TRI-COUNTY
REGIONAL ENERGY NETWORK
SAN LUIS OBISPO • SANTA BARBARA • VENTURA

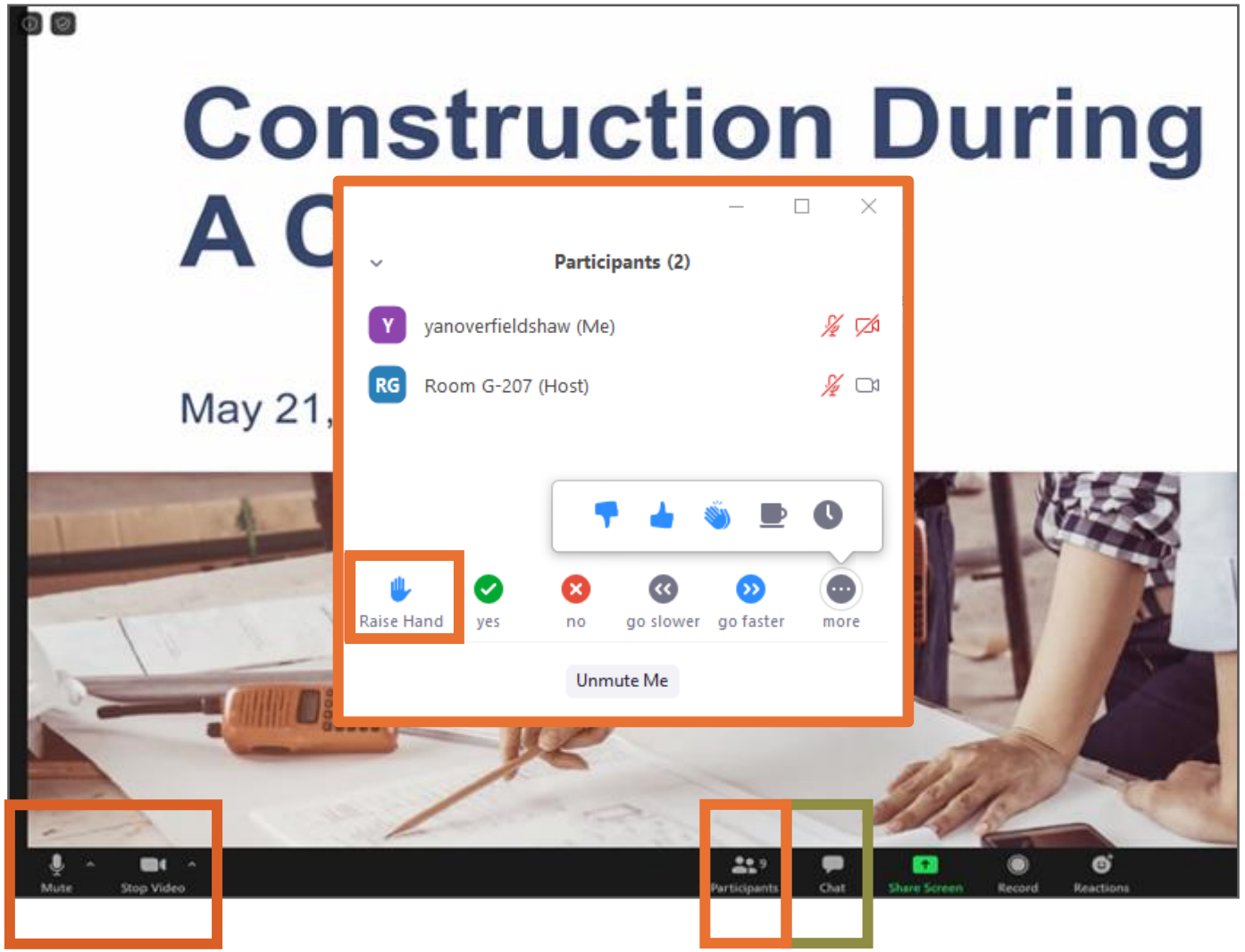
Everything You Always Wanted to Know About EVs, but were afraid to ask

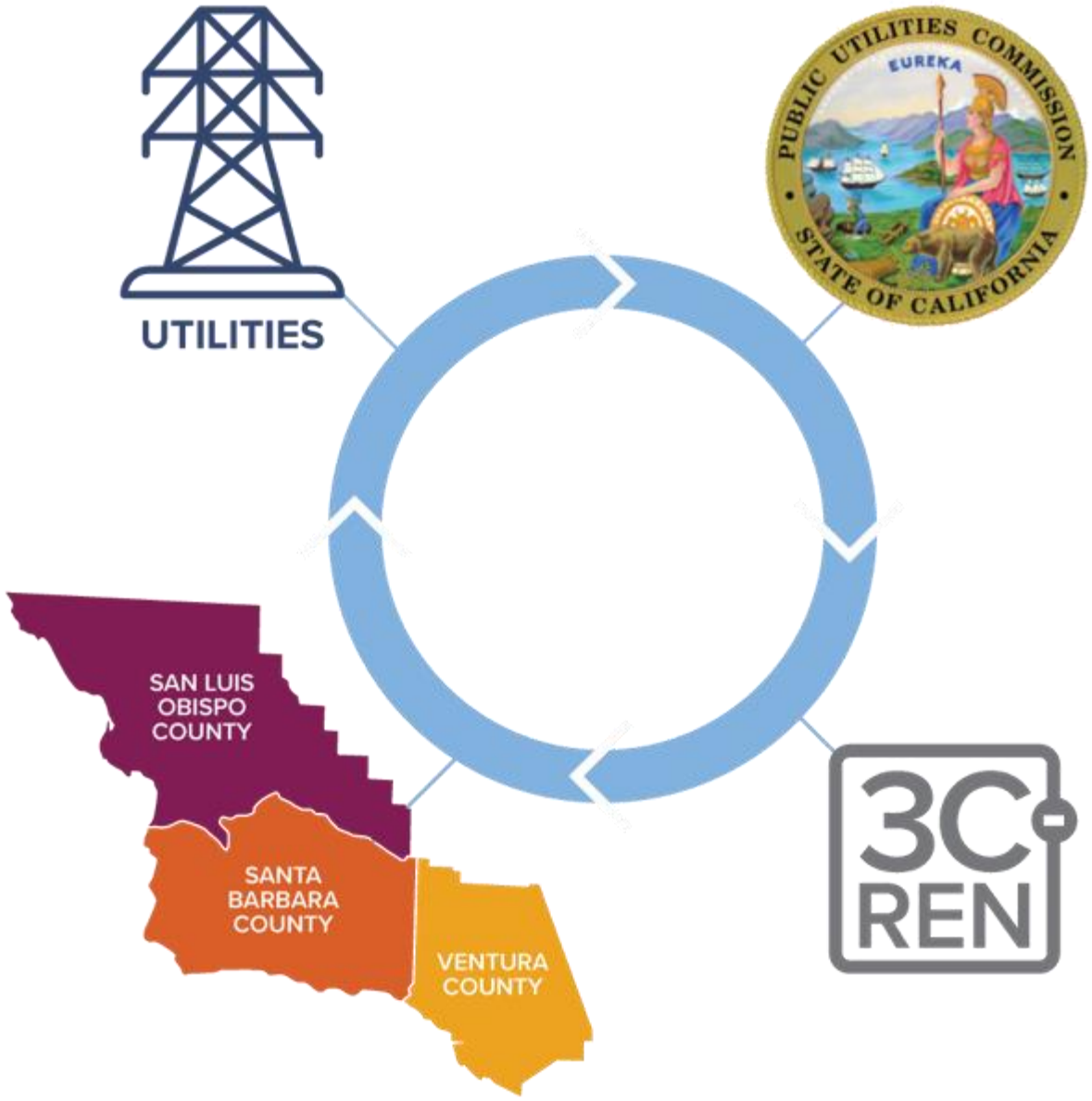
Nick Brown & Robert Fortunato

May 5, 2025

Zoom Orientation

- Add an **introduction** in the chat.
  Be sure **full name** is displayed.
- Did you call in? Please **share** first and last name with us.
- Please **mute** upon joining
- Use the "**Chat**“ to share questions or comments
- Under "**Participant**" select "**Raise Hand**" to share a question or comment verbally
- Session may be **recorded** and posted to 3C-REN's on-demand page
- Slides/recording are **shared** after most events
- 3C-REN does **not** allow **AI notetakers**, unless used to accommodate a disability.





Tri-County Regional Energy Network

3C-REN is a collaboration between the tri-counties

Our programs reduce energy use for a more sustainable, equitable and economically vibrant Central Coast

Our free services are funded via the CPUC, bringing ratepayer dollars back to the region

Our Services

Incentives

HOME ENERGY SAVINGS

3c-ren.org/for-residents
3c-ren.org/multifamily

COMMERCIAL ENERGY SAVINGS

3c-ren.org/commercial

Contractors can enroll at
3c-ren.org/contractors

Training

BUILDING PERFORMANCE TRAINING

3c-ren.org/events
3c-ren.org/building

ENERGY CODE CONNECT

3c-ren.org/code

View past trainings at
3c-ren.org/on-demand

Technical Assistance

AGRICULTURE ENERGY SOLUTIONS

3c-ren.org/agriculture

ENERGY ASSURANCE SERVICES

3c-ren.org/assurance

Everything you wanted to know about Electric Vehicles

But were afraid to ask!

May 8, 2025

Robert Fortunato

&

Nick Brown

3C-REN

TRI-COUNTY REGIONAL ENERGY NETWORK

ForStrategy Consulting, Inc.

BUILD SMART

AGENDA:

- Address your questions and concerns about EVs.
- Overview the EV Market
- EV Concepts you need to understand
- Electricity and Charging
- Choosing and living with your EV
- Cost of Ownership
- Resistance to EVs – FAQ’s and Myths
- What the Code Requires for EV Charging
- Bi-directional Charging
- Case Studies
- Summary

IMPORTANT NOTICE!

Products Not Approved

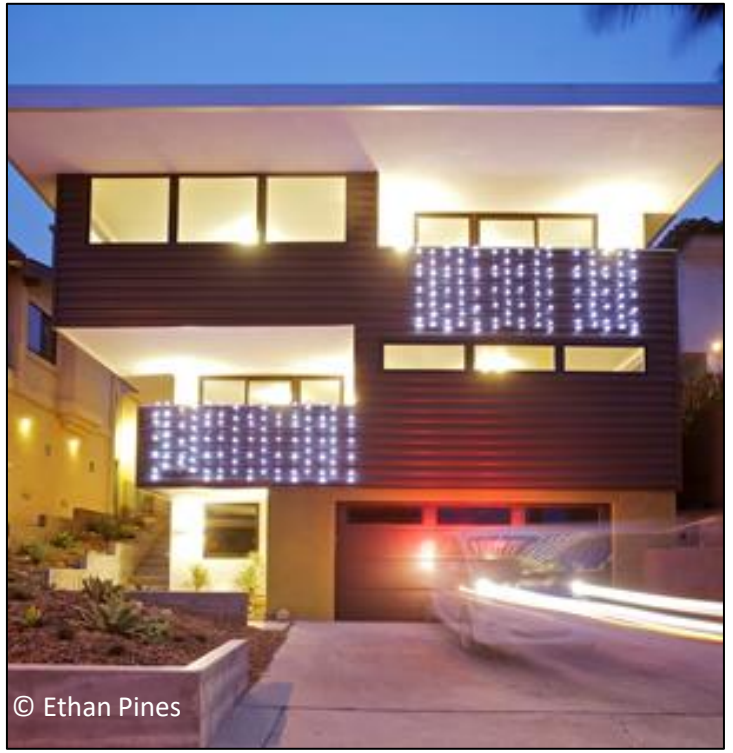
DISCLAIMER:

- Any products used in this presentation are just used as examples of options to convert a building to all-electric. This presentation does not recommend any specific products.

- Any estimates of costs, utility costs, incentives, and savings are rough estimates, not to be relied upon solely to justify a project. Experienced architects and engineers should be hired to do their own evaluation of all projects.

Robert Fortunato

Owner/Builder, Green Idea House
President, ForStrategy Consulting, Inc.



Green Idea House:

Completed in 2012

2,150 sf, 3 BR & 2 Bath

6.5 kW PV array (26 panels)

Green Point Rated, Living Building Challenge NZE Petal

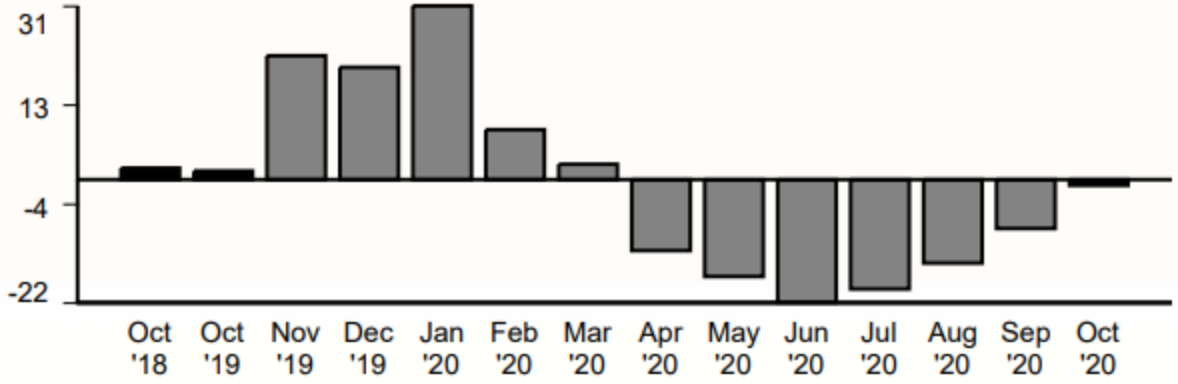
Robert Fortunato

Your past and current electricity usage

	Electricity (kWh)
Winter Season - Consumption	
On peak	62
Off peak	130
Super off peak	230
Winter Season – Net Generation	
On peak	-99
Off peak	-354
Super off peak	-1
Total electricity usage this month in kWh	**-32**

Your daily average electricity usage (kWh)

2 Years ago: 2.00 Last year: 1.53 This year: -1.03



Additional information regarding your Net Consumption/Generation:

- *Your year-to-date energy charges total as of previous month: -$1,215.44*
- *Your current month energy charge total: -$42.36*
- *Your year-to-date energy charges: -$1,257.80*
- *Your year-to-date kWh: -1,703 kWh*

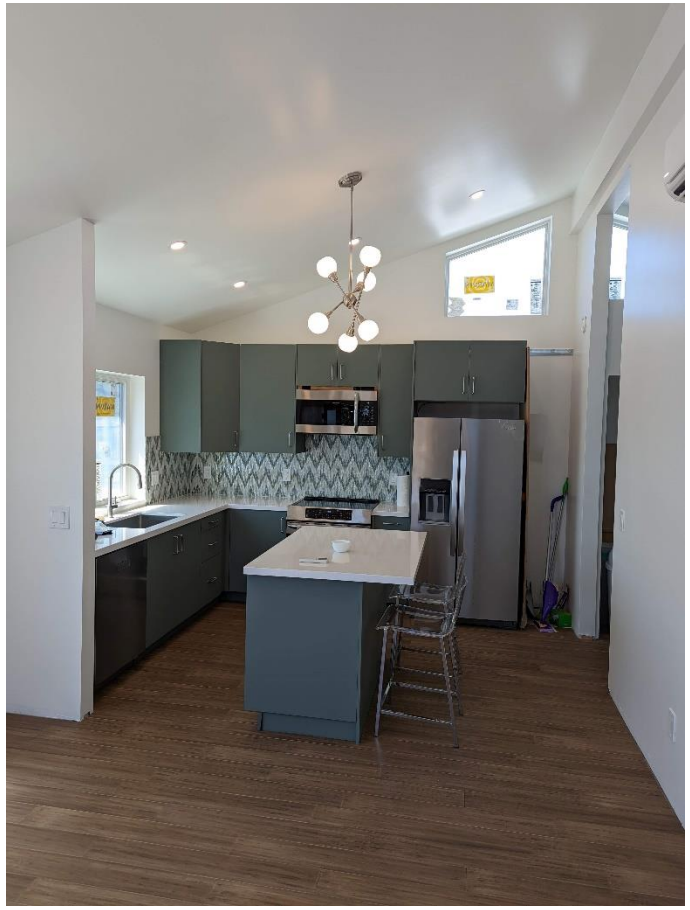
- 2nd single family residence in California and 12th single family residence (anywhere!) to certify under The Living Building Challenge's Zero Energy program

Nick Brown

Owner/Builder, Net Zero Nest
President, Build Smart Group

CABEC CERTIFIED CEA ENERGY ANALYST

Nick Brown
R19-15-30001 NR16-17-10002



Net Zero Nest:

- Completed in 2016
- 1,950 sf, 3 BR & 3 Bath
- 4.4 kW PV array (16 panels)
- Green Point Rated

All-Electric ADU:

- Completed in 2022
- 576 sf, 1 BR & 1 Bath
- 4.1 kW PV array (12 panels)
- Net Zero Carbon

Instructor for various classes:

- All-Electric Homes
- Demyth-defying Heat Pumps
- Energy Standards for Residential Architects
- Net-zero Design

SOUTHERN CALIFORNIA EDISON®
An EDISON INTERNATIONAL® Company

Details of your tracked charges

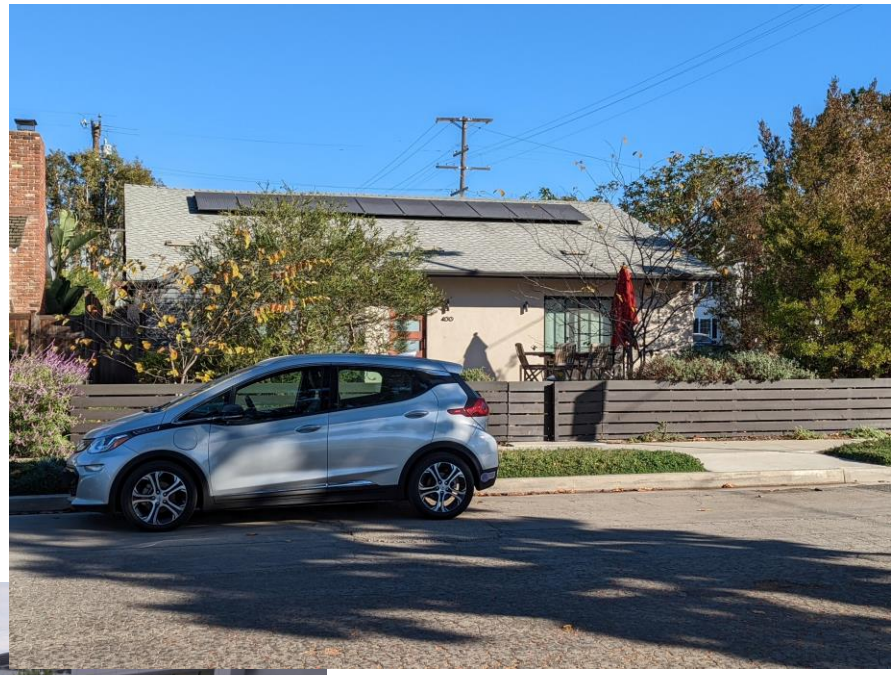
Your rate: DOMESTIC
Billing period: Feb 5 '16 to Mar 8 '16 (32 days)

Delivery charges		
Energy-Winter		
Tier 1 (within baseline)	-124 kWh x $0.07682	-$9.53
DWR bond charge	-124 kWh x $0.00539	-$0.67
Generation charges		
DWR		
DWR energy credit	-124 kWh x -$0.00022	$0.03
SCE		
Energy-Winter		
Tier 1 (within baseline)	-124 kWh x $0.06909	-$8.57
Energy Charge Total		**-$18.74**

Additional information regarding your Net Consumption/Generation:

- *Your cumulative energy charge total as of previous month: -$214.88*
- *Your current month energy charge total: -$18.74*
- *Your cumulative energy charge Year-to-Date: -$233.62 **
- *Your cumulative kWh Year-to-Date: -1,162 kWh*

**If you earned a credit on your bill the amount you receive may be less than your Cumulative Energy Charge which is based on SCE's rates. Your "Compensation Total" is based on*




BEAM
EV

Types of E-Vehicles (non-Hydrogen)

Hybrid

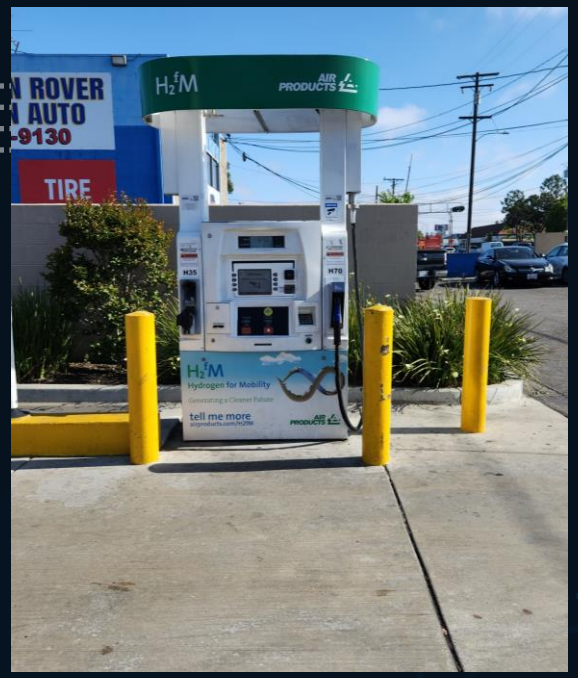
- Added battery and regen brakes to ICE car
- Saves $300 – $800/yr
- EV is slow speeds only
- No learning curve
- No incentives
- Two powertrains

PHEV

- Hybrid with a Plug
- Savings depends on how much you plug in
- 20-40 miles EV only
- Use gas on long trips
- Maybe incentives
- Two powertrains

EV

- Battery only – no ICE
- Savings $1,300+/yr
- 200-400 miles Range
- Use public L3 chargers on road trips
- Incentives
- One powertrain minimizes maintenance

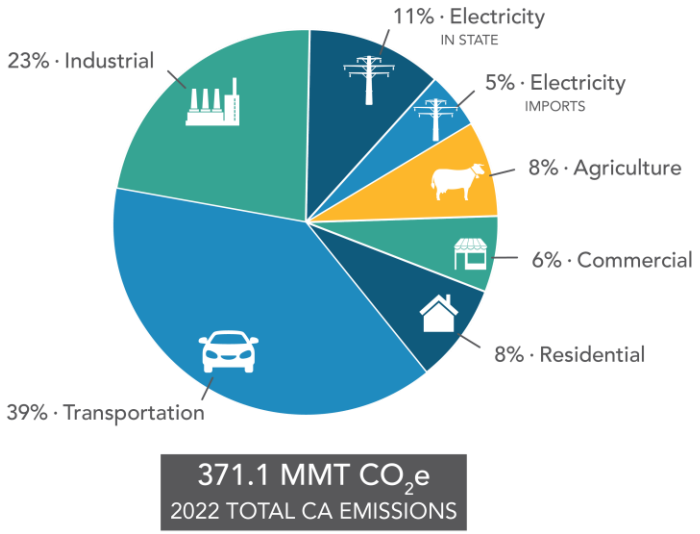


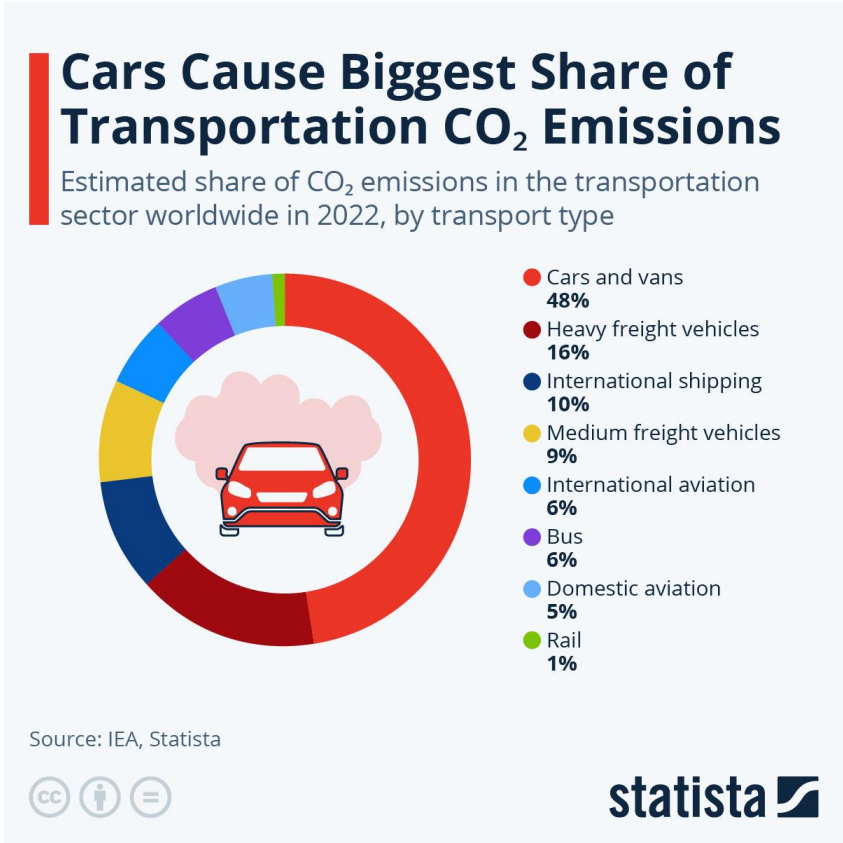
Why Not Hydrogen?

- Hydrogen is $18 per kilo. The hydrogen car carries 4 kilos max. Each kilo gets the driver 66 miles x 4 = 264 mile range for $72.
- By comparison the average electric vehicle has an 80kWh battery and gets 3.5 miles per kilowatt hour = 280 mile range @ 30 cents per kilowatt hour is $24
- Made primarily from methane gas
- Few fueling stations
- I can’t make hydrogen on my roof, but I can make electricity.
- Electric cars may occasionally catch fire, but they don’t explode.

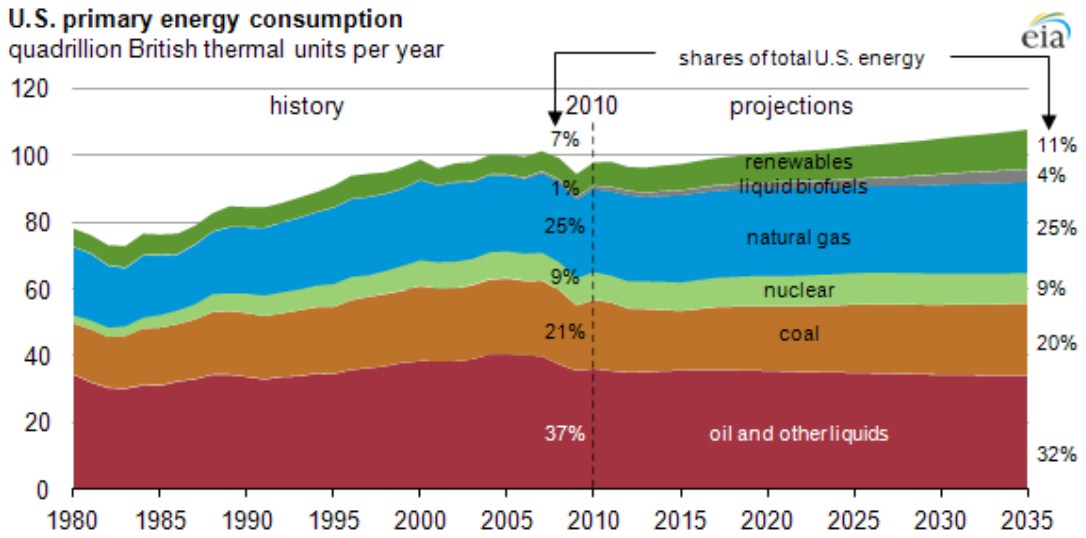
First EV commercials aired in 2011

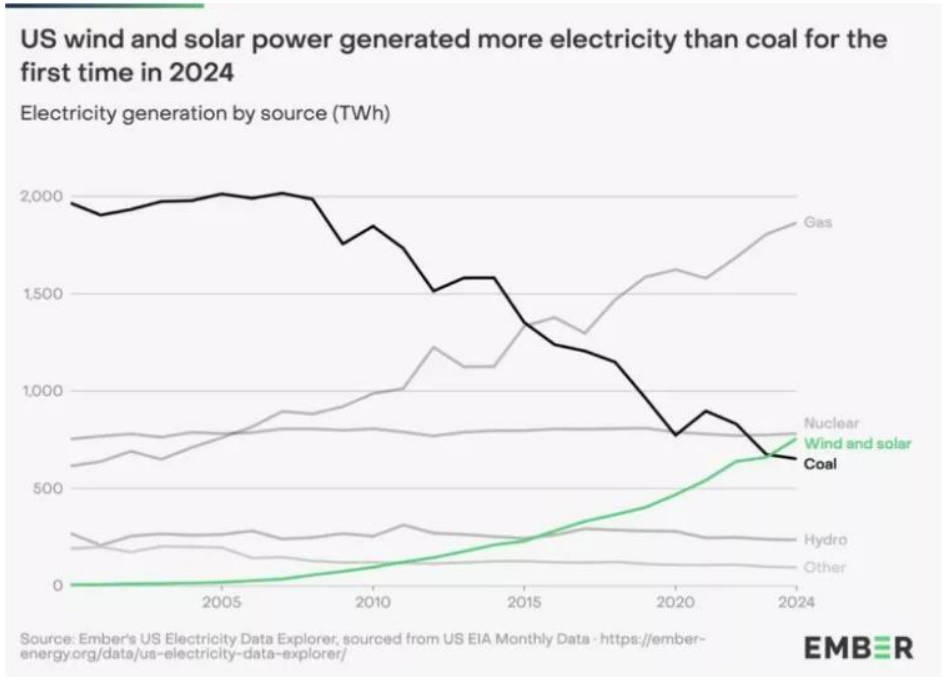
Why EVs? - Emissions (pollution)





Energy Generation and Consumption

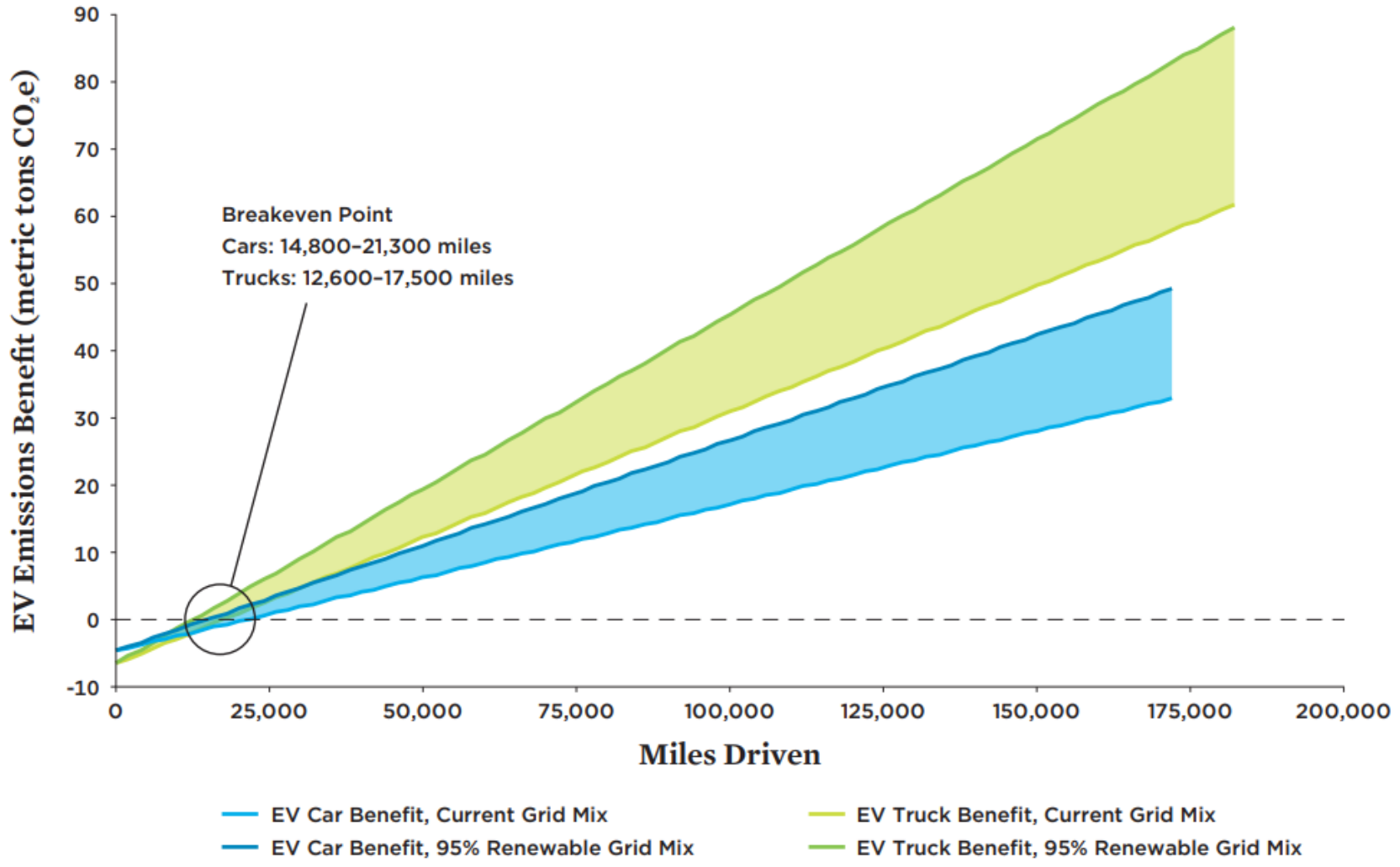




In 2024, wind and solar power provided 17% of the electricity in the US. For the first time ever, these renewables beat coal, which provided just 15% of the US's electricity. The graph above shows how US electricity sources have changed from 2000 to 2024.
(Source: Ember.)

Energy Generation and Consumption

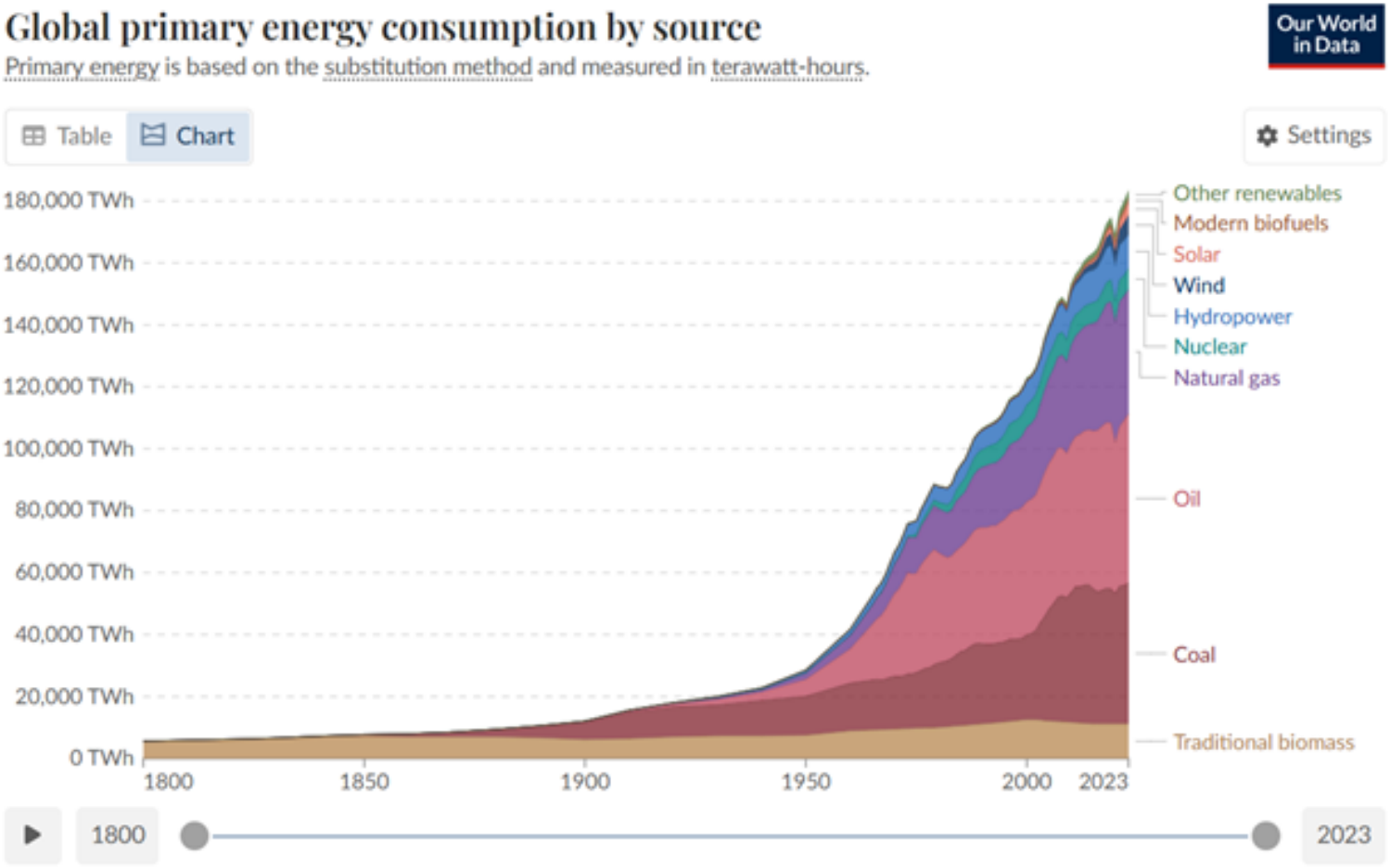
FIGURE 6. Breakeven Points for EV Car and Truck Emissions



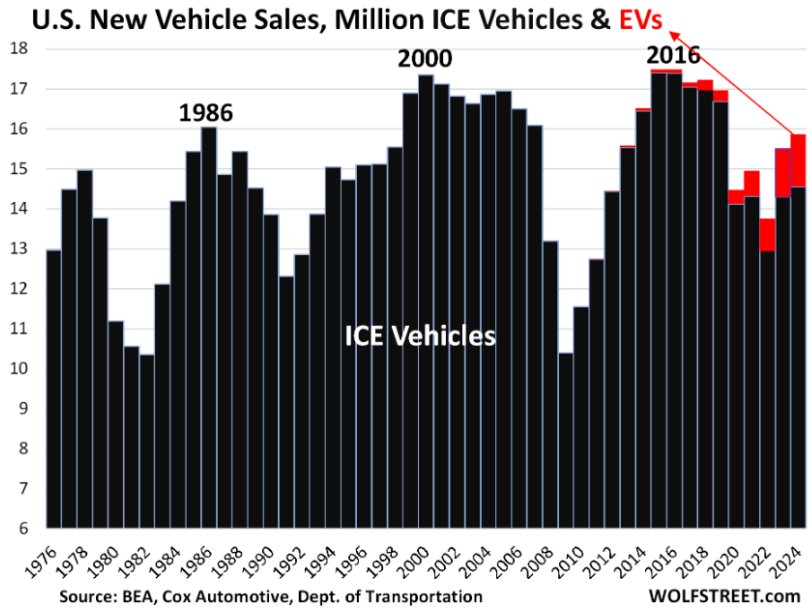
The breakeven point for EV manufacturing emissions averages 17,500 miles (17 months) for 300-mile-range electric pickup trucks and 21,300 miles (22 months) for a 300-mile-range electric car, based on the current grid mix. This breakeven point assumes constant electricity emissions; actual breakeven points would be lower if electricity emissions fall over time.

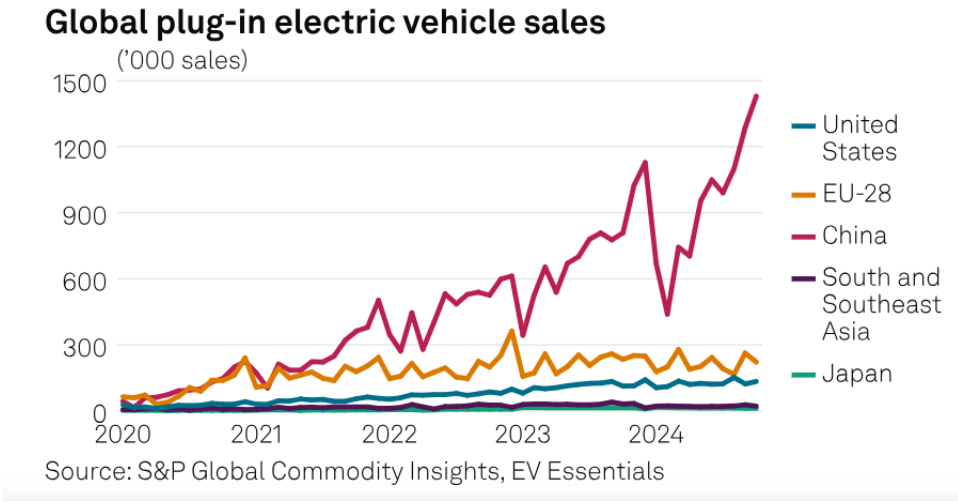
https://blog.greenenergyconsumers.org/blog/lifecycle-emissions-of-electric-cars-vs.-gasoline

Global Energy Use



Overview of the EV Market





- 30% of CA new car sales
- 1/3 of EV sales in U.S. are from CA

- 50% of cars sold in China have a plug
- 96% of cars sold in Norway are EVs


BEN & JERRY'S


LOS ANGELES CITY FIRE DEPT.
82
E-82


FedEx


CHANGE
IS COMING
ELECTRIC CONSTRUCTION VEHICLES


ELECTRIC
VOLVO
LXP 02T

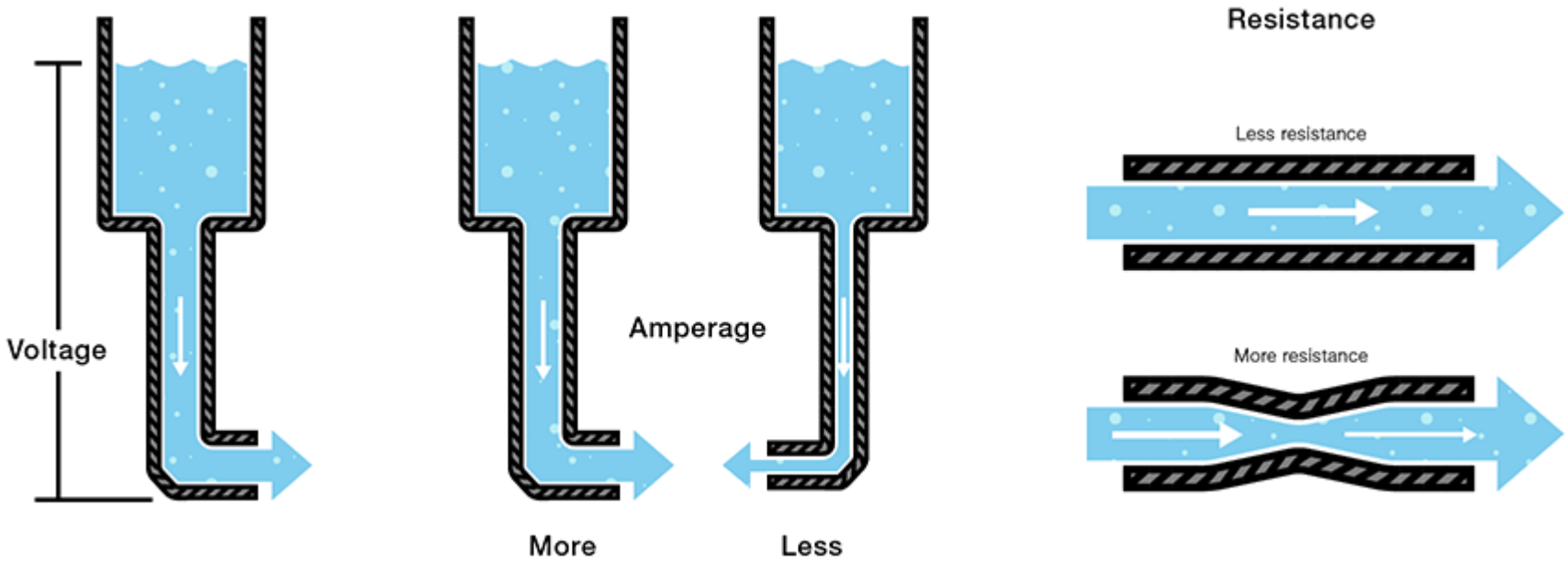
EV Lingo - Glossary of Terms

- ICE – Internal combustion engine – A gas powered car.
- MPGe - Miles per gallon equivalent. Used to estimate the equivalent energy use of PHEVs and EVs to compare to cars without plugs. Importantly, not the same as a PHEV's gas-only mpg.
- mi/kWh - Miles per kilowatt hour. The EV version of MPG, this is miles traveled per unit of energy (kWh) in the battery. A higher number means greater efficiency. Typical numbers range between 2.0 and 4.0 mi/kWh.
- Gas-only mpg - The gas mileage a PHEV gets when its battery is spent.
- EVSE - Electric vehicle supply equipment. The technical term for what most people call a charger that supplies 240-volt power to an EV. It can be wall-mounted or a stand-mounted unit.
- EVCS (Electric Vehicle Charging System) encompasses the entire charging infrastructure, including the EVSE, payment systems, and supporting infrastructure. In essence, EVSE is a component of EVCS.
- Max acceptance rate - The maximum power a vehicle can accept from a charger. EVs have two separate ratings for DC fast and Level 2 charging. PHEVs generally have only a Level 2 max acceptance rate.
- Regenerative brakes - Capture momentum to create electricity as the car slows down or coasts. Used on hybrids, PHEVs, and EVs.
- One-pedal driving - Using regenerative brakes, the driver can speed up or slow down just by modulating the accelerator pedal.
- Bi-directional charging – When your car and the charger allow you to use the car's battery energy for other uses.
- Traction Battery – The large battery that moves the car vs the smaller battery that runs the electronics.

Electricity is like Plumbing

Pressure x Flow = Power

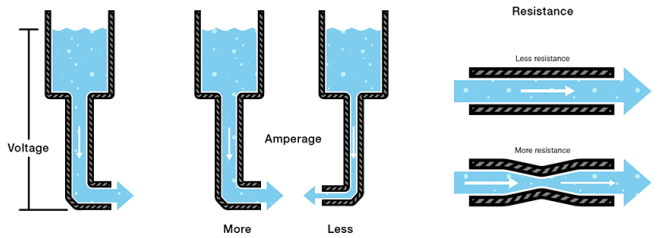
Volts x Amps = Watts



kW vs kWh

Pressure x Flow = Power

Volts x Amps = Watts



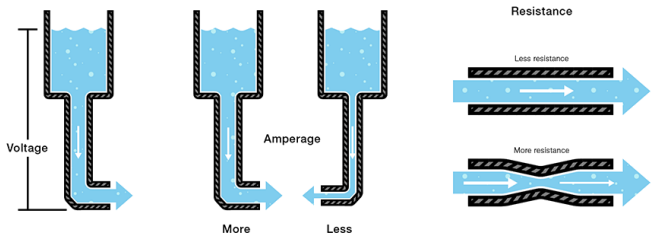
kW = Kilowatt = 1000 watts = measure of electrical power = For EVs, it is used to express the power output of an on-board charger or electric motor (which can be converted to horsepower).

kWh = Kilowatt Hour = Kilowatt hour = A unit of energy that is stored inside a battery that can be released over time. Think of it like a gallon of gasoline. E.G. a 10 kwh battery can release 1kW for 10 hours.

kW vs kWh

Pressure x Flow = Power

Volts x Amps = Watts

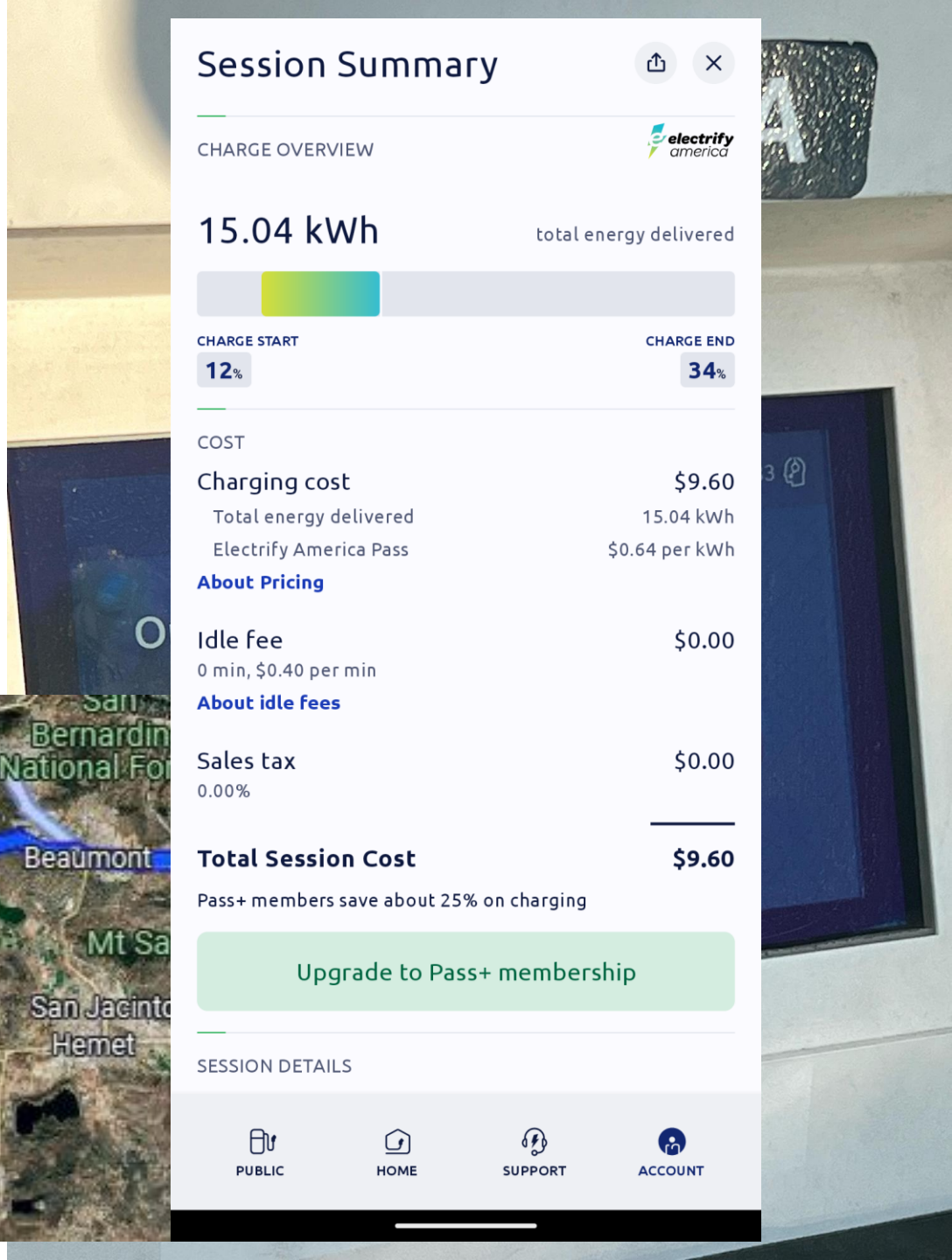


Examples:

- At home our EV Charges at 7.5 kW
- At a DC Fast Charger our EV can charge at up to 250 kW
- The average EV gets 3.5 miles per kWh
- The average car drives 1000 miles/month. At 3.5 miles per kWh =286 kWh x $.25/kWh = $71 (gas @$3.50@35mpg=$100)

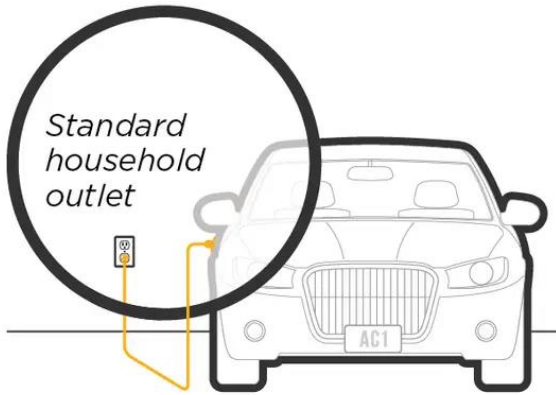
Public Charging

- Search on the apps or your car
- Apps tell you if chargers are available
- Sometimes there is a wait
- Cost per kWh is higher than at home
- Time to get coffee or a meal



Electric Vehicle Charging Levels

AC Level One



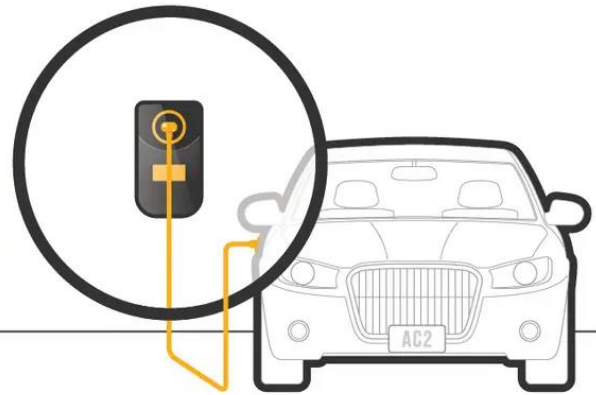
VOLTAGE:
120V 1-Phase AC

AMPS:
12-16 Amps

CHARGING LOADS:
1.4 to 1.9 KW

VEHICLE CHARGE TIME:
3-5 Miles per Hour

AC Level Two



VOLTAGE:
208V or 240V 1-Phase AC

AMPS:
12-80 Amps (typ. 32 Amps)

CHARGING LOADS:
2.5 to 19.2 kW (typ. 6.6kW)

VEHICLE CHARGE TIME:
10-20 Miles per Hour
20+ for some EV models

DC Fast Charge

VOLTAGE:
208V or 480V 3-Phase AC

AMPS:
<100 Amps

CHARGING LOADS:
50-350 kW

VEHICLE CHARGE TIME:
60-80 Miles in 20 Minutes

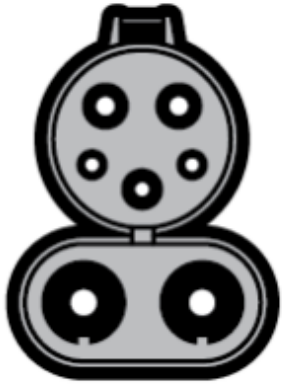
Sources: Advanced Energy and EPA

Charger Connection Interfaces

TYPE

J1772

Level 1 and Level 2, used by all non-Tesla manufacturers until 2025.



TYPE

CCS

DC fast charging, used by most non-Tesla manufacturers through 2025.

TYPE

CHAdeMO

DC fast charging, used only by Nissan Leaf and Mitsubishi Outlander PHEVs.

TYPE

NACS

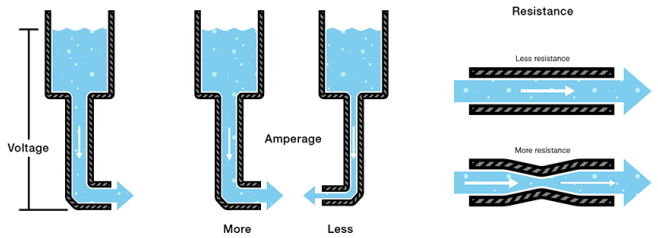
Level 2 DC fast charging, used by Tesla and now a growing list of others.

NEMA 3 rating - common on most home chargers, is resistant to nearly all ambient temperatures in addition to the rain, sleet, and snow that the average U.S. consumer would face. NEMA 4 rating is even more watertight

Home Charging Needs

Pressure x Flow = Power

Volts x Amps = Watts

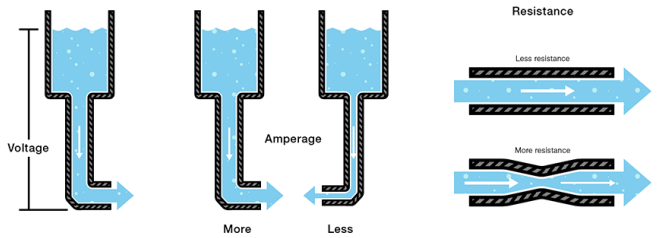


- **If 15 amps will do the job, it's better than 30 or 40 amps**
  - **EV chargers**
    - **120V 15 amp = 1.8 kW per hour = 6 miles per hour**
    - **240V 20 amp = 4.8 kW per hour = 19 miles per hour**
    - **240V 50 amp = 12 kW per hour = 48 miles per hour**
    - **240V 80 amp = 19.2kWper hour = 76 miles per hour**

Electrical Panel Capacities

Pressure x Flow = Power

Volts x Amps = Watts



Peak Panel Capacities

- 80 amp panel = 240v x 80a = 19,200 watts or 19.2 kW
- 100 amp panel = 240v x 100a = 24,000 watts or 24 kW
- 200 amp panel = 240v x 200a = 48,000 watts or 48 kW

Home Chargers w Load Management

Choosing and Living with Your EV

Evaluating Your Next Car (EV)

- Cost vs Cost of Ownership
- Range - Battery Capacity (kWh)
- Efficiency - MPGe - miles/kWh
- Speed of Charge
  - Home Charging
  - DC Charging on the road
- Charging Network access
- Regenerative braking
- Battery cooling system/preconditioning capability
- Bi-directional charging capability

Evaluating your needs

- Can you charge at home?
  - Is your car at home during the day or does your work have charging?
  - Panel constraints?
- Are public chargers otherwise available?
- Single vs dual car ownership?
- Short trips vs long distance?
  - Compatible with the Tesla network?
- Department of Energy's Alternative Fuels Data Center has an easy-to-use calculator at afdc.energy.gov/calc.
- What is a NEV and should I get one?
- Is solar an option?

MPGe

Bolt EV:

- EPA estimated city: 131 MPGe
- EPA estimated highway: 109 MPGe
- Car and Driver highway test: 180 MPGe
- EPA estimated combined: 120 MPGe

Tesla Model Y Long Range:

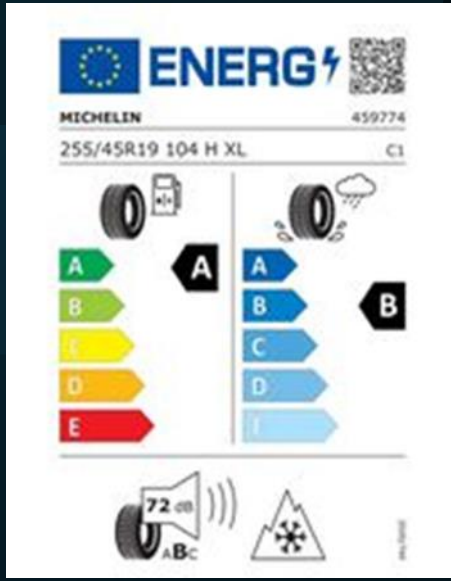
- EPA estimated city: 127 MPGe
- EPA estimated highway: 117 MPGe
- Car and Driver highway test: 94 MPGe
- EPA estimated combined: 121 MPGe

Factor to consider: Driving at lower speeds around town will yield a significantly better range than highway driving. They also observed 90 MPGe during their two-week test.

Install a home EV Charger?

- Plan to charge at home?
- Will 120v outlet work for you?
- Cost for L2: ~ $500 for charger and $500 for installation
  - Additional if a panel upgrade is necessary
  - If so, consider load management devices
  - If you have solar consider solar management EV charger
- Location considerations
- Read Consumer Reports Article

EV Maintenance - Less than ICE Vehicles



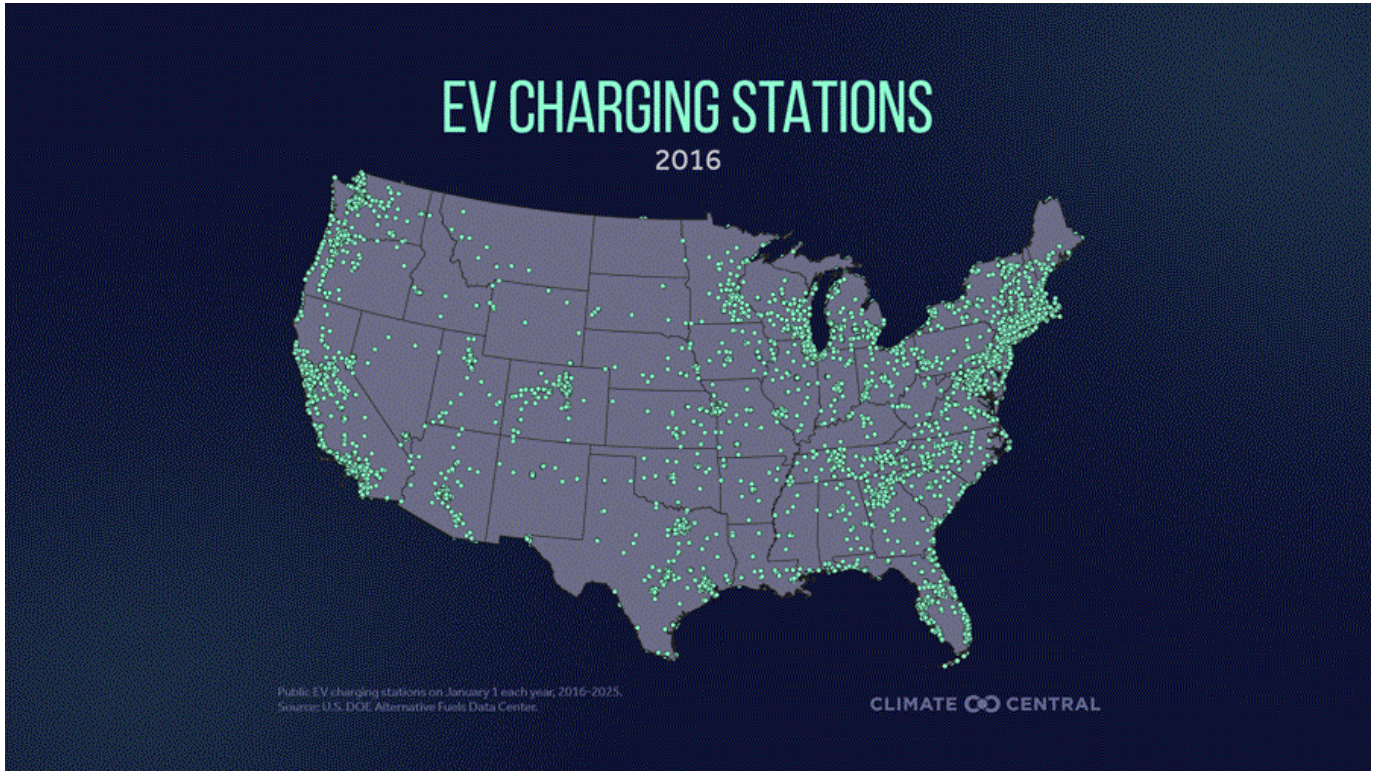
- The battery, motor, and associated electronics require little to no regular maintenance.
- There are fewer fluids, such as engine oil, that require regular maintenance.
- Brake wear is significantly reduced due to regenerative braking.
- There are far fewer moving parts relative to a conventional gasoline engine.
- Consumer Reports estimates that maintenance costs are 50% less for EVs than ICE cars.
- Should I only charge to 80%
- How often will you have to replace the battery, brakes or tires on an EV?
- Tires - rolling resistance ratings
  - Consumer Reports Rolling resistance article
  - EU has already instituted a reporting protocol for tires: EPREL Public website.
- Tires vs brake replacement – one pedal driving
  - $600 for brakes @ 40 - 50k miles vs $850 for tires @ 30 - 40k miles?

How to plan for road trips

- Expected Range
- DC Fast Charging
  - kW ratings / compatibility/ charging etiquette / grace period / subscriptions
- Apps such as A Better Route Planner, PlugShare, ChargeHub, Chargeway and Google Maps will show you all of the available chargers
- To minimize the hassle, download the apps for various charging networks—Applegreen Electric, ChargePoint, Electrify America, EVgo, Flo, and Tesla
- 20 – 80 % SOC
- Adapters
- Weight, Towing
- Cold weather, elevation gain, road conditions
- What to know when renting an EV
- Preconditioning Batteries before charging

It’s All About the Network

The number of public EV charging ports in the U.S. has grown more than 6-fold over the last decade, from about 30,000 in 2016 to nearly 196,000 in January 2025.



EV Cost of Ownership

EV Incentives New Cars

- Find Incentives and qualifications
  - https://www.fueleconomy.gov/feg/tax2023.shtml
  - Have dealer apply for tax credit immediately to lock it in IRS Form 8936
  - Suv limit $80k
  - Sedan limit $55k
  - U.S. Battery… components
  - Household income limit $300k
  - Head of household income limit $225
  - Individual income limit $150K
  - Above may not apply if leased

Federal Tax Credits for Plug-in Electric and Fuel Cell Electric Vehicles
(Vehicles placed in service on or after January 1, 2025 and before January 1, 2026)

Attention: Not every version of the models listed below will necessarily qualify. Please check with the dealer/seller to determine the eligibility of your specific vehicle.

Make	Model	Model Year	Vehicle Type	Credit Amount	MSRP Limit	Eligibility
Acura						
	ZDX	2024–2025	EV	$7,500	$80,000	Check w/ dealer
Cadillac						
	LYRIQ (Luxury, Sport, & V-Series Models)	2024–2026	EV	$7,500	$80,000	Check w/ dealer
	OPTIQ	2025	EV	$7,500	$80,000	Check w/ dealer
	VISTIQ	2026	EV	$7,500	$80,000	Check w/ dealer
Chevrolet						
	Blazer EV (LT, RS & SS Models)	2024–2025	EV	$7,500	$80,000	Check w/ dealer
	Equinox EV (LT & RS Models)	2024–2025	EV	$7,500	$80,000	Check w/ dealer
	Silverado EV (LT Model)	2025	EV	$7,500	$80,000	Check w/ dealer

EV Incentives Used Cars

Used Cars

- Find Incentives and qualifications
  - https://www.fueleconomy.gov/feg/tax2023.shtml
- The income threshold is lower for used EV buyers: $150,000 for joint filers, $112,500 for a head of household, and $75,000 for an individual.
- Vehicle must be purchased from a dealer, have a sale price of $25,000 or less, and must have a model year two years prior to the current calendar year.
- Tax credit is $4,000 or 30 percent of the sale price of the vehicle, whichever is lower.
- In other words, a one-owner used car sold at a dealership may be eligible for a tax credit, but a two-owner car won't be. A one-owner car sold privately won't be eligible, either.
- Buyer must use the tax credit all in the same year

Why EVs – Cost Advantage

Gas **30** miles

EV **46** miles

Local fuel price/gallon	Est. MPG of gas vehicle		Est. mile/kWh for EV	Utility kWh rate*
$ 3.50	30.00	RESET ALL	3.320	$ .25
	2025		2025	
	Toyota		Toyota	
	RAV4 AWD LE - Automatic		bZ4X LIMITED (3.32 mi/kWh	

https://chooseev.com/savings-calculator/

Why EVs – Cost Advantage

How much should it cost to drive **15,000** miles per year?

A year of driving, a year of saving.

Average annual driving estimates vary across the US, but the EPA and DOE use 15,000 miles/year as the average for most fuel use estimates. This estimate is based on the above inputs.

Switch to EV and save big on fuel.
Estimated annual savings:*

$ 620

https://chooseev.com/savings-calculator/

Why EVs – Cost Advantage

How much did fuel cost for the last 5 years? **15,000** mi/yr.

Understanding your savings potential.

Savings add up! The following cost and savings estimates are based on the information you've provided above. Think of all of the things you could do with the potential savings.

Switch to EV and your 5 year savings could look like this:*

$ 3,102

Gas **$8,750** /5 yrs

EV **$5,647** /5 yrs

https://chooseev.com/savings-calculator/

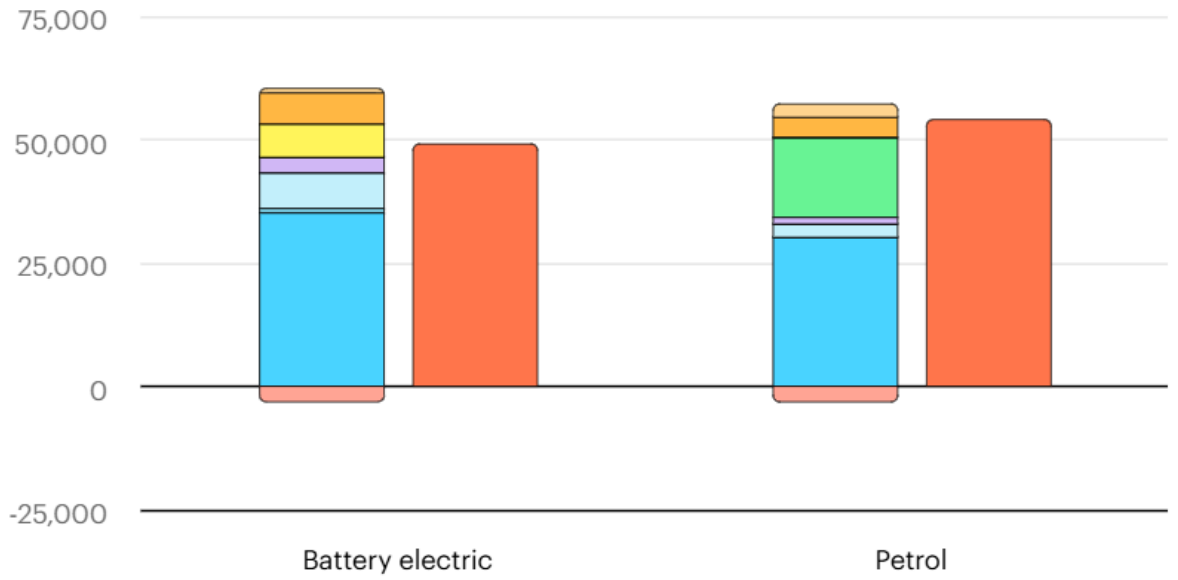
Why EVs – Total Cost of Ownership

https://www.iea.org/data-and-statistics/data-tools/electric-vehicles-total-cost-of-ownership-tool

Why Evs – Total Cost of Ownership

Estimated Total Cost of Ownership (TCO)

Battery electric TCO	Petrol TCO
0.09 USD/km	0.14 USD/km
1400 USD/year	2097 USD/year



Vehicle cost (MSRP) · Home charger cost · Purchase taxes · Financing

Annual registration fees · Liquid fuel purchase · Liquid fuel taxes · Electricity purchase

Electricity taxes · Insurance · Maintenance · Residual/resale value · Net cost

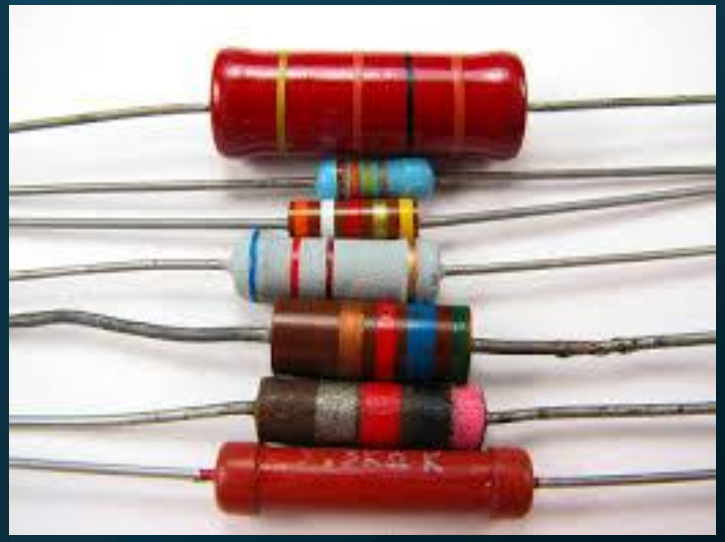
https://www.iea.org/data-and-statistics/data-tools/electric-vehicles-total-cost-of-ownership-tool

In this analysis of ICE pickup trucks compared to electric pickups with a high daily mileage (100 miles), the EVs eclipse ICE pickups in lower operating costs in year two.

Source: JD Power & Associates

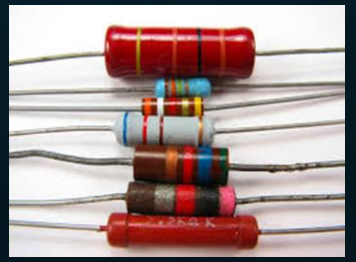
Why EVs – TCO for Fleets

https://www.automotive-fleet.com/10224679/calculating-a-true-tco-for-evs



Resistance to EVs – FAQ’s and Myths

Resistance to EVs – FAQ's and Myths

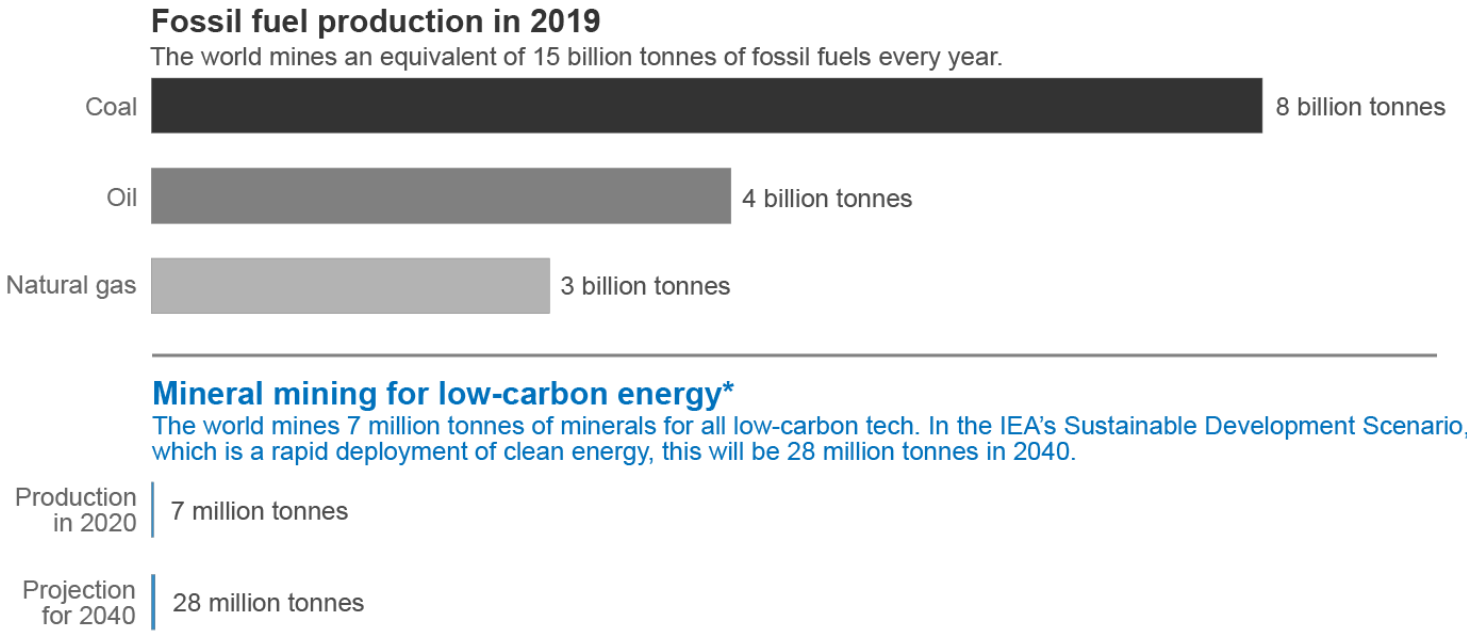


- Range Anxiety – Average daily commute is 50mi. Average EV gets 270 mi range. The LD network of chargers is getting better by the day.
- EVs are just as polluting as ICE vehicles – EV's are 3x more efficient and the grid is almost 50% renewable - and getting cleaner by the day.
- The Grid can't handle it - The U.S. added 1.2 million EVs to the grid in 2023, and electricity use decreased!
- Batteries will be too expensive to replace – EVs have gone 250k miles w/o a battery replacement. Warranties are 8 years, 100,000 miles
- Child Labor and mining re batteries – Cobalt from Nigeria is no longer in most battery chemistries. Compared to oil company local population and environmental devastation, mining is minimal.

Resistance to EVs – FAQ's and Myths

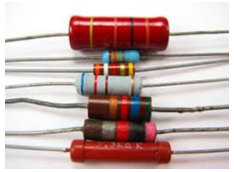
https://www.sustainabilitybynumbers.com/p/mining-low-carbon-vs-fossil

Mining quantities for low-carbon energy are just a fraction of what we mine for fossil fuels



*The total mineral production for solar, wind energy, geothermal, hydropower, electric vehicles, battery storage, nuclear, and grid networks.

Data sources: International Energy Agency (IEA); US Energy Information Administration (EIA); BP. **Author:** Hannah Ritchie.



Resistance to EVs – FAQ's and Myths

What happens to batteries - landfilled?

- Almost infinitely recyclable at 95 – 98%
- What Really happens to used Electric Car Batteries - (you might be surprised)

Resistance to EVs – FAQ's and Myths

EV's don't work in Cold Weather

RIVIAN Electric Vehicles Discussion

For those of you who are curious. My Rivian lives about 250 km (150 miles) away from James Bay (part of the Arctic Ocean.)

We occasionally get -40°C (-40 F) temperatures. Here is how my R1S reacts to that weather:

- Back hatch door button does not work. (Must open or close through central screen.)

- Back hatch door once needed muscle help to open.

- I get recurrent thermal management warnings on driver screen.

- The charge door button does not work (must open or close through central screen.)

- Door mirrors wheeze when opening.

- Tire pressure drops by 11-12 psi compared to summer, thus triggering a low pressure warning on driver screen.

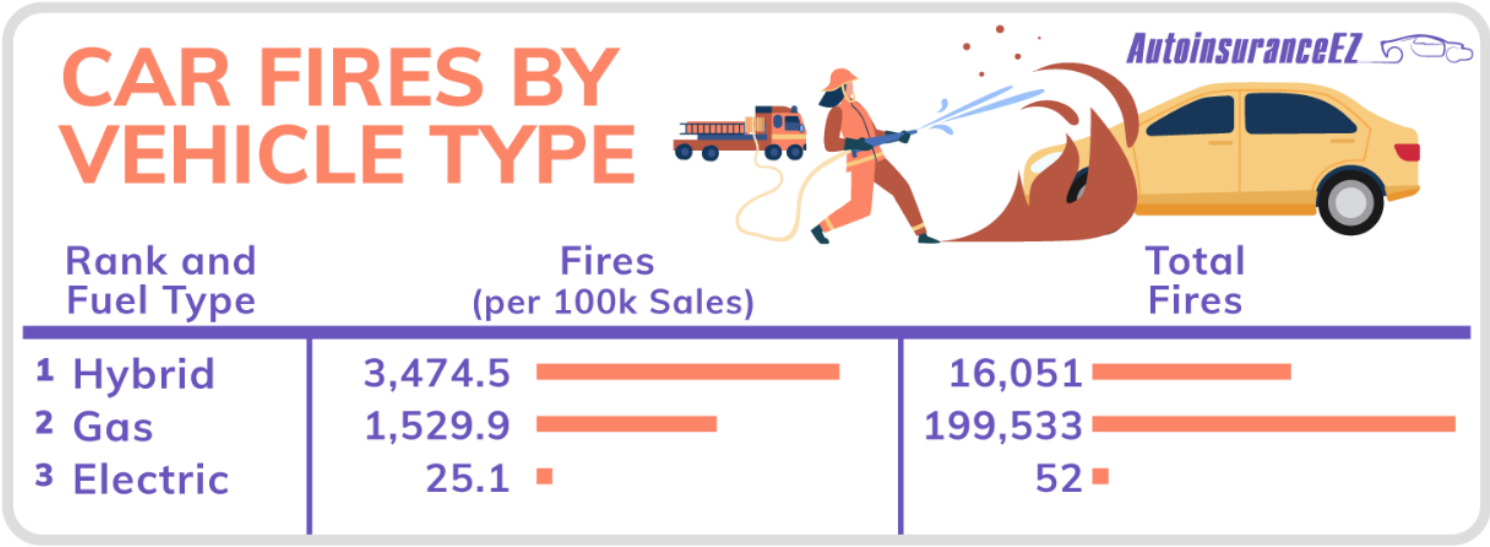
When it's that cold and windy with -50°C windchill (-57 F), the vehicle needs nearly 15 minutes to warm-up. It's shorter when there's no wind.

Other than that, R1S is perfectly fine.

How about my Diesel pick-up truck?

- Won't start. Period.

Resistance to EVs – FAQ's and Myths



Less prone to fires than ICE

- EVs catch fire much less often than ICE vehicles—they are about 60 times less likely to catch fire than ICE vehicles. ICE vehicle fires are extremely common in the U.S. They are estimated to happen 500–600 times on average every day.
- Because batteries are protected by the car's frame, they generally will only ignite in the most severe crashes.
- In the rare situations when EV batteries ignite, they can be more difficult to extinguish, although they do not explode like gasoline fires.
- The National Fire Protection Association has EV fire safety protocols and training resources available to guide first responders.

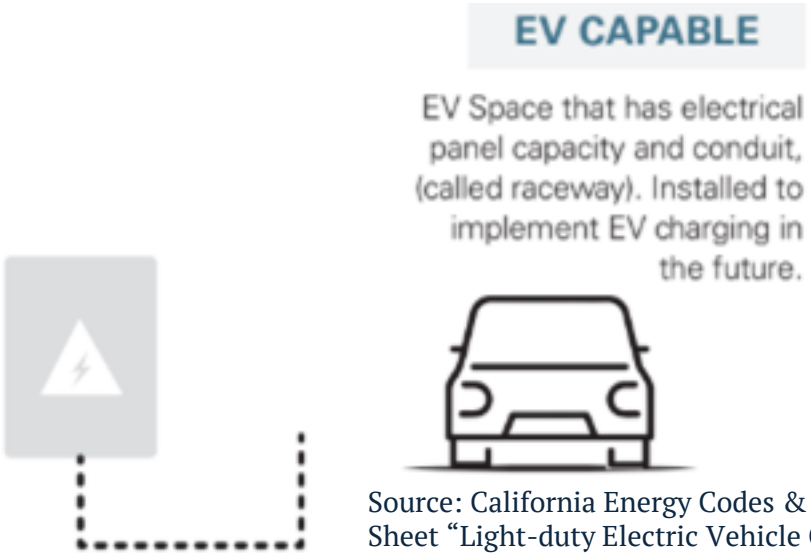
California Code Requirements for Electric Vehicle (EV) Charging

- When does CALGreen require EV chargers to be installed?
- When do new homes have to be EV charger capable?
- What's required for EV charging of big trucks?
- When is the van accessible EV space required?

Single Family Mandatory Requirements

Mandatory EV Charging Requirement for New Single Family, Duplex and Townhomes with Attached Private Garages:

1. **EV Capable:** For each dwelling unit, install a listed raceway to accommodate a dedicated 208/240-volt, 40 Amp branch circuit.



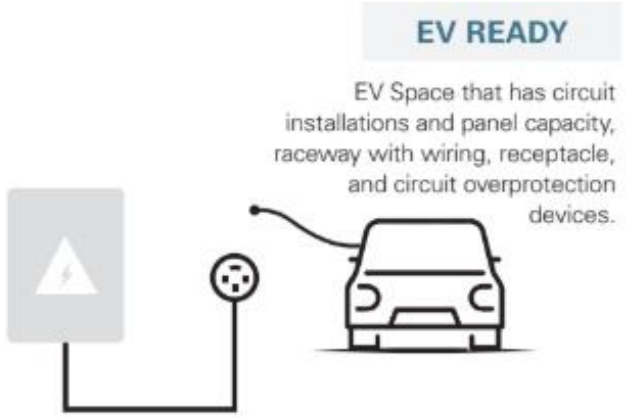
Source: California Energy Codes & Standards 2022 CalGreen Interim Update Fact Sheet "Light-duty Electric Vehicle Charging Infrastructure Requirements"

Multifamily Mandatory Requirements

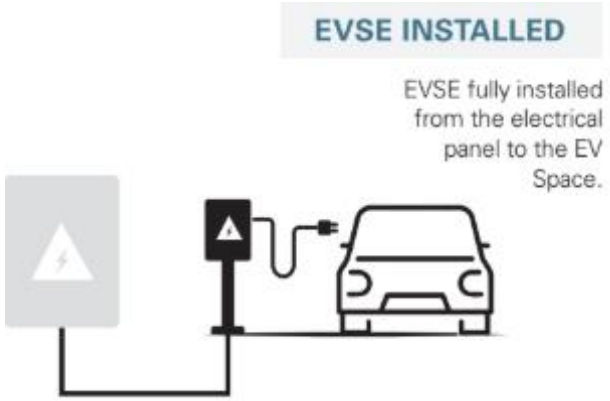
Mandatory EV Charging Requirement for New Multifamily Dwellings, Hotels and Motels:

1. **EV Ready:**
   - 40% of parking spaces must have low power level 2 EV charging receptacles
   - For multifamily parking facilities, at least one receptacle is required per dwelling unit, but this only applies to up to 40% of parking spaces

Exception: Areas of parking facilities served by parking lifts



2. **EVSE Installed/EVCS:**
   - 10% of parking spaces must have level 2 EV chargers
   - For multifamily parking facilities with common use or unassigned parking areas, EV chargers must be provided and made available for use by all residents or guests



Source: California Energy Codes & Standards 2022 CalGreen Interim Update Fact Sheet "Light-duty Electric Vehicle Charging Infrastructure Requirements"

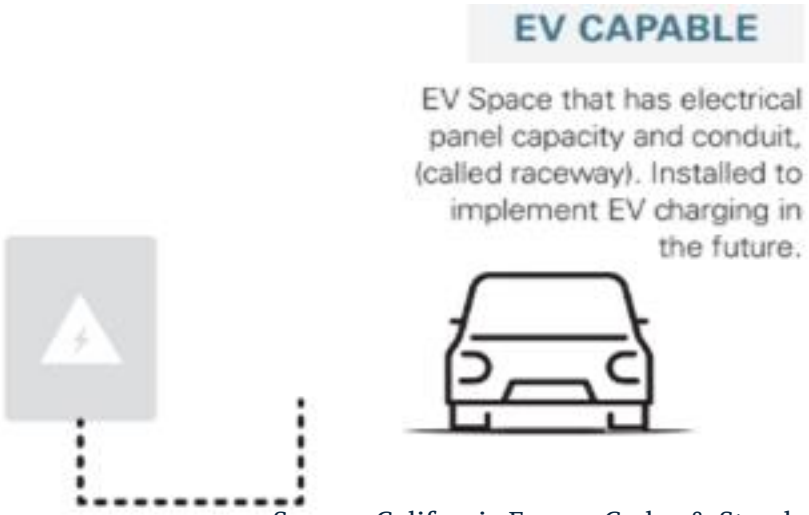
* One in 25 spaces required to have an EV charger must be ADA accessible

Mandatory EV Charging Requirements for Additions and Alterations of Parking Facilities Serving Existing Multifamily Buildings:

1. **EV Capable:** 10% of parking spaces added or altered must be ready to support future Level 2 EV chargers.

Triggers:

- New parking facilities are added
- Electric systems area added/altered and work requires building permit
- Lighting systems area added/altered and work requires building permit

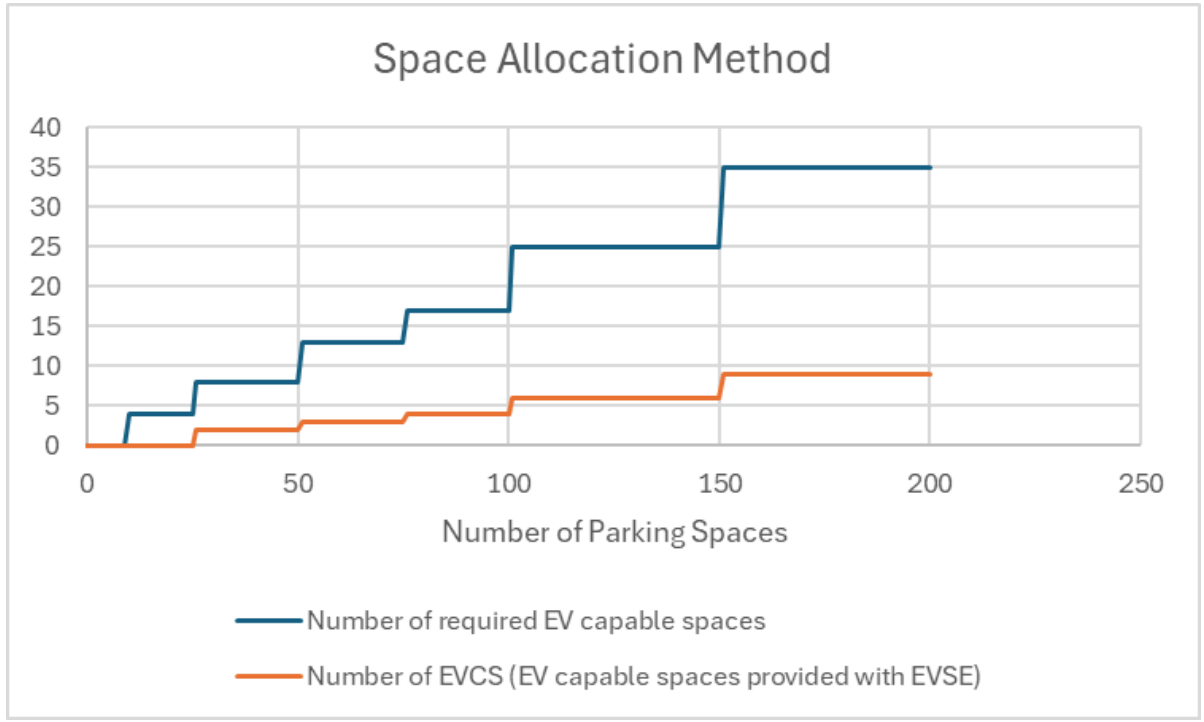


Source: California Energy Codes & Standards 2022 CalGreen Interim Update Fact Sheet "Light-duty Electric Vehicle Charging Infrastructure Requirements"

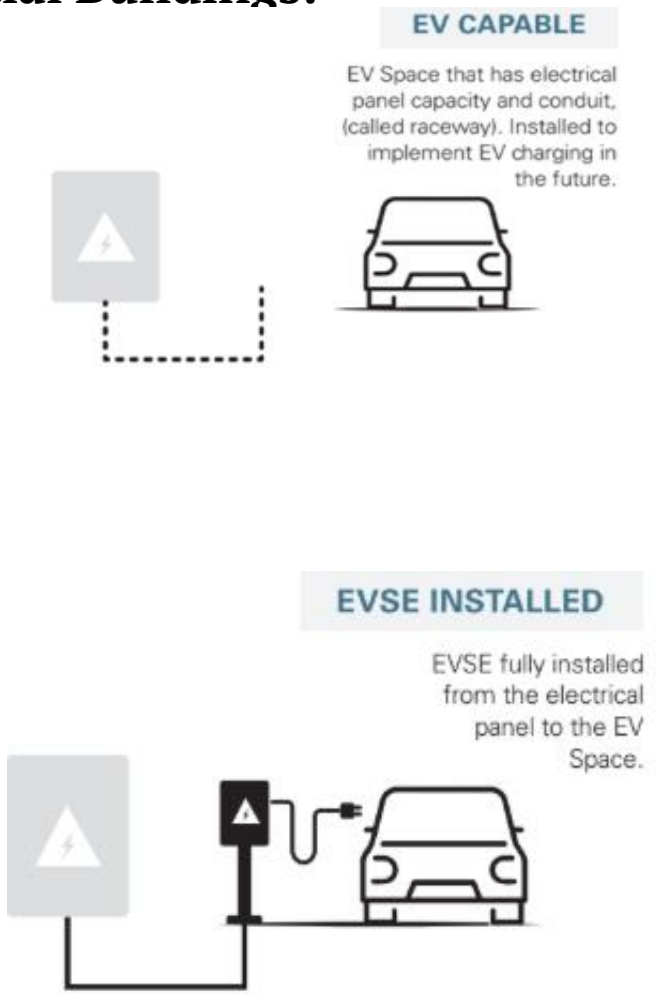
Nonresidential Mandatory Requirements

Mandatory EV Charging Requirement for Nonresidential Buildings:

1. **EV Capable:** Number is based on table 5.106.5.3.1
2. **EVSE Installed/EVCS:** Number is based on table 5.106.5.3.1



Graphic made based on Table 5.106.5.3.1 from 2022 Title 24, Part 11 (CALGreen) with July 2024 Supplement

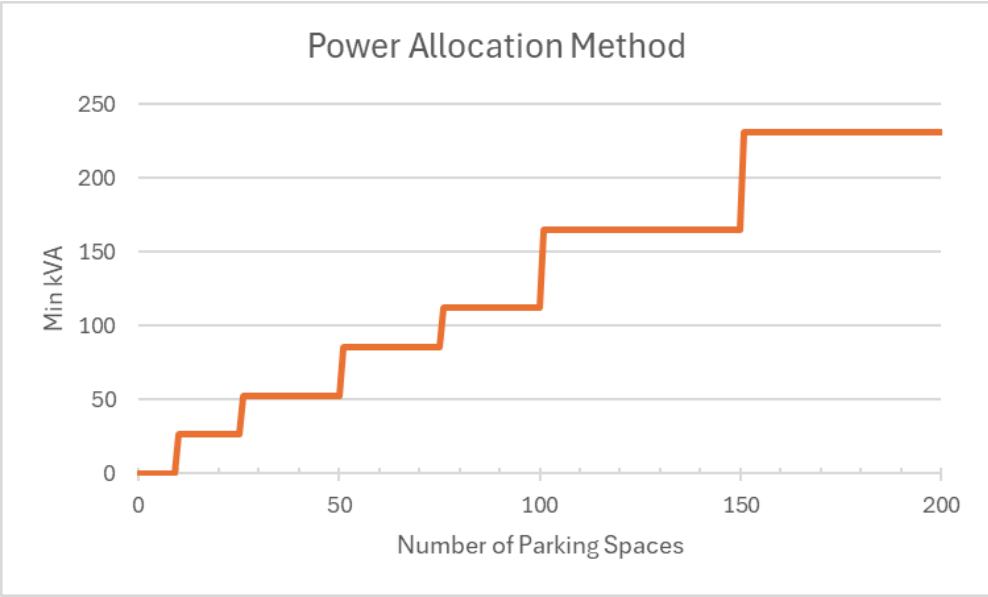


Source: California Energy Codes & Standards 2022 CalGreen Interim Update Fact Sheet "Light-duty Electric Vehicle Charging Infrastructure Requirements"

Two Compliance Methods/Substitutions

Two Compliance Methods:

1. Space Allocation Method
2. Power Allocation Method



Substitutions:

- 1:5 Ratio - 1 DCFC= 5 EV capables space OR 5 EVCS
- 2:1 Ratio - 2 low power level 2 receptacles = 1 level 2 EV capable space

*At least one Level 2 EVSE (charger) shall be provided for both methods

Graphic made based on Table 5.106.5.3.6 from 2022 Title 24, Part 11 (CALGreen) with July 2024 Supplement

Mandatory EV Charging Requirements for Additions and Alterations of Parking Facilities Serving Existing Nonresidential Buildings:

Same Requirements apply, but only for the number of parking spaces being added or altered

Triggers:

- Increase in power supply to electric service panel in parking facility addition or alteration
- New PV system covering existing parking spaces
- When the addition or alteration to a structure is an additional 1,000 sf with an electrical panel upgrade
- When the addition or alteration to a structure is a tenant improvement project with a permit valuation of more than $200,000 and includes an increase in power supply to an electric service panel

Mandatory EV Charging Requirement for Medium-duty and Heavy-duty Vehicles

- No Chargers Required yet
- Power Capacity must be reserved for future Chargers
- Grocery, Retail, & Warehouse buildings

TABLE 5.106.5.4.1
RACEWAY CONDUIT AND PANEL POWER REQUIREMENTS FOR MEDIUM- AND HEAVY-DUTY EVSE [N]

BUILDING TYPE	BUILDING SIZE (SQ. FT.)	NUMBER OF OFF-STREET LOADING SPACES	ADDITIONAL CAPACITY REQUIRED (KVA) FOR RACEWAY & BUSWAY AND TRANSFORMER & PANEL
Grocery	10,000 to 90,000	1 or 2	200
		3 or Greater	400
	Greater than 90,000	1 or Greater	400
Retail	10,000 to 135,000	1 or 2	200
		3 or Greater	400
	Greater than 135,000	1 or Greater	400
Warehouse	20,000 to 256,000	1 or 2	200
		3 or Greater	400
	Greater than 256,000	1 or Greater	400

Table 5.106.5.4.1 from 2022 Title 24, Part 11 (CALGreen) with July 2024 Supplement

Exceptions

1. Case-by-case basis in which local enforcing agency identifies one of the following:
    - No local utility power supply
    - The local utility is unable to supply adequate power
    - An EV charging installation will have an adverse impact on the cost of the project

2. Accessory Dwelling Units (ADU) and Junior Accessory Dwelling Units (JADU) without additional parking facilities

3. Parking spaces accessible only by automated mechanical car parking systems

EV Charging Stations

Understanding Scoping (3 of 3)

Public Housing, Public Accommodations, Commercial Facilities, and Public Buildings covered by the California Building Code (CBC)

- Accessibility regulations do not require EVCS to be installed. As previously stated, CALGreen requires EV infrastructure to be provided and the EVCS to be planned, but not installed.
- When EVCS are installed, accessible EVCS shall be provided for common use/public use in accordance with the scoping and technical provisions.

https://afdc.energy.gov/fuels/electricity-ada-compliance

DSA
DIVISION OF THE STATE ARCHITECT
DEPARTMENT OF GENERAL SERVICES

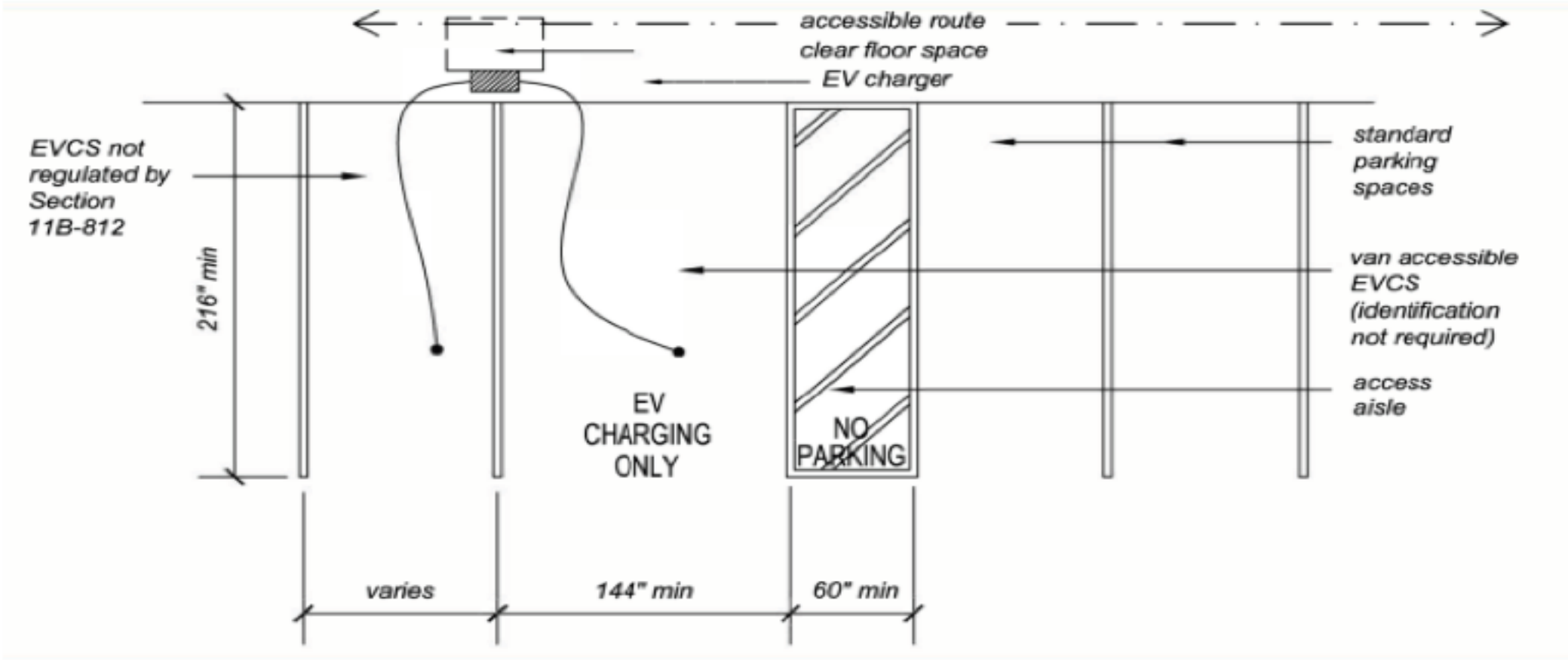
TABLE **11B-228.3.2.1**

ELECTRIC VEHICLE CHARGING STATIONS **FOR** *PUBLIC USE* **AND** *COMMON USE*

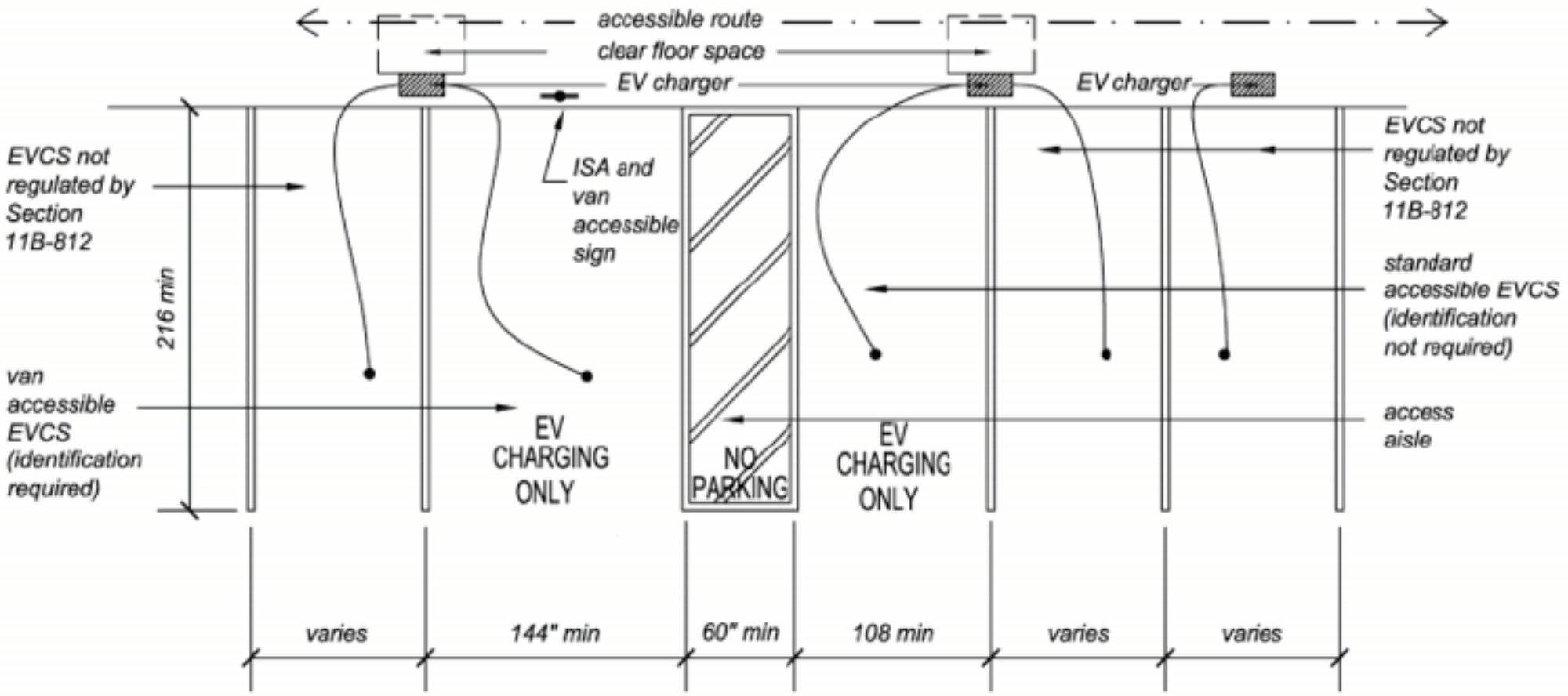
TOTAL NUMBER OF *EVCS* AT A *FACILITY*[1]	**MINIMUM NUMBER (by type) OF *EVCS* REQUIRED TO COMPLY WITH SECTION 11B-812[1]**		
	Van Accessible	**Standard Accessible**	**Ambulatory**
1 to 4	*1*	*0*	*0*
5 to 25	*1*	*1*	*0*
26 to 50	*1*	*1*	*1*
51 to 75	*1*	*2*	*2*
76 to 100	*1*	*3*	*3*
101 and over	*1, plus 1 for each 300, or fraction thereof, over 100*	*3, plus 1 for each 60, or fraction thereof, over 100*	*3, plus 1 for each 50, or fraction thereof, over 100*

1. *Where an EV charger can simultaneously charge more than one vehicle, the number of EVCS provided shall be considered equivalent to the number of electric vehicles that can be simultaneously charged.*

Sample Layout for 2 EV Chargers with 1 Van Accessible Space Required

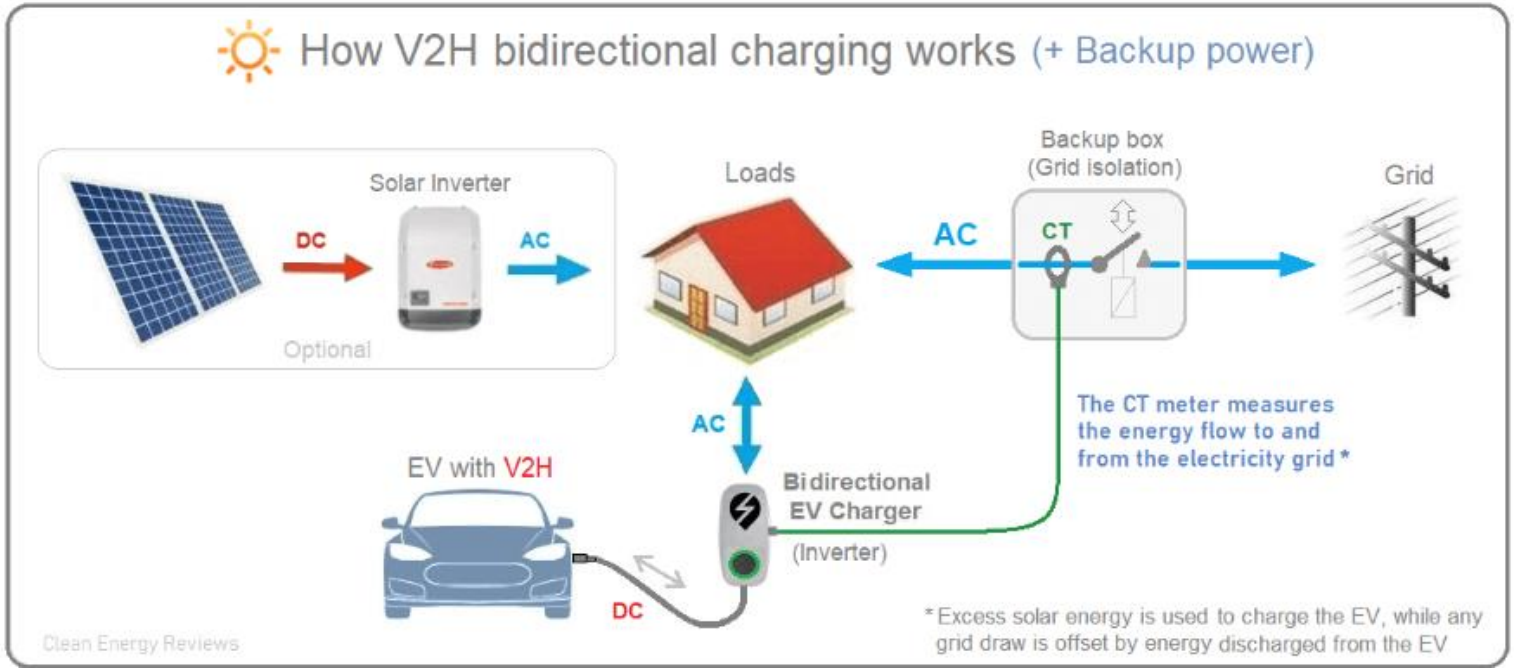


Sample Layout for Smaller Building:
5 EV Chargers w/2 Accessible Spaces Required



Bi-Directional EV Charging

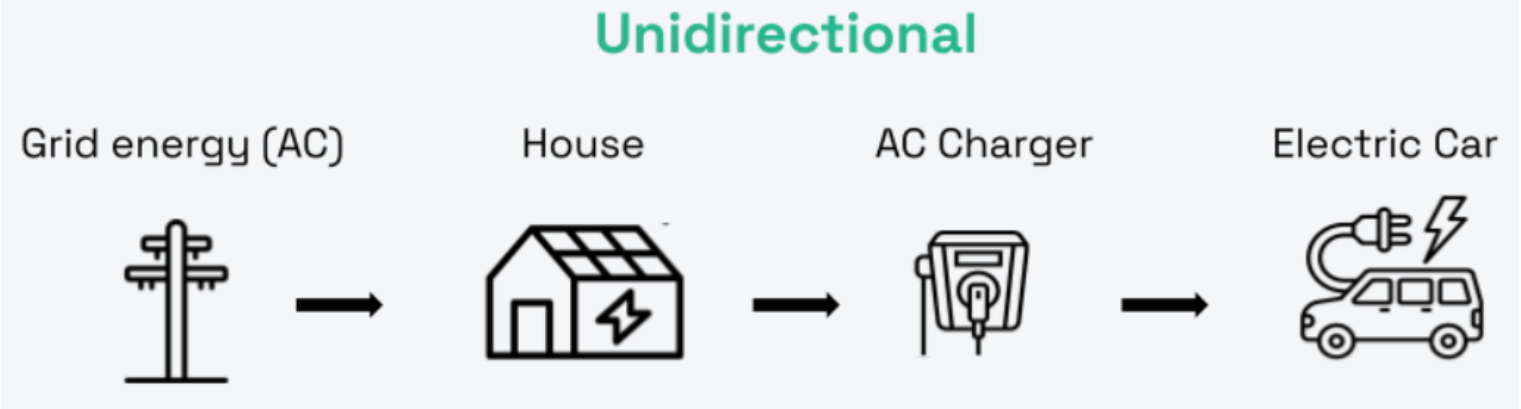
How It Changes Everything

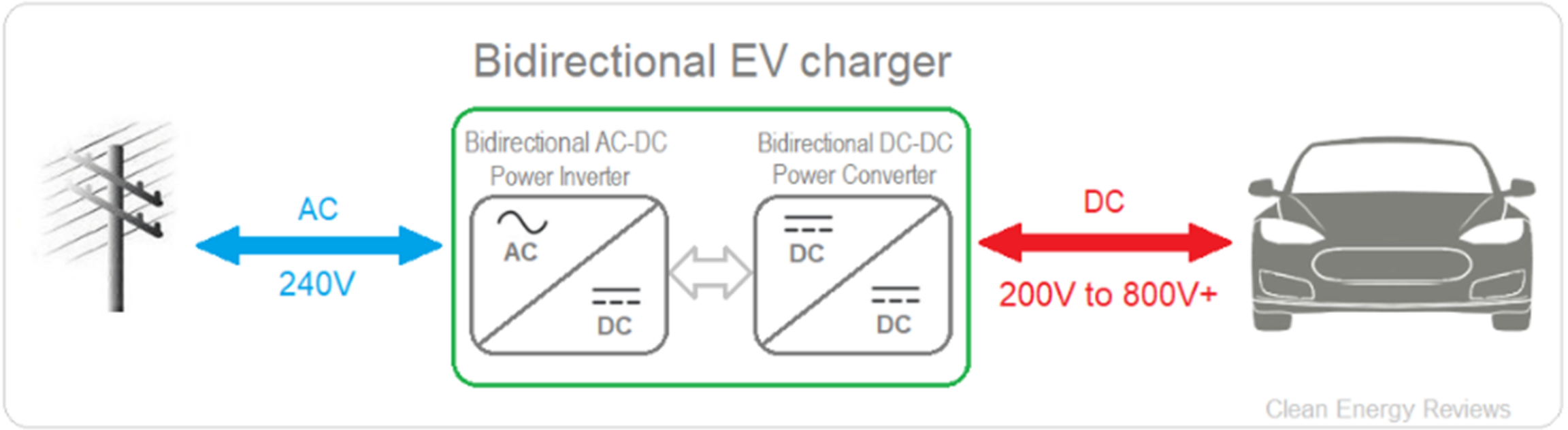


What Problems are We Looking to Solve with Bi-directional Charging?

- Batteries are the most expensive part of the renewable supply chain. How do we make them less expensive?
- NEM 3 and TOU demands that we utilize as much of the solar we produce on site. That requires more battery storage.
- How can I more easily utilize the massive traction batteries of my EV to power critical loads in a blackout or other situations?
- Can you somehow wire an EV directly into your home panel to run a few loads?
- The grid needs to be smarter, more resilient and distributed.

Unidirectional Charging:



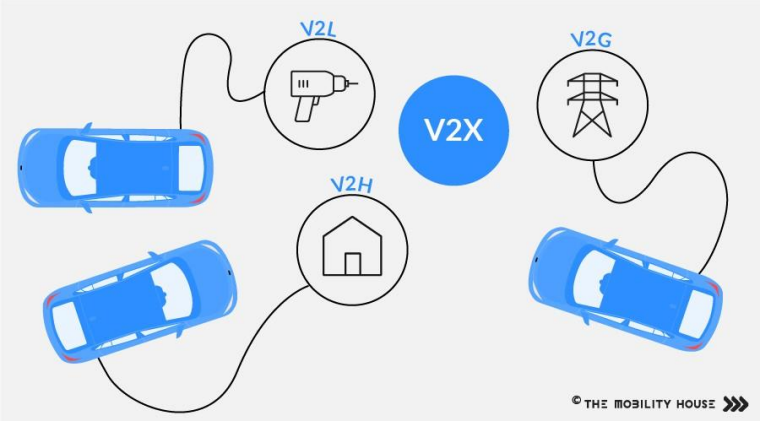


Bi-Directional Charging:

- Two-way charging (charging and discharging)
- Allows an EV battery to act as a mobile power station
  - Power the grid
  - Power your home
  - Power emergency equipment and more

Acronyms for different ways to use bi-directional charging:

- V2X - Vehicle to everything: an umbrella term that encompasses all bidirectional charging options.

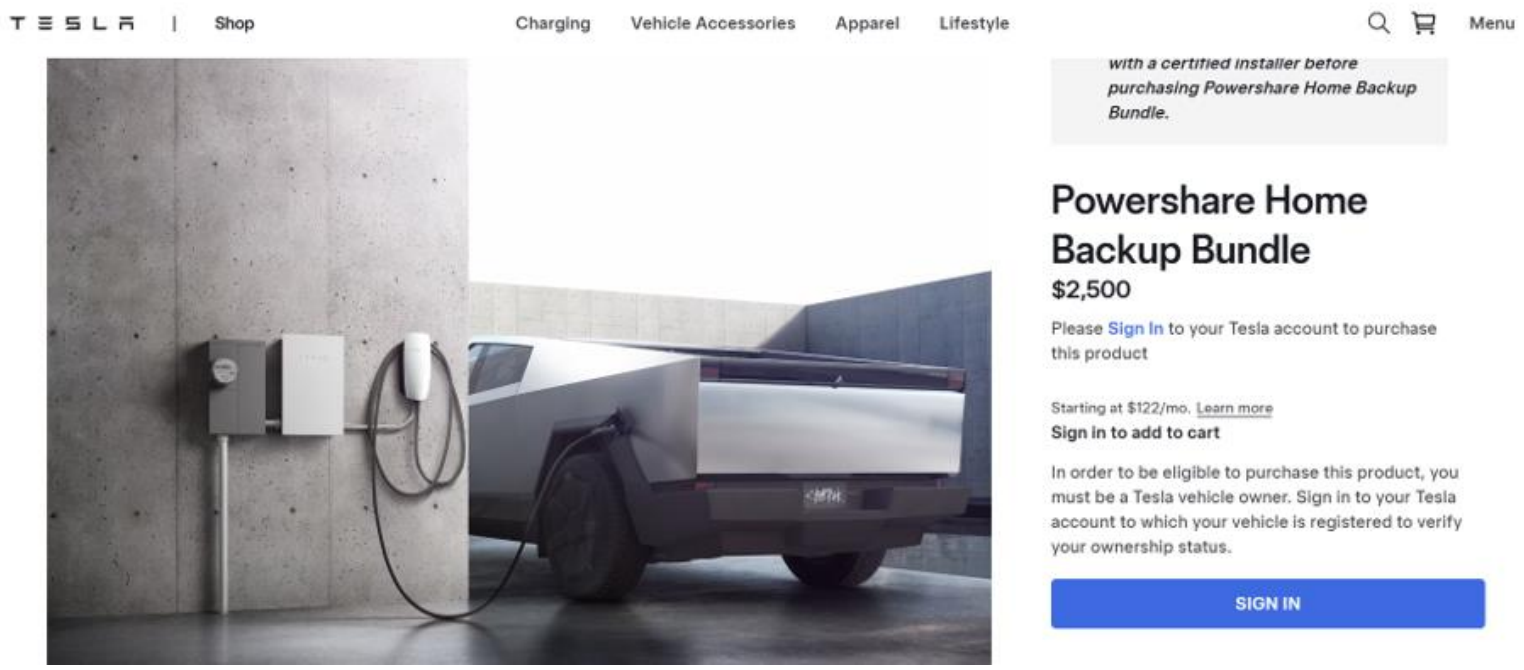


Acronyms for different ways to use bi-directional charging:

- V2L - Vehicle to load allows your EV to power camping equipment, power tools, home appliances or other devices either on board or with an adapter.

Acronyms for different ways to use bi-directional charging:

- V2L - The F150 Lightning and the Cybertruck have 120v and 240v outlets for mobile carpentry and welding shops.



- V2H - Vehicle to home, or vehicle to building (V2B) allows the EV battery to be used behind the meter for backup power and the ability to mitigate peak electricity or NEM 3 rates.

Acronyms for different ways to use bi-directional charging:

- V2G - Vehicle to grid is sending electricity back to the utility network, just like buildings with solar power can do.

Acronyms for different ways to use bi-directional charging:

V2V - Vehicle to vehicle: Another form of V2L, EV owners can charge other EV’s.

Acronyms for different ways to use bi-directional charging:

Background and use cases:

- After the Fukushima earthquake Nissan and Mitsubishi used their EV's as portable battery packs in this emergency. They built inverters and tasked the vehicles to assist in the rescue and recovery efforts.

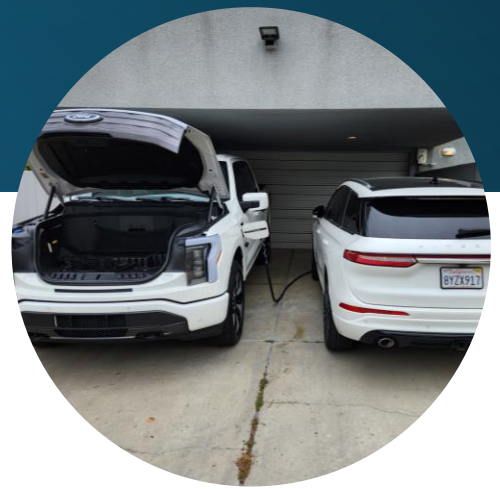
Background and use cases:

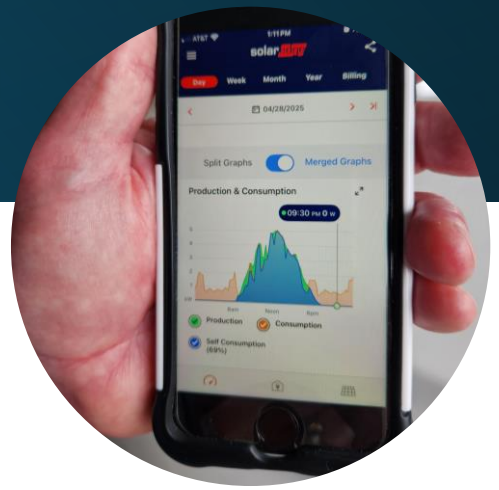
- School Bus fleets are being transitioned to all-electric to reduce pollution and provide a revenue stream for the schools. They can charge during the day and provide grid capability in the peak 4 – 9p periods.

Background and use cases:

Neighbor’s F-150 Lightning

- 131 kWh battery
- 7.5 kW solar system





Inverters in an Emergency!

Benefits of bi-directional charging:

Greatly reduced cost of batteries:

• Tesla power Wall is	$12k for 13.5 kWh =	$889/kWh
• Chevy Bolt is	$24k for 60 kWh =	$400/kWh
• Hyundai Ioniq 6 is	$44k for 77.4 kWh =	$568/kWh
• Ford F150 Lightning is	$78k for 131 kWh =	$595/kWh
• Tesla Model Y is	$49k for 75 kWh =	$653/kWh

Other Benefits of bi-directional charging:

- NEM 3.0 users need more battery storage and this could be the most efficient way to get it.
- EV owners can mitigate peak electricity rates in time of use (TOU) pricing.
- In an emergency, can power the whole house for about two days, more if on a critical load panel.
- Mobile power station capability allow you to help others in an emergency (V2L, V2B or V2V).
- Could help to stabilize the grid.

Concerns/Technical challenges of Bi-Directional Charging:

- V2G Technical standards are still being finalized
- If V2G, an Automatic Transfer Switch (ATS) or breaker interlock is needed
  - Best if solar and a small battery are designed into the system
- V2G Charger hardware cost could make up the savings in battery costs
  - A standard Level 2 home charger without V2G functionality typically costs around $500 plus installation. V2G could double that..
  - V2G specific charger hardware cost with an ATS and a hybrid inverter/controller can range from $2,500 to $7,500.
  - The cost to add V2G functionality to the vehicle itself is about $200 - $400.
- The high number of charge/discharge cycles may degrade the vehicle battery.
- Electric car manufacturers may not provide warranties for V2X operations.

More and more EVs sold in the U.S. offer bidirectional charging:

- Ford F-150 Lightning (V2G, V2H)
- Nissan Leaf (V2H, V2G)
- VW ID.4 (V2G, V2H)
- Polestar 3 (V2G)
- Tesla Cybertruck (V2L, V2H)
- Chevrolet Silverado EV RST (V2G, V2H, V2L)
- GMC Sierra EV Denali Edition 1 (V2G, V2H, V2L)
- Chevrolet Blazer EV (V2H, V2G)
- 2024 Chevrolet Equinox EV (V2H, V2G)
- Cadillac Lyriq (V2H, V2G)
- Genesis GV60 (V2L)
- Hyundai Ioniq 5 (V2L)
- Hyundai Ioniq 6 (V2L)
- Kia EV6 (V2L)
- Kia Niro (V2L)
- Mitsubishi Outlander PHEV (V2L)

Additional vehicle data can be found here: https://www.cleanenergyreviews.info/blog/bidirectional-ev-charging-v2g-v2h-v2l

More Bi-Directional Vehicles are coming!

- BMW, Volvo and Porsche are all reportedly testing functionality.
- Tesla has said all of its models will support bidirectionality by 2025.
- General Motors will make V2H charging a default feature this year including the Escalade IQ, Cadillac's first full-size all-electric SUV.
- Ram is also launching its first vehicle with bidirectional charging this year with the Ram 1500 REV electric truck expected to launch in Q4 of 2024.
- BMW's next-generation "Neue Klasse" electric vehicles, are scheduled for production in 2025, will support V2G charging.
- BMW's industry partner E.ON, a German public utility company, will coordinate access to energy management features.

Ways to Access Bi-directional Charging:

- V2L If your car does not have an outlet, adapters are available for around $99 which gives you 120v and 16A

- V2H and V2G:
  - Big names like Enphase, SolarEdge and Wallbox are developing bi-directional chargers for the U.S. market that they will need to pair with hybrid inverters.
  - Ford Charge Station Pro, GM Energy Home System, Tesla Powershare, and others are releasing energy management platforms with V2h and V2G.
  - A more detailed listing and review of bi-directional inverters can be found here: https://www.cleanenergyreviews.info/blog/bidirectional-ev-chargers-review

Recommendations:

- Make your next car an EV with V2G capability.
- To maximize the benefits of V2X make it easy to have your EV plugged in all the time.
- To optimize for NEM 3, calculate evening loads and how long your EV will be plugged in during daylight hours.
- Buy a smaller battery (5 kWh?) for the house, paired with solar that can run the house and the EV’s in a power outage and do a bit of energy arbitrage when the EV is not there.
- Use the EV with V2G capability as your main backup resource tool.
- Have a critical loads panel or a smart panel that allows you to control the loads in a longer-term emergency.

Summary

- EVs are fun to drive, quick w a low center of gravity.
- They are better for your heath and your wallet.
- Like all technologies, the cost is coming down and the capabilities are going up.
- Little to no maintenance.
- Total cost of ownership is 40% less
- At home, charging with solar the best value, but still outpaces ICE vehicles in many use cases.
- Know your facts vs myths
- Know requirements for EV charging.
- Start preparing for bi-directional charging

Additional References

- Tony Seba Rethinking the Future:
- Plug in America - You have questions. We have answers!
- The US Added 1.2 Million EVs To The Grid Last Year, & Electricity Use Went Down
- https://www.cbtnews.com/evs-prove-cheaper-to-own-than-gas-cars-over-five-years-despite-high-initial-costs/
- EV Economics: How a combination of factors makes EV ownership more affordable
- Mineral requirements for clean energy transitions
- A Fossil Fuel Economy Requires 535x More Mining Than a Clean Energy Economy
- Mining quantities for low-carbon energy is hundreds to thousands of times lower than mining for fossil fuels
- Gas vs. Electric Car Fires in 2025 (Shocking Stats)
- What Really happens to used Electric Car Batteries - (you might be surprised)
- Net Zero Nest www.netzeronest.com
- Green Idea House www.greenideahouse.com

Questions??? - Keep in Touch!

Nick

Robert

fortunato@forstrategy.com nick@buildsmartgroup.com

Questions about Title 24?

3C-REN offers a *free* Code Coach Service

Online:
3c-ren.org/code

Call:
805.781.1201

Energy Code Coaches are local experts who can help answer your Title 24 Part 6 or Part 11 questions.

They can provide code citations and offer advice for your res or non-res projects.

Closing

Continuing Education Units Available

- Contact dresurreccion@co.slo.ca.us for AIA LUs

Coming to Your Inbox Soon!

- Slides, Recording, & Survey – Please Take It and Help Us Out!

Energy Code Implementation Series:

- May 14 - Single Family Additions and Alterations
- June 25 - Additional Dwelling Units (ADUs)
- July 23 - Multifamily

Other Upcoming Nick Brown x 3C-REN Courses:

- May 16 – All Electric ADUs (IN-PERSON)
- June 27 – Ask the Experts: Heat Pump Water Heater Installations

Any phone numbers who joined? Please share your name!

Thank you!

More info: **3c-ren.org**

Questions: **info@3c-ren.org**

Email updates: **3c-ren.org/newsletter**

3C REN

TRI-COUNTY REGIONAL ENERGY NETWORK

SAN LUIS OBISPO • SANTA BARBARA • VENTURA