clean Fuels Program and the Employee Commute Options Program; the administration and technical support of several grants (Diesel Emissions Mitigation grants, Diesel Emission Reduction Act grants, and the Congestion Mitigation and Air Quality grants), and MHD ZEV infrastructure Pilot Program are examples of programs and policies DEQ has implemented to support the transition. The Oregon Department of Transportation's primary role in the ZEV transition is to convene state agencies to coordinate efforts and to facilitate the equitable deployment of EV charging and hydrogen fueling infrastructure throughout the state. Currently, ODOT administers sector specific grants including the transit Low or No Emission Vehicle Program and the National EV Infrastructure formula program.

To address the concern of medium- and heavy-duty truck emissions and ensure Oregon remains on track to meet its climate goals, Oregon has joined a multistate ZEV action plan, has rules for manufacturers to make and sell ZEVs and a robust clean fuels program that incentivizes ZEV adoption away from fossil fuel use for MHD vehicles.

# Multi-State MHD ZEV Action Plan

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

[5] Motor Vehicle Emission Simulator (MOVES3), US Environmental Protection Agency.
[6] Oregon Clean Truck Program, MJ Bradley and Associates, 2021.
[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

Understanding.[9] 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 percent of new MHD vehicle sales to be ZEV by 2030, and 100 percent of sales to be ZEV no later than 2050. The MOU recommended the development of an Action Plan to recommend strategies to accelerate the deployment of MHD ZEVs.

The Northeast States for Coordinated Air Use Management (NESCAUM) led the MOU Action Plan development with a multi-state task force. The resulting action plan emphasizes an equitable transition that considers overburdened communities who are impacted by MHD emissions. The strategies recommended in the action plan include the adoption of the Advanced Clean Trucks rule, 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. Action Plan recommendations are summarized in this report under the section “Incentive Program Design Considerations”.

# Advanced Clean Trucks Rule

The Advanced Clean Trucks (ACT) 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 million metric tons and 2.4 MMT by 2040. Additionally, ZEV trucks have no tailpipe emissions which also result in a reduction of NOx and $PM_{2.5}$ emissions, resulting in NOx reductions in 2040 to be 3.9 tons per day and 0.12 tpd in $PM_{2.5}$ reductions. While the ACT rule requires manufactures to have ZEVs available, an incentive program would support and encourage Oregon fleets to make the transition.

# Oregon’s Clean Fuels Program

The Clean Fuels Program is one of Oregon's most successful policies for addressing the state's contribution to global climate change. This 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 making those fuels more cleanly 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.

- The transition to biofuels and electricity are reducing tailpipe pollution including carbon monoxide, nitrogen oxides, and particulate matter and improving public health of

[9] Multi-State Medium- and Heavy-Duty Zero Emission Vehicle Memorandum of Understanding https://www.nescaum.org/documents/mhdv-zev-mou-20220329.pdf/

Oregonians. This is especially important for Oregon's historically overburdened communities that are located near major transportation corridors, multimodal facilities, and distribution hubs.

- The 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 has reduced the cost of low-carbon fuels and creates the financial incentive to decarbonize the transportation sector as no other program can do.

The CFP incentivizes the transition to 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 that can offset the cost of the electricity itself or any other capital or operating costs State Agencies including DEQ, ODOT, ODOE and DLCD, continue to work collaboratively on the Every Mile Counts, effort to find ways to reduce transportation emissions by adopting cleaner fuels, using better vehicle technology, and reducing the number of vehicle miles that are traveled in Oregon.[10]

# Medium- and heavy-duty vehicles

There has been rapid progress in ZEV, 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 as there are many barriers to overcome in vehicle design and charging infrastructure with few existing Class 8 ZEV models available on the market. Understanding what MHD vehicles and sectors are currently in use in Oregon can help support utilization of an incentive program as well as set target goals. The adoption of ACT included a one-time reporting requirement for Oregon fleets that will provide additional details about Oregon’s fleet in terms or sector, location, and fuel usage and will be available in 2023.

## Oregon’s medium- and heavy-duty fleet

For this report, the categories in Table 1 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). Figure 1 is a visual presentation of some vehicle types in each class category.

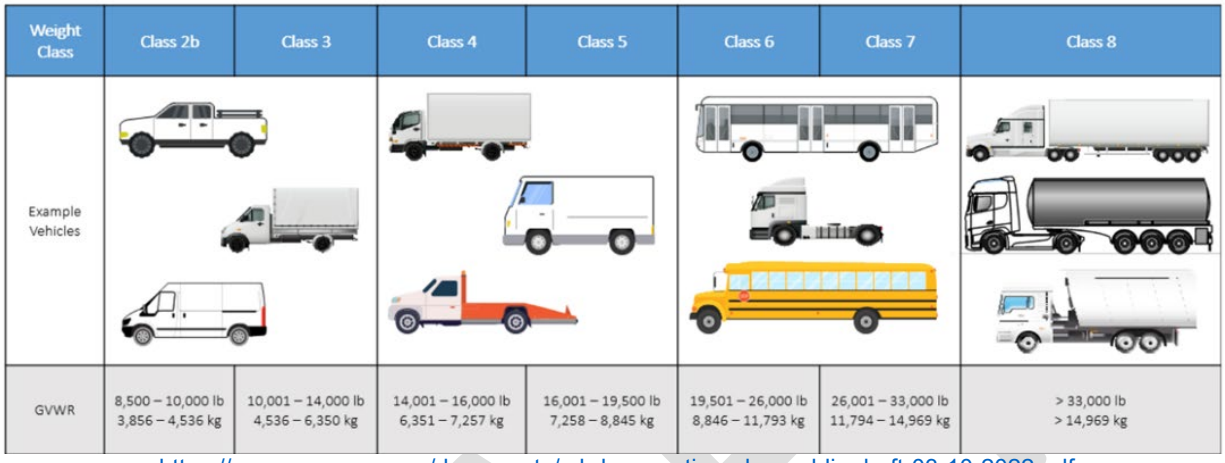
**Table 1: MHD vehicle categories and corresponding weight ranges**

| 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.** |

[10] Oregon Advance Clean Truck Staff report, DEQ 2021

| | |
|---|---|
| **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+** |

**Figure 1: MHD Vehicle Classification by Gross Vehicle Weight Rating**




https://www.nescaum.org/documents/mhd-zev-action-plan-public-draft-03-10-2022.pdf

The Medium and Heavy-Duty Truck Alternative Fuels Study examined data provided by ODOT's Division or Motor Vehicles and Commerce and Compliance Division. Based on the data, Table 2 shows the number of Oregon based vehicles and the percent of the fleet for each class for Oregon registered vehicles. This data shows that T 84% of MHD vehicles registered with DMV fall in the 2b-3 category which are vehicles greater than 8,500 lbs. but less than 14,000 lbs.

**Table 2: 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 medium- and heavy-duty diesel engines. Most of the programs from DEQ focus on vehicles, but certain programs can also support installation of ZEV infrastructure.

Those incentives are funded through three revenue streams, described below and summarized in Table 3. Each revenue stream includes specific parameters that guide eligibility and project design.

**Table 3: Oregon Funding Programs Supporting the Adoption of MHD ZEV**

| Point Agency | Program | Eligibility | Incentive Levels | Coverage for Infrastructure | Small/Minority-Owned Fleets/Priority Communities | Scrappage | Stacking | Funding Source | Funding Amount |
|---|---|---|---|---|---|---|---|---|---|
| DEQ | DERA | 2010 or older diesel vehicle (Class 4-8) | 25-45% of project costs | Yes; limited to BEV 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 | CMAQ | 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 |
| DEQ | DEM | 2010 or older diesel (Class 4-8) | 25-100% of project costs | Yes | Yes | Yes | May stack with federal or private funds | VW Settlement | ~$8 million thru 2025 |
| 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 | NEVI | 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 |
| DEQ | Charging Pilot | Match support and commitment to ZEV Fleet | Cost Share and RFP in development | Yes | Yes | No | May stack with local or federal funds | State | $15 Million |
| 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 |

## 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 DERA state allocation funds for 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, a total of $14.6 million was spent on DERA projects within Oregon to treat more than 800 diesel engines. In recent years, Oregon has focused its DERA state allocation resources 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 in close proximity to where people live. In addition, these funds assist school districts with meeting the retrofit and replacement requirements in ORS 468A.796 (2019).

## Congestion Mitigation and Air Quality

Amount: $250,000 per year
Focus: Diesel emission reduction in non-attainment areas
Purpose: of the Congestion Mitigation and Air Quality Program is to improve air quality by reducing transportation emissions in areas in non-attainment or maintenance for air quality issues. The Federal Highway Administration (FHWA) and the Federal Transportation Administration have been delegated authority to implement the CMAQ program.[11] 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 (DEQ CMAQ) to reduce diesel emissions.[12] DEQ has used funds to pay for the 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.

## 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 Volkswagen scandal; a $72.9 million settlement dedicated to projects that reduce diesel emissions. Today the program has provided funding for the purchase of several medium and heavy duty zero emission vehicles as a part of our school bus replacement work and competitive grants.
DEQ plans to provide approximately $40 million (~$8 million per year) between 2021 and 2025 to support businesses, governments, and equipment owners in retrofitting, repowering, or replacing older, more polluting diesel engines with new, cleaner alternative technologies. As a

[11] https://www.fhwa.dot.gov/fastact/factsheets/cmaqfs.cfm
[12] 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

reimbursement program, the percentage of funding varies from 25-100%, depending on the project type, equipment, and owner.[13]

Program goals of the Diesel Emissions Mitigation Grant Program to address air quality challenges facing Oregon include:

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

This grant has supports incentivizing the transition to zero emissions vehicles through partnerships with Oregon cities, school districts, and businesses. In the City of Beaverton, DEQ partnered with Beaverton School Districts to provide $50,000 per bus for the purchase of two new electric school buses. In the competitive grant program, we are currently under contract to fund $2.6 million for the city of Portland purchase of eight new heavy-duty trucks, $1.6 million with Titan freight systems for the purchase of 6 new 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.

### FTA Low or No Emission Vehicle Program

Amount: Approximately $1.1 billion
Focus: Support low or no emission vehicles for transit agencies
Purpose: ODOT administers federal funding through the FTA Low or No Emission Vehicle Program. Certain transit agencies are direct recipients of funding from this program. In 2021, the Infrastructure Investment and Jobs Act substantially increased the funding available under the Federal Transit Authority's Low or No Emission Vehicle Program (5339(c)). 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. In Fiscal Year 2022, $1.1 billion was available for grants, with a 10%-15% local match required, depending on project characteristics. The Oregon Department of Transportation will receive over $2 million for the City of Sandy transit service to buy battery electric buses and install charging equipment, and the Corvallis Transit System will receive over $2.6 million to buy battery electric buses and building a charging depot with electric charging stations (administered by the City of Corvallis).

# Medium- and Heavy-duty ZEV infrastructure

ZEV adoption for MHD is only possible if the infrastructure needed to charge or refuel electric vehicles exists. This is a key barrier to both battery and fuel cell electric vehicle adoption, particularly in the medium- and heavy-duty sectors.

## Electric charging infrastructure

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.[14]

[13] 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
[14] U.S. Medium- and Heavy-Duty Truck Electrification Infrastructure Assessment, Atlas Public Policy, 2021

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

**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 than those charging up with a 6.6 kW Level 2 charger. Vehicles with smaller batteries and/or longer dwell times, such as urban delivery trucks, may be well suited for Level 2 charging.[15]

**DC Fast Charging (DCFC) for Medium and Heavy-duty Electric Trucks**
DCFC ranges from 50 kW to 3 Megawatt (MW) and offers a much faster rate of charge, taking substantially less time to charge a battery electric vehicle, depending on power level, 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 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 or less downtime, such as long-haul trucks, are expected to rely on DCFC.

**Three Categories of Medium and Heavy-duty Battery Electric Truck Charging Infrastructure**
In addition, there are three broad categories of charging infrastructure for MHD BEVs: depot charging (private), opportunity charging (public) and en-route charging (public). These 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 facilities, where only vehicles in a private fleet have access. This type of charging is ideal for vehicles that return to a home base frequently and can charge overnight. The charging infrastructure utilized in depot charging may range from Level 2 to 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; however, depot charging requires the provision of onsite charging for all vehicles in a fleet.[16]

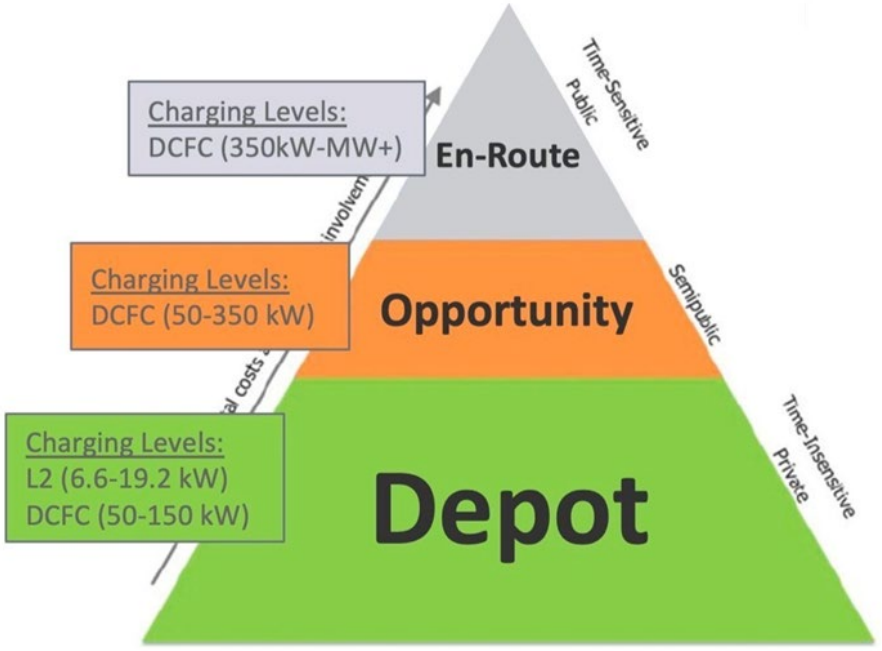
Public charging is a necessity for medium and heavy duty-vehicles without a consistent home base and/or with longer distance routes. Both opportunity and en-route charging require DCFCs for a faster charging experience. **Opportunity charging** is particularly needed in densely populated economic centers, to primarily serve local commercial vehicle traffic to extend vehicle range while on break or while stopped for loading/unloading. Opportunity charging is best suited

[15] Communication with John Halliwell, Electric Power Research Institute, and Charlie Allcock, Charlie Allcock Consulting, September 1, 2022.
[16] Perspectives on Charging Medium-and Heavy-Duty Electric Vehicles

for battery electric Class 3 through 6 vehicles and will likely incorporate DCFC ranging from 50 to 350 kW. [15,17]

Public **en-route charging** should be located along freight routes and will be needed to serve commercial MHD vehicles that travel longer distances than a single charge will allow, such as long-distance transit vehicles or long-haul trucks. En-route charging should be designed to primarily serve larger vehicles, such as Class 6 through 8, and thus should include higher power level DCFC chargers (350 kW – 1 MW and above). [15,16]

**Figure 2: MHD ZEV Charging Infrastructure**




Inspired by National Research Council. *Overcoming barriers to deployment of plug-in electric vehicles*. National Academies Press, 2015.

**Fleet Considerations: Charging Connectors, Quantity, Electrical Capacity, and Costs**
Currently, MHD vehicles that utilize lower-powered DCFC (50 kW-350 kW) use the same connector as light-duty vehicles – the Combined Charging System standard 1 (CCS1). For higher-powered DCFC (1 MW and above), there is an effort underway to develop the Megawatt Charging System (MCS) standard. In June, 2022, CharIN officially launched the MCS standard, which is based on the CCS standard, and focuses on Class 6, 7 and 8 commercial vehicles that can accept a > 1 MW charge rate.

A fleet operator determining which level of charging is appropriate for their fleet must consider how many vehicles need to be charged, the size of their batteries, how quickly vehicles will need to be back on the road, and how long each vehicle will needed to be plugged in to fully charge. Once the number and type of dedicated chargers is determined, fleets should then work with their electric utility to understand whether electrical upgrades are needed, explore managed

[17] Communication with John Halliwell, Electric Power Research Institute, and Charlie Allcock, Charlie Allcock Consulting, September 1, 2022.

charging strategies, and assess if the utility can support these new demands within existing electrical capacity or whether they will need electrical capacity upgrades. [18]

Charger capacity and installation costs can pose significant up-front costs for fleets.[19] Charger costs vary based on power level which is directly associated by how quickly a vehicle can charge the battery and return to driving. Costs for equipment for DCFC (ranging from 50 kW to 350 kW) can span $20,000 - $150,000, and installation costs can vary from $10,000 to $66,000 per plug. 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 on the utility side of the meter.[18]

In Oregon, Portland's Electric Island is the only public charging station designed for medium- and heavy-duty vehicles. A collaboration between Daimler Trucks North America and Portland General Electric, the site includes eight chargers from 150 kW to 350 kW and is designed to accommodate vehicles ranging in size from cars to buses and semi-trucks. In total, the site is wired for up to 5 MW of charging, thus allowing for the current chargers to be replaced with higher-powered chargers once they are available in the future, including the planned MW+ chargers.

# Hydrogen refueling infrastructure

Refueling hydrogen fuel cell electric vehicles, or FCEVs, is more akin to the experience of refueling conventional gasoline vehicles, with fuel primarily stored onsite and pumped into a vehicle via a nozzle. For hydrogen FCEVs, fill time is determined by the size of the vehicle tank and the pressure of the nozzle. Generally, it is much faster to fuel a FCEV than a BEV, taking approximately 5-15 minutes depending on the factors mentioned above. Lower pressure stations have a slower fueling rate and thus may be more appropriate for return-to-base fleets such as transit buses and local commercial vehicles. Larger vehicles with longer routes, such as long-haul trucks, are more likely to rely on public fueling infrastructure that delivers faster fueling.21

A hydrogen fueling station, whether public or a private depot, typically requires a hydrogen storage tank at its facility as well as a compressor and dispensing equipment to further pressurize the stored hydrogen and dispense it into vehicles. Hydrogen at a fueling station can either be produced onsite or delivered in gaseous or liquid form. Larger capacity stations may choose to store hydrogen in liquid form, as a liquid storage tank holds nearly nine times more hydrogen than a gaseous tank and, in this case, the hydrogen fueling station must also have equipment to convert the liquid hydrogen back into gaseous form for fueling purposes.[20]
As hydrogen in the transportation sector is still a niche market, there is not a lot of data available regarding the costs of building a hydrogen fueling station, particularly for medium- and heavy-duty 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 medium- and heavy-duty station. [21]
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

[18] Jessie Lund, John Schroeder, Emily Porter, and Dave Mullaney, Charting the Course for Early Truck Electrification, RMI, 2022, https://rmi.org/insight/electrify-trucking/.
[19] Perspectives on Charging Medium-and Heavy-Duty Electric Vehicles
[20] Hydrogen Pathway Study Transportation Electrification Infrastructure Needs Analysis; ODOT, Kittelson & Associates, Inc. and RMI, 2022.
[21] Perspectives on Charging Medium-and Heavy-Duty Electric Vehicles

arrival in Oregon. In addition, ODOT has successfully nominated two freight corridors for "hydrogen-pending" designation under the Federal Highway Administration's Alternative Fuel Corridor program: I-5 and I-84.

# Existing infrastructure incentive programs in Oregon

## National EV Infrastructure Formula Program

The Infrastructure Investment and Jobs Act included $5 billion for EV charging infrastructure. ODOT will receive $52 million over five years through the NEVI program for the installation of fast-charging stations every 50 miles along Oregon's EV Alternative Fuel Corridors; a 20% non-federal match is required for program expenditures, hence the overall investment through this program will be $65 million. 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 will go beyond this minimum guidance and require one higher powered charger (up to 350 kW) and invest in sufficient wiring for two additional chargers (up to 350 kW) to future-proof the site. In addition, ODOT will recommend the development of pull-through station designs in many sites, to better enable larger medium-duty vehicles or those towing a trailer, to refuel at NEVI-funded EV charging stations.

## DEQ MHD Charging Pilot

In HB 5202 the 2022 Oregon Legislature allocated $15 million into the Medium and Heavy-Duty Electrification Fund, established in HB 4139 (2022) for a grant program supporting medium and heavy-duty zero-emission vehicle 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. Projects will be awarded through a competitive request for proposal process with priority given 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 project(s) early in 2023.

While implementing this new pilot program DEQ expects to accelerate and support the transition of medium and heavy-duty fleets to electric. By transitioning away from diesel fuel, we will reduce greenhouse gas emissions in Oregon and support the new Advanced Clean Trucks Rule requiring increasing MHD ZEV fleet sales in the state. Additionally, the communities adjacent to Oregon's freight corridors will benefit from the reduction of diesel PM2.5, NOx, and other toxic air pollutants with increased adoption of zero emissions trucks.

Among the air quality and community benefits associated with this pilot Oregon DEQ will use the program to identify barriers and opportunities facing Oregon's freight industry in transition to electric. We will expand Oregon's expertise planning, siting, and building MHD ZEV charging and fueling infrastructure. Our 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

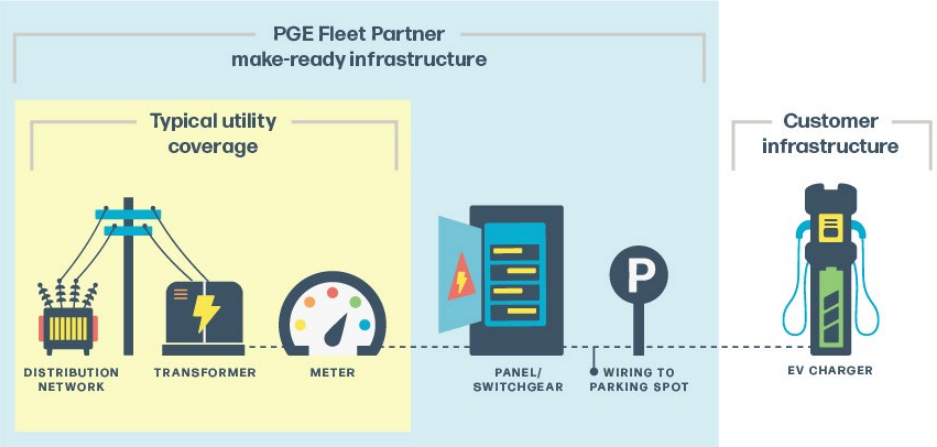
### Portland General Electric (PGE) Business EV Charging Rebates

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

### Portland General Electric (PGE) Fleet Partner Program

In addition to incentives for installation PGE offers free planning assistance to fleets that includes 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 (see Figure 3).

**Figure 3: PGE Fleet Partner Make Ready Infrastructure**




https://portlandgeneral.com/energy-choices/electric-vehicles-charging/business-charging-fleets/fleet-charging

### Pacific Power (PAC) Oregon Rebates for Business EV Chargers

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

# Other support for MHD adoption

## Utilities' Role in support of ZEV adoption

Oregon's electric utilities play a critical role in efforts to electrify the transportation sector. As described above, 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 Clean Fuels Program.

The utilities are working with multiple stakeholders to create a portfolio of programs that address many facets of creating Oregon's EV ecosystem by consolidating three separate 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 later this year. In the meantime, the utilities continue to implement their existing Clean Fuels Program workplans for 2022 which include PGE's Drive Change Fund and their Electric School Bus Fund, and PacifiCorp's Electric Mobility Fund. They 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 and are generally awarded to the owner or operator of the charger. A credit is equal to 1 ton of GHGs reduced and is calculated based on the carbon intensity of electricity 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. Generally speaking, utilities who are served by the Bonneville Power Administration have near-zero carbon electricity and is much lower than the statewide average.

Charger owners/operators report their electricity use to CFP on a quarterly basis and the web-based reporting system calculates the number of credits generated and deposits them into their accounts. The credits can then be sold to other entities immediately. The price for the credits is market-based and CFP published 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 to be transacted 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 such as garbage trucks, forklifts, cargo handling equipment, transport refrigeration units, and ocean-going vessel shore power systems. CFP is continuously evaluating new models of MHD ZEVs to be eligible for credit generation.

## Potential federal funding

There are other funding mechanisms that may aid in the adoption of more MHD ZEV vehicles. Federal funding may take the form of formula funding, such as the National Electric Vehicle Infrastructure Program (NEVI), or take the form of discretionary, competitive grants that are guaranteed. Each program has specific criteria that must be met to access funds, such as compliance with Buy America steel and iron requirements, scrappage, and matching funds.

## Infrastructure Investment and Jobs Act

In addition to NEVI, the IIJA established additional funding programs that could be used to support MHD vehicles and infrastructure. For example, the Carbon Reduction Program funds emissions reduction and includes charging infrastructure and state fleet vehicles as eligible projects.

## EPA Clean School Bus Program

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.

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

# Grants for charging and fueling infrastructure (Section 11401)

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.

## Inflation Reduction Act

### Qualified Commercial Clean Vehicles (Section 13403)

Beginning January 1, 2023, the IRA'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 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 (EPA) to create an incentive program providing funding to replace Class 6 and 7 vehicles with comparable zero emission vehicles, build ZEV charging infrastructure, fund workforce development and training, and fund planning and technical activities to support the adoption of ZEVs.

# Current MHD ZEV Incentive Programs in U.S. and Canada

## Vehicle Incentive Programs

There are numerous programs to support ZEV adoption for MHD vehicles throughout North America. All of them vary in terms of what type of vehicles are covered, the amount that is funded by the incentive, and where the funding originates. 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 voluntary 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 percent of the cost to repower engines and up to 100 percent 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 (HVIP)

This program supports deployment of zero-emission and near-zero-emission technologies. HVIP provides point-of-sale vouchers and is a model to demonstrate the function, flexibility, and effectiveness of 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 and provides $7.5K to $240K depending on vehicle cost.

### California's Clean Off-Road Equipment Voucher Incentive Project (CORE)

The CORE 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. CORE provides vouchers to California purchasers and lessees of zero emission off-road equipment, such as large forklifts, cargo handling equipment, construction equipment, landscaping equipment and on- and off-road terminal tractors, on a first-come, first-served basis, with increased incentives for equipment located in disadvantaged communities. The most recent allocation of funding for this program includes $108.5 million from the FY2021-22 GHG Reduction Fund and $86.5 million from the Air Pollution Reduction Fund. Voucher amounts vary based on equipment type but are capped at $500,000.

### Hawaii's Diesel Replacement Rebate (DRR) program

The DRR program provides rebates for the replacement of medium- and heavy-duty 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 vehicles. 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 offers rebates for public and private purchases or leasing of qualified new vehicles registered in the Commonwealth 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 (ZIP)

NJ ZIP is a pilot voucher program, with a Phase 1 voucher pool of $44.25M. On July 13, 2022, the Board approved a $45M Phase 2 of the pilot. Phase 1 of this pilot supports businesses and institutions purchasing new, medium-duty zero-emission vehicles that will operate in the greater Camden, Newark, New Brunswick, and greater Shore areas. This pilot is funded by the Regional Greenhouse Gas Initiative proceeds allocated to NJEDA for the purposes of reducing harmful emissions, especially in communities disproportionately impacted by transportation emissions, and creating economic opportunity within the state. The Phase 1 pilot program provides vouchers with base values ranging between $25,000 to $100,000.

### New Jersey Equipment Modernization Program

The NJEMP provides funding for replacements of non-road construction equipment, reimbursing grantees up to 25% for each project (not to exceed $100,000). 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, administered by the New York State Energy Research and Development Authority, helps make it easier for fleets to adopt zero-emission vehicle technologies while removing the oldest, dirtiest diesel engines from New York roads. NYTVIP 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 based on a percentage of the incremental cost of the vehicle, which is the difference in cost between the zero-emission vehicle and a comparable diesel vehicle, up to a per-vehicle cap. Voucher incentive amounts may differ by vehicle type, vehicle weight class, and location where the vehicle is domiciled.

### Government of Quebec's Écocamionnage Program

The Écocamionnage program aims to reduce GHG emissions in the road transportation industry 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 provides up to $175,000 based on vehicle class and battery capacity.

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

| 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 & 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 biz 25% bonus for small biz $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

# Existing MHD Charging Infrastructure Incentive Programs

In addition to vehicle incentives, states are increasingly offering incentives for the ZEV infrastructure to support these vehicles. These programs are both utility and state-run and are either standalone or paired with those that offer vehicle incentives.

## Utility Programs

### 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 mitigate 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 NY's vehicle incentive programs (NY Truck Voucher Incentive Program or NYC Clean Trucks Program).

### Southern CA 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 medium- and heavy-duty vehicles. Once a customer 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 easily and cost-effectively install charging infrastructure to support the transition of on road and off-road medium- and heavy-duty fleets to battery electric vehicles. The program is funded through customer rates. To be eligible, customers must own or have a purchase order for a minimum of two medium- or heavy-duty electric vehicles. Both Level 2 and DC fast chargers are eligible under this program, through a variety of charger installation configurations based on participant charging needs. Through this program, PG&E will construct, own and maintain all electrical infrastructure from the transformer to the customer's meter whereas fleet operates 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. In addition, charging equipment rebates (from $15,000 to $42,000, depending on charger power level) are 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 the charging infrastructure needed to power medium- and heavy-duty electric fleets. Through this program, SDG&E helps install make-ready charging infrastructure for MD/HD 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 applicable to 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. In addition, for business customers currently charging a fleet of EVs, SDG&E offers a new rate structure – the EV-HP rate, allowing 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.

## State Programs

### EnergIIZE Commercial Vehicles

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 CALSTART. EnergIIZE provides incentives for zero emission vehicle infrastructure equipment for medium- and heavy-duty battery electric and hydrogen fuel cell vehicles operated and domiciled in California. There are four funding lanes through which fleets can apply:

- The EV Fast Track funding lane is a first-come, first-served incentive that provides up to $500,000 (or 50% of eligible equipment and software costs) for commercial fleet users that currently own or are in the process of purchasing MD/HD battery electric vehicles. Funding through this lane can be used for EV charging equipment (Level 2 or DCFC, charge management software) and/or make ready (switchgears, electrical panel upgrades, wiring and conduit, meters).

- The EV Jumpstart funding lane is a competitive process providing up to $750,000 (or 75% of eligible equipment and software costs) for EV commercial fleet users who are: small businesses; a certified Minority Business Enterprise, Woman-Owned, Veteran-Owned, or LGBT-owned business; transit agencies located in or have at least 50% of fleet operations in a designated disadvantaged community; school districts in a designated disadvantaged community; a low-income community, tribal entity or non-profit organization. This can be used for charging equipment or make ready costs for Level 2, DCFC and charge management software.

- The EV Public Charging funding lane is a competitive process providing up to $500,000 (or 50% of eligible equipment and software costs) to commercial fleet users or station owners interested in deploying publicly accessible charging infrastructure for commercial MD/HD EVs. This incentive is for DCFC only (150 kW or greater), with future proofing for 350 kW encouraged. This can be used for charging equipment and/or make ready costs.

- The Hydrogen funding lane is a competitive process providing up to $2 million (or 50% of eligible equipment and software costs) to commercial fleet users or station owners who seek to deploy hydrogen refueling infrastructure for MD/HD hydrogen FCEVs.

### CALeVIP

The California Electric Vehicle Incentive Project provides incentives for the installation of Level 2 and DC fast chargers. Like EnergIIZE, CALeVIP is funded through the California Energy Commission's Clean Transportation Program and implemented by the Center for Sustainable Energy. CALeVIP 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

[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.

DCFC, capped at 75%-80% of project cost. Many offer additional incentives for projects located at multi-unit dwellings or within a disadvantaged or low-income community.

### CA's Low Carbon Fuel Standard Infrastructure Crediting Provision

In 2018, California amended the Low Carbon Fuel Standard to include a zero emission vehicle infrastructure crediting provision designed to support the deployment of ZEV infrastructure. The ZEV infrastructure provision include both Hydrogen Refueling Infrastructure and Direct Current Fast Charging Infrastructure. Through this provision, in addition to generating LCFS 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 FCEVs to take up station capacity.

In addition to the programs listed above that are dedicated to ZEV infrastructure, some states include infrastructure in vehicle incentive programs. These programs were discussed above under vehicle incentives.

# Incentive program design considerations

There are numerous ways to design incentive programs to support adoption of MHD ZEVs, all have positive and negative aspects. Programs design includes 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" are the most effective.[24]

NESCAUM published their Multi-State Medium- and Heavy-Duty Zero-Emission Vehicle Action Plan 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 incentive programs that:
- To deliver early benefits to communities historically exposed to higher levels of air pollution, state vehicle and infrastructure incentive programs should:
- To support small fleets, minority-owned fleets, and independent owner/operators, state vehicle and incentive programs should:
- 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

In addition to the action plan, NESCAUM held a roundtable discussion in July 2022 with lead staff who are implementing current ZEV incentive programs. They covered many topics of consideration for developing and implementing an incentive program for MHD ZEV. 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

The main emphasis from the NESCAUM round table on outreach and engagement for incentive programs was that outreach was important for a transparency, should be done throughout process, and should include small fleets. Whether this is in response to a draft funding announcement or program design feedback using social media, having meetings during off hours, and engaging with public and private agencies, as well as environmental justice communities was stressed. Engagement with electric and hydrogen providers to discuss short- and long-term impacts and feasibility was also included. There was mention of hosting feedback sessions after the programs have launched to understand how the applicants feel about the process and what problem solving is needed.

## Vehicle eligibility

Medium-and Heavy- duty 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 DERA and VW program as their structure which includes 2b-8 classes eligible.

Other considerations regarding vehicle eligibility had to do with availability from manufacturers to be placed on the road more rapidly, cost of vehicles, and what level of infrastructure was available in a given time period.

## Repowers or conversion eligibility

Repowering or vehicle conversions can be less expensive than new ZEV purchases which may be more inclusive to smaller fleets.

New York allows repowers and works directly with the repower providers. This has encouraged different market segments to participate that might not otherwise and is more inclusive to vehicle types where new ZEV vehicles are not available or too costly. Some of California’s programs also offer this option, but feel it has been underutilized so far, and they are 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 challenging 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.

## 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 value. Sometimes voucher systems are run through vehicle dealerships. Grants or rebates involve contracts with an agency that generally specifies vehicle purchase, timeline and amount- with reimbursement provided after the purchase of a vehicle. There are also tax rebates that are provided at the time of filing, 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 less trucks and a contract rebate track for the larger fleets. The vouchers track was meant to support smaller fleets through a quick and easy process- for the applicants and for 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 the rest of the vehicles, 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.

Regardless of one or the other or both types being offered, educating the fleets 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 such as the difference between cost of the ZEV's compared the cost of diesel counterparts (differential cost), what nearby states are offering, and what information is available about the market value of a base model vehicle, and cost effectiveness in reducing emissions.

Quebec's approach is to fund approximately 50% of incremental cost, based on class of vehicle and power of the battery. Information about the vehicles is obtained from the manufacturers and then given incentive levels. Other vehicle programs took 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.

Overall, when determining incentive levels, most programs started at certain levels and adjusted as they received feedback and found solutions to barriers for fleets. Incentives are about finding the right balance to incentive the most ZEV purchases.

# 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 such as how long projects take to assess and complete, current versus future needs, and incentive levels.

There are clear advantages to planning for the highest possible need of electricity or future proofing- to dig once rather than go back and built out further in the future. However, that may mean providing incentives for vehicles and needs that are not currently on the road. Because infrastructure projects have so many steps and milestones involved, some programs offer reimbursement at those steps, rather than at the completion of the project to increase accessible of these projects and allow for lower initial capital investment from the applicant.

# Small fleets

The difference in small versus large fleets is much greater than then number of vehicles that are owned. There are additional considerations when designing a program that targets supporting small fleet ZEV adoption. The technology is still new and may not be a good fit for a small fleet. 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 to do not have fleet redundancy. Financially smaller fleets may be at a disadvantage as 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. In Quebec, 75% of the fleets have 5 vehicle or less and 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 if they apply, providing 80% 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 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.

# Equity

Equity has been considered for MHD ZEV programs in a variety of ways. One way is reaching out to community groups and over burned 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). Others use interactive maps to track vehicle deployment in EJ communities, and some use a similar system for scoring (contracted grants).

Providing technical support, or directing people to the appropriate technical support, both for vehicles and infrastructure is also part of the equity aspect of these programs. Reaching out to communities to make sure they are aware of the opportunities and how to apply. Engaging with small and minority owned fleets is also an important inclusion, and that varied from program to program regarding 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, all the programs emphasize the importance of including this concept balanced with early adoption and overall reduced emissions.

# Stakeholder listening sessions and feedback

Two listening sessions were held to provide space for comments and feedback from stakeholders on the MHD ZEV incentive Report. May 31 and September 27, 2022.
Many stakeholders brought up the issue that for some sectors, specifically non-road and long-haul vehicles, *technology does not exist* right now for them to adopt ZEV vehicles. Whether the vehicles are not made for the application, the load, or the range it will limit who the early adaptor sectors and use cases are for incentives.

Numerous commentors said that they have had success and like the design the California HVIP program and supported Oregon adopting a similar or the same program in Oregon. There were also comments made about having *consistency along the west coast*, so that if other states had better incentives that it would deter new purchases in Oregon. Similarly, if Oregon had significant more comprehensive program, it would not be sustainable long term.

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

A comment we received from numerous stakeholders was to allow for a long contract time for infrastructure, and for vehicles if using vehicle rebates. Currently the estimates are 18-24 months from start to install on charging equipment. For vehicles there is s till large lack in the supply chain issues from COVID-19 so order to delivery if double or triple what it was in 2019.

The most comments were made based on program implementation. Stakeholders want more flexibility in the type of technology and class of vehicles that can be purchased with an incentive. This includes eligibility of smaller weight class vehicles, no minimum number of vehicles being purchased, capping businesses with large fleets for applying for funding. Other comments focused on the type of program pointing out that there are benefits and issues with all of them including vouchers, rebates, and tax incentives. Most comment supporting the “cash on the hood” style program so that there is less need for capital expense and can be more equitable for small businesses. One commentor mentioned the idea of prioritizing funding in underserved communities, and the rest being lottery-based awards. Multiples comments were centered around fuel agnostic- so proving funding for battery and hydrogen vehicles and infrastructure. The concept of a applicants receiving funds for a new vehicle being required to scrap or destroy an older, more polluting vehicles came up at this meeting. It was mentioned that large fleets tend to cycle through vehicles at a higher rate and only keep them in service for 4-5 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 the turn-over and capital to invest in ZEV vehicles and infrastructure and want to be early adaptors. A commentor did mention New York’s program that allows the applicant to buy an older used vehicle from another fleet to scrap instead of scrapping their own.

Stakeholders mentioned that the varying electric companies throughout the state all with different levels of structure and investment in electric infrastructure is a problem in Oregon. California was mentioned as it has a requirement for all utilities to have a “make ready” type system to assess and install infrastructure in their territory more swiftly. This also may cut down time for installation from 18-24 months. Some electrical providers I Oregon have developed such programs and

others have not, meaning that the ease in which infrastructure can be installed may impact who can take advantage of incentives throughout the state, impacting rural and urban areas differently. Other comments were also made on the need to put more effort into rural areas being ready for infrastructure for a more equitable adoption of ZEVs. Beyond readiness, the concept of 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. Stakeholders encouraged Oregon to provide state funds that can be used with federal funds as match or stacked. This would allow those with less capital to still seek competitive federal program funding, lowering the barrier to adoption particularly for school bus and transit bus programs.

Comments were also made on what Oregon's benchmarks and goals are with an incentive program. Would the program 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 outcome will aid in developing appropriate implementation and metrics. For instance, we received a comment about a point-of-sale voucher program being the most equitable and potentially having the largest impact on Environmental Justice communities.

Many important and relevant points were provided in the listening session that should be considered when developing an incentive program including:

- Oregon has many small fleets
- Oregon's proximity to California who also has MHD vehicle incentives
- Urban and rural access to both vehicles and infrastructure buildouts
- Renewable sources for electricity
- Work force opportunities associated with ZEV adoption

Overall, it is clear that the stakeholder that include fleets, non-profits, manufacturers, and other government agencies are engaged and excited about a ZEV incentive program for Oregon.

# Recommendations and Next steps

*To be added after second stakeholder listening session*

# 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. However, the total cost of ownership for ZEV vehicles tends to be lower because of fewer maintenance costs and often lower fuel costs. According to an analysis conducted by the California Air Resources Board, model year 2024 ZEV trucks are forecasted to be between $14,000 and $87,000 higher than that of a conventional vehicle depending on class. [25]
Drop if vehicle cost in in part due to decreasing battery costs. Overall, battery costs have dropped by 87 percent since 2010, and continue to drop (Henze 2019). In 2019, ICF 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.

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

[25] Comparison of Medium- and Heavy-Duty Technologies in California, ICF, 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 costs to consider including infrastructure and installation costs. Costs for installing chargers have a significant range 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, can be a major cost 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

Currently there are mechanisms to offset the costs of infrastructure to support MHD ZEV adoption including Oregon utilities to spend nearly $20 million on Level 2 and DC fast charging stations and the recent $100 million federal Infrastructure Investment and Jobs Act that will provide funding for EV related items including charging infrastructure. Charging infrastructure

costs could be mitigated by Oregon's Clean Fuels Program, where credits generated by charger owners, fleet operators, and transit agencies, could be sold to fund electric vehicle and future infrastructure investments.

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 Oregonians. Incentivizing adoption of ZEV now is imperative to support climate initiative and the livability of Oregon.