In accordance with the Department of Labor and Industry's statute 326.0981, Subd. 11,

"This educational offering is recognized by the Minnesota Department of Labor and Industry as satisfying **1.5 hours** of credit toward **Building Officials and Residential Contractors code /1 hour energy** continuing education requirements."

For additional continuing education approvals, please see your credit tracking card.

Electric Cars are coming!
What Should Real Estate Owners and Building Industry Professionals Know About Charging?

Jukka Kukkonen, PlugInConnect, LLC
jukka@pluginconnect.com

PlugInConnect
Explore the electric future

Portion of the work presented here was funded by
Department of Energy and Minnesota Pollution Control Agency

What I do:

- Plug-in vehicle market and business development
  www.PlugInConnect.com
- Charging information for condos and apartment buildings
  www.MultiHousingCharging.com
- Charging information for workplaces
  www.WorkplaceCharging.com
- MN EV Owners
  www.pluginconnect.com/mnevowners.html
- EV market expert at Fresh Energy
  www.Fresh-Energy.org

PlugInConnect
Explore the electric future

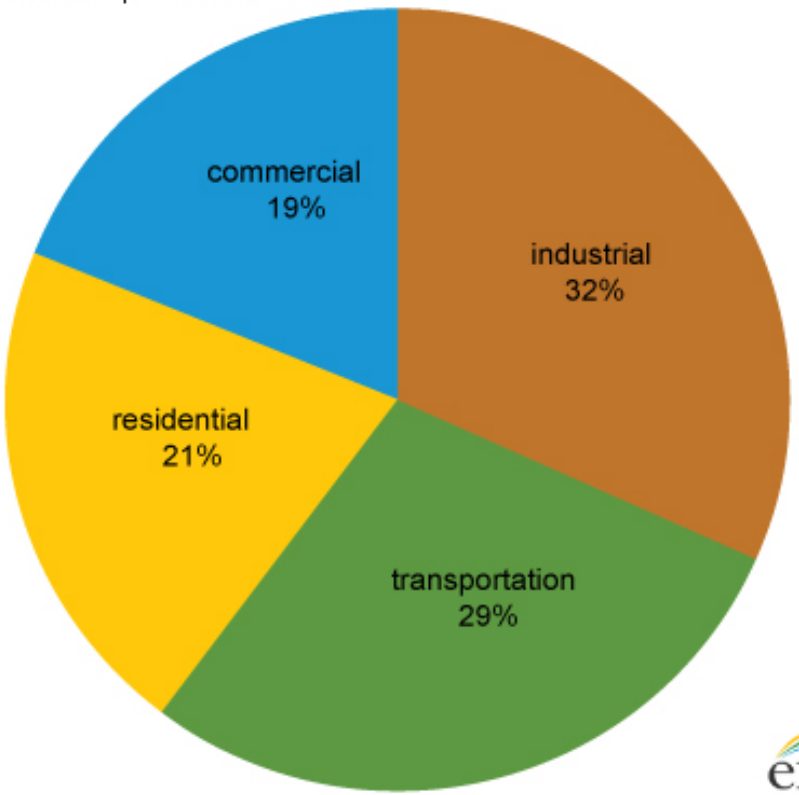
MN ELECTRIC VEHICLE OWNERS

Fresh Energy

- **Electric Vehicle Market and Technologies,** ETLS 699-01, CRN: 43150
- A one semester introductory graduate course exploring the key areas of electric vehicle market and technologies. This course will provide an understanding of the present state of electric vehicle market and technologies, perspectives on the dynamics of the market and plenty of ideas on future opportunities. This course will provide a solid foundation for anyone considering future career or business options with EVs and related technologies in this fast-growing field.

Share of total U.S. energy consumed by end-use sector in the United States, 2016

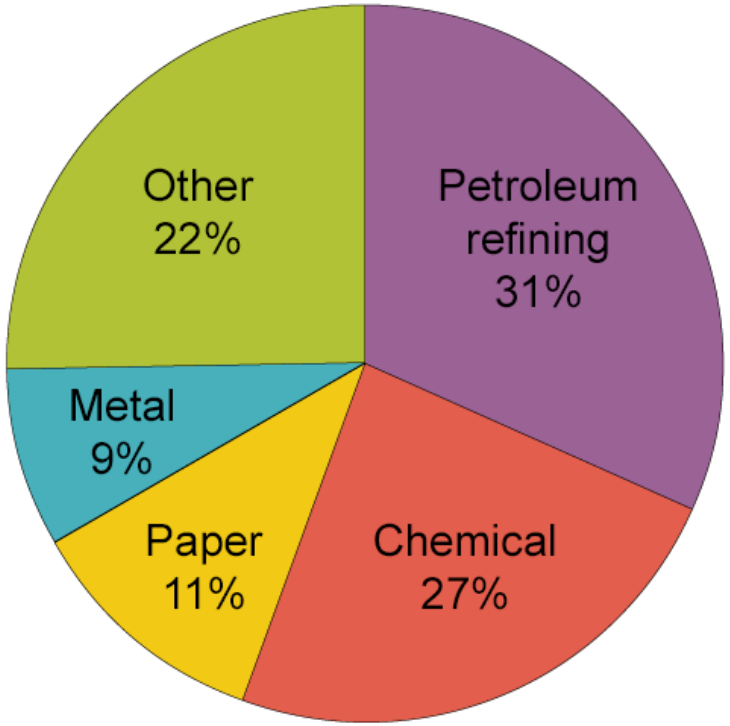
Total = 97.4 quadrillion British thermal units



Note: Sum of individual percentages may not equal 100 because of independent rounding.

Source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 2.1, April 2017, preliminary data

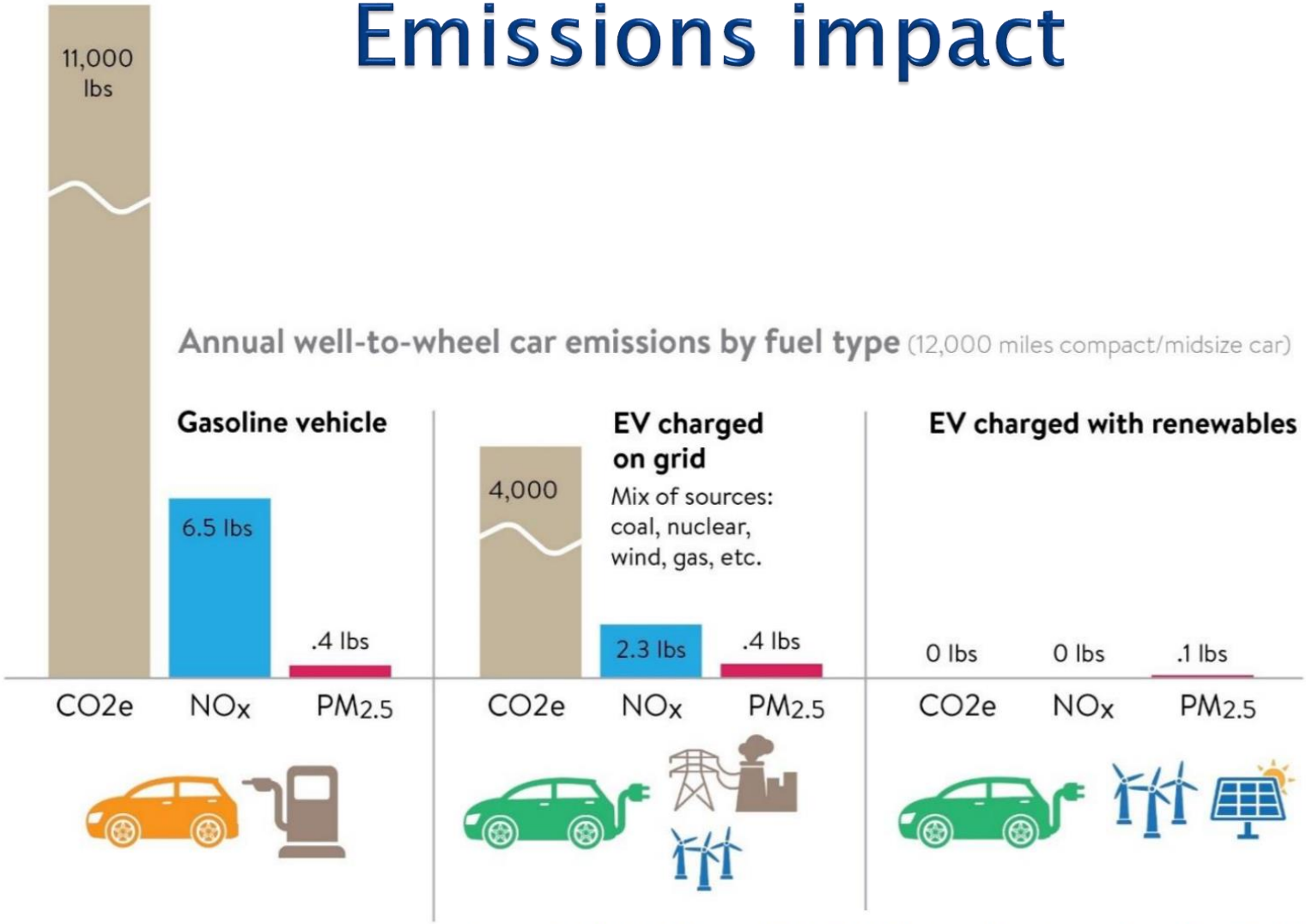
Energy use by type of industry, 2010[1]



Source: U.S. Energy Information Administration, *Manufacturing Energy Consumption Survey 2010*, Table 1.2 (March 2013)

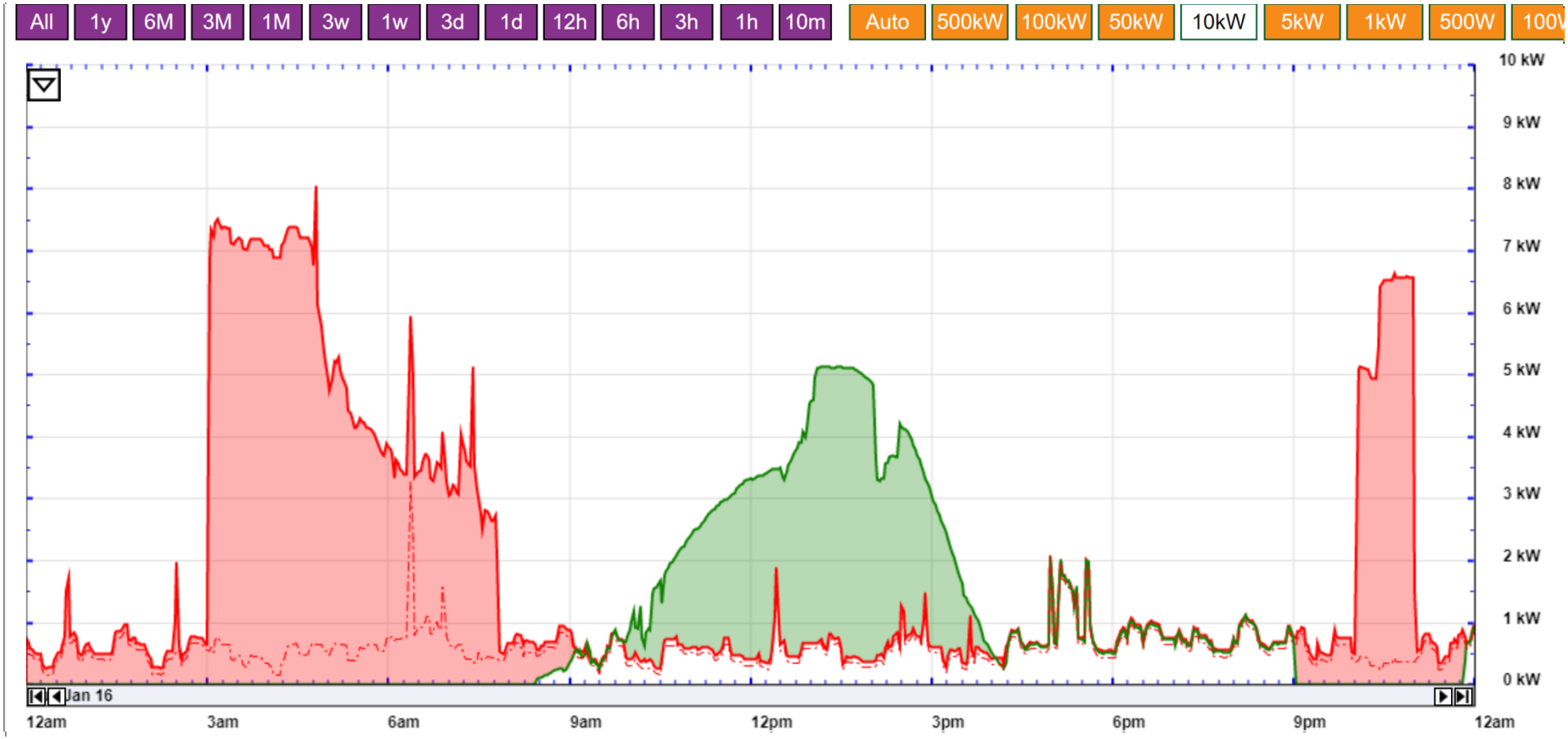
[1]Includes all use of energy and fuels; excludes shipments of energy sources produced onsite.

Emissions impact



Source: MOVES2014a and 2014 EPA National Emissions Inventory Database

Residential household



Graph:
Jukka Kukkonen

Electric era in transportation is coming.

- Over 1,400,000 plug-in vehicles on US roads.
- Over 11,000 PEVs in MN. Over 100 million gas free miles in 2019.

- Very high satisfaction: Over 90% of owners say their next vehicle will be a PEV too.
- People are hesitant to try new things but we are approaching the tipping point.

Photo: Chevrolet

“20 percent of Americans (50 million people) saying they are likely to buy an EV for their next car.”

March 2018 survey.
n= 1003

“About 6 in 10 prospective car buyers in Minnesota are interested in electric vehicles, including 30 percent who say they would consider buying or leasing one within the next two years.”

April 2019 survey.
n= 413

Union of Concerned Scientists

CR Consumer Reports

Data: AAA,
UCS, Consumer Reports

Choose your ride!

BMW 330e, Mitsubishi Outlander, Toyota Prius Prime, Volvo XC 90, Ford Fusion Energi, etc

Chrysler Pacifica PHEV

Chevrolet Volt 2017 and Honda Clarity PHEV

Chevrolet Volt 2012

Tesla Model S and X

Tesla Model 3

Chevrolet Bolt

Nissan Leaf 2018

2019 Leaf Plus

Nissan Leaf 2012

miles

0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340

Electric range | Hybrid mode

Photos:
Vehicle manufacturers

Plug-in vehicles available in Minnesota (December 2016)

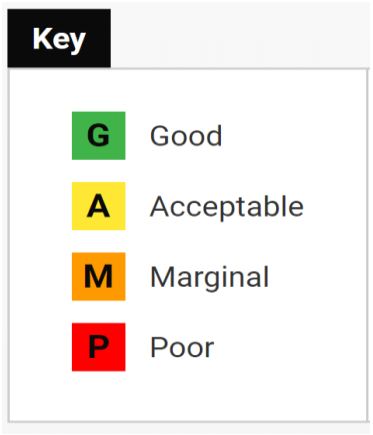
Manufacturer									Range			Charging speed (miles/hr)			Performance			
Name	Model	Photo	Seating	PEV Type	Battery size (kWh)	Base MSRP	Federal tax credit	Price after federal tax credit	Electric Range (miles)	Total Range (miles)	Level 2 Charging Rate (kW)	Level 1 120v	Level 2 240v	DCFC 400+v	MPGe/MPG	Top Spd (mph)	Accel. 0-60 mph (sec)	Crash Rating
Audi	A3 E-Tron		5	PHEV	9	$38,900	$4,168	$34,732	17	430	3.3	4	8	N/A	86/39	130	7.6	NR
BMW	i3		4	BEV	33	$43,600	$7,500	$36,100	114	114 (180)	7.4	5	27	166	124 (39)	93	7.0	4 star
BMW	i8		4	PHEV	7.2	$141,000	$3,793	$137,207	15	330	3.3	3	7	N/A	76/28	155	4.2	NR
BMW	X5 xDrive40e		5	PHEV	9	$62,100	$4,700	$57,400	14	540	3.3	2	5	N/A	56/24	130	6.5	NR
BMW	330E		5	PHEV	7.6	$43,700	$4,000	$39,700	14	350	3.7	3	8	N/A	72/31	130	5.9	NR
Chevrolet	Volt		4.5	PHEV	18.4	$33,170	$7,500	$25,670	53	420	3.3	4	10	N/A	106/42	98	8.4	N/A
Ford																	7.9	4 star
Ford																	10.3	5 star
Ford	Fusion Energi		5	PHEV	7.6	$33,120	$4,007	$29,113	21	550	3.3	4	10	N/A	88/38	85	8.5	5 star
Hyundai	Sonata PHEV		5	PHEV	10	$34,600	$4,919	$29,681	27	570	3.3	4	8	N/A	99/40	NA	7	NR
Nissan	Leaf		5	BEV	30	$30,680	$7,500	$23,180	107	107	3.3 or 6.6	5	11 or 22	152	114	90	10.1	5 star
Porsche	Panamera S E-hybrid		2	PHEV	9.4	$77,000	$4,752	$72,248	16	540	3	3	6	N/A	65/25	167	5.2	NR
Porsche	Cayenne S E-hybrid		5	PHEV	10.8	$93,000	$5,300	$87,700	14	480	3	3	6	N/A	65/25	151	5.4	NR
Tesla Motors	Model S		5	BEV	60 - 100	$68,000	$7,500	$60,500	210-315	210-315	10 or 20	4	60	375	101	155	2.8	5 star
Tesla Motors	Model X		7	BEV	75 - 100	$90,000	$7,500	$82,500	238-289	238-289	10 or 20	4	55	341	92	155	3.2	5 star
Toyota	Prius Prime		4	PHEV	8.8	$27,100	$4,500	$22,600	25	640	3.3	6	13	N/A	133/54	155	3.2	NR
Volvo	XC90 T8		7	PHEV	9	$69,000	$4,600	$64,400	14	350	3.3	2	5	N/A	53/25	125	5.9	NR

This table was updated in December 2016 by Jukka Kukkonen, PluginConnect.

Photos and information sources: Manufacturers' websites and www.fueleconomy.gov

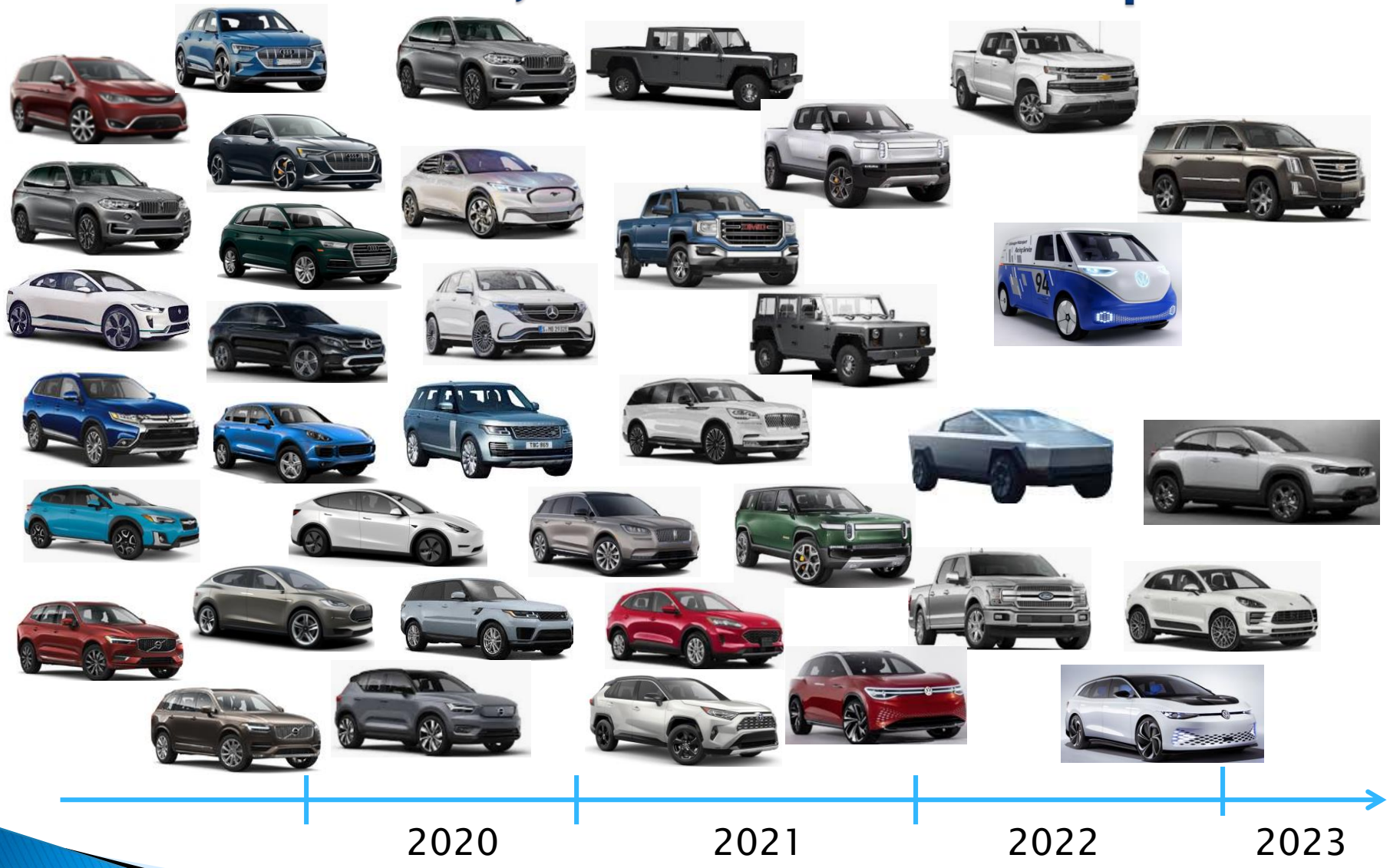
More info: www.pluginconnect.com/MNpevmodels.html

The Insurance Institute for Highway Safety (IIHS) crash test ratings for EVs available in Minnesota

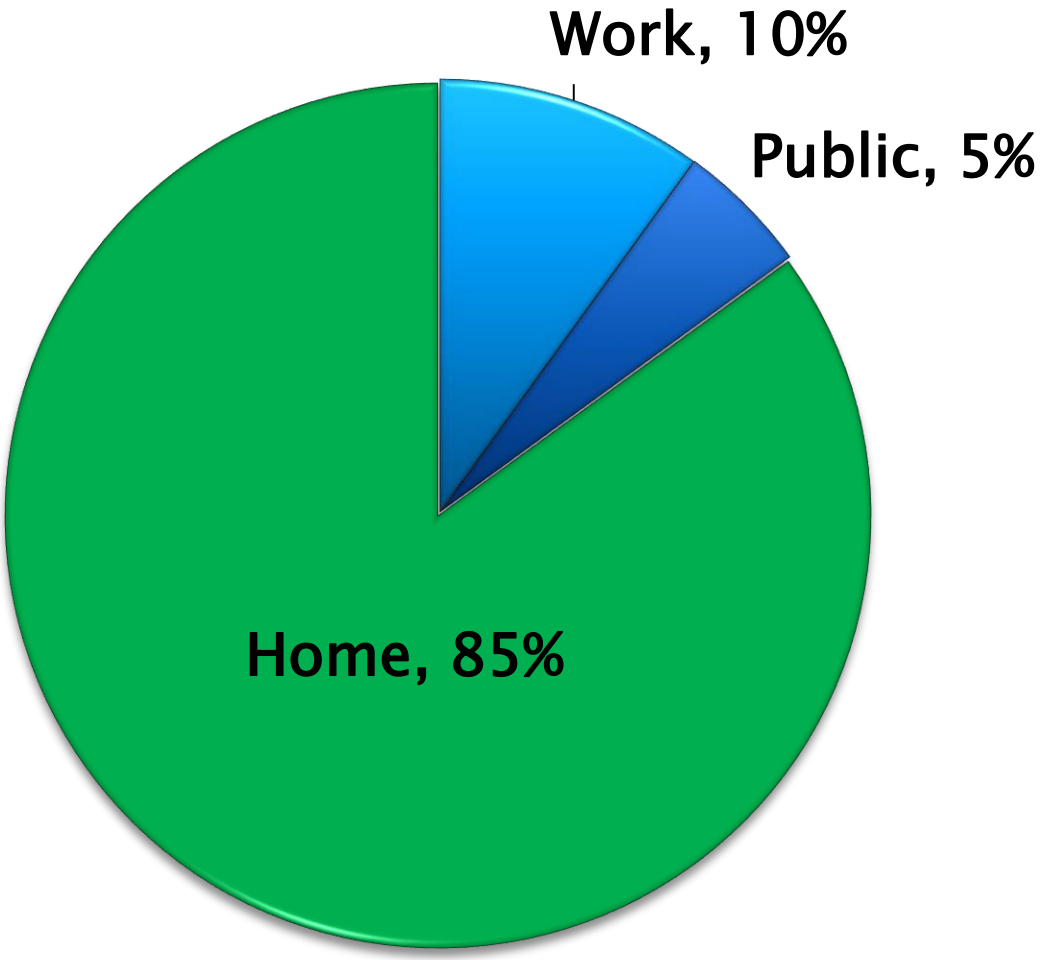


Make and Model	IIHS rating	Results report
Audi e-tron	Top Safety Pick +	https://www.iihs.org/ratings/vehicle/audi/e-tron-4-door-suv/2019
BMW i3	Good	https://www.iihs.org/ratings/vehicle/bmw/i3-4-door-hatchback/2019
BMW i8	Not rated yet	
BMW X5 xDrive40e	Top Safety Pick +	https://www.iihs.org/ratings/vehicle/bmw/x5-4-door-suv/2019
BMW 330e	Top Safety Pick +	https://www.iihs.org/ratings/vehicle/bmw/3-series-4-door-sedan/2019
BMW 530e	Top Safety Pick +	https://www.iihs.org/ratings/vehicle/bmw/5-series-4-door-sedan/2019
BMW 745e	Not rated yet	
Chevrolet Bolt EV	Top Safety Pick	https://www.iihs.org/ratings/vehicle/chevrolet/bolt-4-door-hatchback/2019
Chevrolet Volt	Good	https://www.iihs.org/ratings/vehicle/chevrolet/volt-4-door-hatchback/2019
Chrysler Pacifica Hybrid	Top Safety Pick	https://www.iihs.org/ratings/vehicle/chrysler/pacifica-minivan/2019
Ford Fusion Energi	Good	https://www.iihs.org/ratings/vehicle/ford/fusion-4-door-sedan/2019
Honda Clarity PHEV	Not rated yet	
Jaguar I-PACE	Not rated yet	
Kia Niro PHEV	Top Safety Pick +	https://www.iihs.org/ratings/vehicle/kia/niro-plug-in-hybrid-4-door-wagon/2019
Mercedes- Benz GLC350e	Top Safety Pick +	https://www.iihs.org/ratings/vehicle/mercedes-benz/glc-4-door-suv/2019
Mini Cooper S E ALL4	Good	https://www.iihs.org/ratings/vehicle/mini/countryman-4-door-hatchback/2019
Mitsubishi Outlander PHEV	Good	https://www.iihs.org/ratings/vehicle/mitsubishi/outlander-phev-4-door-suv/2019
Nissan Leaf	Good	https://www.iihs.org/ratings/vehicle/nissan/leaf-4-door-hatchback/2019
Porsche Panamera S E-hybrid	Not rated yet	
Porsche Cayenne S E-hybrid	Not rated yet	
Tesla Model 3	Top Safety Pick +	https://www.iihs.org/ratings/vehicle/tesla/model-3-4-door-sedan/2019
Tesla Model S	Good	https://www.iihs.org/ratings/vehicle/tesla/model-s-4-door-hatchback/2017
Tesla Model X	Not rated yet	
Toyota Prius Prime	Top Safety Pick	https://www.iihs.org/ratings/vehicle/toyota/prius-prime-4-door-hatchback/2019
Volvo S90 T8	Top Safety Pick	https://www.iihs.org/ratings/vehicle/volvo/s90-4-door-sedan/2019
Volvo XC60 T8	Top Safety Pick	https://www.iihs.org/ratings/vehicle/volvo/xc60-4-door-suv/2019
Volvo XC90 T8	Top Safety Pick	https://www.iihs.org/ratings/vehicle/volvo/xc90-4-door-suv/2019

Electric CUVs, SUVs and Pickup trucks



Where does the energy flow?



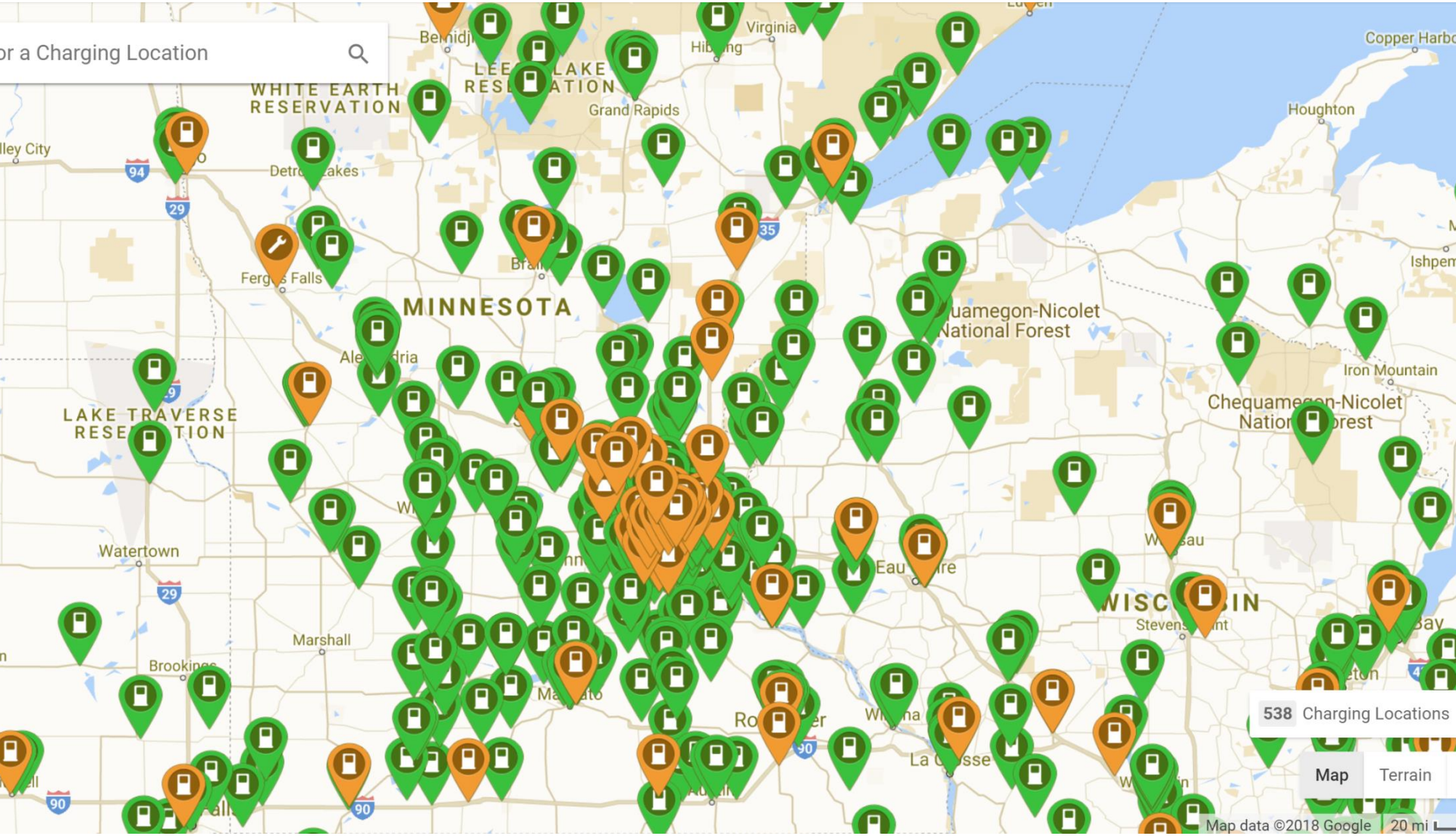
How to charge an EV?

Level 1
120 Volt

Level 2
240 Volt

DC fast charge

Pictures: Bosch, Clipper Creek, ChargePoint, ABB

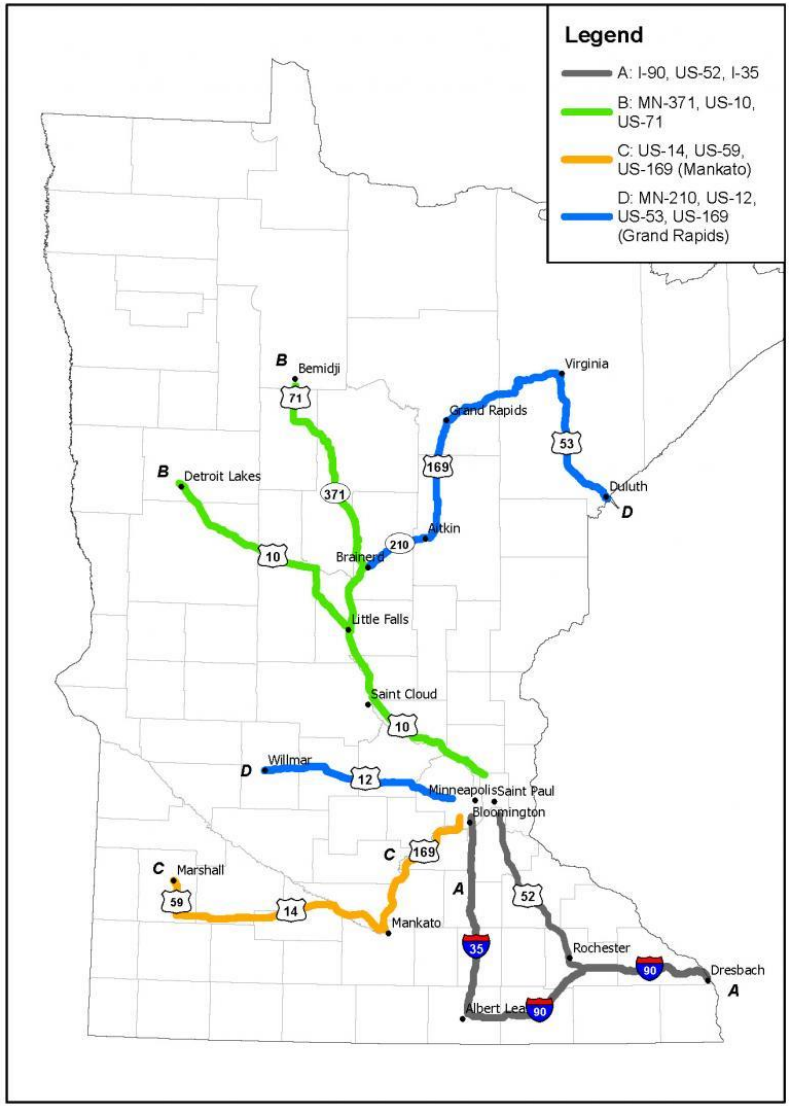


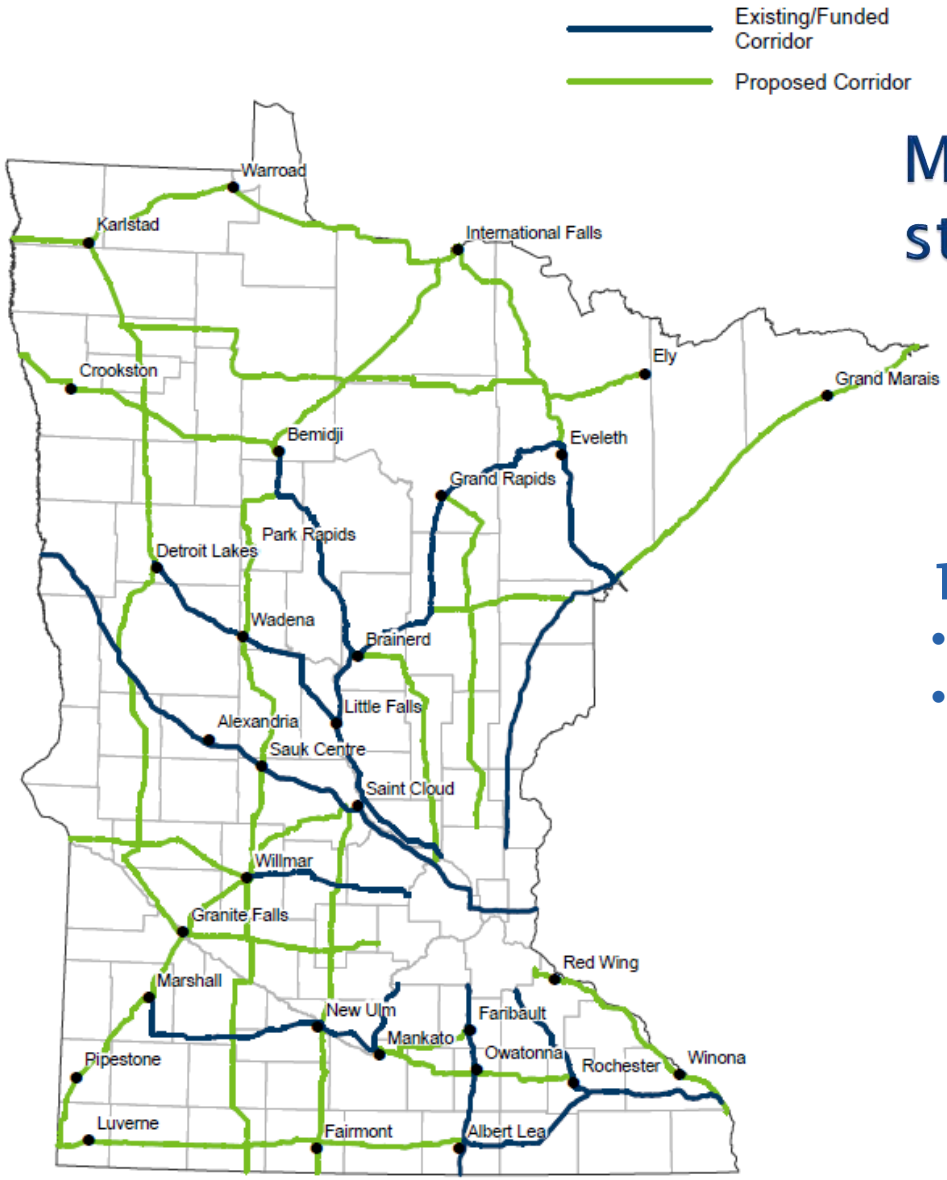
Map: PlugShare.com

MPCA VW settlement DCFC corridors

Phase 1(2018-2019)

- DCFC stations at 30- to 70-mile increments along identified highways
- Minimum 50 kW
- Adequate conduit size at each station for future upgrades as well as space for extending the parking pad.
- Encourage renewable energy (wind and solar) (Utility program or energy credits)





MPCA Phase 2 EV charging stations (2020–2023)

15% of Phase 2 Funds = $3,525,000

- 90% Fast charging
- 10% Level 2 charging

Highway Fast Charging Corridors

- 1,100 miles from Phase 1 (22 stations)
- Nearly 2,500 miles proposed in Phase 2 (43 stations)

Map and info:
MPCA

ICE vs EV household

13,500miles/year x 1.8 drivers =24,300miles/year

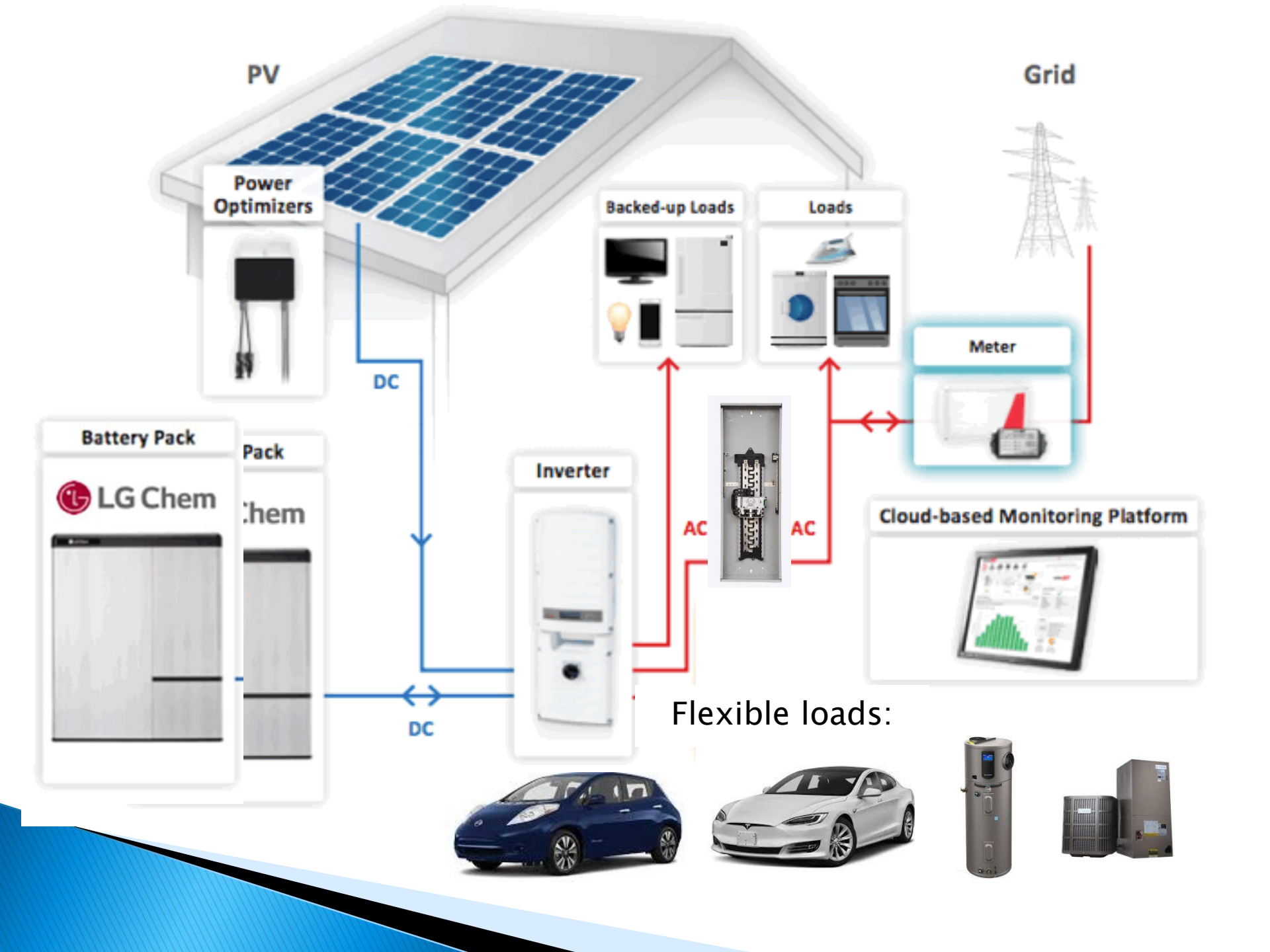
ICE household

- 25MPG
- 970 gallons
- 33.7 kWh/gallon
- 33,000kWh
- $2.5/gallon
- $2,425

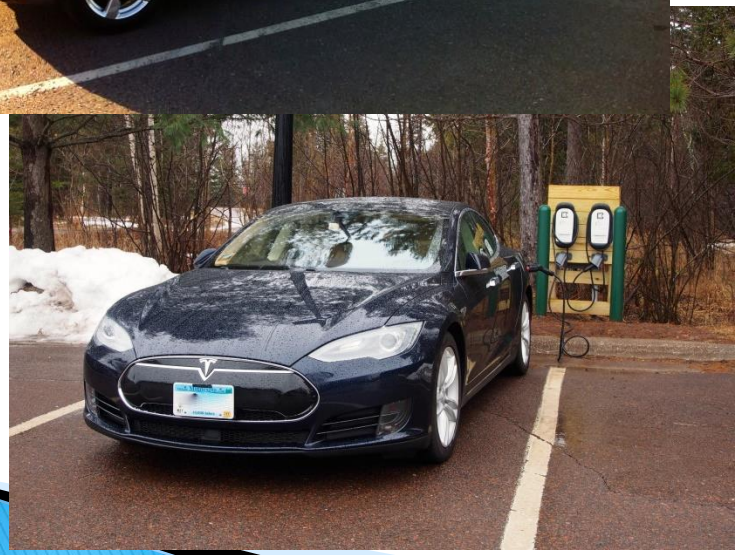
EV household

- 3 miles/kWh
- 8,100kWh
- $0.07/kWh
- $570

Annual energy cost difference: $1855.


PV
Grid
Power Optimizers
Backed-up Loads
Loads
Meter
DC
Battery Pack
LG Chem
Inverter
AC
AC
Cloud-based Monitoring Platform
DC
Flexible loads:

EV Charging for Multi-Housing and Commercial Properties



BENEFITS FOR BUILDING OWNERS / MANAGERS

- New service product
- Client attraction and retention
- Future proofing the property
- LEED points
- Property value increase
- Green credentials and publicity

How to future proof your property?

California Green Building Standards Code 2016

- Both residential and non-residential
  - 3 % of parking spots (residential)
  - 6 % of parking spots (non-residential)
  - 208/240V 40A circuit breaker
  - Conduit size minimum 1 inch

- Cost estimates:
  - $53 for single family homes
  - $110 for multi housing buildings

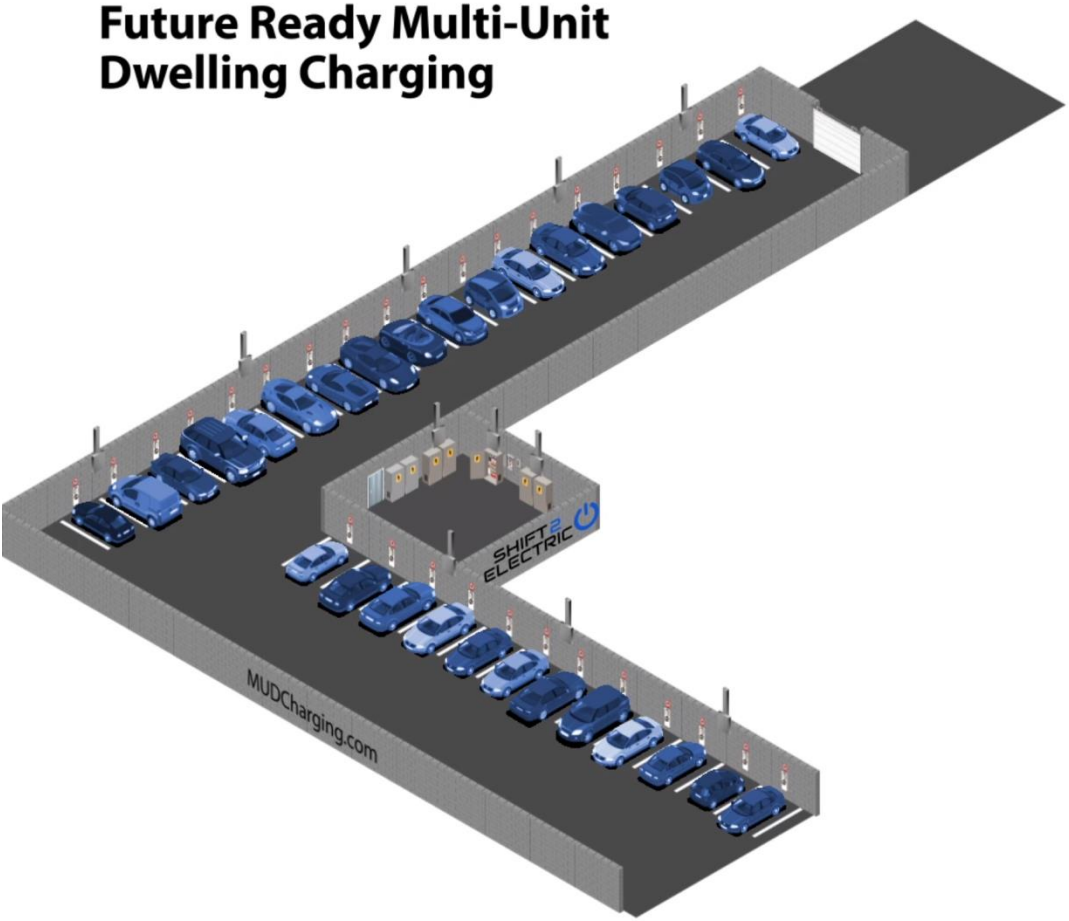
LEED v4 Credit 8, Green Vehicles

1 Point for Green Parking and Electric Vehicle Charging

- Designate 5% of all parking spaces for green vehicles
- Install Electric vehicle Supply Equipment (EVSE) in 2% of all parking spaces used by the project.
- The EVSE must:
  - Be Level 2 (208/240V) or higher
  - Use standardized connector (J1772)
  - Be networked and be capable of participating in a demand-response program or time-of-use pricing to encourage off-peak charging.

Source:
LEED Reference Guide

Future Ready Multi-Unit Dwelling Charging



1 inch conduit to every 4th parking spot terminated to a junction box.

Breaker panel capacity to serve 208/240V 50A line to these spots.

Simple charging station installation for 25% of vehicles.

EVs 25-50%, Power shared between every two stations

EVs 50-75%, Power shared between every three stations

EVs 75-100%, Power shared between every four stations
Increase power capacity to each junction box to 208/240V 80A

Use charging stations with embedded metering and power sharing capability

For more info, visit **MUDCharging.com**

Considerations

- Electrical service
- Breaker panel capacity
- Future expansion
- Proximity to the electrical service
- Safety
- Cord management
- Connectivity
- Lighting
- Signage

Workplace Charging approaches

WPC SIMPLE

The WPC Simple concept is developed to give employers **an affordable and easy way** to provide workplace charging for their employees.

LOW COST APPROACH

- Non-networked EVSEs
- 80% Level 1 and 20% Level 2
- EVSEs $400-$600
- No ongoing fees

WPC ADVANCED

The WPC Advanced concept provides **more flexibility and functions** for employers who are ready to take the next step.

HIGHER COSTS, MORE FUNCTIONS

- Smart Level 2 EVSEs
- EVSEs $1000-$4000
- Annual connectivity fees $100-$300
- Payment fees

Choose the approach that works best for your organization and remember that you can always upgrade later from simple to advanced.

WPC SIMPLE

WPC ADVANCED

INITIAL INSTALLATION

- 10 Level 1 EVSEs (low power, easy pricing)
- 2 level 2 EVSEs
- Future-proof with extra conduit and breaker capacity

- 50% more charging stations than the present number of EV owners at your workplace
- Future-proof with extra conduit and breaker capacity

LOCATION

- Close to electrical service
- Not prime location to keep the ICEing down
- Dedicated parking
- No need to move cars around during workday

- Close to electrical service
- Not prime location to keep the ICEing down
- First come – First serve
- Provide enough EVSEs

ICEing: An Internal Combustion Engine (ICE) vehicle parking in a EV charging space

WPC SIMPLE

WPC ADVANCED

PARKING ENFORCEMENT

- No ICEing
- Need to charge
- Dedicated spots marked with registration plate numbers

- No ICEing
- Need to charge

PRICING

- Monthly flat fee (payroll deduction) For example: Level 1 20$, Level 2 $30
- WPC Pricing calculator tool

- Pricing per user group: Employees, Fleet, Visitors
- Should be a bit more expensive than home charging

WPC SIMPLE

PROVIDE FLEXIBILITY

- Shared smart Level 2 stations for employees/visitors
- Prime location
- Higher fees

WPC ADVANCED

SMART FEATURES

- Access control
- Data collection and reporting
- Power sharing and control

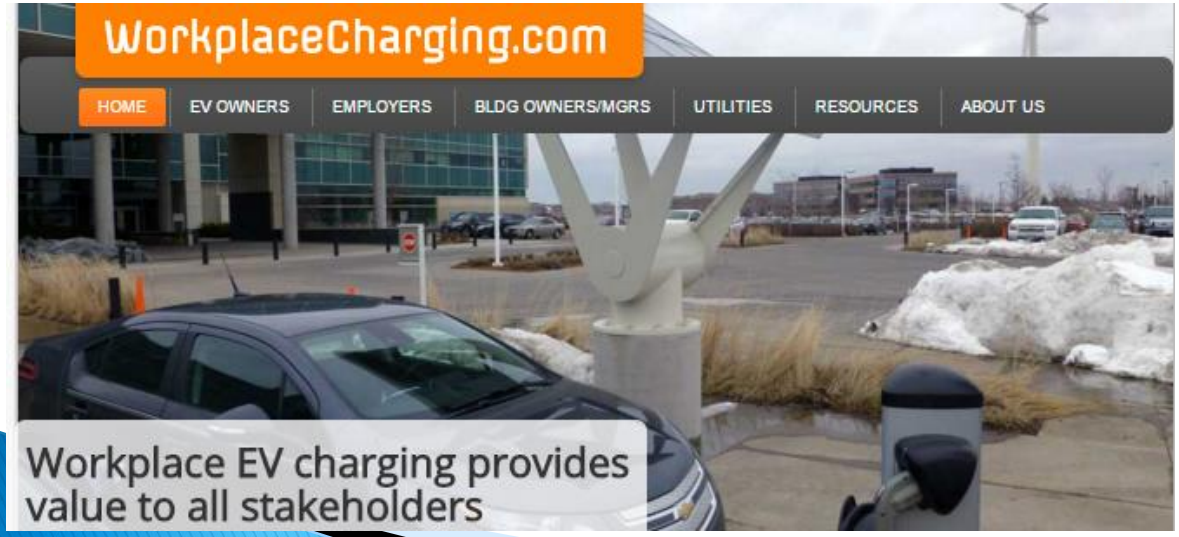
REMEMBER TO CONTACT YOUR ELECTRIC UTILITY COMPANY TO SEE HOW THEY COULD HELP

ENGAGE DRIVERS AND GAUGE INTEREST BY SURVEYING YOUR EMPLOYEES WITH WPC SURVEY TOOL

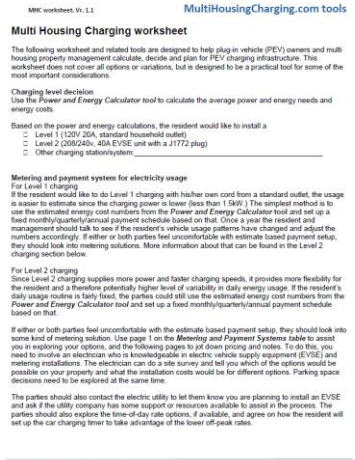
For more information visit WorkplaceCharging.com

Resources


MultiHousingCharging.com
HOME PAGE
EV OWNERS
HOAS
BLDG OWNERS/MGRS
UTILITIES
TOOLS AND RESOURCES
ABOUT US
Practical processes
to PEV charging.
AN INCREASING NUMBER OF PROPERTIES ARE ADDING EV CHARGING AS A NEW AMENITY
A growing number of people are choosing to drive electric vehicles and plug-in hybrids. These vehicles need to be charged at home rather than filled up at the gas station. In single family homes, EV charging systems are very straightforward to choose and install. Multi housing charging (MHC) can


WorkplaceCharging.com
HOME
EV OWNERS
EMPLOYERS
BLDG OWNERS/MGRS
UTILITIES
RESOURCES
ABOUT US
Workplace EV charging provides value to all stakeholders

Multi Housing Charging worksheet



MHC worksheet, Vr. 1.1 MultiHousingCharging.com tools

Multi Housing Charging worksheet

The following worksheet and related tools are designed to help plug-in vehicle (PEV) owners and multi housing property management calculate, decide and plan for PEV charging infrastructure. This worksheet does not cover all options or variations, but is designed to be a practical tool for some of the most important considerations.

Charging level decision
Use the ***Power and Energy Calculator tool*** to calculate the average power and energy needs and energy costs.

Based on the power and energy calculations, the resident would like to install a
- ☐ Level 1 (120V 20A, standard household outlet)
- ☐ Level 2 (208/240v, 40A EVSE unit with a J1772 plug)
- ☐ Other charging station/system:_____

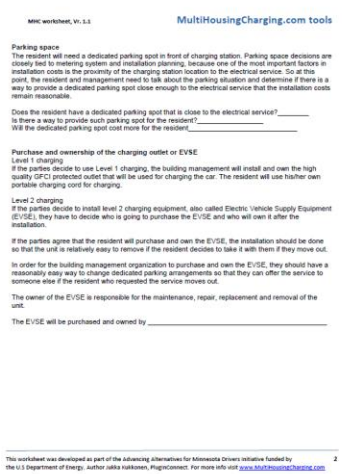
Metering and payment system for electricity usage
For Level 1 charging
If the resident would like to do Level 1 charging with his/her own cord from a standard outlet, the usage is easier to estimate since the charging power is lower (less than 1.5kW) The simplest method is to use the estimated energy cost numbers from the ***Power and Energy Calculator*** tool and set up a fixed monthly/quarterly/annual payment schedule based on that. Once a year the resident and management should talk to see if the resident's vehicle usage patterns have changed and adjust the numbers accordingly. If either or both parties feel uncomfortable with estimate based payment setup, they should look into metering solutions. More information about that can be found in the Level 2 charging section below.

For Level 2 charging
Since Level 2 charging supplies more power and faster charging speeds, it provides more flexibility for the resident and a therefore potentially higher level of variability in daily energy usage. If the resident's daily usage routine is fairly fixed, the parties could still use the estimated energy cost numbers from the ***Power and Energy Calculator tool*** and set up a fixed monthly/quarterly/annual payment schedule based on that.

If either or both parties feel uncomfortable with the estimate based payment setup, they should look into some kind of metering solution. Use page 1 on the ***Metering and Payment Systems table*** to assist you in exploring your options, and the following pages to jot down pricing and notes. To do this, you need to involve an electrician who is knowledgeable in electric vehicle supply equipment (EVSE) and metering installations. The electrician can do a site survey and tell you which of the options would be possible on your property and what the installation costs would be for different options. Parking space decisions need to be explored at the same time.

The parties should also contact the electric utility to let them know you are planning to install an EVSE and ask if the utility company has some support or resources available to assist in the process. The parties should also explore the time-of-day rate options, if available, and agree on how the resident will set up the car charging timer to take advantage of the lower off-peak rates.

This worksheet was developed as part of the Advancing Alternatives for Minnesota Drivers Initiative funded by the U.S Department of Energy. Author Jukka Kukkonen, PluginConnect. For more info visit www.MultiHousingCharging.com 1



MHC worksheet, Vr. 1.1 MultiHousingCharging.com tools

Parking space
The resident will need a dedicated parking spot in front of charging station. Parking space decisions are closely tied to metering system and installation planning, because one of the most important factors in installation costs is the proximity of the charging station location to the electrical service. So at this point, the resident and management need to talk about the parking situation and determine if there is a way to provide a dedicated parking spot close enough to the electrical service that the installation costs remain reasonable.

Does the resident have a dedicated parking spot that is close to the electrical service?_____
Is there a way to provide such parking spot for the resident?_____
Will the dedicated parking spot cost more for the resident?_____

Purchase and ownership of the charging outlet or EVSE
Level 1 charging
If the parties decide to use Level 1 charging, the building management will install and own the high quality GFCI protected outlet that will be used for charging the car. The resident will use his/her own portable charging cord for charging.

Level 2 charging
If the parties decide to install level 2 charging equipment, also called Electric Vehicle Supply Equipment (EVSE), they have to decide who is going to purchase the EVSE and who will own it after the installation.

If the parties agree that the resident will purchase and own the EVSE, the installation should be done so that the unit is relatively easy to remove if the resident decides to take it with them if they move out.

In order for the building management organization to purchase and own the EVSE, they should have a reasonably easy way to charge dedicated parking arrangements so that they can offer the service to someone else if the resident who requested the service moves out.

The owner of the EVSE is responsible for the maintenance, repair, replacement and removal of the unit.

The EVSE will be purchased and owned by _____

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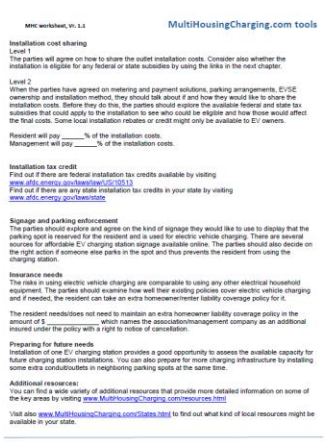

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Installation cost sharing
Level 1
The parties will agree on how to share the outlet installation costs. Consider also whether the installation is eligible for any federal or state subsidies by using the links in the next chapter.

Level 2
When the parties have agreed on metering and payment solutions, parking arrangements, EVSE ownership and installation method, they should talk about if and how they would like to share the installation costs. Before they do this, the parties should explore the available federal and state tax subsidies that could apply to the installation to see who could be eligible and how those would affect the final costs. Some local installation rebates or credit might only be available to EV owners.

Resident will pay _____% of the installation costs.
Management will pay _____% of the installation costs.

Installation tax credit
Find out if there are federal installation tax credits available by visiting
www.afdc.energy.gov/laws/law/US/10513
Find out if there are any state installation tax credits in your state by visiting
www.afdc.energy.gov/laws/state

Signage and parking enforcement
The parties should explore and agree on the kind of signage they would like to use to display that the parking spot is reserved for the resident and is used for electric vehicle charging. There are several sources for affordable EV charging station signage available online. The parties should also decide on the right action if someone else parks in the spot and thus prevents the resident from using the charging station.

Insurance needs
The risks in using electric vehicle charging are comparable to using any other electrical household equipment. The parties should examine how well their existing policies cover electric vehicle charging and if needed, the resident can take an extra homeowner/renter liability coverage policy for it.

The resident needs/does not need to maintain an extra homeowner liability coverage policy in the amount of $_____ which names the association/management company as an additional insured under the policy with a right to notice of cancellation.

Preparing for future needs
Installation of one EV charging station provides a good opportunity to assess the available capacity for future charging station installations. You can also prepare for more charging infrastructure by installing some extra conduit/outlets in neighboring parking spots at the same time.

Additional resources:
You can find a wide variety of additional resources that provide more detailed information on some of the key areas by visiting www.MultiHousingCharging.com/resources.html

Visit also www.MultiHousingCharging.com/States.html to find out what kind of local resources might be available in your state.

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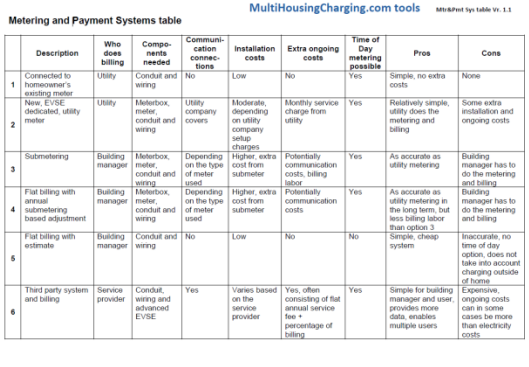
Metering and Payment Systems Table



MultiHousingCharging.com tools Mtr&Pmt Sys table Vr. 1.1

Metering and Payment Systems table

	Description	Who does billing	Compo-nents needed	Communi-cation connec-tions	Installation costs	Extra ongoing costs	Time of Day metering possible	Pros	Cons
1	Connected to homeowner's existing meter	Utility	Conduit and wiring	No	Low	No	Yes	Simple, no extra costs	None
2	New, EVSE dedicated, utility meter	Utility	Meterbox, meter, conduit and wiring	Utility company covers	Moderate, depending on utility company setup charges	Monthly service charge from utility	Yes	Relatively simple, utility does the metering and billing	Some extra installation and ongoing costs
3	Submetering	Building manager	Meterbox, meter, conduit and wiring	Depending on the type of meter used	Higher, extra cost from submeter	Potentially communication costs, billing labor	Yes	As accurate as utility metering	Building manager has to do the metering and billing
4	Flat billing with annual submetering based adjustment	Building manager	Meterbox, meter, conduit and wiring	Depending on the type of meter used	Higher, extra cost from submeter	Potentially communication costs	Yes	As accurate as utility metering in the long term, but less billing labor than option 3	Building manager has to do the metering and billing
5	Flat billing with estimate	Building manager	Conduit and wiring	No	Low	No	No	Simple, cheap system	Inaccurate, no time of day option, does not take into account charging outside of home
6	Third party system and billing	Service provider	Conduit, wiring and advanced EVSE	Yes	Varies based on the service provider	Yes, often consisting of flat annual service fee + percentage of billing	Yes	Simple for building manager and user, provides more data, enables multiple users	Expensive, ongoing costs can in some cases be more than electricity costs

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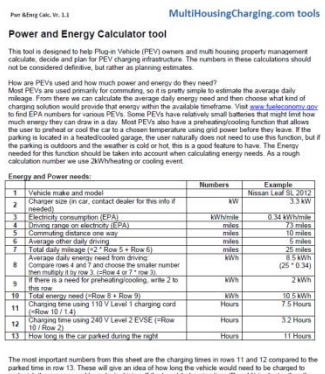
Power and Energy Calculator tool



Per &Eng Calc, Vr. 1.1 MultiHousingCharging.com tools

Power and Energy Calculator tool

This tool is designed to help Plug-in Vehicle (PEV) owners and multi housing property management calculate, decide and plan for PEV charging infrastructure. The numbers in these calculations should not be considered definitive, but rather as planning estimates.

How are PEVs used and how much power and energy do they need?
Most PEVs are used primarily for commuting, so it is pretty simple to estimate the average daily mileage. From there we can calculate the average daily energy need and then choose what kind of charging solution would provide that energy within the available timeframe. Visit www.fueleconomy.gov to find EPA numbers for various PEVs. Some PEVs have relatively small batteries that might limit how much energy they can draw in a day. Most PEVs also have a preheating/cooling function that allows the user to preheat or cool the car to a chosen temperature using grid power before they leave. If the parking is located in a heated/cooled garage, the user naturally does not need to use this function, but if the parking is outdoors and the weather is cold or hot, this is a good feature to have. The Energy needed for this function should be taken into account when calculating energy needs. As a rough calculation number we use 2kWh/heating or cooling event.

Energy and Power needs:

		Numbers	Example
1	Vehicle make and model		Nissan Leaf SL 2012
2	Charger size (in car, contact dealer for this info if needed)	kW	3.3 kW
3	Electricity consumption (EPA)	kWh/mile	0.34 kWh/mile
4	Driving range on electricity (EPA)	miles	73 miles
5	Commuting distance one way	miles	10 miles
6	Average other daily driving	miles	5 miles
7	Total daily mileage (=2 * Row 5 + Row 6)	miles	25 miles
8	Average daily energy need from driving: Compare rows 4 and 7 and choose the smaller number then multiply it by row 3. (=Row 4 or 7 * row 3)	kWh	8.5 kWh (25 * 0.34)
9	If there is a need for preheating/cooling, write 2 to this row	kWh	2 kWh
10	Total energy need (=Row 8 + Row 9)	kWh	10.5 kWh
11	Charging time using 110 V Level 1 charging cord (=Row 10 / 1.4)	Hours	7.5 Hours
12	Charging time using 240 V Level 2 EVSE (=Row 10 / Row 2)	Hours	3.2 Hours
13	How long is the car parked during the night	Hours	11 Hours

The most important numbers from this sheet are the charging times in rows 11 and 12 compared to the parked time in row 13. These will give an idea of how long the vehicle would need to be charged to replenish the energy used by a day's driving. If the Level 1 charging time (Row 11) is shorter than the time that the owner expects the car to be parked at night, then Level 1 charging can be considered, but if it is longer, then Level 2 EVSE is needed.

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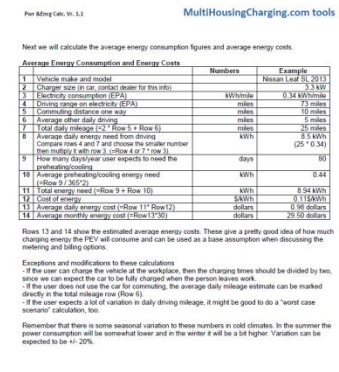

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Next we will calculate the average energy consumption figures and average energy costs.

Average Energy Consumption and Energy Costs

		Numbers	Example
1	Vehicle make and model		Nissan Leaf SL 2013
2	Charger size (in car, contact dealer for this info)		3.3 kW
3	Electricity consumption (EPA)	kWh/mile	0.34 kWh/mile
4	Driving range on electricity (EPA)	miles	73 miles
5	Commuting distance one way	miles	10 miles
6	Average other daily driving	miles	5 miles
7	Total daily mileage (=2 * Row 5 + Row 6)	miles	25 miles
8	Average daily energy need from driving: Compare rows 4 and 7 and choose the smaller number then multiply it with row 3. (=Row 4 or 7 * row 3)	kWh	8.5 kWh (25 * 0.34)
9	How many days/year user expects to need the preheating/cooling	days	80
10	Average preheating/cooling energy need (=Row 9 / 365*2)	kWh	0.44
11	Total energy need (=Row 9 + Row 10)	kWh	8.94 kWh
12	Cost of energy	$/kWh	0.11$/kWh
13	Average daily energy cost (=Row 11* Row12)	dollars	0.98 dollars
14	Average monthly energy cost (=Row13*30)	dollars	29.50 dollars

Rows 13 and 14 show the estimated average energy costs. These give a pretty good idea of how much charging energy the PEV will consume and can be used as a base assumption when discussing the metering and billing options.

Exceptions and modifications to these calculations
- If the user can charge the vehicle at the workplace, then the charging times should be divided by two, since we can expect the car to be fully charged when the person leaves work.
- If the user does not use the car for commuting, the average daily mileage estimate can be marked directly in the total mileage row (Row 6).
- If the user expects a lot of variation in daily driving mileage, it might be good to do a "worst case scenario" calculation, too.

Remember that there is some seasonal variation to these numbers in cold climates. In the summer the power consumption will be somewhat lower and in the winter it will be a bit higher. Variation can be expected to be +/- 20%.

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Let's dive in

- Choose the location
- Figure out the charging functions: home, workplace, fleet, corridor, destination…
- Who will use it?
- Which stations would you use?
- How will users pay for the service?
- Who do you partner with to make this happen?
- Future expansion?
- Stakeholder benefits.

Electric Cars are coming!
What Should Real Estate Owners and Building Industry Professionals Know About Charging?

Q&A+O

For more information visit:

PlugInConnect.com
MultiHousingCharging.com
WorkplaceCharging.com

Jukka Kukkonen,
PlugInConnect, LLC
jukka@pluginconnect.com