

ELECTRIC VEHICLE CHARGING

A KEY PIECE OF ELECTRIFYING TRANSPORT

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BACKGROUND WITH EVS

- Robert Fernatt, President of the West Virginia Electric Auto Association
- Native West Virginian living in Martinsburg
- Day job in Information Technology
- Interested in efficient vehicles for many years due to long commutes
- First EV, Nissan Leaf, in 2015
- Installed solar array and L2 EVSE in 2017
- Second EV, Tesla Model 3, in 2018
- \$5/month electric bill since March 2018 for all-electric home and EV



WVEAA

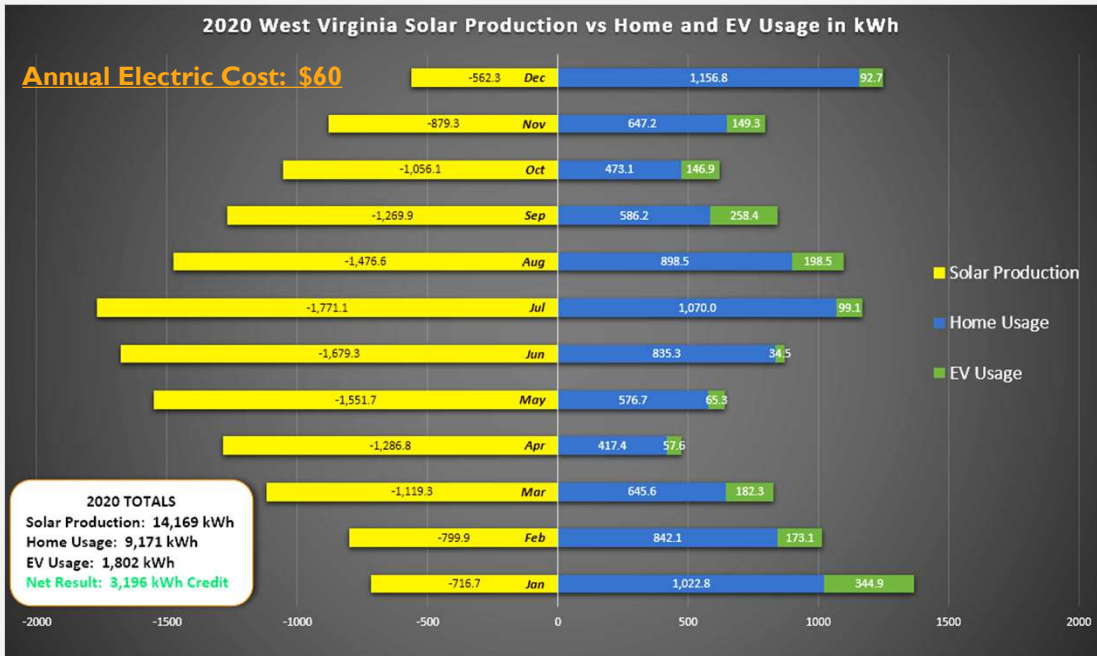
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BACKGROUND WITH EVS

- Several years of experience living with the technology from a consumer perspective and serving public education and advocacy roles
- A brief word about why EV technologies appeal to certain groups:
 - Environmental advocates
 - National security advocates; *electricity (and its associated jobs) are local; it is not a global commodity*
 - Faith-based groups, respecting creation
 - Personal energy security, independence, cost control
 - Pioneers who want to be on the cutting edge with the latest technology



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AGENDA

- Snapshot of Electric Vehicle (EV) market
- EV charging overview
- Considerations when installing an EV charger
- What's coming for heavy duty EVs
- Questions

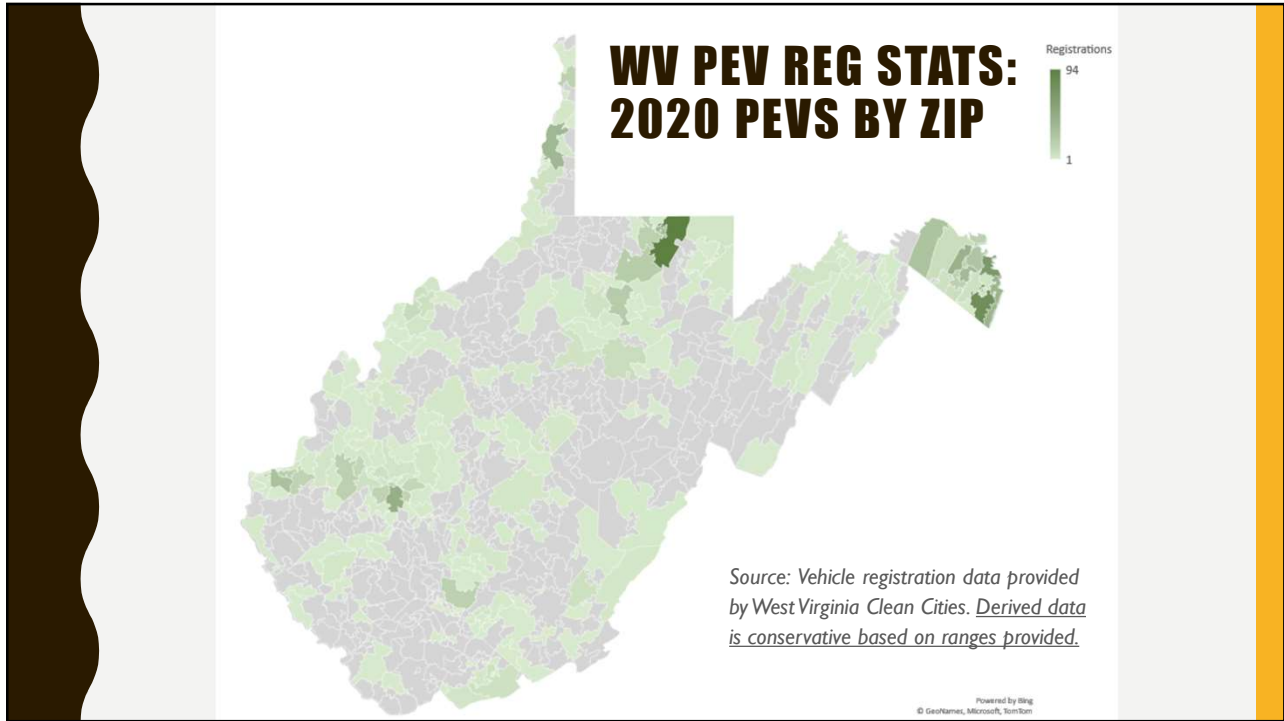


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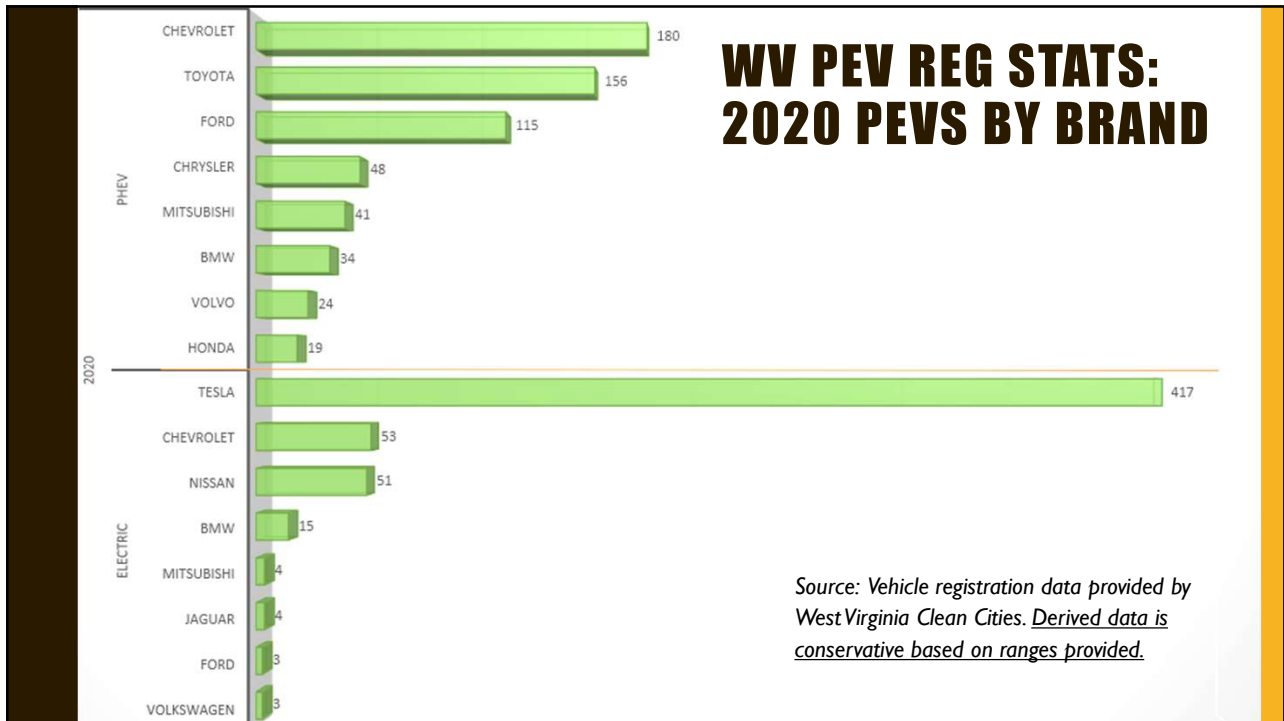
EV MARKET SNAPSHOT

WHERE DO WE STAND AND WHAT'S COMING?

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US PEV SALES & SHARE FORECAST 2021-2030



Source: evadoption.com. Historical sales data: GoodCarBadCar.net, InsideEVs, IHS Markit/Auto Manufacturers Alliance, Advanced Technology Sales Dashboard, Research & Chart: Loren McDonald/EVAdoption

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COMPANY STATEMENTS...

EXCLUSIVE

Porsche: Electrified cars will represent 80% of its sales in 2030

Ford Targets 50 Percent EV Sales by 2030

Nissan is targeting 40 percent of U.S. vehicles sales to be of fully electric models by 2030. The automaker intends to debut new models in support of the powertrain and sales

Volkswagen says it wants a quarter of its car sales to be electric by 2026, then 50 percent to be battery-powered by 2030. It is aiming for almost 100 percent of its new vehicle sales to be electric by 2040, and for the company to be carbon

Nonetheless, General Motors CEO Mary Barra announced Tuesday that GM aims to deliver 400,000 EVs in North America by the end of 2023, as reported by [Automotive News](#).

Electric Vehicle Checkpoint: Was The Super Bowl Trying to Sell You an EV?

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FOLLOW THE MONEY...

Volkswagen increases spending on EVs to \$100 billion

Volvo to Plow \$35 Billion Into Accelerating Electric Car Shift

- Automaker raises battery-based EV investment, sales targets
- Accelerates efforts after later entry into mass-market EVs

Hyundai Motor plans to invest US\$16b in EV

WED, MAR 02, 2022 - 3:07 PM

AUTOS

Electric Dodge muscle car and Ram pickup part of Stellantis' \$35.5 billion EV plans

Cadillac is going electric – every new vehicle will be all-electric starting now

GM Will Boost EV and AV Investments to \$35 Billion Through 2025

GM will pull ahead construction of two new Ultium battery cell plants in the U.S., in addition to plants in Ohio and Tennessee now being built

VOLKSWAGEN TO STOP PRODUCING GAS- AND DIESEL-ENGINE VEHICLES BY 2026

Daimler Will Pull the Plug on Gasoline, Diesel Engines, Focus on EVs

Mercedes-Benz To Spend \$47 Billion To Speed Conversion To Electric-Only Lineup

Ford to invest \$11.4B, 11,000 jobs in Tenn., Hardin County for electric vehicles

Ford to make new investment of up to \$20 billion in EV push-

Nissan to invest \$17.6 billion over next five years to ramp up electric vehicle offering

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AUTOMAKERS TARGET \$515 BILLION FOR EVs AND BATTERIES

"...does not include the tens of billions of dollars being invested in additional production capacity by the world's largest battery companies..."

Source: Reuters - Exclusive: Global automakers now target \$515 billion for EVs, batteries

With these investments, more EVs are coming, and they need charging!

Global automaker EV & battery investments

Auto industry investments in battery technology and electric vehicles are led by German automaker Volkswagen and total \$515 billion

Automaker	Investment (Billions)
Volkswagen	105
Daimler	45
Stellantis	35
Ford	30
GM	25
BMW	25
SAIC	25
Tesla	25
Changan	25
Hyundai/Kia	25
GAC	20
Dongfeng	15
Great Wall	15
Honda	15
Toyota	15
Renault	15
Geely	15
Jaguar Land Rover	10
BYD	10
Volvo	10
FAW	10
Nio	10
Xpeng	10
BAIC	10
Li Auto	10
WM Motor	10
Mazda	10
Jianghuai	10
Chery	10
Tata	10
Mahindra	10



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EV CHARGING

LEVEL 1, LEVEL 2, DCFC, OH MY!

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AC LEVEL 1, 2 & DC FAST CHARGE (DCFC)

AC Level 1	AC Level 2	DC Fast Charge
		
Voltage 120V 1-Phase AC	Voltage 208V or 240V 1-Phase AC	Voltage 208V or 480V 3-Phase AC
Amps 12 – 16 Amps	Amps 12 – 80 Amps (Typ. 32 Amps)	Amps <125 Amps (Typ. 60 Amps)
Charging Loads 1.4 to 1.9 kW	Charging Loads 2.5 to 19.2 kW (Typ. 7kW)	Charging Loads <90 kW (Typ. 50kW)
Charge time for vehicle 3 – 5 miles of range per hour	Charge time for vehicle 10 – 20 miles of Range per hour	Charge time for vehicle 80% Charge in 20 – 30 minutes
Level 1 Charging	Level 2 Charging	Level 3 Charging

150-350kW is common for interstate DCFC stalls.

Source: bateselectric.com – Commercial DC EV Charging Stations

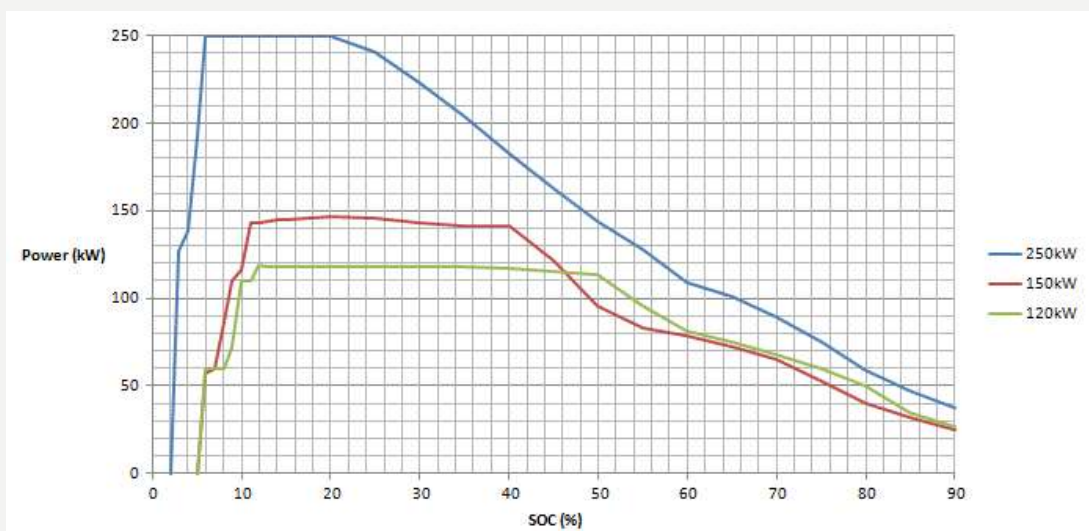
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PEV CHARGING

- Effective charge rate is the combination of what the charger can deliver and what the EV can accept
- For AC Level 2, most recent EVs support 6-12kW charging, but some up to 19.2kW or 10-70 miles of range/hour
- Electric Vehicle Supply Equipment (EVSE) vs 'charger'
- For DCFC, EV charging capabilities vary. Most recent EVs support 50kW (Bolt, LEAF) to 250kW (Tesla, Porsche) fast DC charging or 150-1,000 miles of range/hour at peak
- Peak EV power draw is affected by variables such as temperature and State of Charge (SoC) among others

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DCFC CHARGE CURVE EXAMPLE - MODEL 3



Source: reddit.com – r/teslamotors - SCV3 Full-Speed 250kW Charging Curve

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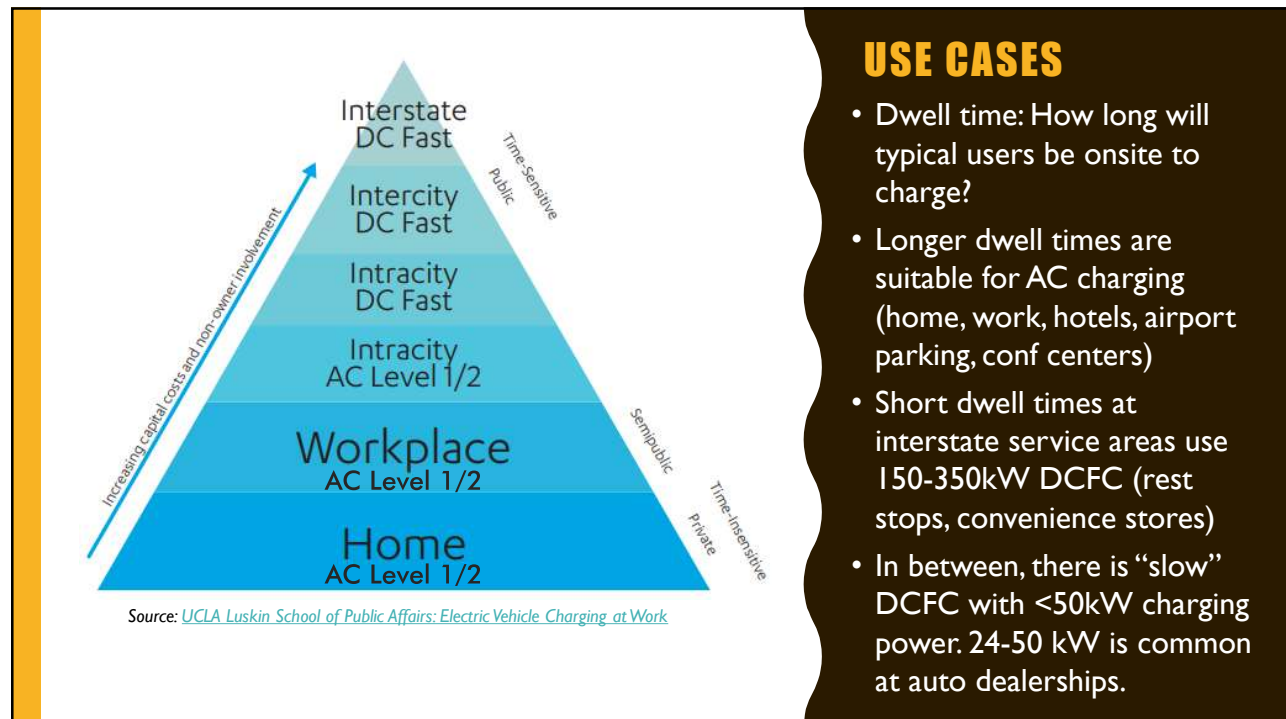
CHARGE CONNECTORS: STANDARDS...

- AC Level 1 and 2: J1772 or Tesla (Destination)
- DCFC: Tesla (Supercharger), CCS I, CHAdeMO (phasing out)

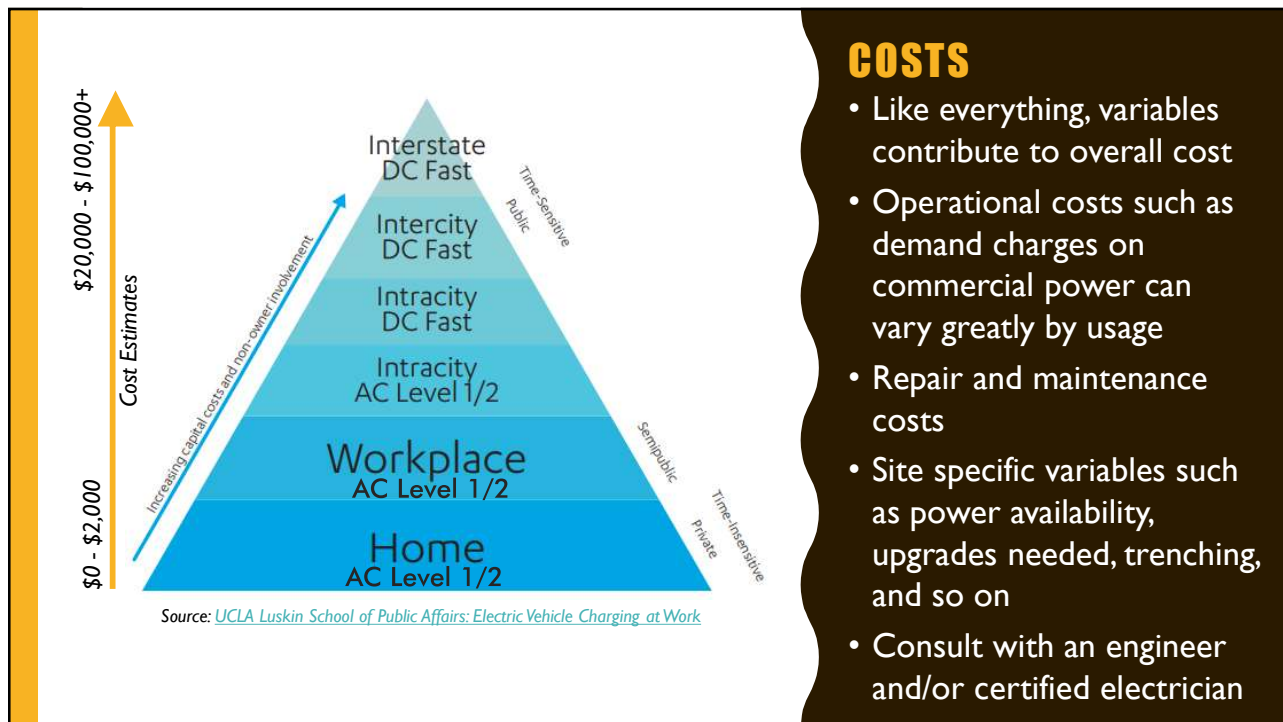


Source: enelx.com – The Different EV Charging Connector Types

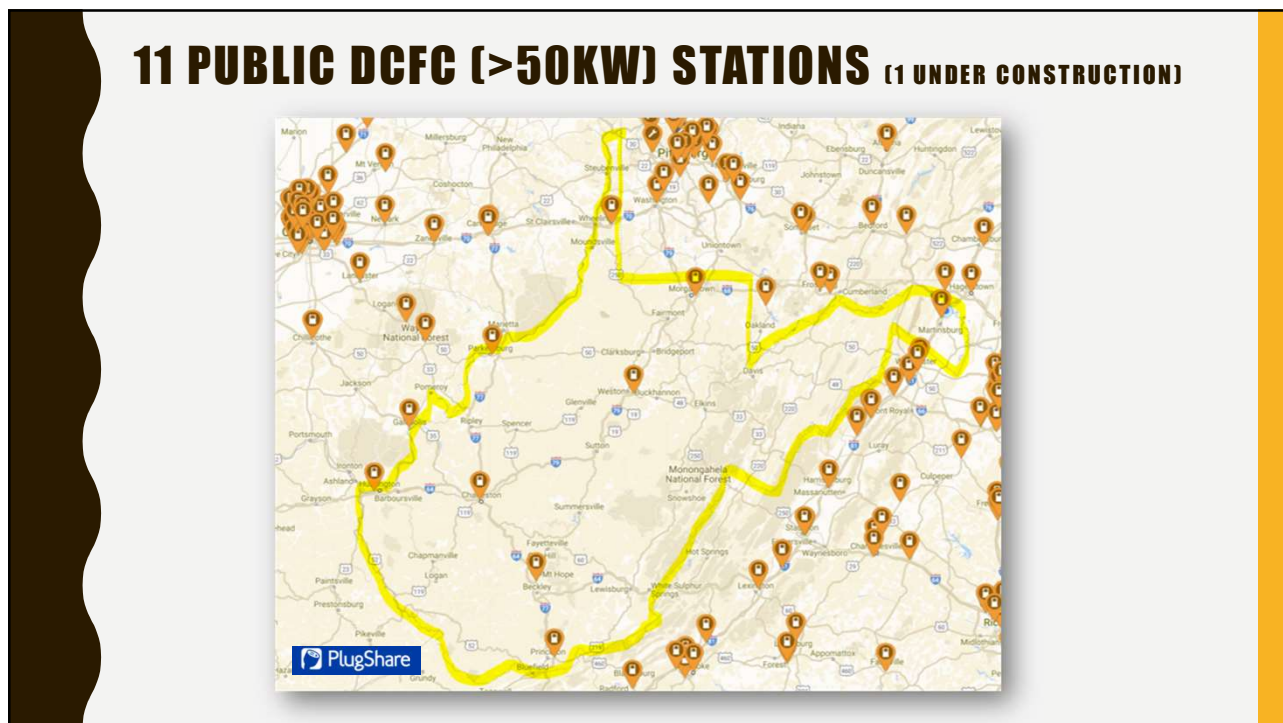
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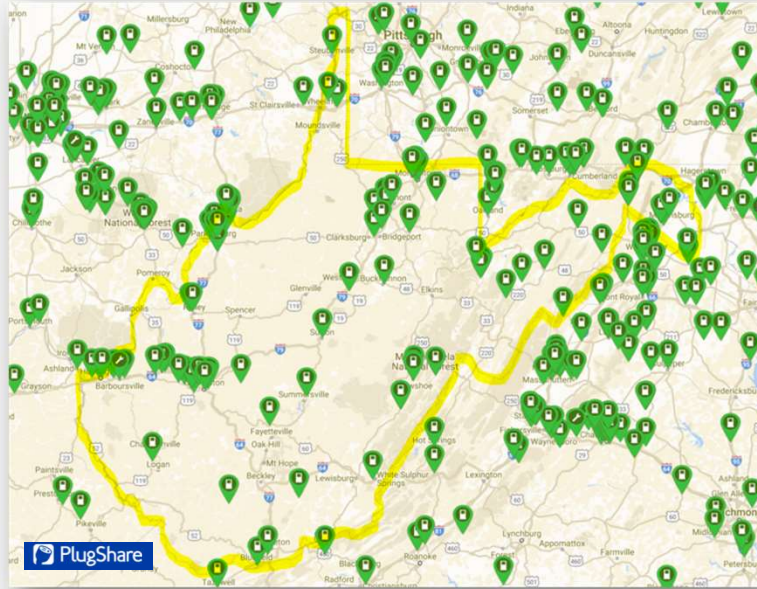


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AROUND 100 AC LEVEL 2 STATIONS



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EV CHARGING RESOURCES – AFDC.ENERGY.GOV

Alternative Fuels Data Center

- Multi-Unit Dwellings
- Workplace Charging
- Public Charging
- Operation and Maintenance
- Signage
- Laws & Incentives
- See <https://afdc.energy.gov/>

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Alternative Fuels Data Center

FUELS & VEHICLES | CONSERVE FUEL | LOCATE STATIONS | LAWS & INCENTIVES | Maps & Data | Case Studies

EEER » AFDC » Fuels & Vehicles » Electricity

Electric Vehicle Charging for Multi-Unit Dwellings

Plug-in electric vehicle (PEV) charging stations for multi-unit dwellings (MuDs)—also called multi-family buildings—such as condos or apartments, provide property owners with a unique way to help attract and retain residents and foster an environmentally sustainable community. MuD owners face unique considerations when installing charging stations, ranging from parking and electrical service access to billing and legal concerns. Use the resources below to learn more about best practices for installing MuD charging stations or get started by downloading the [Plug-in Electric Vehicle Charging Infrastructure Guidelines for Multi-unit Dwellings](#).

Resources for Multi-Unit Dwelling Owners

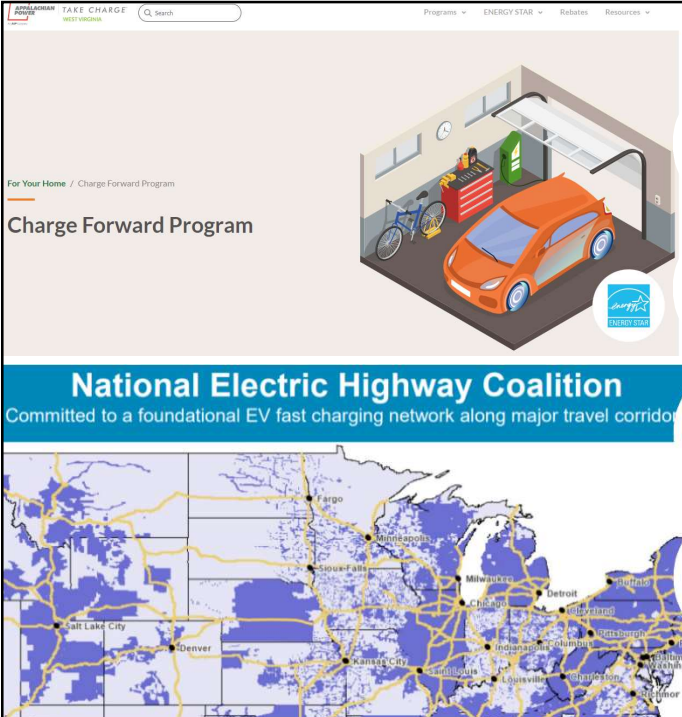
MuD owners, managers, and related organizations can use the resources below to assess the need for PEV charging stations. In addition, building owners may be able to take advantage of [state or utility incentives](#) for installing charging infrastructure at MuDs.

- [PEV Charging Guide for Property Owners, Managers and Homeowner Associations](#)
- [Ready-made templates to survey residents' current and future interest in PEVs](#)
- [MuD How-to Guide for PEV readiness](#)
- [Charging Infrastructure Development](#)

Resources for Multi-Unit Dwelling Residents

MuD residents can learn more about the benefits of PEV charging, and help your community

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INCENTIVES

- From [AFDC Incentives](#):
- No current West Virginia state or federal tax credits unless reinstated
- [Appalachian Power Charge Forward \\$250 Consumer Incentive](#)
- [National Electric Highway Coalition Investments](#)

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CHARGING BEST PRACTICES

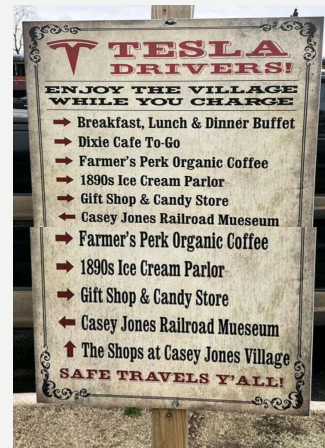
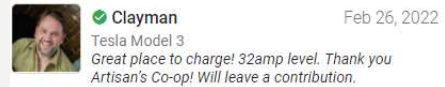
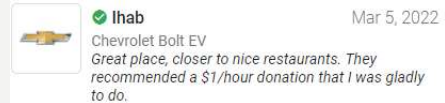
- Locate EV chargers away from parking spots near entrances - more likely to be blocked
- Location should avoid potential hazards or obstructions such as cart returns, piled snow, areas that collect standing water
- Ensure adequate lighting for safe charging if chargers are accessible at night
- Ensure that signage clearly marks the charging spots and spells out any fees or restrictions
- If possible, provide a contact number for problems with equipment or blocked chargers
- Try to offer trash disposal to avoid litter



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RELIABLE, ACCESSIBLE

- How will maintenance and repair be funded?
- Will there be a cost to charge and if so, how will users pay? Parking meters, smart EVSEs, monthly rent addon, donation, etc.?
- How could EVSEs be a business positive for a 'captive audience'?
- Bottom line: Care and feeding for EV charging equipment goes beyond the initial public relations boost.



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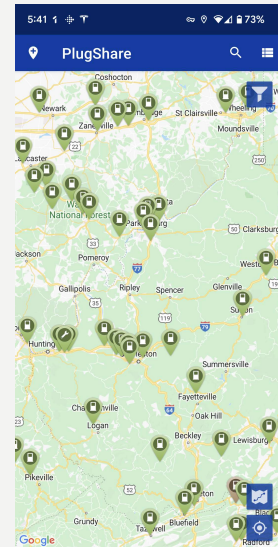
CHARGING CHALLENGES – ICE'D



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PUBLICIZING YOUR CHARGING STATION

- Make sure to list your station on free services like PlugShare so that EV drivers can find you
- Include specs like the number of stalls, charging speed (kW), plugs supported, access restrictions, etc.
- Include amenities like restrooms, nearby food options, lodging, and shopping
- Include any fees for charging, parking, idle fees, etc.
- Review the listing periodically to look for comments about potential issues such as an inoperative charger, frayed cable, or frequent ICEing



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WHAT ABOUT COMMERCIAL EV CHARGING?

- Commercial electric vehicles (buses, trucks) require large batteries, high-power charging
- New standards from a consortium of companies are coming to support these heavy-duty EVs with charging in the 1.0 to 3.75 MW range (~15x Tesla V3 250kW SC)
- See [CharIN Megawatt Charging System \(MCS\)](#)
- Electrifying vehicle fleets could result in significant fuel and maintenance savings



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EV HEAVY TRANSPORT

- Used DCFC public chargers
- Travelled 2,524 miles on demo trip from Florida to California
- 69 passenger double decker bus
- 676 kWh battery pack

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OTHER ELECTRIC “VEHICLES” NEED CHARGING



“...contract to build seven battery-powered ferries for Fjord, Norwegian transport conglomerate. The news comes after the operators of the first all-electric ferry in Norway, the *Ampere*, reported impressive statistics after operating the ship for over 2 years. They claim that the all-electric ferry cuts emissions by 95% and costs by 80%.”

Proterra/Komatsu
Excavator

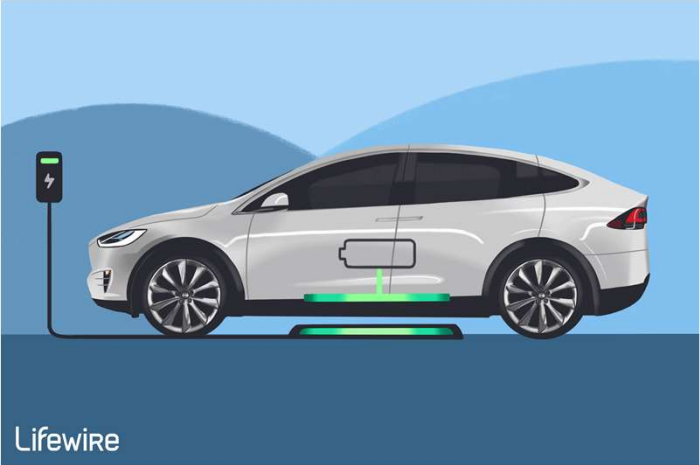
Bobcat T7X Electric
Compact Loader

Wabtec Electric
Locomotive



Pipistrel Alpha Electro
Serial production Battery Electric Aircraft

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Lifewire

WIRELESS EV CHARGING?

- Less efficient due to power transfer losses
- Safety concerns with very high-power magnetic fields
- Creates additional expense for the EVSE (about 20%)
- Adds expense and weight for the EV itself
- Something to watch, but probably not something that is going to see mass adoption soon

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QUESTIONS?

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