

Agenda

The series guides users through the following topics:

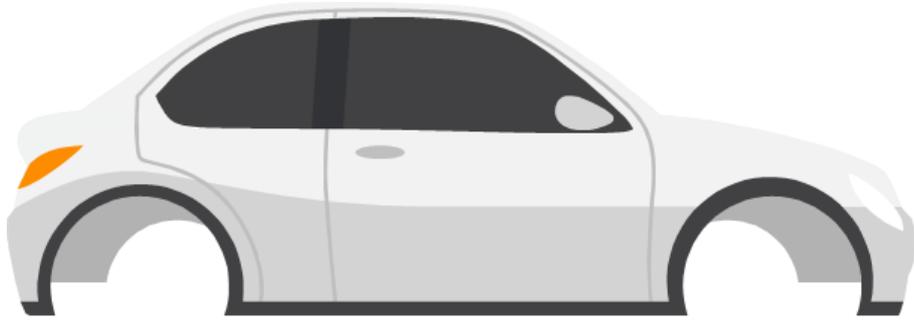
- Intro
- EV 101
- EV Policies (MDE)
- Charging Infrastructure Planning
- Working with Electric Utilities
- Fleet Training
- Fleet Analysis
- State and Federal Incentives (IRS)



Icebreaker:

Does your fleet have any EVs?





Electrifying Fleet Vehicles 101

Step 1. Research Current Available EV Models:

Manufacturer	Model	Max Seating	Estimated range (max mi)
Blue Bird	All American RE	84	120
	Micro Bird G5	30	100
	Vision	72	120
Motiv Power Systems/Collins Bus Corp.	Epic E-450 Chassis, Type A	16/ 24	105
Phoenix Motorcars/ Starcraft Quest body	Zeus 600 (Ford E-450 base)	13/ 23	110
Motiv Power Systems/ Trans Tech	Epic E-450 Chassis, Type A	16/ 24	120
GreenPower	BEAST	90	140
Lion Electric	LIONA	24	150
	LIONC	77	155
	LIOND	83	155
Thomas Built/ Proterra electric drive	Saf-T-Liner C2 "Jouley"	81	138
IC Bus	CE Series Electric	29/ 77	135/ 200

How to analyze your vehicle routes to determine if electric is a good option for your fleet?

- Review U.S. original equipment manufacturers (OEMs)



AFDC Vehicle Search Tool:

afdc.energy.gov/vehicles/search/

Step 2: Review EV constraints and advantages

Advantages

- Torque/performance
 - Quiet operation
- No tailpipe emissions
 - Charging flexibility
- Low electricity/fuel costs
 - Lower O&M costs

Considerations

- Higher upfront capital cost
- Additional infrastructure
- Changing utility rate structures
- Vehicle options
- Training for drivers and technicians

Step 3: Review Vehicle Requirements and Performance

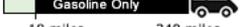
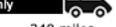
Connect with Fleet Managers

- EV battery capacity and energy efficiency impact **range and reliability**.
- Track **key performance indicators** by using **Telematics, charging software, or data loggers** can help fleets track real time data, receive diagnostic information, lower costs, optimize battery use, and analyze charging strategies



Step 4: Compare EVs and Charging Costs



EPA Fuel Economy	2020 Chevrolet Bolt EV Electricity  118 MPGe 127 108 combined city highway 29 kWh/100 mi  Electricity 259 miles Total Range	2020 Nissan Leaf SV/SL (62 kW battery) Electricity  104 MPGe 114 94 combined city highway 32 kWh/100 mi  Electricity 215 miles Total Range	2020 BMW X3 xDrive30e Elec + Gas  60 MPGe combined city/highway .0 gal/100mi of gas + 56 kWh/100mi Prem. Gas  24 MPG combined city/highway 4.2 gal/100mi  Gasoline Only 18 miles Elec + Gas All Elec: 0-17 mi  Total Range 340 miles	2020 Ford Fusion Regular Gasoline  23 MPG 20 29 combined city highway 4.3 gal/100mi  Gasoline 414 miles Total Range
You save or spend *27 MPG avg 2020 vehicle	You SAVE \$3,250 in fuel costs over 5 years compared to the average new vehicle	You SAVE \$2,750 in fuel costs over 5 years compared to the average new vehicle	You SPEND -\$1,750 more in fuel costs over 5 years compared to the average new vehicle	You SPEND -\$1,000 more in fuel costs over 5 years compared to the average new vehicle
Cost to Drive 25 Miles	\$0.93	\$1.05	\$2.14 single charge \$2.97 gas driven only	\$2.37
Tailpipe CO2 Grams/mile	0 grams per mile (77 g upstream CO2)	0 grams per mile (77 g upstream CO2)	204 grams per mile (77 g upstream CO2)	354 grams per mile (77 g upstream CO2)





Maryland
Department of
the Environment

MDE EV Programs



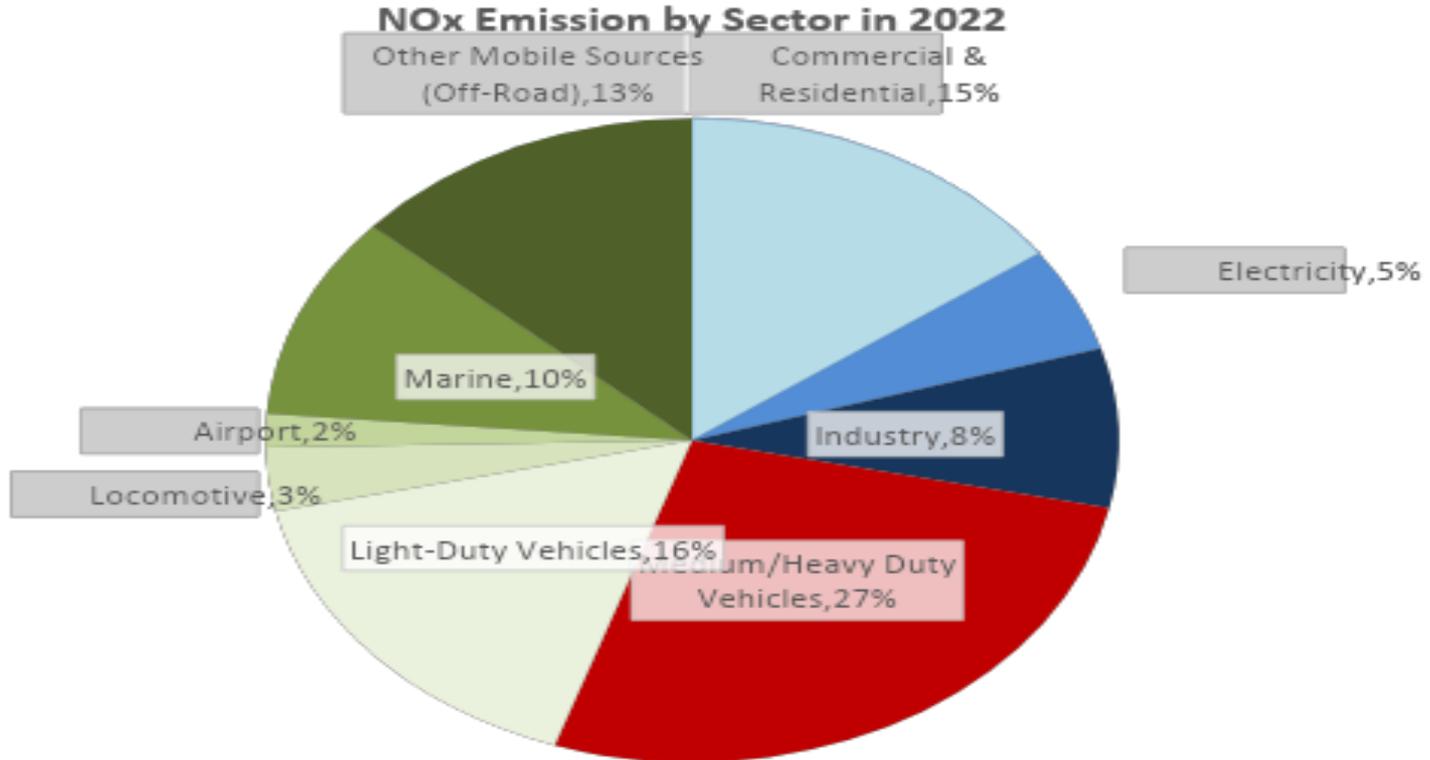


MDE-Environmental Focus

- NAAQS (National Ambient Air Quality Standards)
 - Non attainment for Ozone
 - NOx greatest contributor to ozone
 - On road Mobile Sources are largest contributor to NOx in Maryland
- Climate Change
 - Due to geographic location, Maryland very vulnerable to effects of Climate Change
 - 2015 Maryland updated to the Maryland GGRA (Greenhouse Gas Reduction Act), requires 60% reduction by 2031
 - On-road mobile sources account for over a third of all GHG emissions



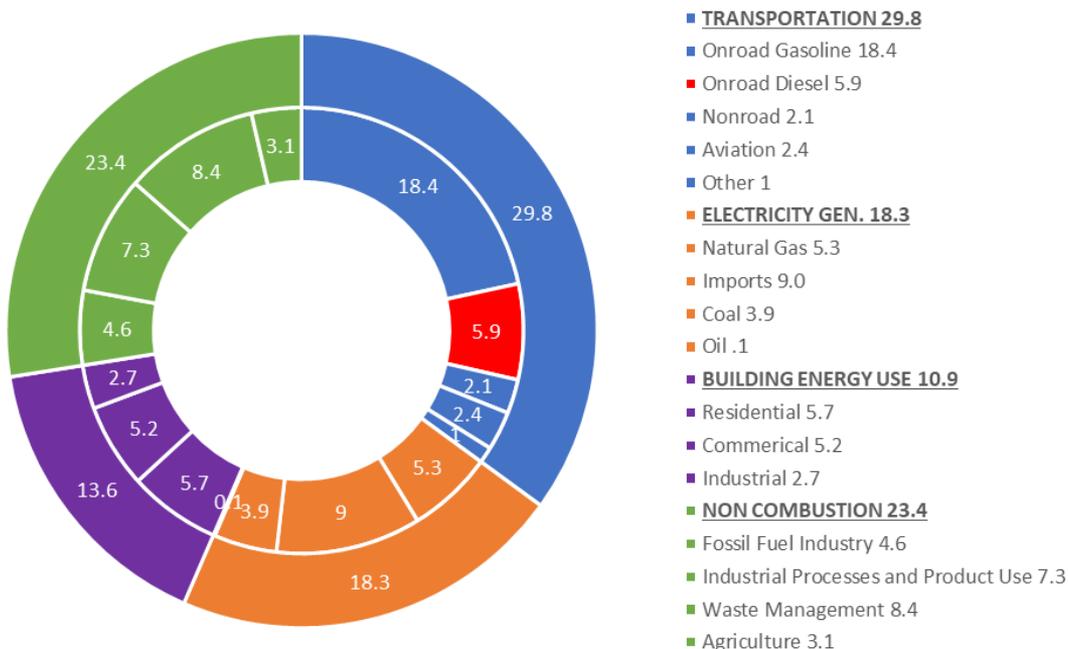
Air Quality Impacts





Greenhouse Gas Emission in Maryland

2020 GHG Emissions in Maryland
(85.06 Million Metric Tons of CO2 equivalent)



Source: Maryland 2020 Greenhouse Gas Inventory



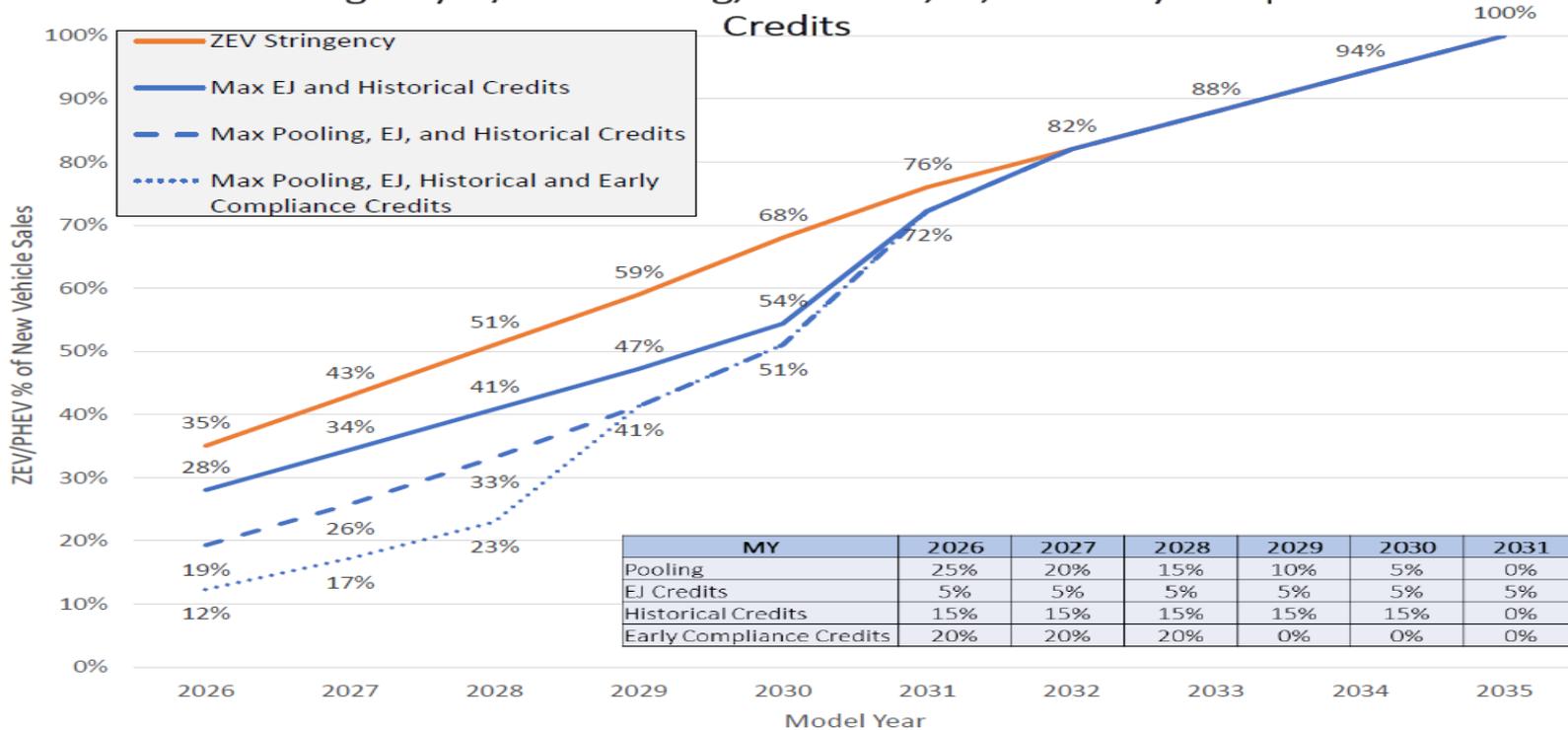
California ACC and ACC II

- The Advanced Clean Car (ACC) Regulation requires a growing percentage of light-duty vehicle sold in Maryland be zero emission.
 - Vehicles with a GVWR under 8,500 lbs.
- ACC adopted in 2007 as required by passage of The Clean Cars Act of 2007 and implemented in MY 2011 thru MY2025.
- ACC II adopted in 2023 and will cover MY26-35 light-duty vehicles.
- ZEV sales are phased-in beginning in MY 2024 (2027 for MD) and increase through MY 2035, remaining constant thereafter.



ZEV Requirement

ZEV Stringency w/Max Pooling, Historical, EJ, and Early Compliance Credits





Program Flexibilities

FLEXIBILITY	DESCRIPTION	SHORTFALL REQUIRED	CAP	SUNSET	IMPACT ON TOTAL REQUIREMENT
Historical Credits	OEM may use converted ACC I ZEV and PHEV credit balances	Yes	15%	After MY 2030	Results in fewer vehicles due to large existing credit balances (cannot be pooled)
Pooling	OEM may transfer excess ZEV and PHEV credits earned in one ZEV state to another ZEV state	Yes	MY 2026 – 25% MY 2027 – 20% MY 2028 – 15% MY 2029 – 10% MY 2030 – 5%	After MY 2030	Same volume of vehicles but allows some variation in where vehicles are delivered
Early Compliance Credits	OEM may meet portion of requirement with qualifying ZEVs and PHEVs delivered in MY 2024 and 2025 in §177 ZEV states	No	15%	After MY 2028	Same volume of vehicles but increases time period for delivery to §177 ZEV states by two years
EJ Credits	OEM receives <u>extra</u> credit for new vehicles <u>placed</u> in community-based programs, etc.	No	5%	After MY 2031	Slightly reduces volume of vehicles in state where EJ credits are accrued (cannot be pooled)
PHEV Credits	OEM may meet portion of requirement with qualifying PHEVs	No	20%	None	Allows portion of ZEVs required to be replaced with PHEVs
Banked 2026+ Credits	OEM may bank 2026+ credits for future use, for 4 additional MYs	Yes	None	None	Same volume of vehicles but allows for some variation from year to year
Trading	OEM may trade or acquire excess ZEV or PHEV credits	Yes	None	None	Same volume of vehicles but allows for variation among OEMs



California ACT

- The Advanced Clean Truck (ACT) Regulation requires a growing percentage of medium- and heavy-duty vehicle sold to be zero emission.
 - Vehicles with a GVWR over 8,500 lbs.
 - Class 2b – Class 8 vehicles.
- ZEV sales are phased-in beginning in MY 2024 (2027 for MD) and increase through MY 2035, remaining constant thereafter.
- Similar credit, banking, and trading program as light-duty manufacturers have under the Advanced Clean Car.

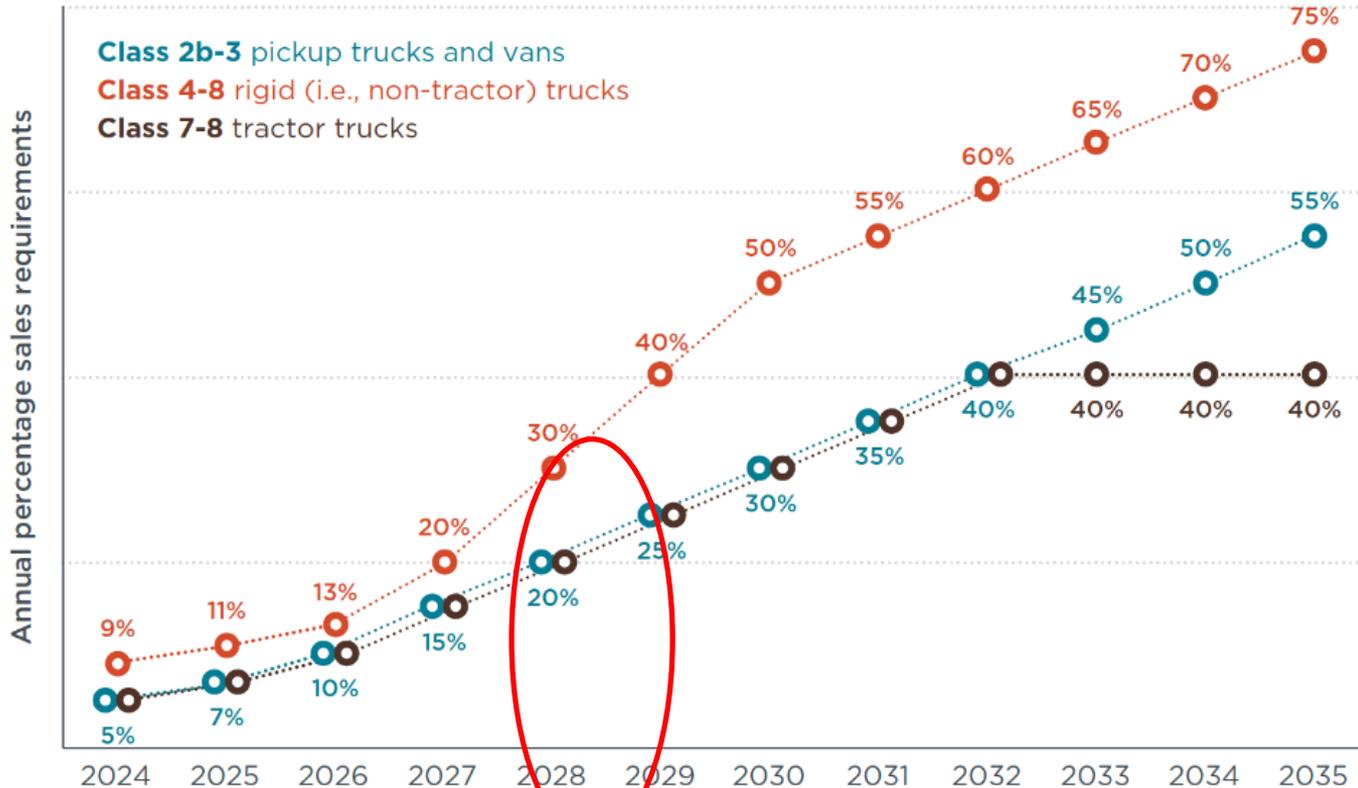


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Advanced Clean Truck (ACT) Program





Medium/Heavy-Duty Trucks

 Minivan	 Utility van	CLASS 1 6,000 lb & less	 Bucket	CLASS 5 16,001 to 19,500 lb	
 Multi-purpose	 Full-size pickup		 City delivery		 Large walk-in
 Minivan	 Utility van		 Beverage		 Single-axle van
 Full-size pickup	 Step van		 School bus		 Rack
 Walk-in	 Conventional van	CLASS 3 10,001 to 14,000 lb	 Refuse	CLASS 7 26,001 to 33,000	
 City delivery			 City transit bus		 Medium conventional
 Conventional van	 City delivery	CLASS 4 14,001 to 16,000 lb	 Dump	CLASS 8 33,001 lb & over	
 Large walk-in			 Heavy conventional		 COE sleeper



MDE Vehicle Programs

- **MDE's vehicle incentive programs are mainly federally funded**
- **These include:**
 - **Diesel Emission Reduction Act (DERA)**
 - **Clean School Bus Program**
 - **MHD Replacement Program**
- **These programs are largely focused on replacing MHD diesel vehicles**
- **Vehicles being replaced are usually required to be scrapped**



MDE Vehicle Programs

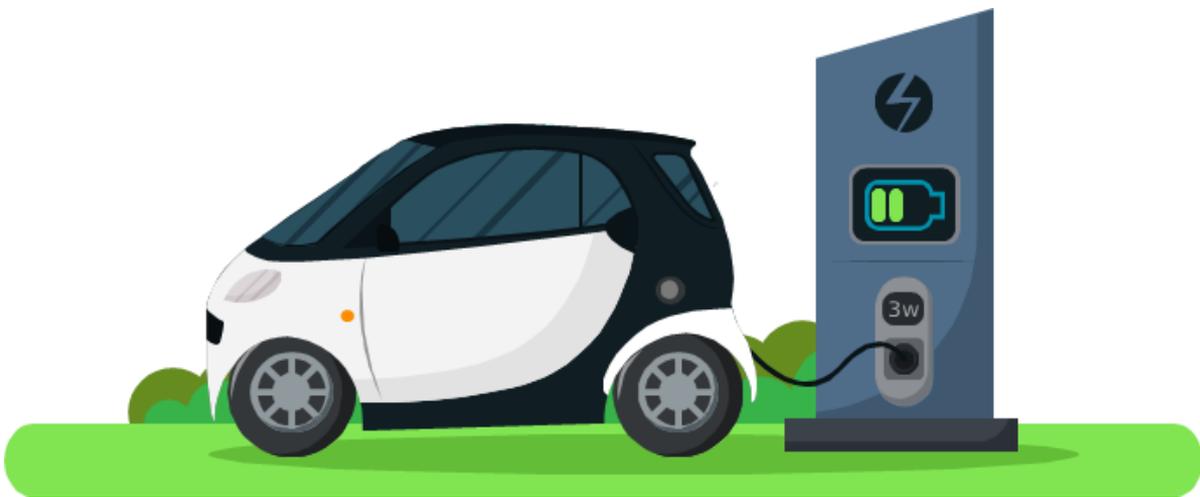
Volkswagen Settlement Program

- Vehicle Replacement Program
 - MDE received approx. \$64 million for vehicle replacements
 - Funded 44 project proposals (school buses, transit buses, RTG cranes, switcher locomotives etc...)
 - Goal was to reduce NOx emissions from VW defeat devices
 - Estimated 575 to 1,730 excess tons of NOx from defeat devices
 - Estimated lifetime NOx reductions from projects approx. 3,000 tons
 - In addition, diesel replacements will reduce CO2 emissions by over 6,000 tons per year
 - Replaced approx. 370 vehicles
 - Remaining funds will be used to reopen two programs
 - Electric M/HD Trucks
 - Electric School Buses



MDE VW EVSE Programs

- MDE: VW Program
 - \$11.3 million
 - Workplace and Corridor/HUB charging
 - Workplace:
 - 60% of charger cost
 - Up to \$4,500 (Network) or \$2,500 (non network)
 - Corridor/HUB
 - 80% of Charger cost
 - Up to \$150,000
 - Three Rounds of Funding:
 - Rounds 1 and 2
 - Corridor/HUB: 26 sites, 71 Chargers
 - Workplace: 50 sites, 315 Chargers
 - Round 3
 - Open later this year



EV CHARGING 101

Charging Infrastructure

Electric Vehicle Supply Equipment (EVSE): All the equipment needed to deliver electrical energy from an electricity source to a PEV battery

- **EV Charging Port (single vs dual):** An EV charging port provides power to charge only one vehicle at a time even though it may have multiple connectors.
- **Connector (plug):** A connector is what is plugged into a vehicle to charge it. Multiple connectors can be available on one EV charging port, but only one vehicle will charge at a time.

Connectors are sometimes called plugs.



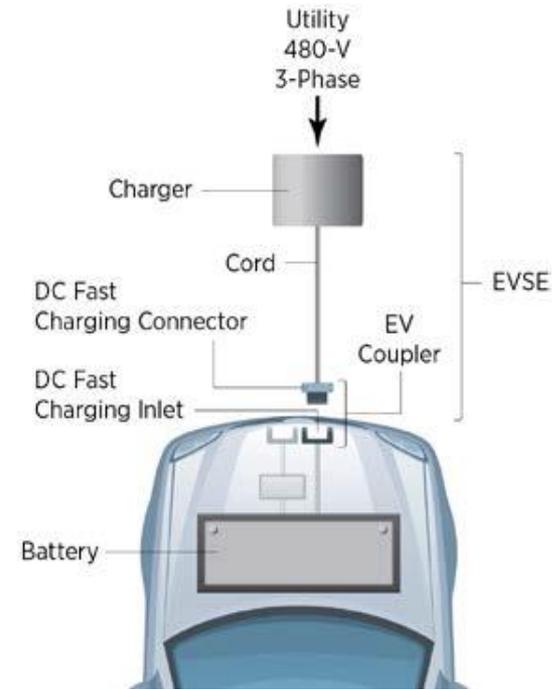
Level 2



DC Fast
Charger



DC and
Level 2

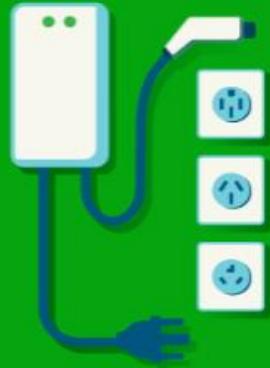


Charging Electric Vehicles at Home & Public

Requires permitting and licensed contractors for installation.

LEVEL 2

Outlet Type	Charging Infrastructure (need electrician)
Charge Cost	Nissan Leaf (15 ¢/kWh): \$9.00 per session \$1.5-5k+
Speed of Charge	10 - 20 miles of range per hour of charged (3-8 hours)
Primary Location	Residential Commercial
Other Locations	On Street Multi unit dwelling Single family residential Garages and driveways



Level Two

220V

Electrical source from a regular home dryer outlet, home hardwire, or public station.

Charge Time

10-20 miles of range per 1 hour of charging.

Charging Electric Vehicles - Public / Vacation

Requires permitting and licensed contractors for installation.

LEVEL 3

Outlet Type	Charging Infrastructure (need electrician)
Charge Cost	Exercise
Install Cost	\$80k-\$120k+
Speed of Charge	80-200 miles of range per hour of charged (30min-1 hour)
Other Locations	Parking lots/garages Public/municipal Transportation hubs Hotels Retail/Workplaces Office parks or Industrial facilities

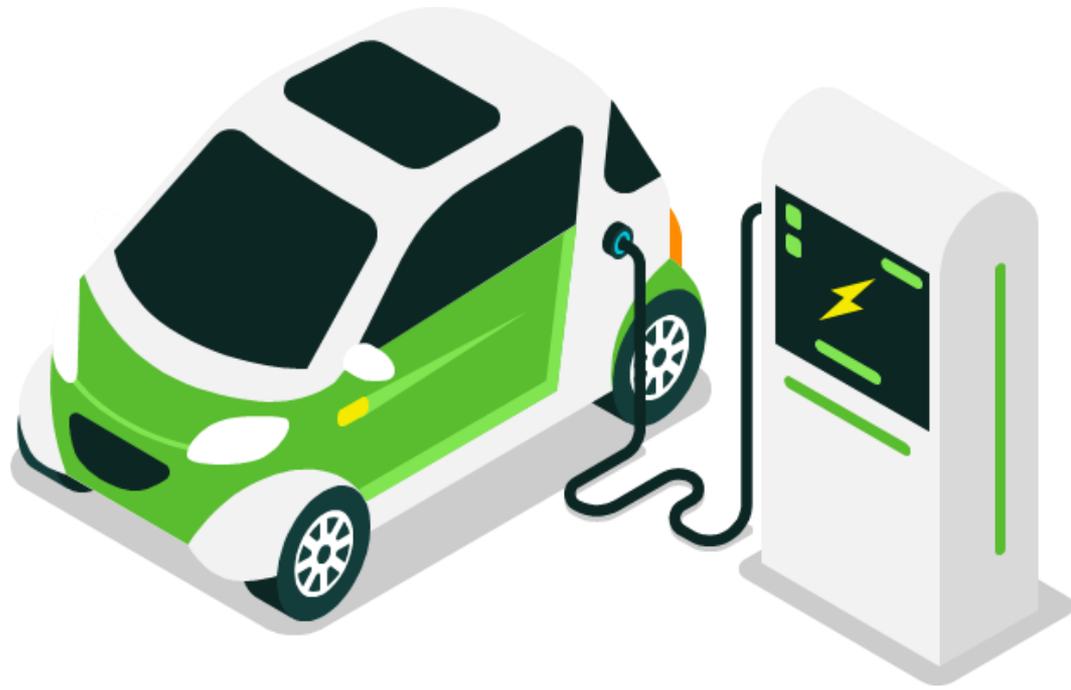


DC Fast Charge

208 or 480V 3-Phase AC
Electrical source from a public station.

Charge Time

60-80 miles of range per 20 minutes of charging.



EVSE - Fleet Planning

How to Determine EV and EVSE Costs

Hardware Costs

Includes: Physical charging stations, ports, panels, transformers, etc., including wiring/conduit.

Look for several bids.

- Signage
- Safety, ADA and Accessibility
- Additional Lighting Requirements
- Standing Water/Flood Issues
- Installation Meets Building Code Requirements
- Installation Meets Local Zoning Requirements

How to Determine EV and EVSE Costs

Software/Networking Costs

Provides data and analytics to fleet managers to inform charging decisions.

Software can be built-in to chargers or purchased from third-party vendors. This enables cost-effective charging management, along with integration of distributed energy resources (DERs) and grid services.

- Networks can be closed or open.
- Different station management systems dependent on provider
- Maintenance (vehicle/infrastructure)
- Training and education
- Demand Rates and Utility Costs

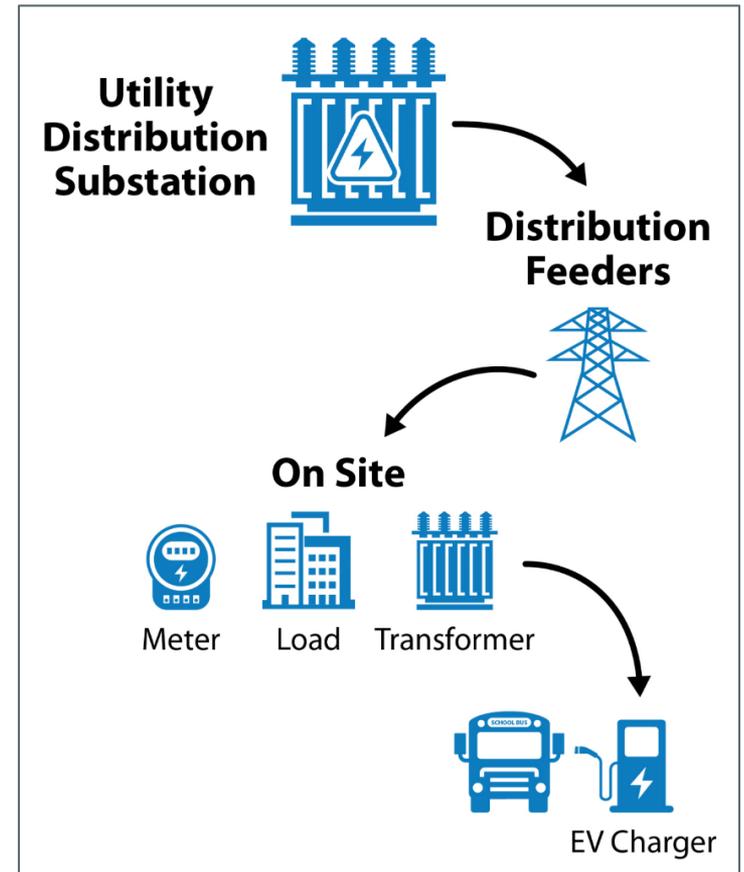
Working With Electric Utilities

MEA can help start the conversation with your utility, assessing your **power needs and utility rates**

Talk to your utility to understand your service equipment and find the most economical way to charge

Understand vehicle energy needs:

1. Overall daily vehicle miles traveled
2. Daily time traveled
3. Vehicle operational efficiency (kwh per mile)
4. Typical auxiliary loads

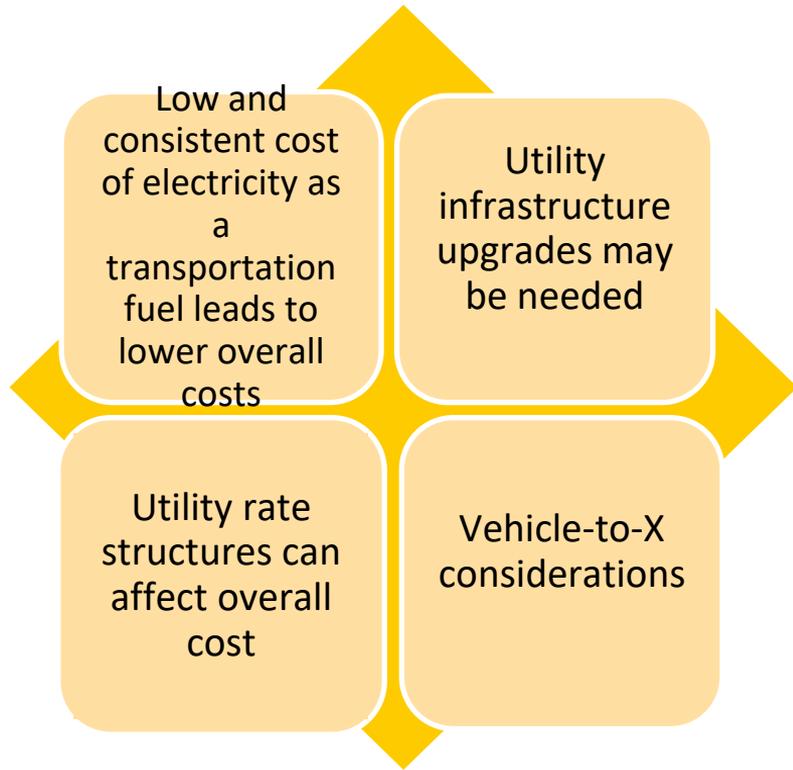


Utility Rate Structures

Demand charges, monthly fees charged to users as part of the utility's cost of maintaining the infrastructure required to deliver electricity, are dependent on peak demand

Peak demand is determined by the highest level of power demanded at one site in a billing period

The more buses charging at the same time, the higher peak demand and demand charges

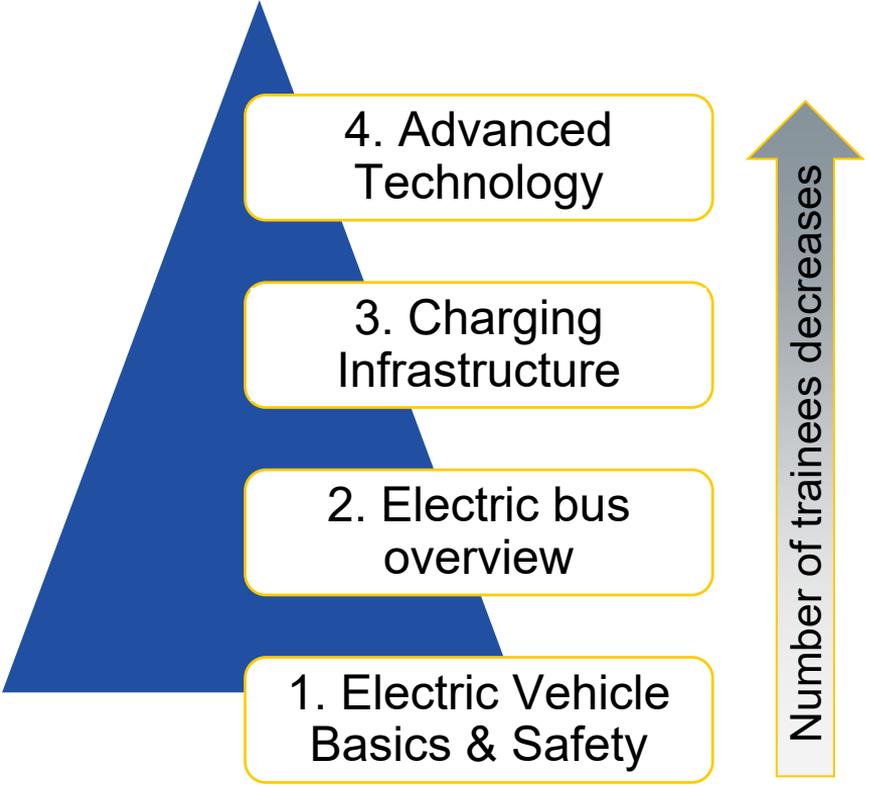


Driver and Technician Training

OEMs typically provide driver and technician training for their vehicles.

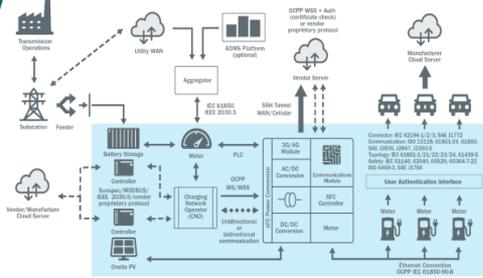
Connect with MEA/MCCC about training

- Maximize the range of EVs
- Reduce range anxiety
- Ensure staff is educated on new technology
- Teach safe maintenance practices
- Ensure a smooth transition



Resiliency Framework

Reference Architecture



1. The location of the DER to EVSE units. (10-20 feet)
2. The climate in the area (canopy/garage for -20°F)
3. The types and size of EVs
4. The expected demand for charging.
5. The availability of grid power, solar and battery capacity.
6. The redundancy of interconnectivity (+30% of avg demand)

Click: Infrastructure Planning and Solutions

1. Plan for charging installations and vehicle acquisition ([takes time to deliver](#))
2. Know when and how often the vehicle must charge ([dwell time](#))
3. Choose the charging technology that can supply the necessary power while avoiding costly installation options ([levels](#))
4. Work with your vehicle and charging infrastructure provider to ensure interoperability between bus and charger ([Reporting and V2G](#))
5. The installation of wiring and circuit breakers for new charging infrastructure may increase the size of the power load on electric panels, substations, transformers, and conductors. ([Futureproofing](#))
6. Review upgrades to meters, electric services, and distribution equipment, and how EV rates can impact charging (fueling) costs. ([demand rates](#))
7. Managed charging, delay charging during peak power to reduce costs and improve charge sessions ([smart charging](#))

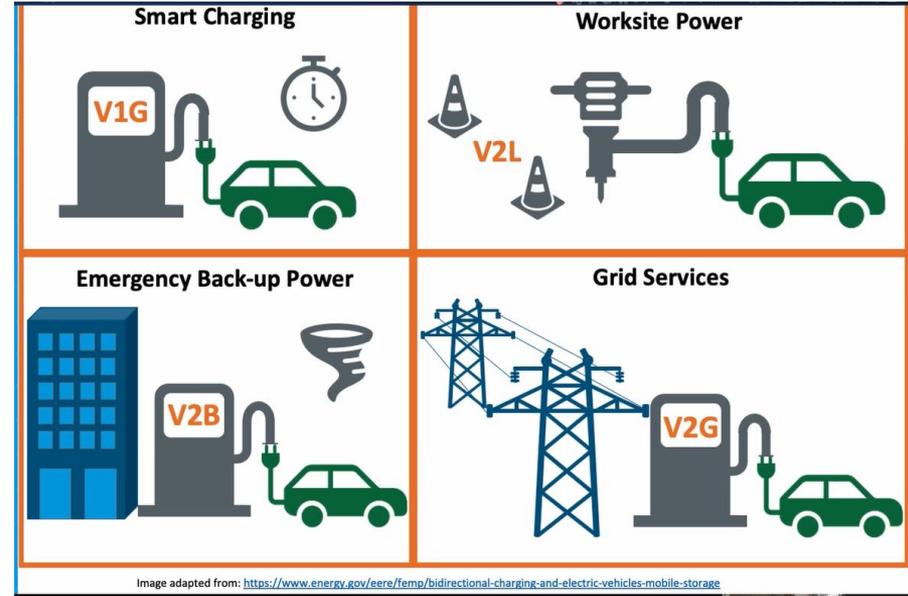


V2G Overview

There are many different forms of advanced charging solutions, such as smart charging, vehicle-to-load, vehicle-to-building, and V2G, but there are barriers to consider

There are opportunities for managed charging to be paired with local power generation

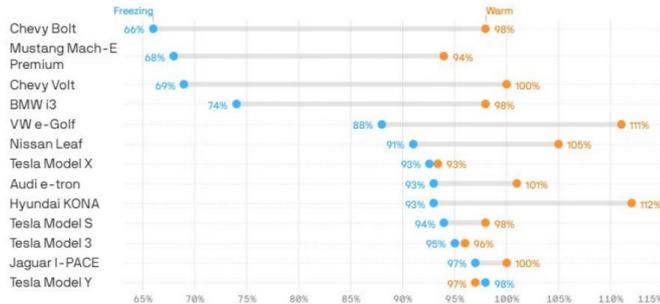
Fleets should track these opportunities and consider where pilot programs may be helpful in unlocking the full potential for advanced charging solutions



Other Considerations: Maintenance and Safety

How weather affects EV battery range

Percentage of EPA range in freezing (20-30°F) and warm (70°F) weather



Data: Recurrent; Chart: Baldi Wang/Avioce

- **First Check with the OEM**
- **EVs typically require less maintenance than conventional vehicles:**
 - Battery, motor require little to no maintenance
 - Fewer fluids to change
 - Brake wear is reduced due to regenerative braking
 - Fewer moving parts
- [EV Safety Checklist](#)
- [Maintenance Checklist](#)



STATE PROGRAMS, TAX INCENTIVES, AND OTHER RESOURCES

afdc.energy.gov/laws

Inflation Reduction Act:
*Commercial Clean Vehicles
Credit*

Presenter:
Christopher K. Green

IRC 45W Credit for Commercial Clean Vehicles

Businesses and tax-exempt organizations that buy a qualified commercial clean vehicle may qualify for a clean vehicle tax credit of up to \$40,000 under Internal Revenue Code (IRC) § 45W

The credit equals the lesser of:

- 15% of the tax basis in the vehicle (30% if the vehicle is not powered by gas or diesel) or

IRC 45W Credit for Commercial Clean Vehicles (Cont.)

Who Qualifies:

- Businesses and tax-exempt organizations qualify for the credit.
- There is no limit on the number of credits the business can claim.
- For businesses, the credits are general business credits and non-refundable, which means the

IRC 45W Credit for Commercial Clean Vehicles (Cont.)

To qualify, a vehicle must be subject to a depreciation allowance, with an exception for purchased vehicles placed in service by a tax-exempt organization.

The vehicle must also:

- Be made by a qualified manufacturer as defined in IRC 30D(d)(1)(C). Qualified manufacturers list is at [IRS.gov](https://www.irs.gov)
- Be for use in the business and not for resale

IRC 45W Credit for Commercial Clean Vehicles (Cont.)

In addition, the vehicle must either be:

1. Treated as a motor vehicle for purposes of Title II of the Clean Air Act and manufactured primarily for use on public roads (not including a vehicle operated exclusively on a rail or rails);
2. Mobile machinery as defined in IRC 4053(8)
(including vehicles that are not designed to perform a

IRC 45W Credit for Commercial Clean Vehicles (Cont.)

The vehicle or machinery must also either be:

1. A plug-in electric vehicle that draws significant propulsion from an electric motor with a battery capacity of at least:
 - 7 kilowatt hours if the gross vehicle weight rating (GVWR) is under 14,000 pounds
 - 15 kilowatt hours if the GVWR is 14,000 pounds or

IRC 45W Credit for Commercial Clean Vehicles (Cont.)

How to Claim the Credit:

- File Form 8936 (check back soon for a revised Form 8936) that should be completed to claim the commercial clean vehicle credit for vehicles placed in service in 2023 and later)
- The vehicle's VIN will be reported on Form 8936
- Along with make, model, model year and placed in service

Clean Vehicle Resources

- [Frequently Asked Questions About the New, Previously-Owned and Qualified Commercial Clean Vehicles Credit Publication](#)
- [Publication 5724-B, Credit for Commercial Clean Vehicles](#)
- [Publication 5724-F, Credit for Commercial Clean Vehicles](#)

WWW.IRS.GOV/CLEANVEHICLES

Contact information

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Next Steps

Questions!

Connect With us about Free resources for:

- Alternative fuels
- Electric vehicles
- Emerging transportation technologies
- Charging equipment information
- Utility connections
- Fleet analysis
- Operational recommendations like routing and maintenance