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 code/energy hours of credit toward Building Officials and Residential Contractors continuing education requirements."

For additional continuing education approvals, please see the continuing education credit section in the conference agenda booklet.

Location, location, location for EV charging

Jukka Kukkonen
Chief EV Educator and Strategist
Shift2Electric.com

Presentation description and objectives:

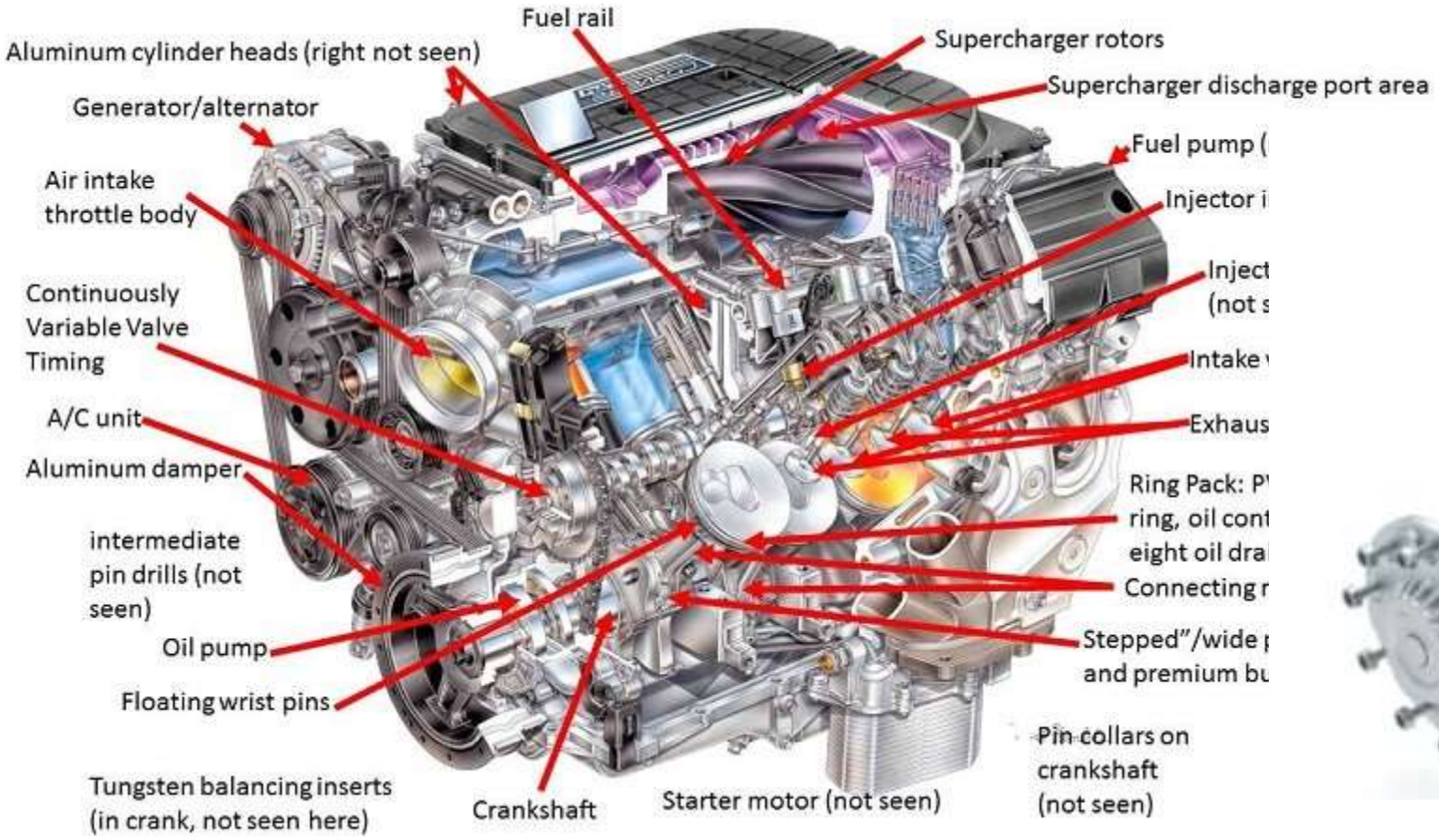
Presentation Description:

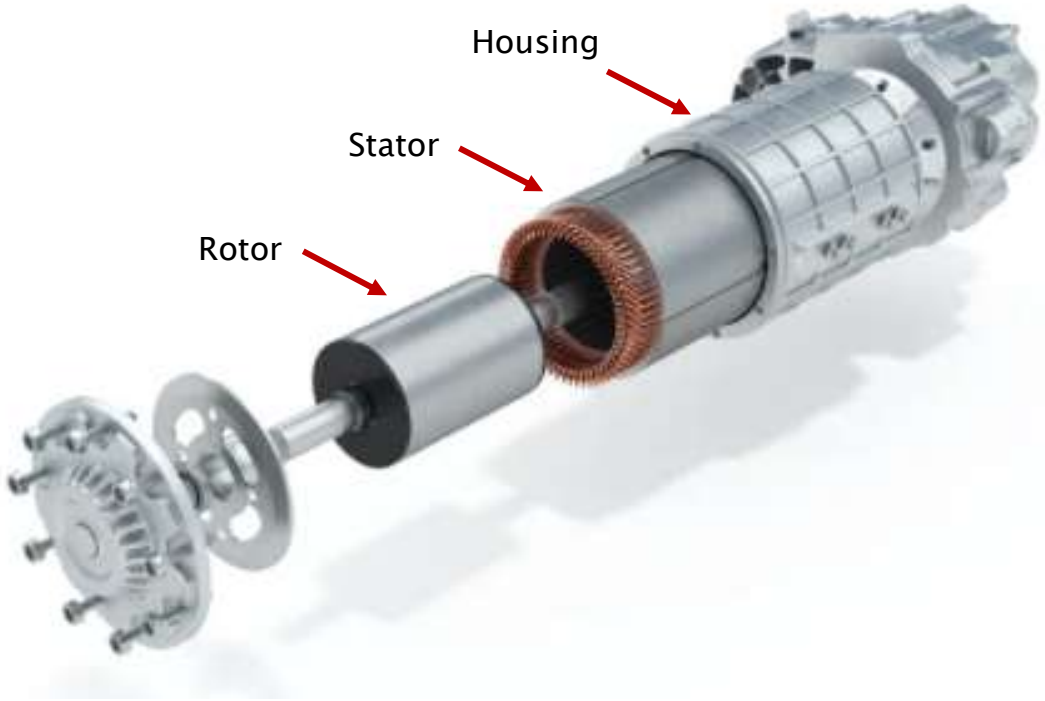
EVs are coming fast, but where are we going to charge them? In this presentation, we will talk about charging at single family homes, condominiums and apartment buildings, workplaces, fleet garages, shopping centers, “gas” stations, convenience stores, restaurants, auto dealers, hotels, parks and any other place our audience wants to know about. We will figure out where to use what kind of charging technology when and why. And utility company representatives will share information on how they are helping to build this infrastructure to power our transportation now and in the future.

Learning Objectives:

1. Participants will know basic technologies, electric vehicle models and the latest market developments
2. Participants will know how people use EVs and the effects on energy consumption and GHG emissions
3. Participants understand different ways to charge EVs and the power levels they provide
4. Participants will learn which locations are most conducive for EV charging.
5. Participants will learn about common concerns and challenges in installing the charging infrastructure to different locations.
6. Participants will learn which charging setups have been commonly used in different locations.
7. Participants will learn what they have to take account when choosing the charging infrastructure.

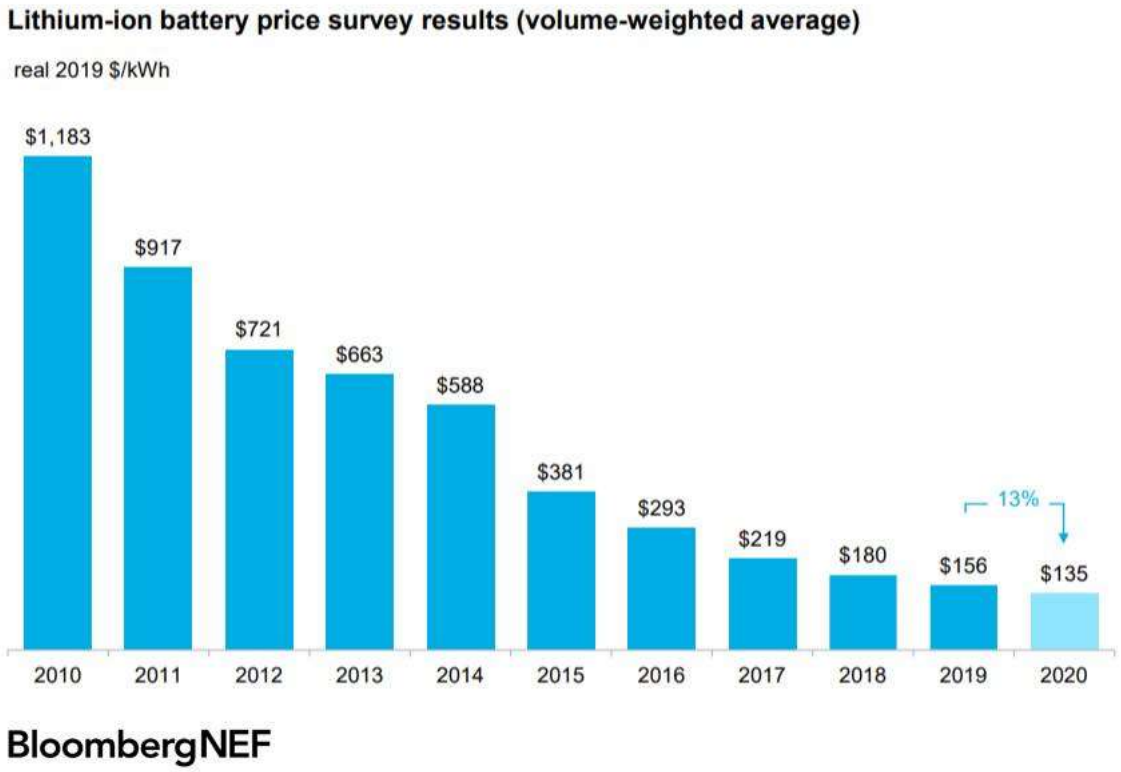
Internal Combustion Engine vs. Electric Motor





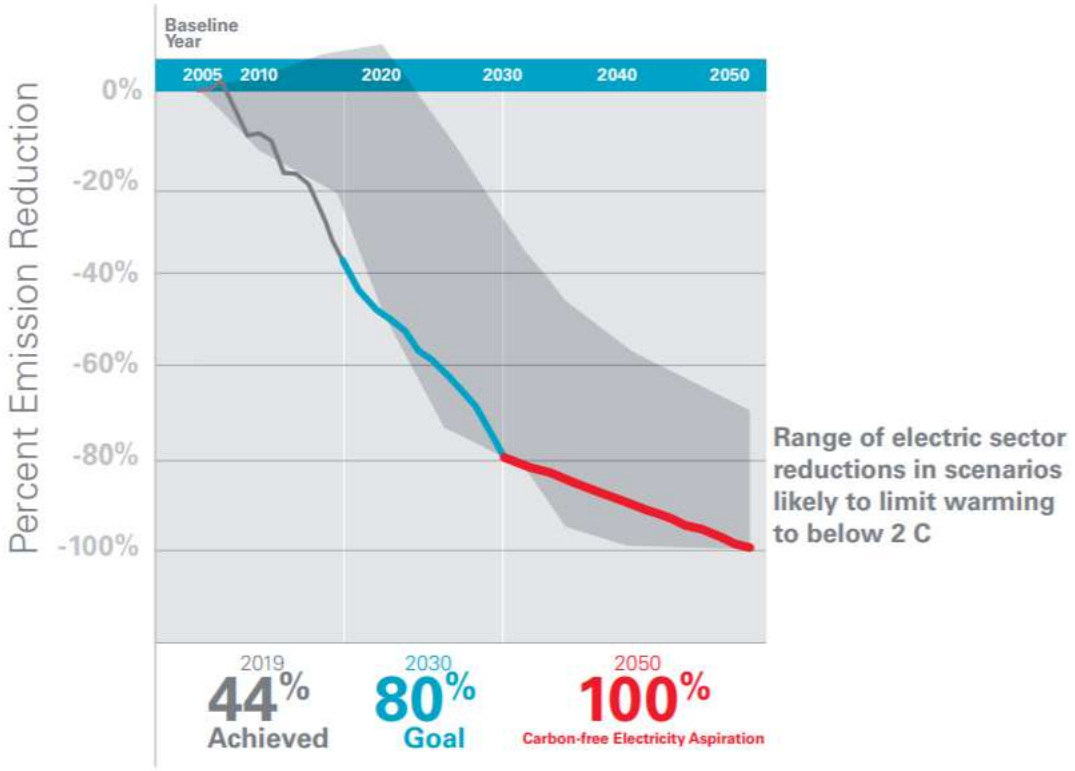
Technology advancements

Battery tech advancement



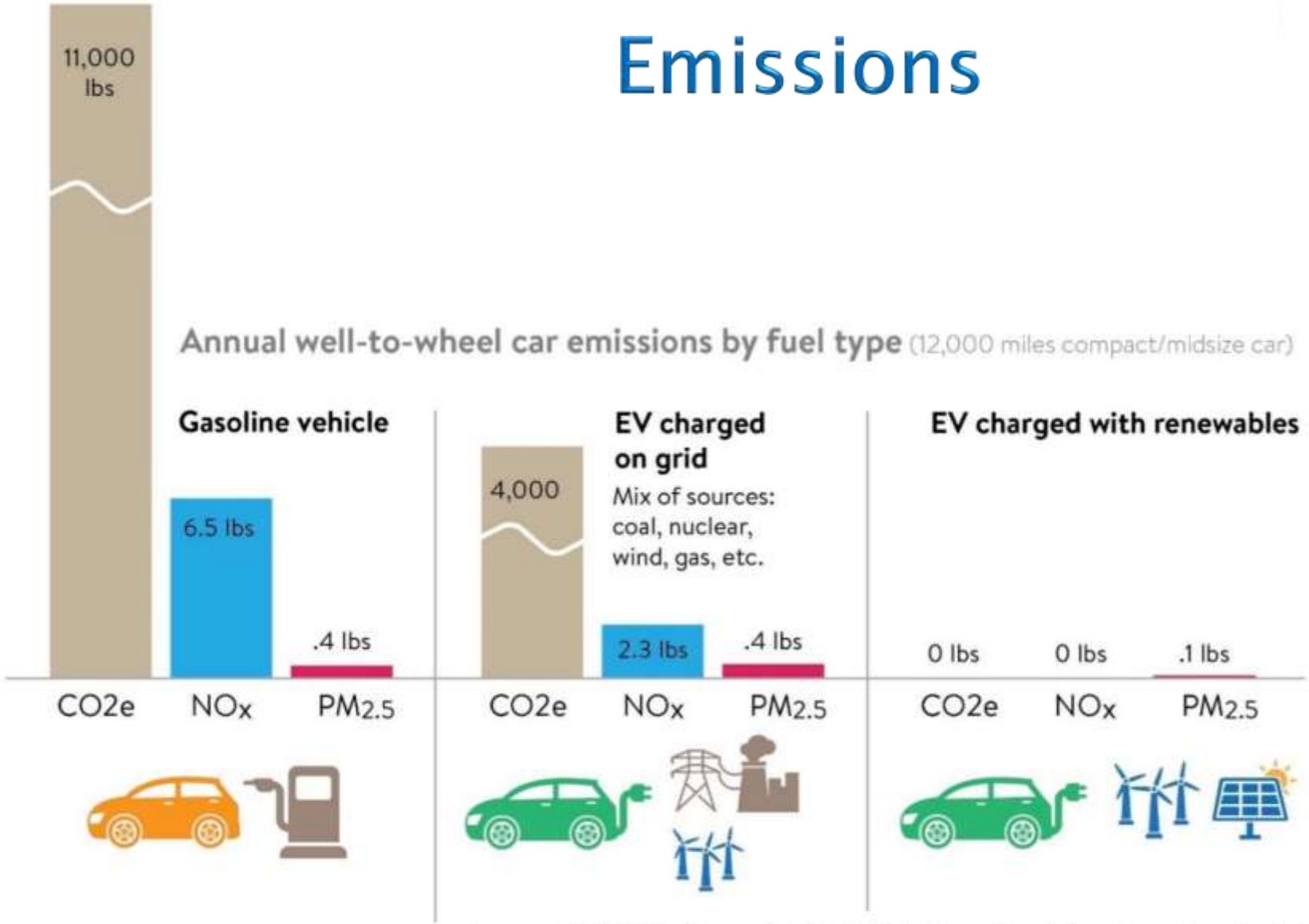
Shift to renewable electricity

Xcel Energy's carbon emissions

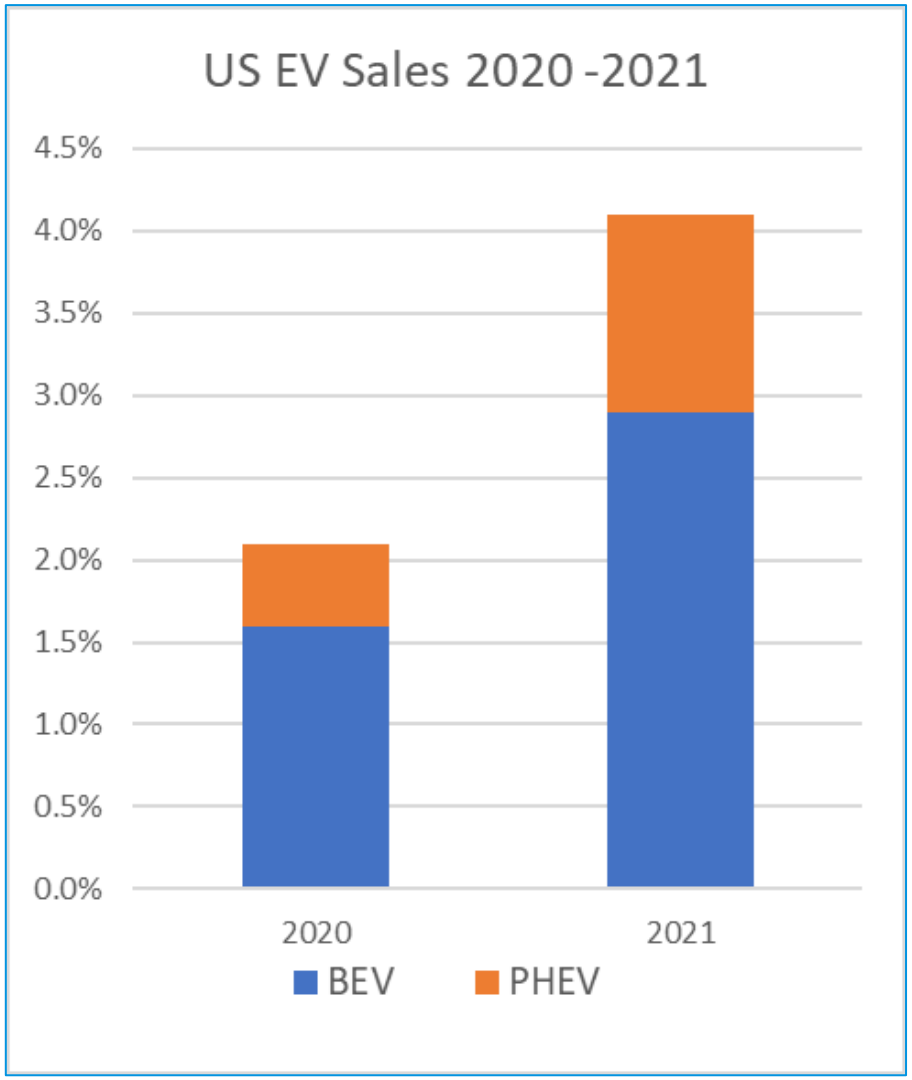


Graphs:
Bloomberg NEF, Xcel Energy

Emissions



Source: MOVES2014a and 2014 EPA National Emissions Inventory Database

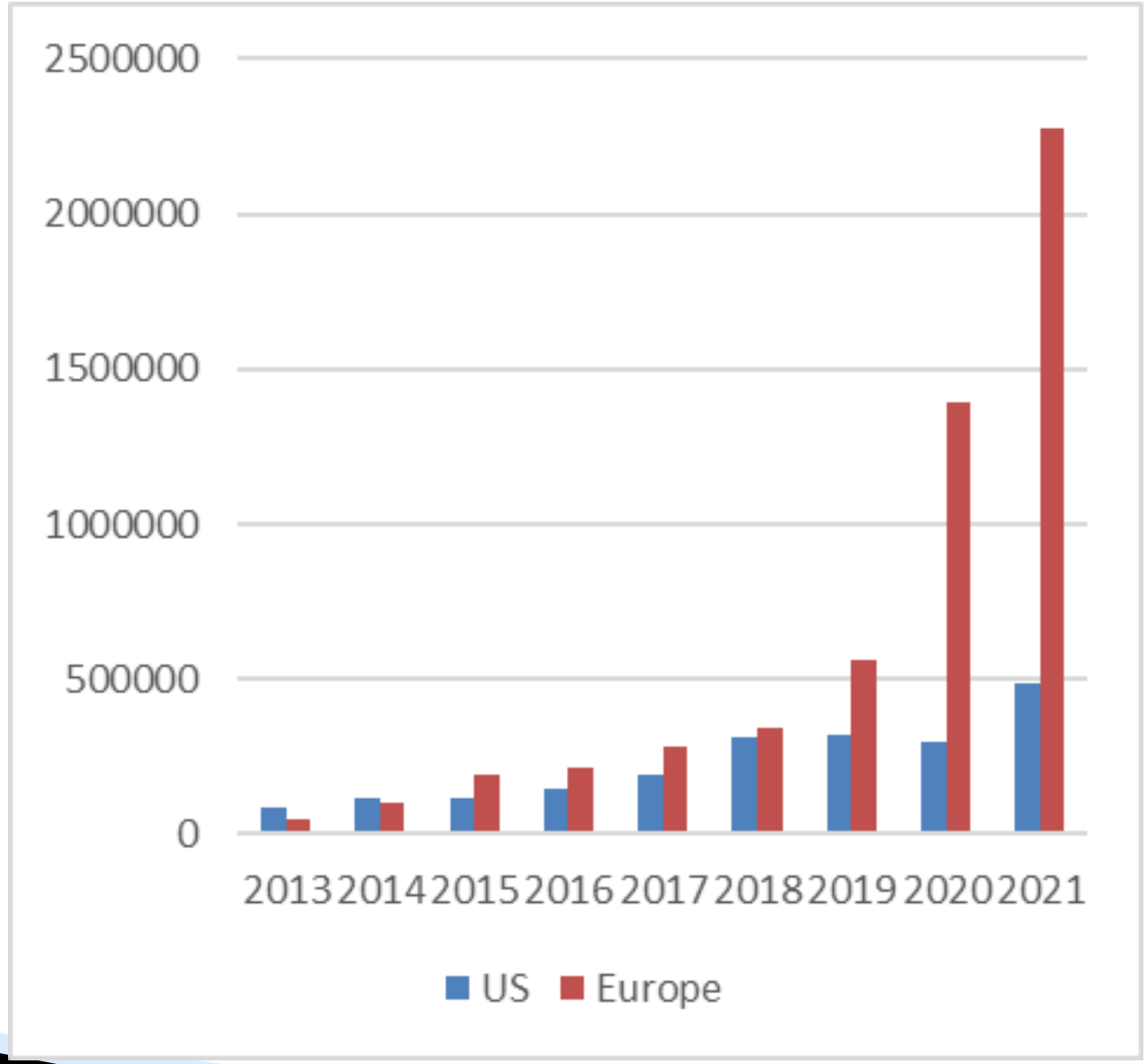


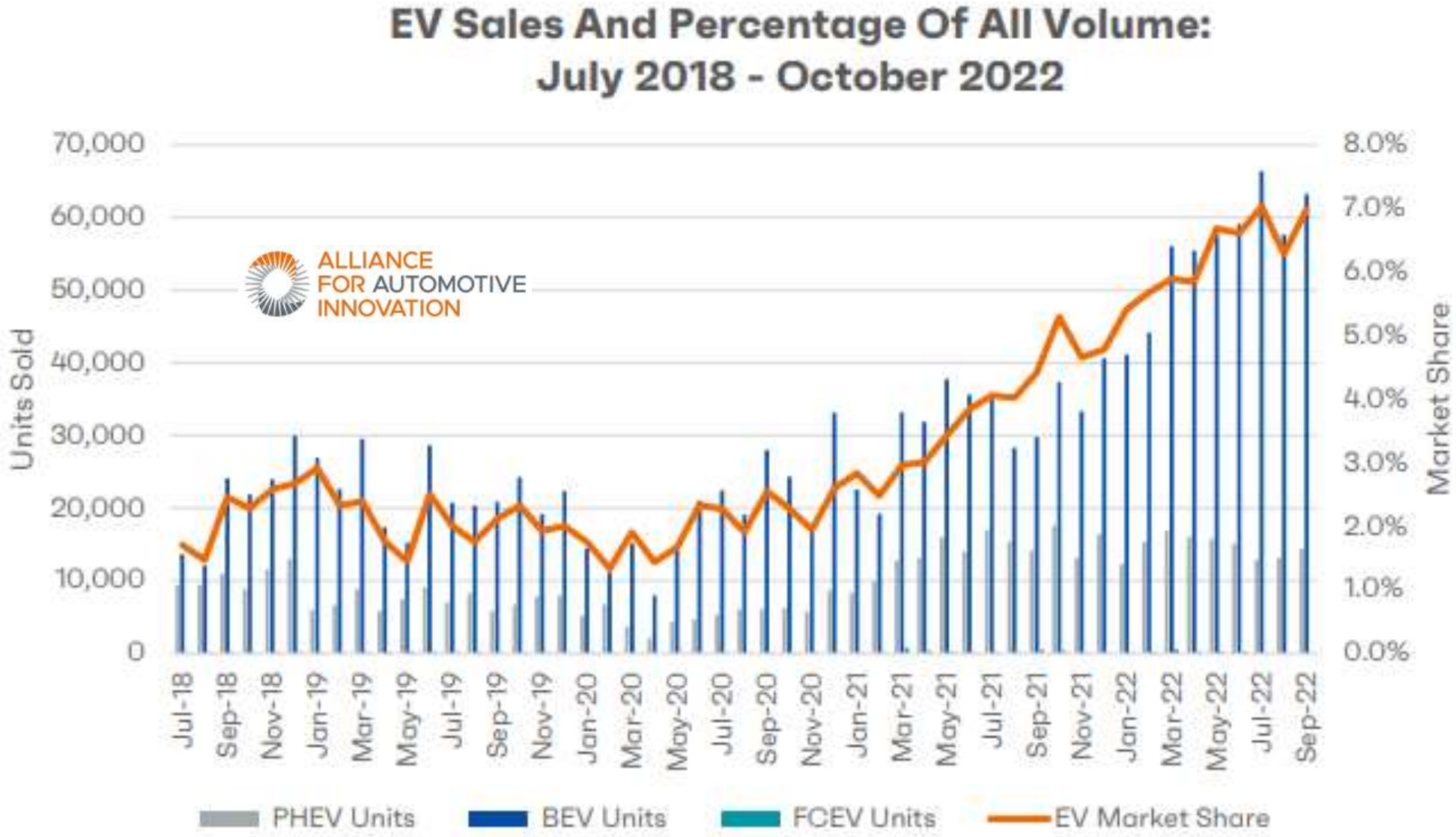
12 most sold EV models in 2021

1	Tesla Model Y	172,700
2	Tesla Model 3	128,600
3	Jeep Wrangler 4xe	28,000
4	Toyota RAV4 Prime	27,707
5	Ford Mustang Mach-E	27,140
6	Toyota Prius Prime	25,042
7	Chevrolet Bolt/EUV	24,803
8	Volkswagen ID4	16,742
9	Nissan Leaf	14,239
10	Audi e-tron and Sportback	10,921
11	Porsche Taycan	9,419
12	Tesla Model S	9,100

Data:
Automotive News,
Vehicle manufacturers and Wards Intelligence

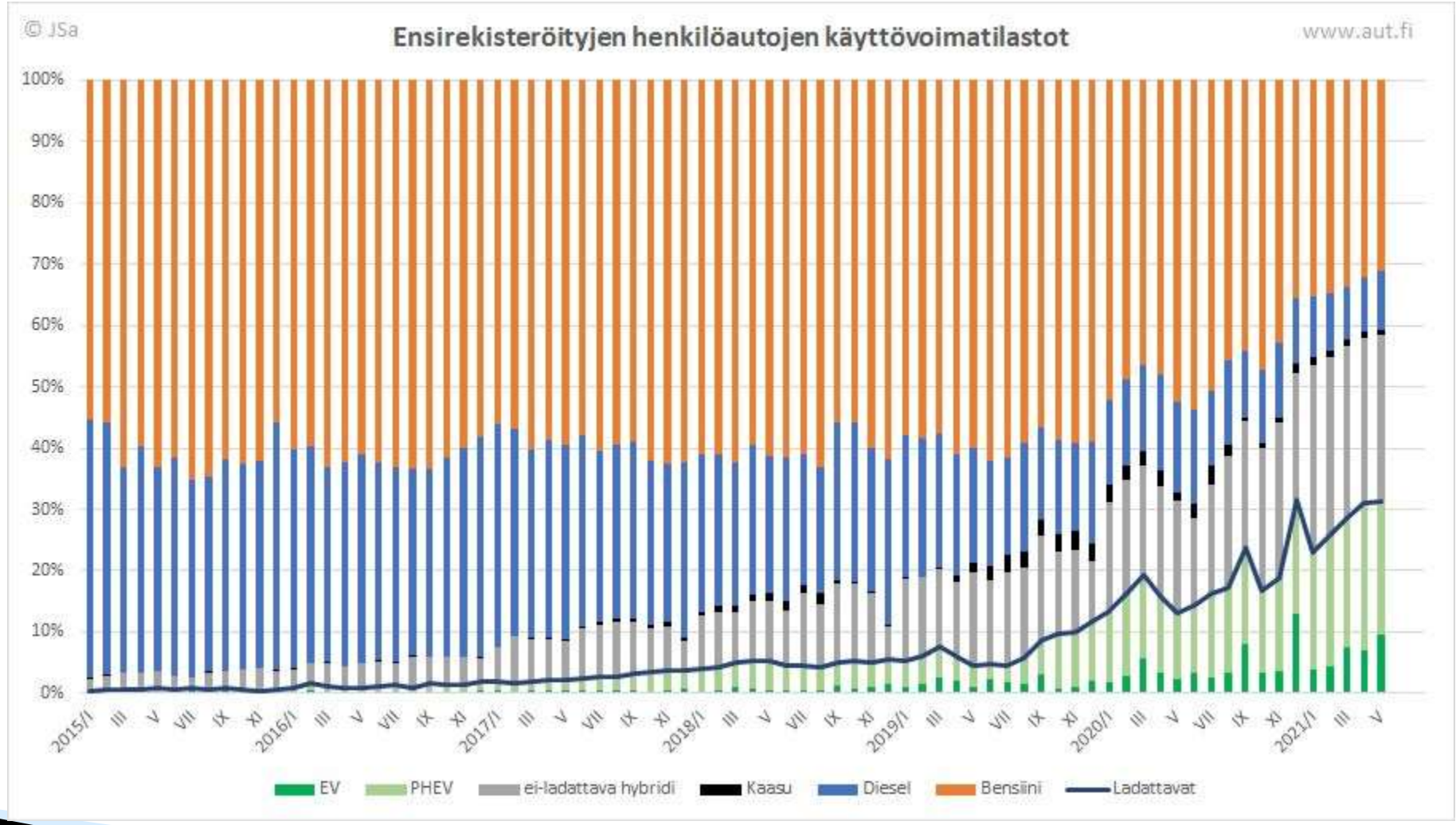
EV sales: US vs Europe



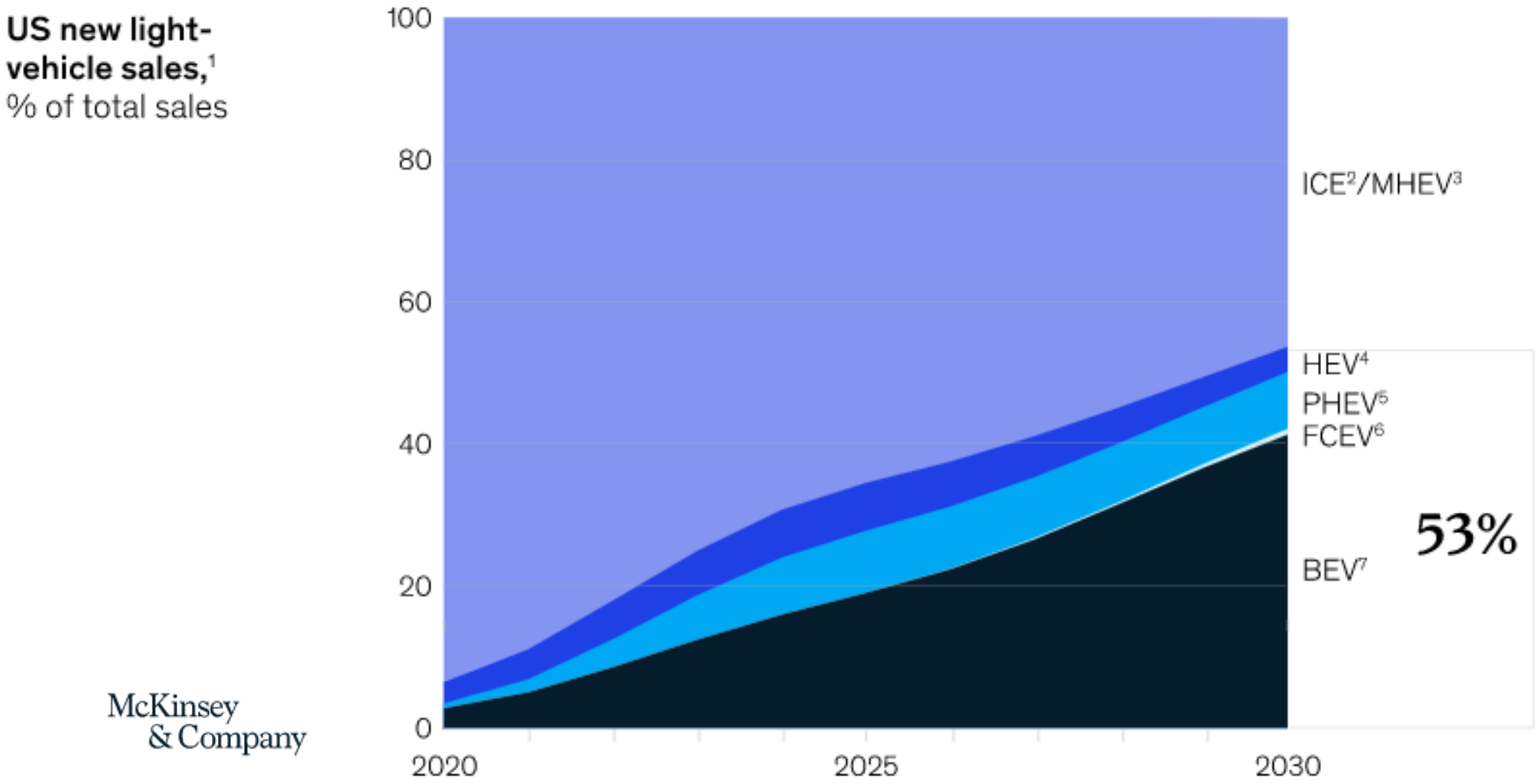


Graph:
Alliance for Automotive Innovation

EV adoption in Finland



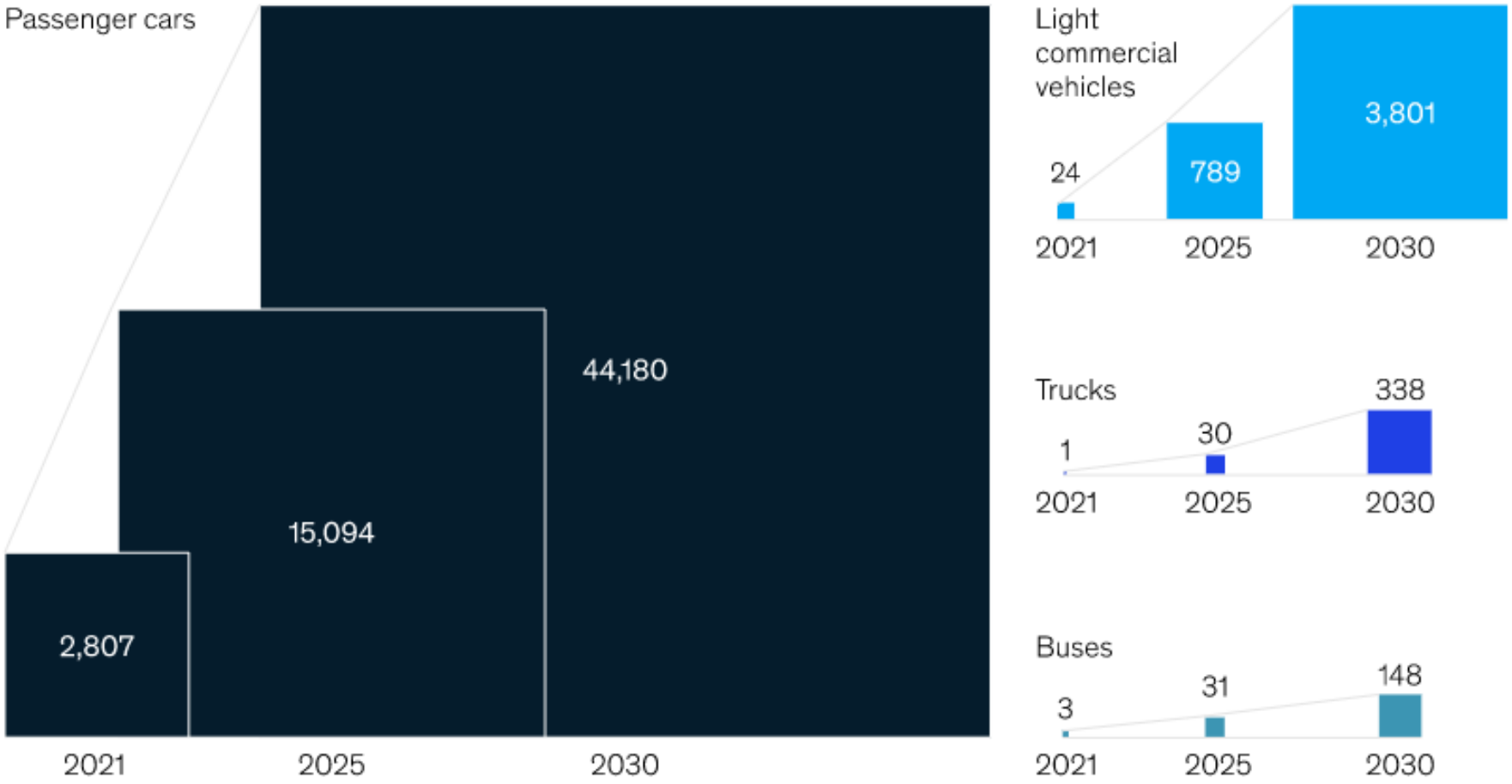
If electric-vehicle adoption continues to accelerate, EVs are likely to account for more than half of all US passenger car sales by 2030.



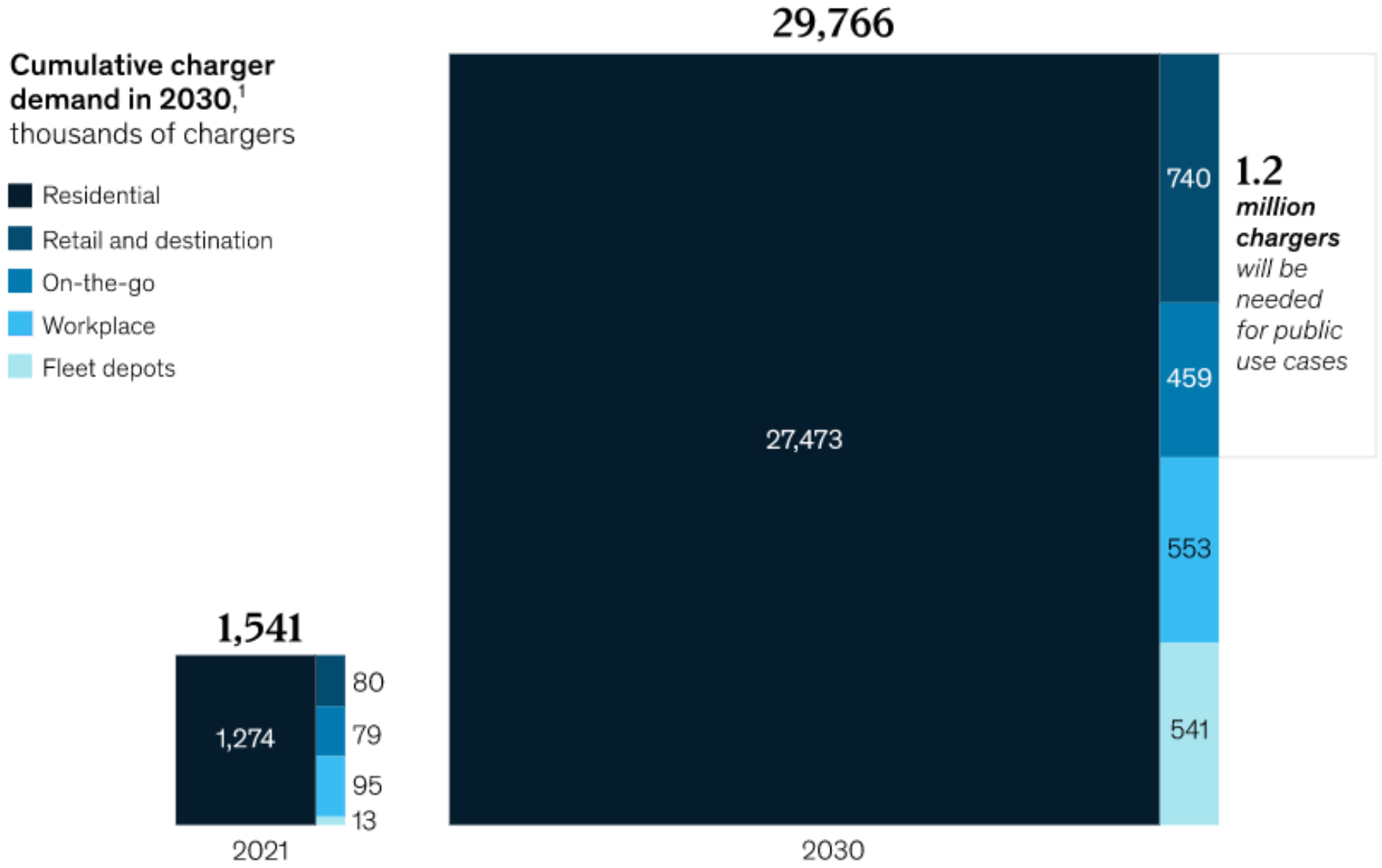
Source: McKinsey&Company

If federal zero-emission vehicle sales targets are met, the United States could have more than 48 million electric vehicles on the road in 2030.

Electric-vehicle parc, by segment[1] growth, thousands of vehicles[2]

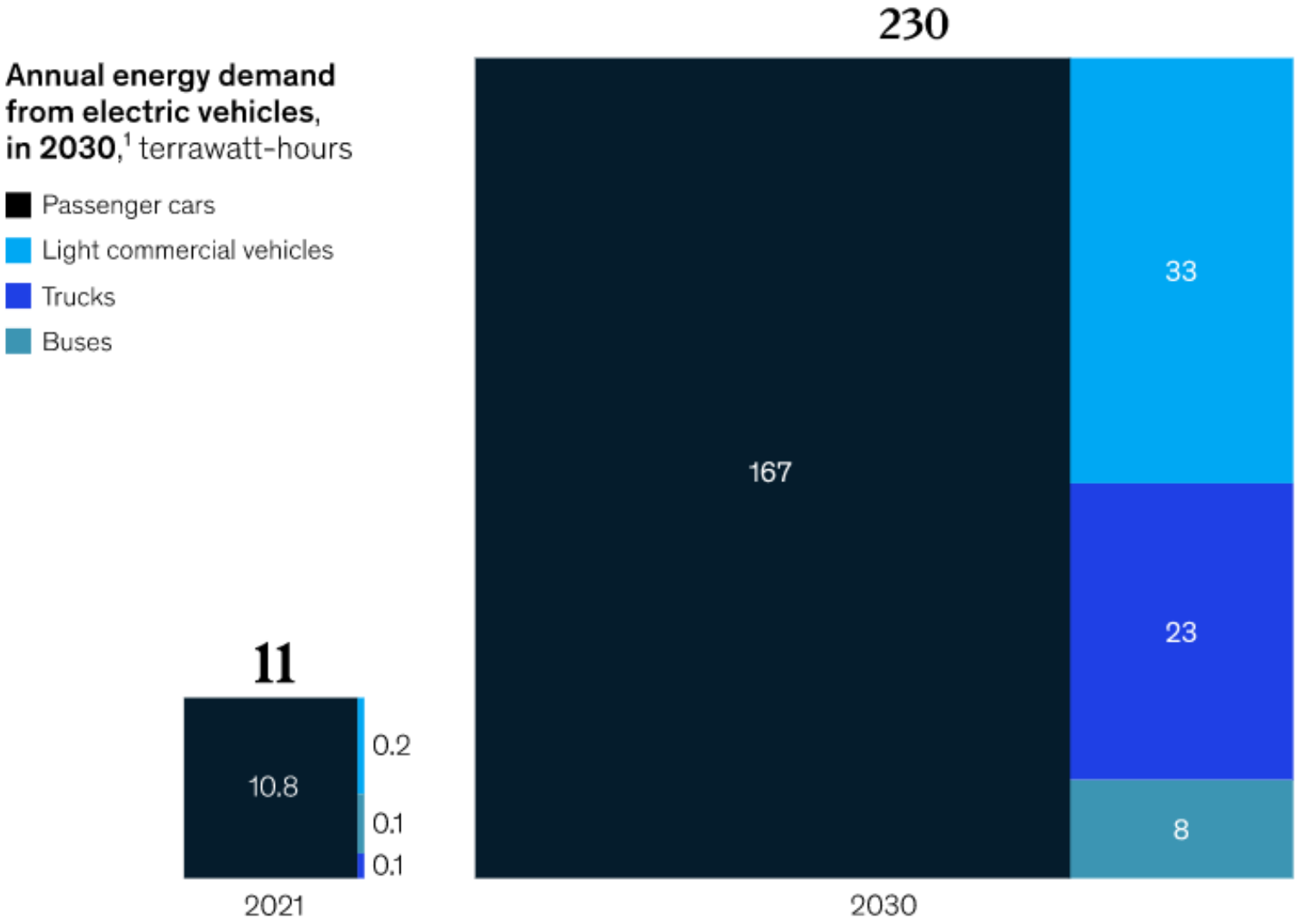


Source: McKinsey&Company



Source:
McKinsey&Company

While most electric-vehicle chargers would be in homes, about 1.2 million would be public chargers.



"The demand estimate for 2030 represents approximately 5 percent of current total electricity demand in the United States."

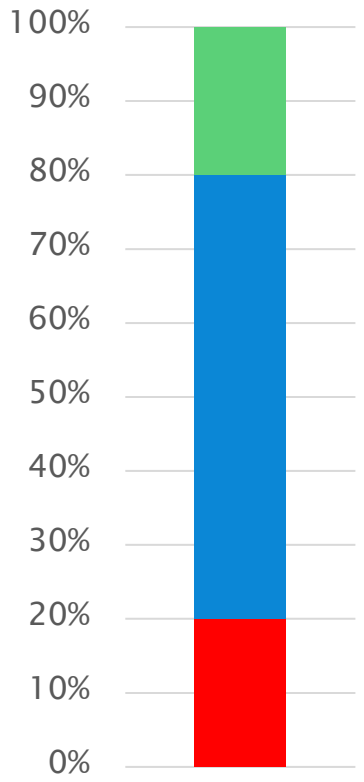
Source: McKinsey&Company

What do people think about EVs in the US?

20% strongly in favor of EVs

60% can be influenced

20% strongly against EVs



Source:
J.D. Power and Wards Auto 2021

New EVs to the US market 2021

Sedans

Polestar 2

Audi e-tron GT

Lucid Air

Crossovers and SUVs

Volkswagen ID.4

Jeep Wrangler 4xe

Kia Sorento PHEV

Ford Mustang Mach-E

Chevrolet EUV

Ford Escape PHEV

Volvo XC40 Recharge

Hyundai Tucson PHEV

Hyundai Santa Fe PHEV

Pickup trucks

Rivian R1T

Photos: Vehicle manufacturers

New EVs to the US market 2022

Sedans

BMW i4

Mercedes EQS

BMW i7

Crossovers and SUVs

BMW iX

Audi Q4 e-tron

Volvo C40 Electric

Nissan Ariya

Hyundai Ioniq 5

Cadillac Lyric

Lexus NX 450h+

Kia Sportage

Kia EV 6

Jeep Grand Cherokee 4xe

Toyota bX4X / Subaru Solterra

Rivian R1S

Pickup trucks

GMC Hummer EV

Ford F-150 Electric

Ford E-Transit

Photos: Vehicle manufacturers

New EVs to the US market 2023

Sedans

BMW i5

Genesis G80

Hyundai Ioniq 6

Crossovers and SUVs

BMW XM

Chevrolet Blazer EV

Polestar 3

Alfa Romeo Tonale

Chevrolet Equinox EV

Volvo EX90

Kia EV 9

Dodge Hornet R/T

Hummer EV SUV

Pickup trucks

Chevrolet Silverado EV

Tesla Cybertruck

Photos: Vehicle manufacturers

Midwest EV Info List (March 2020) Page 1 of 3

Midwest EVOLVE

Manufacturer										Range			Charging speed (miles/hr)			Performance				
Make	Model	Photo	Seating	EV Type	FWD/ RWD/ AWD	Base MSRP	Federal tax credit	Price after federal tax credit	Battery size (kWh)	Electric Range (miles)	Total Range (miles)	Charging rates (kW) L2/DCFC	Level 1 120V	Level 2 240V	DCFC 400+V	MPGe/ MPG	Top Spd (mph)	0-60 mph (sec)	Towing capacity (lbs)	Crash Ratings: IIHS/NHTSA
Audi	e-tron		5	BEV	AWD	$74,800	$7,500	**$67,300**	95	204	204	11/130	3	24	228	74	155	5.5	4000	Top Safety Pick +/ Not rated
Audi	Q5 e		5	PHEV	AWD	$52,900	$6,712	**$46,188**	14.1	20	390	7.4	2	14	N/A	65/27	130	5	4400	Good/ Not rated
Audi	A8L PHEV		5	PHEV	AWD	$94,000	$6,795	**$87,205**	14.1	17	420	7.4	2	12	N/A	54/23	130	4.9	0	Not Rated
BMW	i3		4	BEV	RWD	$44,450	$7,500	**$36,950**	42	153	153 (200)	7.4/50	4	27	147	124 (39)	93	6.9-7.2	0	Good-Acceptable/ Not rated
BMW	i8		4	PHEV	AWD	$147,500	$3,793	**$143,707**	7.2	15	330	3.3	3	7	N/A	76/28	155	4.2	0	Not rated/ Not rated
BMW	X3 xDri																		)	Top Safety Pick + / Not rated
BMW	53																		)	Top Safety Pick + / Not rated
BMW	745e		5	PHEV	AWD	$95,550	$5,836	**$89,714**	12	16	290	3.7	2	6	N/A	56/22	155	4.9	0	Not rated / Not rated
Chevrolet	Bolt EV		5	BEV	FWD	$36,620	$1,875	**$34,745**	66	259	259	7.2/50	4	25	140	118	98	6.5	0	Top Safety Pick / 5 star
Chrysler	Pacifica Hybrid (PHEV)		7	PHEV	FWD	$39,995	$7,500	**$32,495**	16	33	570	6.6	3	16	N/A	84/32	107	7.8	0	Top Safety Pick / 5 star
Ford	Fusion Energi		5	PHEV	FWD	$35,000	$4,609	**$30,391**	9	26	610	3.3	3	9	N/A	97/42	85	8.5	0	Good/ 5 star
Honda	Clarity PHEV		5	PHEV	FWD	$33,400	$7,500	**$25,900**	17	48	340	6.6	4	22	N/A	110/42	110	8.8	0	Not rated/ Not rated
Jaguar	I-PACE		5	BEV	AWD	$69,850	$7,500	**$62,350**	90	246	246	7.0/85	3	16	153	76	124	4.5	0	Not rated
Kia	Niro PHEV		5	PHEV	FWD	$28,500	$4,543	**$23,957**	8.9	26	560	3.3	4	10	N/A	105/46	107	9	0	Top Safety Pick + / 4 star

This table is updated by Jukka Kukkonen, Shift 2 Electric. Photos and information sources: Manufacturers' websites and www.fueleconomy.gov Get the latest version: www.EVInfoList.com

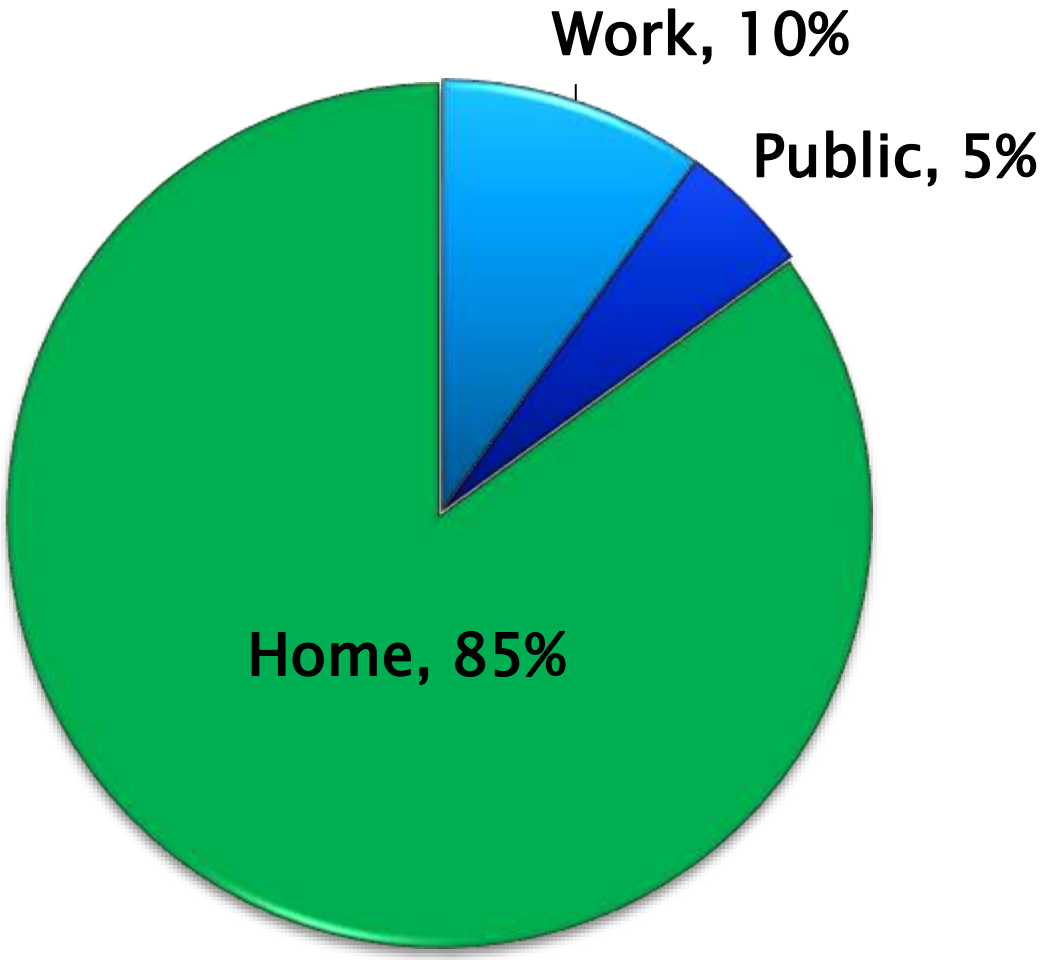
Electric pickups are coming

Photos: Vehicle manufacturers

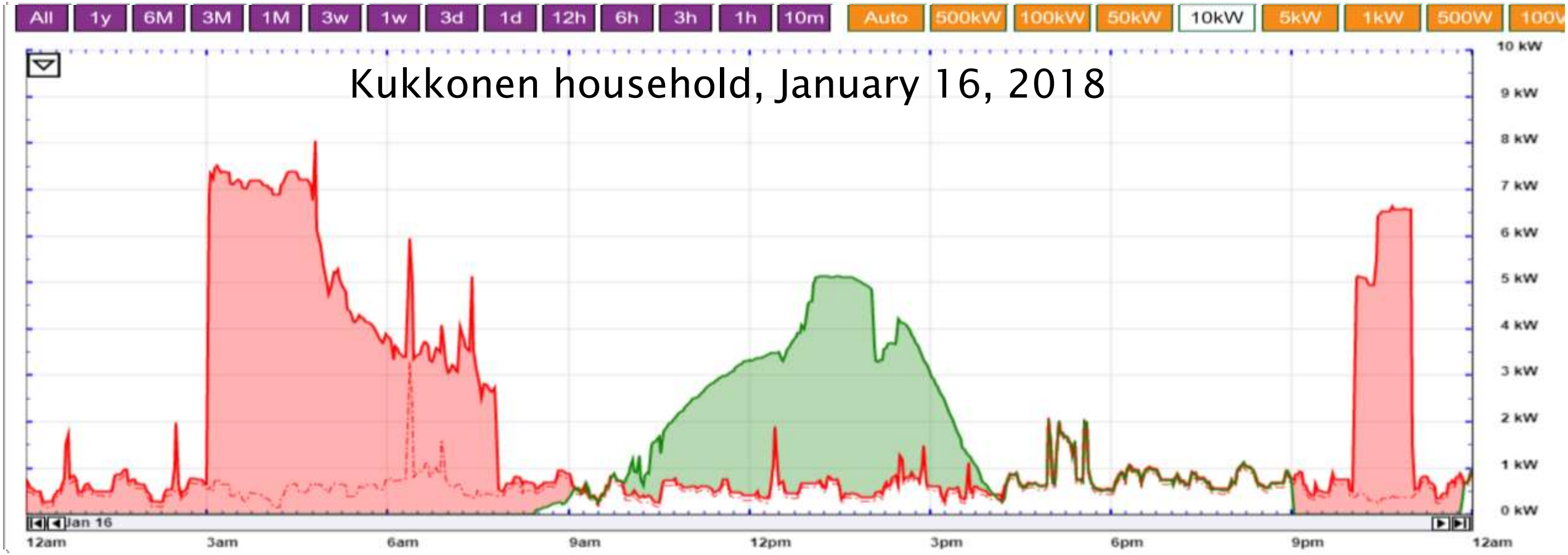
Why EVs make more sense in rural America

- Rural households use more funds to transportation – EVs provide bigger savings opportunity
- Range has increased considerably – Current EVs have on average over 250 miles of range.
- Home charging is usually easy to set up
- Households have multiple vehicles – Flexibility
- Access to gas fueling infrastructure is limited
- Federal home charging incentive (max 30% up to $1000) only available to rural areas and low income neighborhoods starting 1/1/2023
- New federal funding will increase the rural public charging infrastructure
- Powering your vehicle with electricity is local economy booster
- There are a lot of uses for vehicle to load (V2L) power output features

Where does the energy flow?



Value of residential EV charging



Graph: Jukka Kukkonen

Calculate your own charging costs

- How many miles you drive in a month? 1000 miles
- EV efficiency: (Model detailed numbers: FuelEconomy.gov) 3 miles/kWh
- Monthly kWh usage: 1000 miles / 3 miles/kWh = 333kWh
- Regular flat rate $0.12/kWh

  Monthly costs: 333 kWh x $0.12/kWh = **$40/month**
- EV rate (Time of Day pricing) $0.07/kWh

  Monthly costs: 333 kWh x $0.07/kWh = **$23/month**

How to charge an EV?

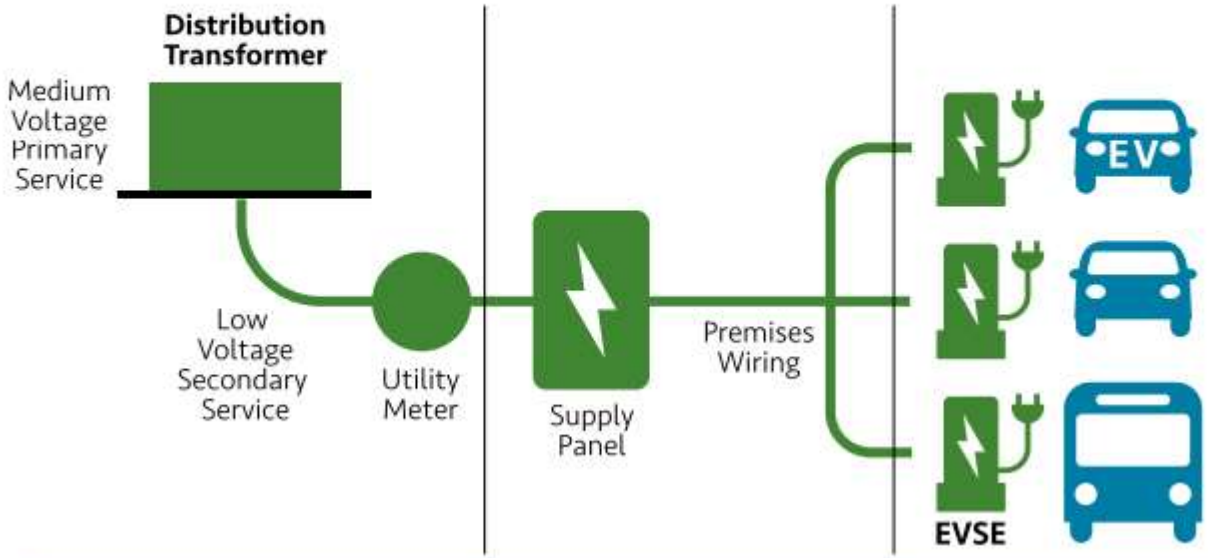
Level 1
120 Volt

Level 2
240 Volt

DC fast charge

Dwell time	Right infrastructure
Minimum 8 hours (with limits)	Level 1
Hours	Level 2
Minutes	DC Fast Charging

Pictures: Clipper Creek, Bosch, ZEF Energy, ABB, Kempower

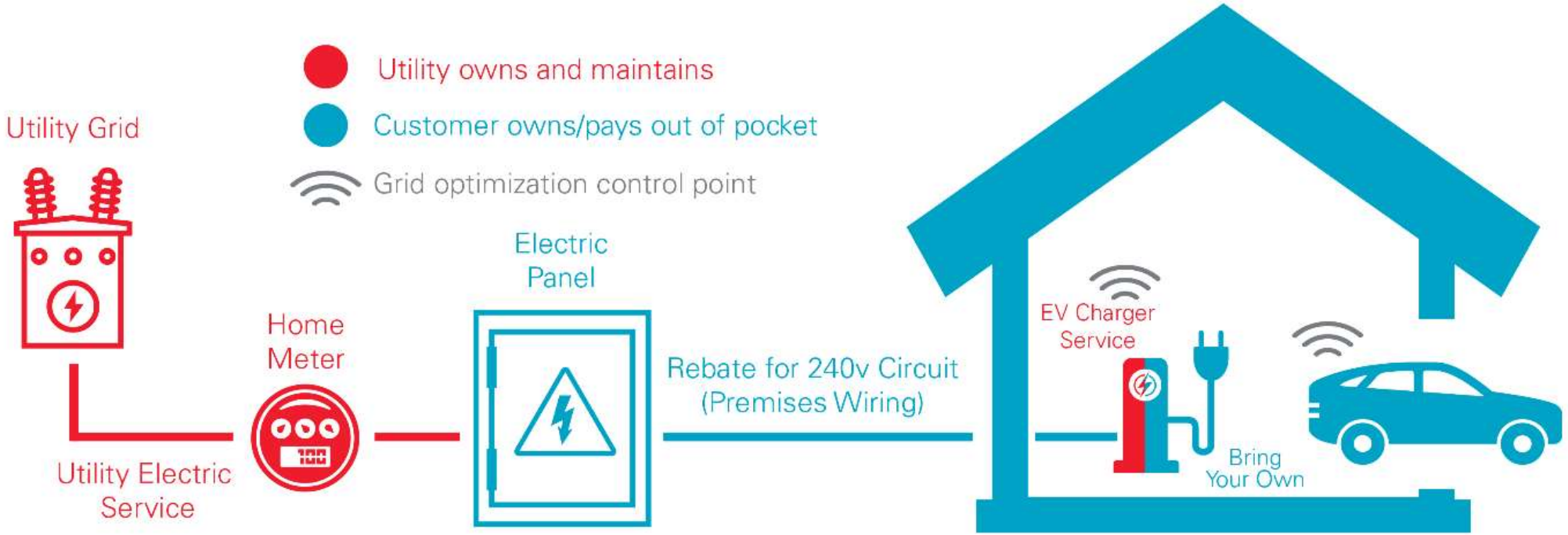


	UTILITY SERVICE	PREMISES WIRING	EVSE
1. Traditional	Electric Company	Customer	
2. Make Ready	Electric Company		Customer
3. EVSE Only	Electric Company	Customer	Elecric Company
4. Full Ownership	Electric Company		

Figure 5.3. Various approaches to ownership of EVSE and related site-wiring. (Adapted from AVISTA, 2020)

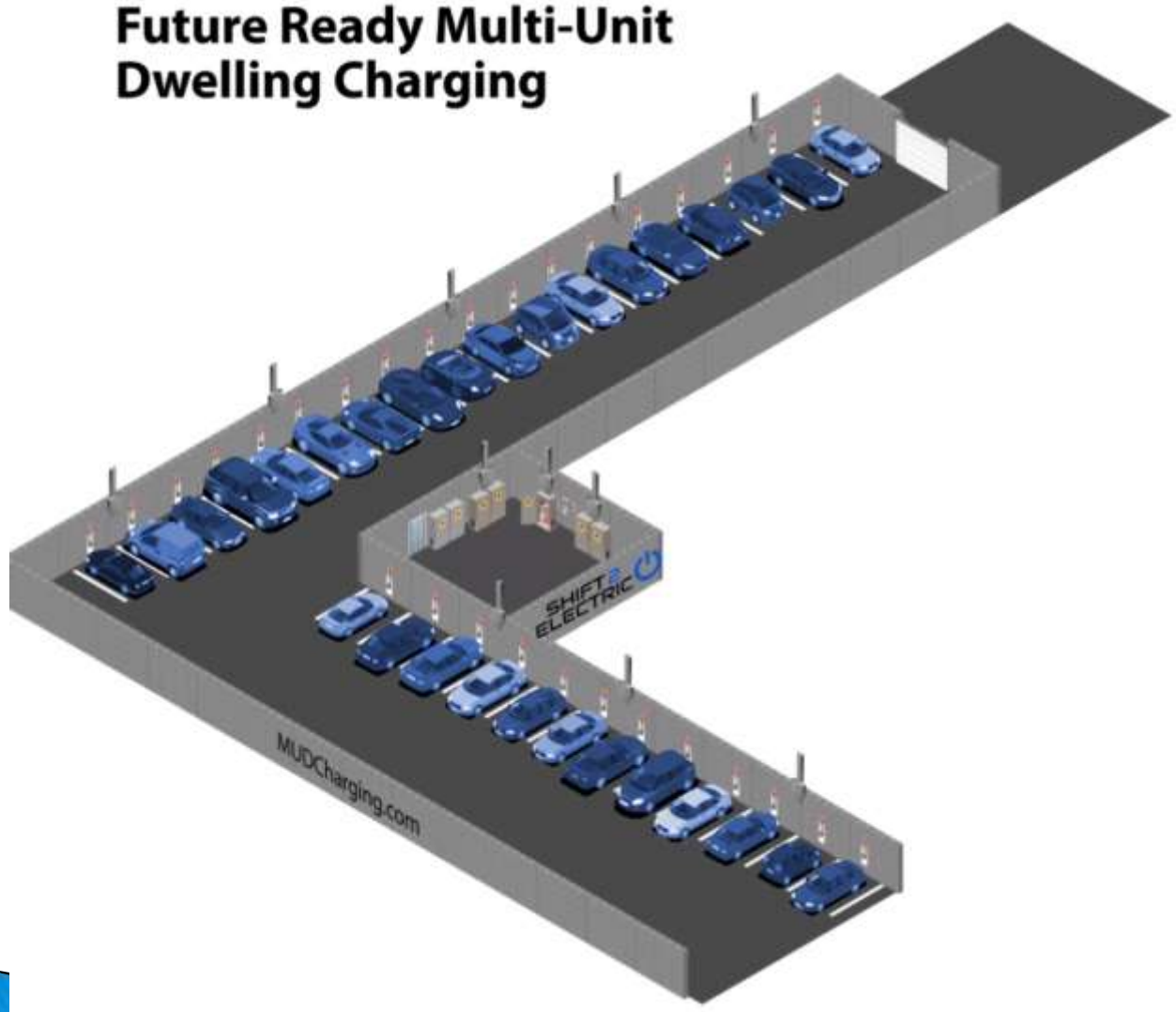
Graph: DOT

Single family home charging



Illustrations:
Xcel Energy

Condominium and Apartment building 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

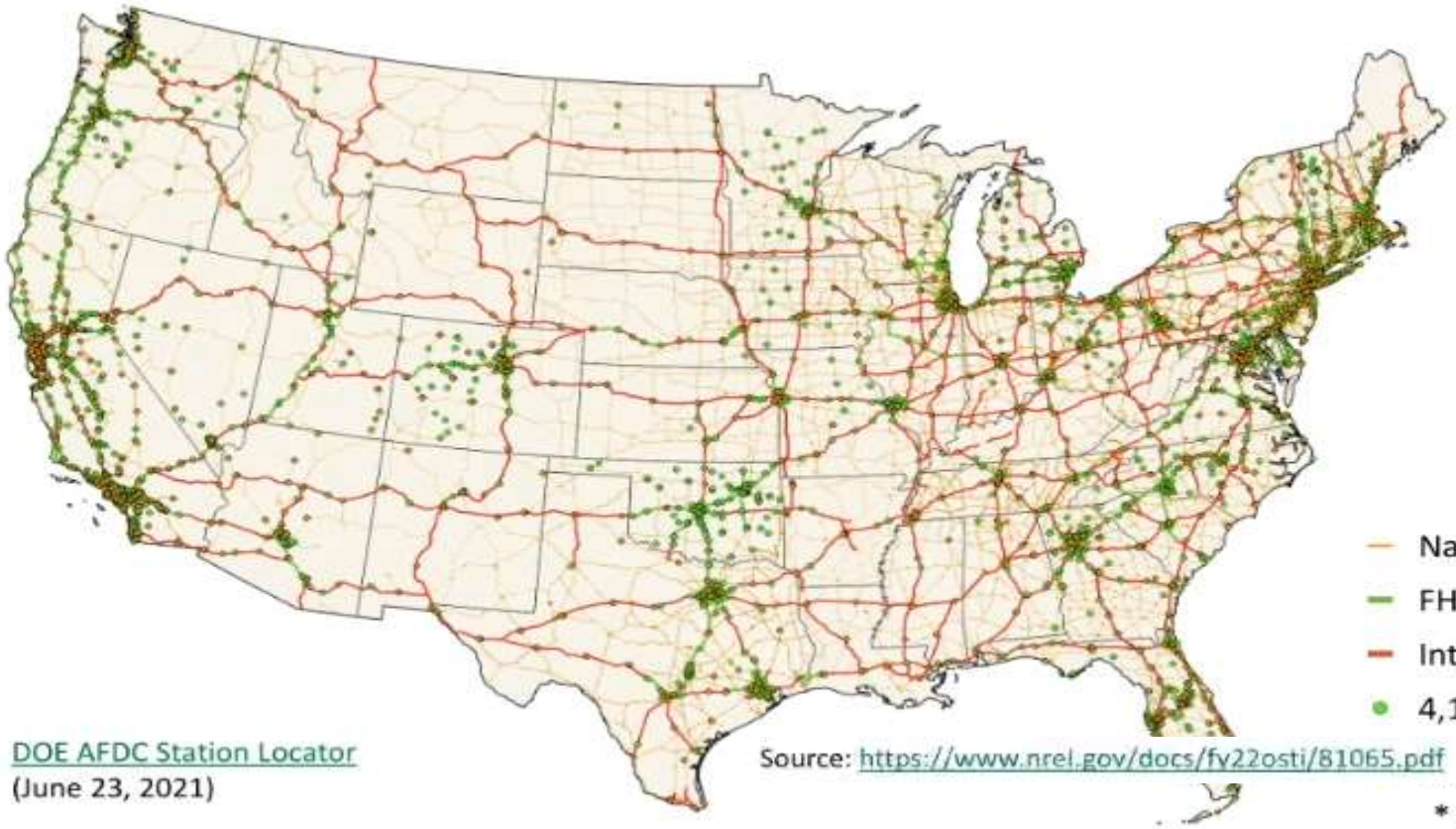
Use charging stations with embedded metering and power sharing capability

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

Source: MUDCharging.com

500,000 fast chargers by 2030

Current distribution of public chargers



DOE AFDC Station Locator
(June 23, 2021)

Source: https://www.nrel.gov/docs/fy22osti/81065.pdf

EVSE Type	Stations	EVSE
Public DCFC	4,105	8,048
Tesla DCFC	1,068	10,554
Total DCFC	5,173	18,602
Public L2	34,267	70,828
Tesla L2	4,439	14,686
Total L2	38,706	85,514
Total Overall	**43,879**	**104,116**

- National Highway System
- FHWA Alt Fuel Corridor (EV Ready)
- Interstate System
- 4,105 Public DCFC Stations
- Supercharger Stations*

* Superchargers typically support 150-250kW per port

The Inflation Reduction Act of 2022 (IRA)

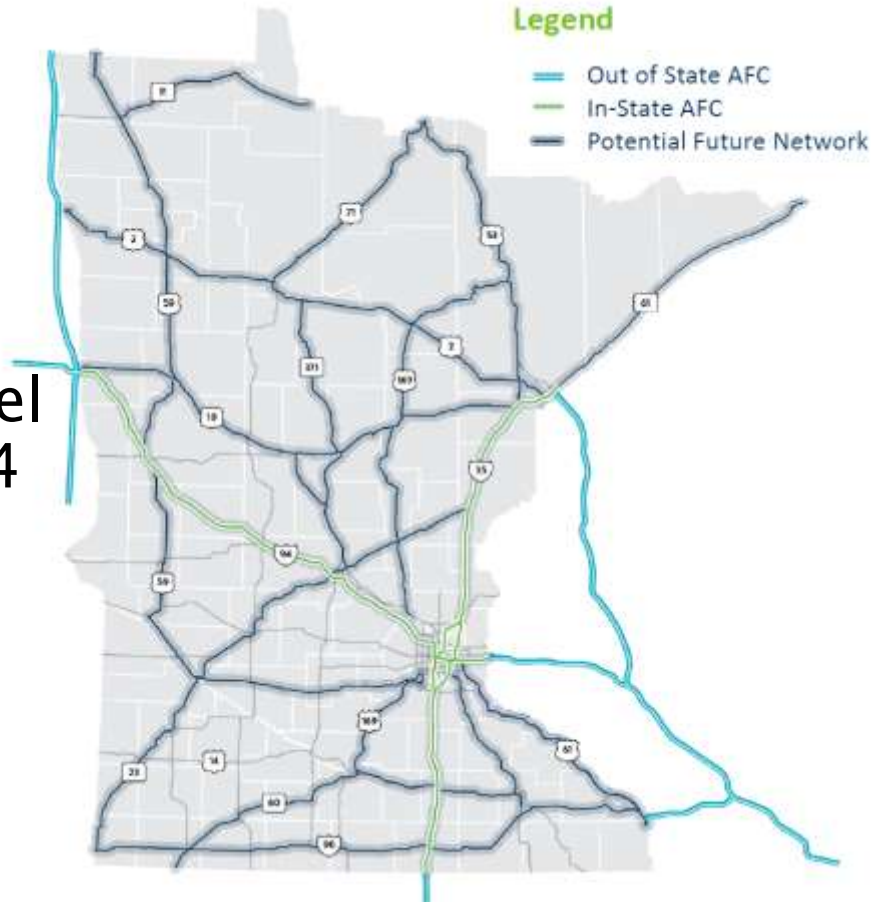
- January 1, 2023 - December 31, 2032.
- Section 30D Credit for New Electric Vehicles up to $7500
- Section 25E Used EV Credit up to $4000.
- Section 45W Commercial Vehicles Credit up to $40,000:
- Section 30C Alternative Fuel Vehicle Refueling Property Credit up to $100,000

Different sections have different limitations and eligibility requirements:

- US manufacturing
- Proportion limits
- Income limits
- Price limits
- Weight limits
- Vehicle age limits
- Etc…

Example of funds available: NEVI

- National EV Infrastructure Formula Program
  - Federal appropriation for Minnesota is $68 million for 2022-26
  - 20% non-federal match required
  - First year funding goes to the Alternative Fuel Corridors (AFCs) IN Minnesota these are I-94 and I-35
    - DC Fast Charging
    - Located every 50 miles
    - Located <1-mile from AFCs
    - Four 150 kW fast chargers at each site. 600kW site power.
  - Following years not tied to AFCs



Graphic : MNDOT

Discretionary grant program

- Another $2.5 billion is earmarked as part of a discretionary grant program for infrastructure for corridor and community charging
- Designed to fill the gaps within the system:
  - Rural areas
  - Disadvantaged communities
  - Urban areas
- The competitive grant program is open to local governments, which can apply directly for the funding

Regional charging strategy

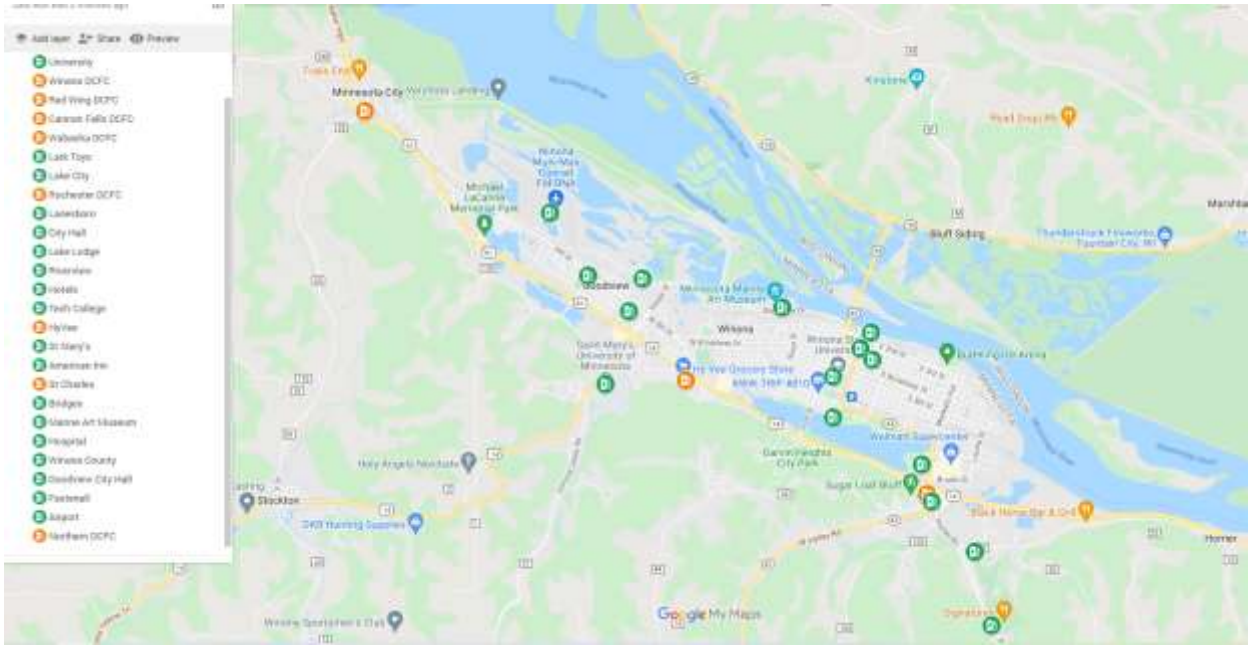
- Why:
  - Concrete plan
  - Internal development
  - External communications
  - Upcoming funding opportunities

- Use with:
  - Potential site host
  - Bordering utilities
  - State officials

- Does NOT cover home charging
  - Single family homes
  - Condominium or Apartment Buildings

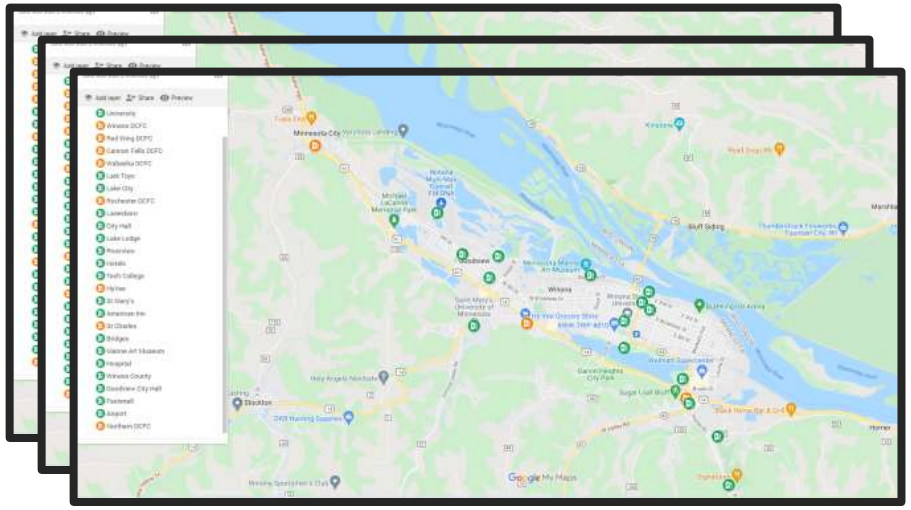
Regional charging strategy

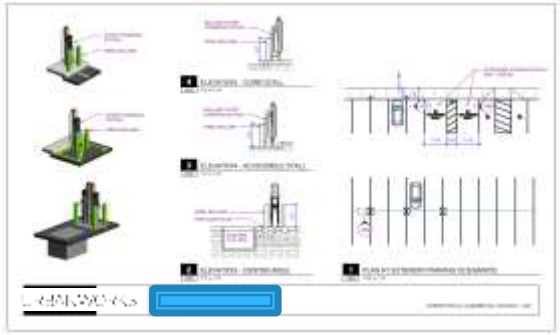
- How:
  - Mapping tool
  - Knowledgeable planning group
    - Local knowledge
    - Electric Vehicle knowledge
    - EV user knowledge
    - Charging infrastructure knowledge
    - Grid knowledge
- What:
  - Categories:
    - Workplace charging
    - Visitor charging (dwell time)
    - Destination charging
    - Corridor charging



Regional charging infrastructure strategy

- Potential sites (5–10 years)
  - Vehicle volumes
  - Use cases
- Power limitations
  - Current status
  - Update needs and costs
- Prioritized locations
  - Use available information to make infrastructure plans for
  - 1–2 years
  - 3–4 years
  - 5–10 years
- Future proofing plans
  - Every site should have an upgrade plan
  - Site power, charging power and number of dispensers
  - Build sites upgrade ready

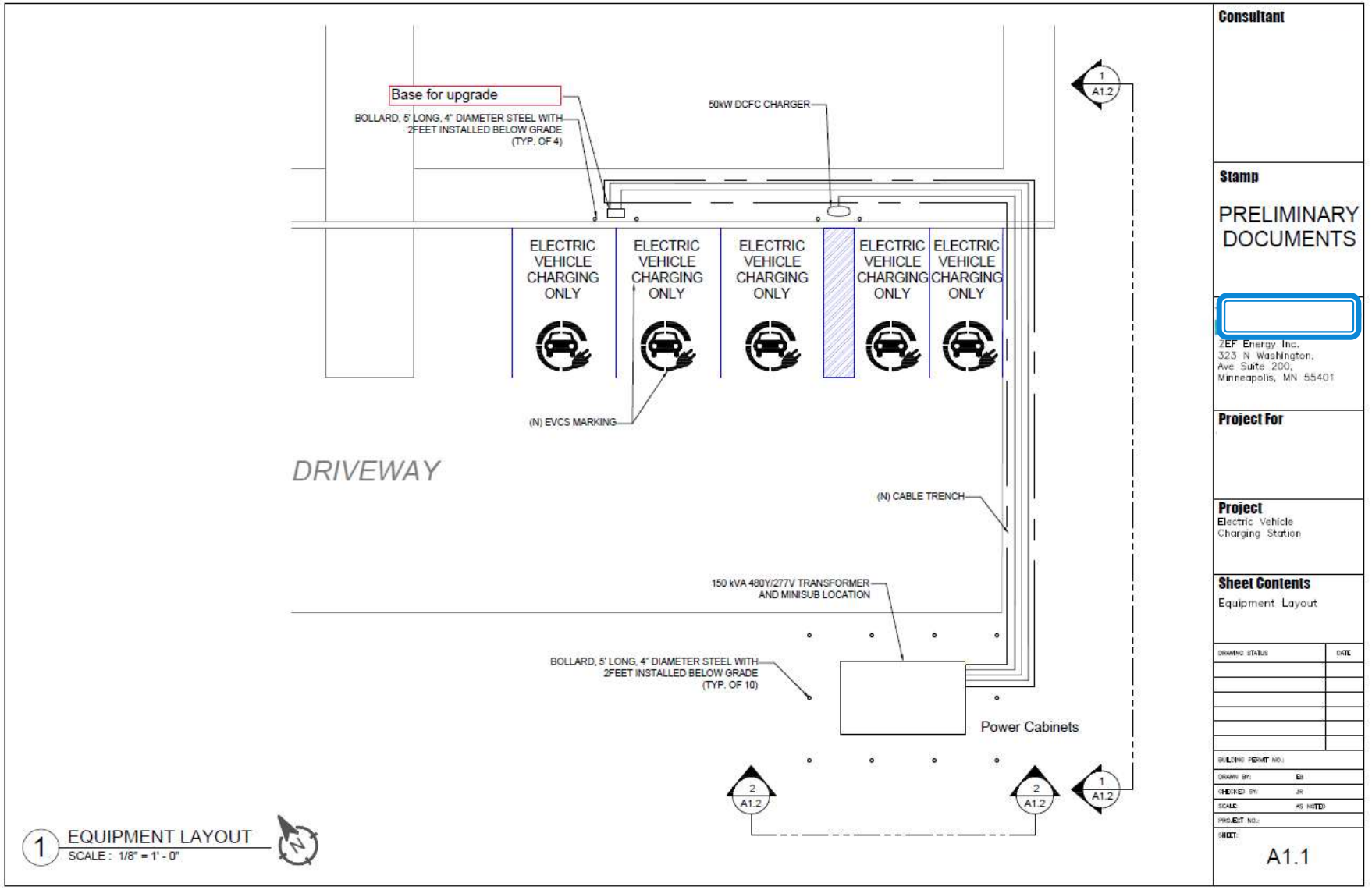




Graphs: Google, UrbanWorks

Site plans

- Initial setup
  - Power capacity
  - First power cabinet and dispensers
  - Drive through setup?
- Future proof:
  - Power capacity upgrade
  - DCFC Power module additions / Power cabinet replacement
  - Dispenser ready foundations and conduits



Redundancy and scalability

Component photos:
Kempower, PLP and ZEF Energy

Photo: Jukka Kukkonen

Grocery stores

Photo: Autovouhotus

Gas stations

Photo: Kempower

Gas stations

Photo: Kempower

Fast food, restaurants and other short stops

Photo: McDonald's

Bus depots

Photo:
LaddAlliansen
Nordic AB

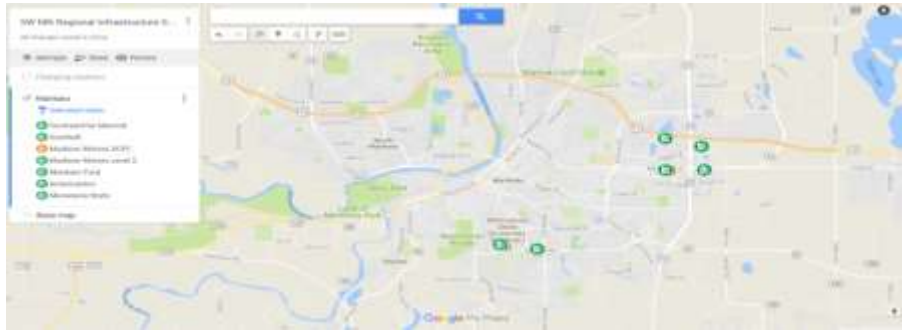
Photo:
GodEnergi A/S

Hotels and Parking ramps

Photo: Kempower

Regional Charging Strategy Workshop (3 hours)

- Kick-off of regional charging development
- Bring local stakeholders together
- Learn about:
  - EVs
  - Charging
  - How people use EVs
  - How do they charge
- Discuss where charging could/should be installed
- Who needs to be involved/engaged
- Build the map together
- Empower local groups to continue the process



Regional charging strategy stakeholders

- City personnel
- County personnel
- Lodging industry
- Fueling station operators
- Destination operators (parks, attractions, etc.)
- Parking infrastructure owners/managers
- Commercial property managers (Shopping, office…)
- Apartment building and condominium owners, developers, managers and HOA board members
- Sustainability managers from companies
- Electricians
- EV owners
- Utility companies

Power starts flowing back – V2X

Photos: Vehicle manufacturers

CHARGING FORWARD

U.S. Department of Transportation

A TOOLKIT FOR PLANNING AND FUNDING RURAL ELECTRIC MOBILITY INFRASTRUCTURE

FEBRUARY 2022

Q&A MNEVBuyer.com

Q&A

Jukka Kukkonen

Chief EV Educator and Strategist

Your exercise

1) Choose an existing or future project that includes EV charging
2) What kind of approach would you take?
   - How many EV charging capable parking spots?
   - Service size, breaker panel capacity, conduit runs etc.
   - How many station will you install initially?
3) Which stakeholders do you work with to make this happen?
4) How do you highlight the value of EV charging at this property?