



IECC 2024 EV Charging Infrastructure Requirements

Michael Tillou, PE
May 8th, 2024



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DOE Building Energy Code Program (BECP)

Development

- ASHRAE Standard 90.1
- International Energy Conservation Code (IECC)
- DOE Determinations on code energy savings

Model Energy Codes








Implementation

- State technical assistance
- State-specific energy, cost and benefit analyses
- Compliance software tools & resources
- User Support
- Trainings
- Field study guideline and methodology



DOE BECP Advancing Energy Codes

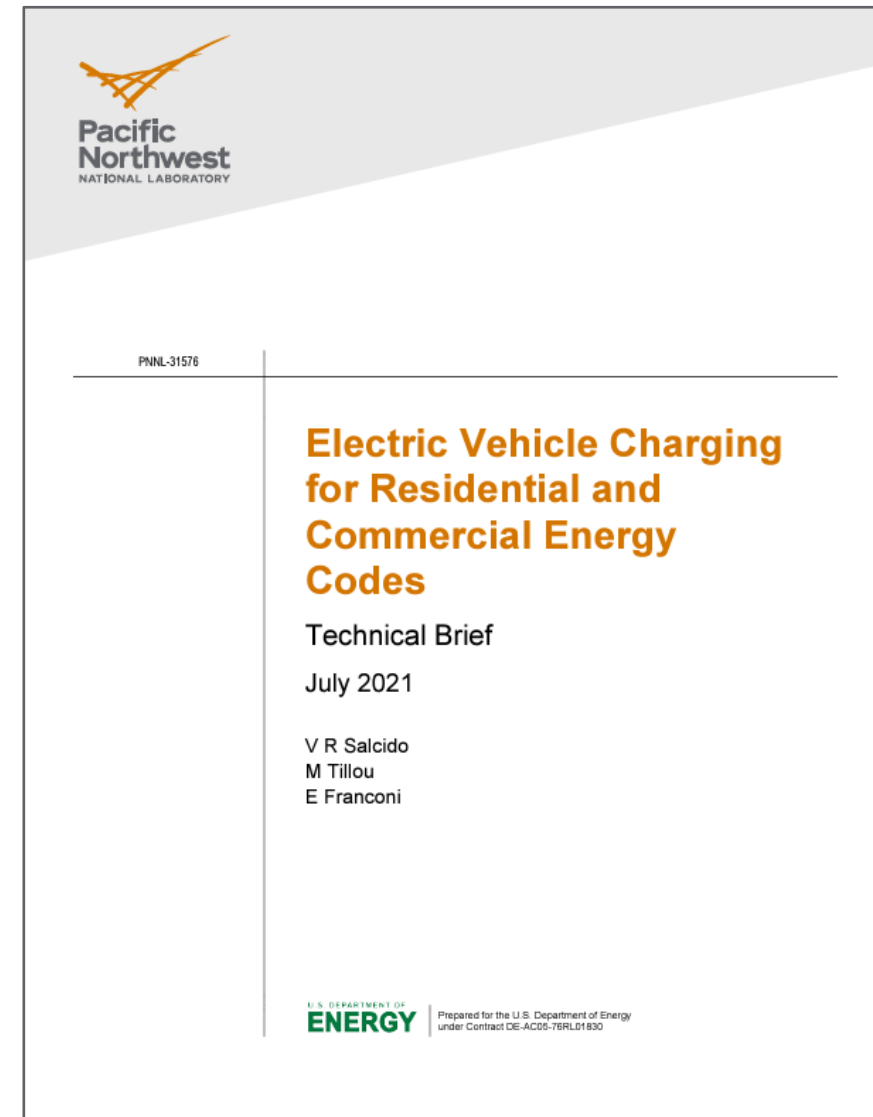
With Code Change Proposals and Informative Technical Briefs

Topic	Description
 EV Charging	Code language for requirements for electric vehicle installed, ready, and/or capable infrastructure
 Load Management	Informative analysis to encourage states to incentivize or establish code requirements for load management measures
 Energy Credits	Code language for additional energy efficiency and grid-interactivity measures that go beyond the prescriptive code
 Demand Response	Code language for thermostats and water heaters requirements to include demand response capability
 PV Required	Code language for on-site solar photovoltaic requirements
 Electric Readiness	Code language for requirements electric outlets installed near fossil fuel water heaters, dryers, and cooking equipment
 Zero Emissions	Optional residential and commercial code language for a performance-based path to achieve zero emissions

Electric Vehicle Charging for Residential and Commercial Energy Codes

EV Charging Requirements Tech Brief

- Written as an overlay to the IECC 2021
- Developed in collaboration with ICC
- Addresses requirements for both Commercial and Residential new construction
- Formed basis for IECC 2024 proposal for EV charging infrastructure



Source: energycodes.gov

IECC 2024 EV Charging Working Group Goals

- **Definitions** – Incorporate, match, and/or be consistent with definitions in other codes (NFPA 70 / NEC, ICC Building Code, Zoning Code)
- **Requirements Table** – Provide proper requirements for different residential and commercial building types with different EV charging profiles and usages.
- **Mandatory language** – Provide technically correct minimum requirements for EV charging infrastructure installation and for energy management (smart / managed charging).

Closely aligned requirements across both the IECC Residential and Commercial provisions

EV Charging Definitions

Key definitions for EV Charging adopted into IECC.

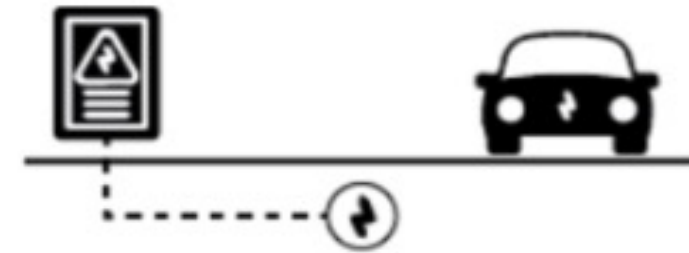
- *AUTOMOBILE PARKING SPACE.*
- *ELECTRIC VEHICLE (EV).*
- *ELECTRIC VEHICLE CAPABLE SPACE (EV CAPABLE SPACE).*
- *ELECTRIC VEHICLE READY SPACE (EV READY SPACE).*
- *ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE).*
- *ELECTRIC VEHICLE SUPPLY EQUIPMENT INSTALLED SPACE (EVSE SPACE).*

The same set of definitions was adopted into both the Commercial and Residential provisions and developed to be consistent with definitions in the NFPA 70 / NEC, and the ICC Building Code.

EV Charging Requirements

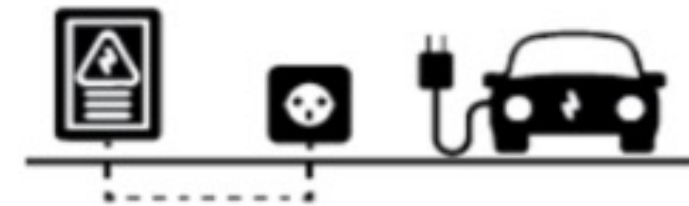
EV Capable Spaces.

Install panel capacity and conduit (raceway) to accommodate the future build-out of EV charging



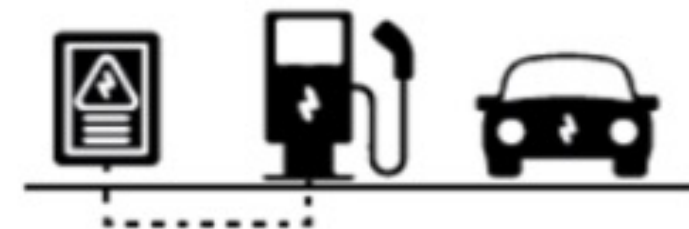
EV Ready Spaces.

Install a full circuit installations including panel capacity, raceway, wiring, receptable, and overprotection devices.



EVSE Spaces.

Install EVSE charging stations during new construction



EV Charging Requirements - Residential



New one- and two-family dwellings and townhouses with a designated attached or detached garage or other on-site private parking provided adjacent to the dwelling unit:

- Provide one EV capable, EV ready or EVSE space per dwelling unit .



New R-2 occupancies or allocated parking for R-2 occupancies in mixed-use buildings:

- Provide EV capable space, EV ready space or EVSE space for 40 percent of the dwelling units or automobile parking spaces, whichever is less.

EV Charging Requirements - Commercial

REQUIRED EV POWER TRANSFER INFRASTRUCTURE

OCCUPANCY	EVSE SPACES	EV READY SPACES	EV CAPABLE SPACES
Group A	10%	0%	10%
Group B	15%	0%	30%
Group E	15%	0%	30%
Group F	2%	0%	5%
Group H	1%	0%	0%
Group I	15%	0%	30%
Group M	15%	0%	30%
Group R-1	20%	5%	75%
Group R-2	20%	5%	75%
Groups R-3 and R-4	2%	0%	5%
Group S exclusive of parking garages	1%	0%	0%
Group S-2 parking garages	15%	0%	30%

EV Charging Capacity Requirements

System capacity. The electrical distribution equipment supplying the branch circuit(s) serving each *EV capable space*, *EV ready space* and *EVSE space* shall:

- Have a calculated load of 7.2 kVA for each space, or
- When controlled by an **energy management system**, have a calculated load not less than 3.3 kVA per space.

Circuit capacity. The branch circuit serving each *EV capable space*, *EV ready space* and *EVSE space* shall:

- Have a rated capacity not less than 50 amperes
- When controlled by an **energy management system**:
 - Have a minimum capacity of 25 amperes per space, or.
 - Have a minimum capacity of 20 amperes per space for R-2 occupancies where all *automobile parking spaces* are *EV ready spaces* or *EVSE spaces*.

EV Charging Cost Effectiveness

Cost effectiveness was also evaluated using data from a more comprehensive October 2021 EV Charging cost study for the Province of Ontario, Canada

				NPV of the Future Retrofit Cost in Year x								
	New Cost (2021 US\$)	Future Retrofit Cost (2021 US\$)	Real Discount Rate	2023	2030	2038	2039	2040	2045	2046	2047	2052
Dedicated 40A Circuit (20% EV Ready)	\$ 4,875	\$ 16,171	7%	\$15,113	\$9,412	\$5,478	\$5,119	\$4,784	\$3,411	\$3,188	\$2,979	\$2,124
			5%	\$15,401	\$10,945	\$7,408	\$7,055	\$6,719	\$5,265	\$5,014	\$4,775	\$3,742
			3%	\$15,700	\$12,766	\$10,077	\$9,784	\$9,499	\$8,194	\$7,955	\$7,723	\$6,662
4-share on 40A circuit (20% EV Ready)	\$ 2,863	\$ 8,926	7%	\$8,342	\$5,195	\$3,023	\$2,826	\$2,641	\$1,883	\$1,760	\$1,645	\$1,173
			5%	\$8,501	\$6,041	\$4,089	\$3,894	\$3,709	\$2,906	\$2,768	\$2,636	\$2,065
			3%	\$8,666	\$7,046	\$5,562	\$5,400	\$5,243	\$4,522	\$4,391	\$4,263	\$3,677
Dedicated Circuits on 4A (100% EV Ready)	\$ 3,833	\$ 12,772	7%	\$11,936	\$7,433	\$4,326	\$4,043	\$3,779	\$2,694	\$2,518	\$2,353	\$1,678
			5%	\$12,164	\$8,644	\$5,851	\$5,572	\$5,307	\$4,158	\$3,960	\$3,772	\$2,955
			3%	\$12,400	\$10,082	\$7,959	\$7,727	\$7,502	\$6,471	\$6,283	\$6,100	\$5,262
3-share on 40A (100% EV Ready)	\$ 2,363	\$ 7,759	7%	\$7,252	\$4,516	\$2,628	\$2,456	\$2,296	\$1,637	\$1,530	\$1,430	\$1,019
			5%	\$7,390	\$5,252	\$3,555	\$3,385	\$3,224	\$2,526	\$2,406	\$2,291	\$1,795
			3%	\$7,533	\$6,125	\$4,835	\$4,695	\$4,558	\$3,932	\$3,817	\$3,706	\$3,197
4-share on 40A (100% EV Ready)	\$ 1,680	\$ 5,483	7%	\$5,124	\$3,191	\$1,857	\$1,736	\$1,622	\$1,157	\$1,081	\$1,010	\$720
			5%	\$5,222	\$3,711	\$2,512	\$2,392	\$2,278	\$1,785	\$1,700	\$1,619	\$1,269
			3%	\$5,323	\$4,328	\$3,417	\$3,317	\$3,220	\$2,778	\$2,697	\$2,619	\$2,259

Installing EV Charging infrastructure at time of construction remains cost effective:

- For 18 years at a 7% real discount rate
- For 24 years at a 5% real discount rate
- At 30 years with a 3% real discount rate

Study cost data was converted to US\$ using Feb 2022 US/CAN international currency exchange rate.

Source: Electric Vehicle Charging Infrastructure Costing Study October 2021

<https://cleanairpartnership.org/cac/wp-content/uploads/2021/10/2-21-050-GTHA-EV-Ready-Costing-Study-2021.10.14.pdf>

EV Charging Strategies in Energy Codes

Next Steps:

- Expand load sharing allowances based on larger branch circuit capacities. Important for occupancies with 100% EV space requirements to manage infrastructure costs and grid impacts.
- Develop requirements that allow greater flexibility for the installation of different types of chargers (ie: DC Fast charging).



**Pacific
Northwest**
NATIONAL LABORATORY

Thank you



**EV CHARGING
FOR ALL
COALITION**



Expanding Access to Affordable At-Home EV Charging

How EV-Ready Codes Can Accelerate an Equitable Transition to EVs

Vanessa Warheit, National Lead
EV Charging for All Coalition
EV Codes Conference, May 2024

EVChAC's Mission

To ensure equitable, safe, and convenient access to affordable EV charging at home and/or at work, for all residents.

Outline

- Introduction
- Equitable, affordable solutions: 4 MFH principles
- Best Practices for Multi-Family charging
- Case studies
- Q&A and Discussion

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Electric Vehicle Building Codes Toolkit

A Guide For Adopting Equitable US Codes

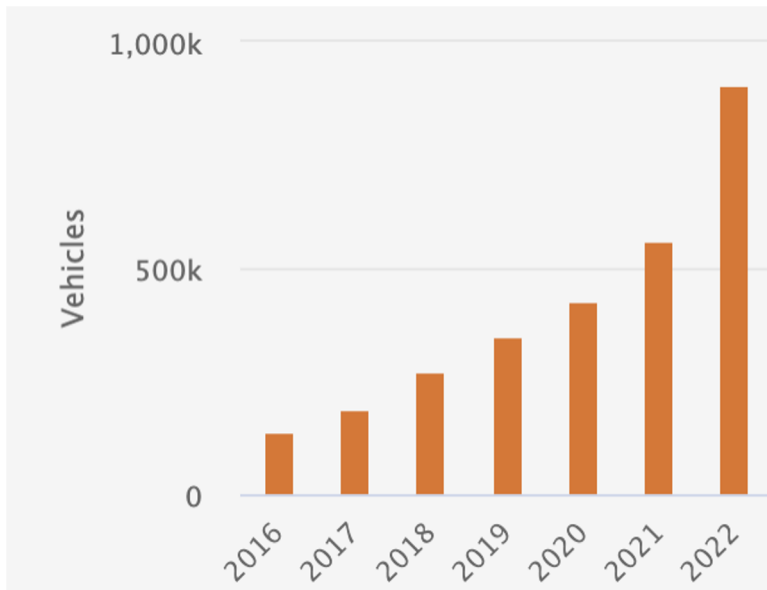
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bit.ly/EVcodestoolkit

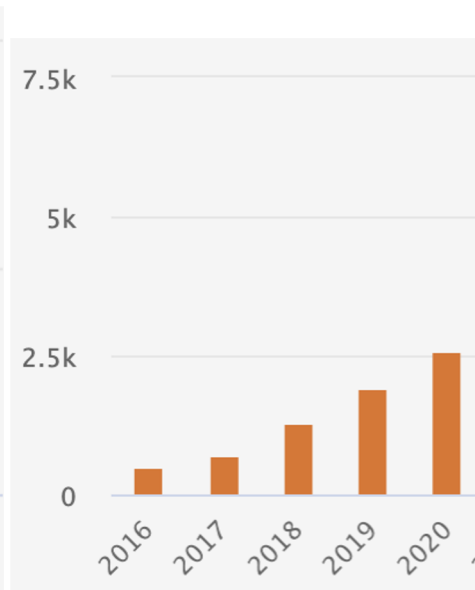
EVs are on an exponential growth curve, everywhere

Electric Vehicle Registrations

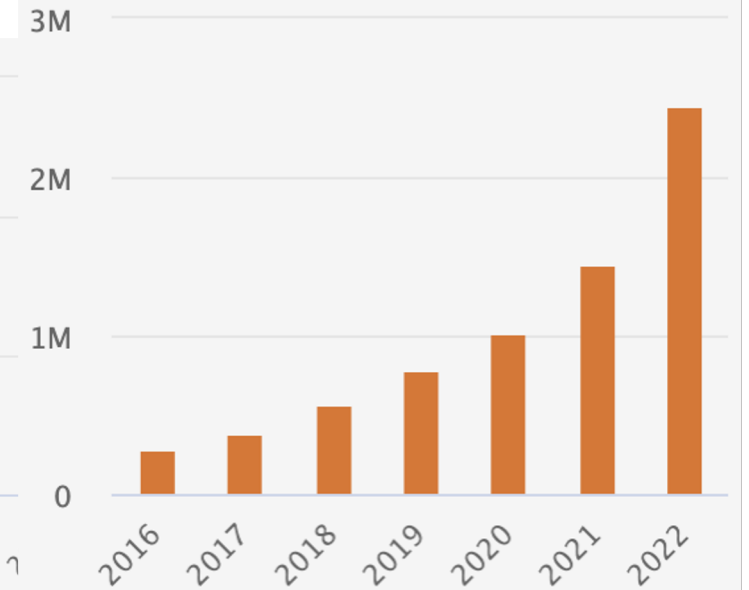
California



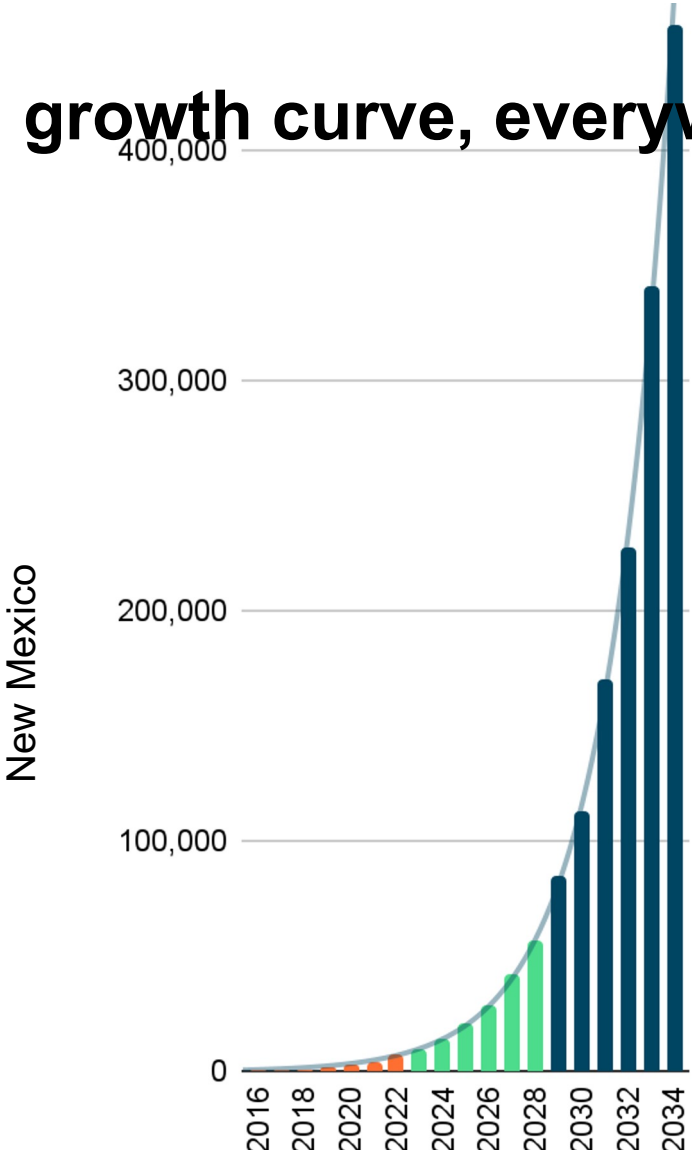
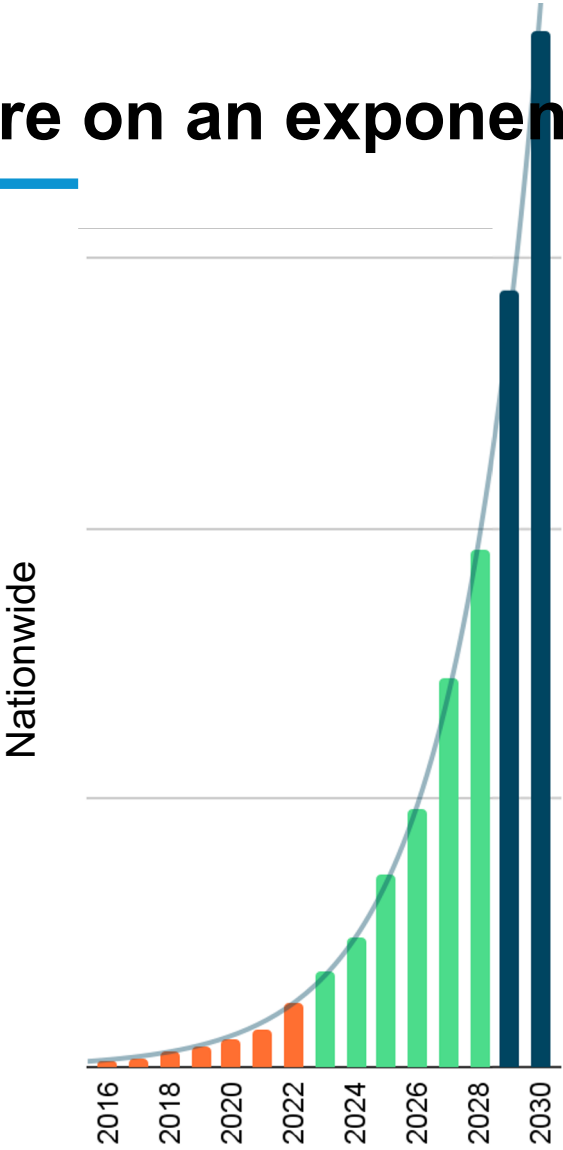
New Mexico



All States

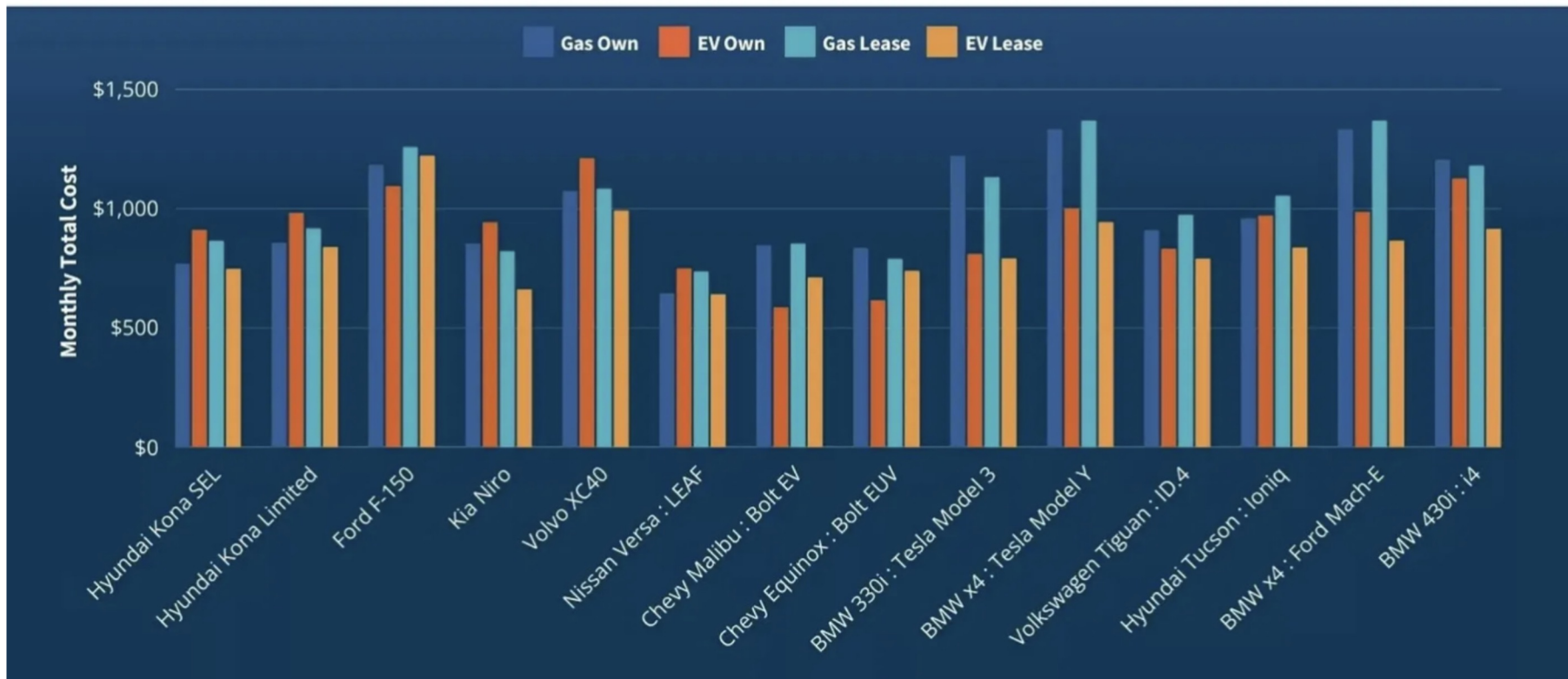


EVs are on an exponential growth curve, everywhere

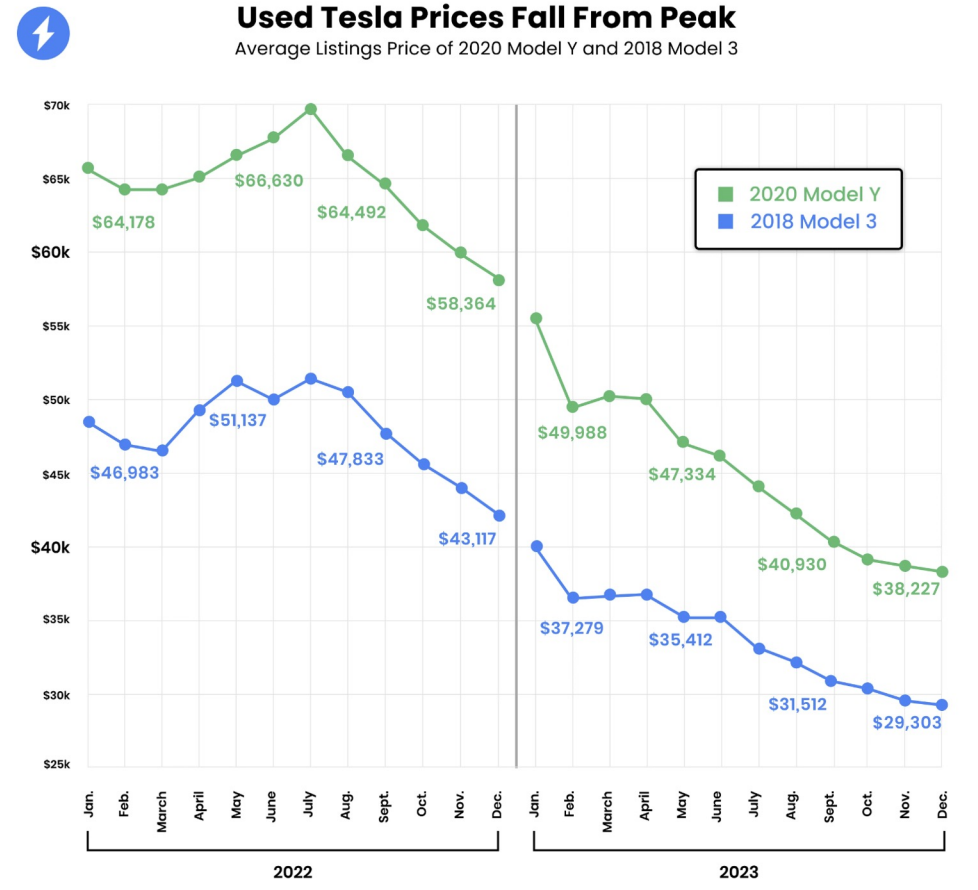
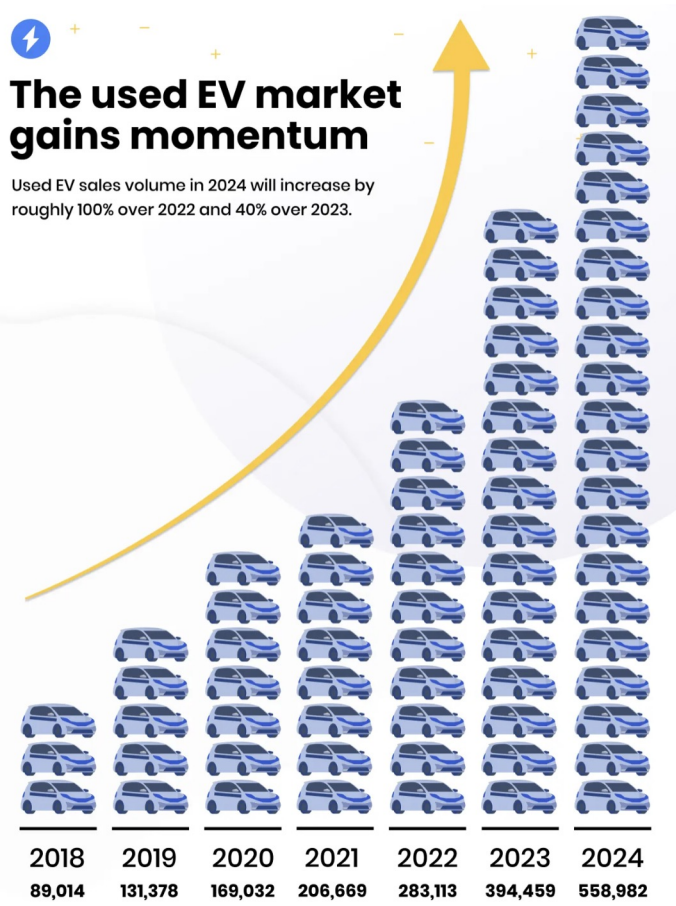


EVs Are Affordable

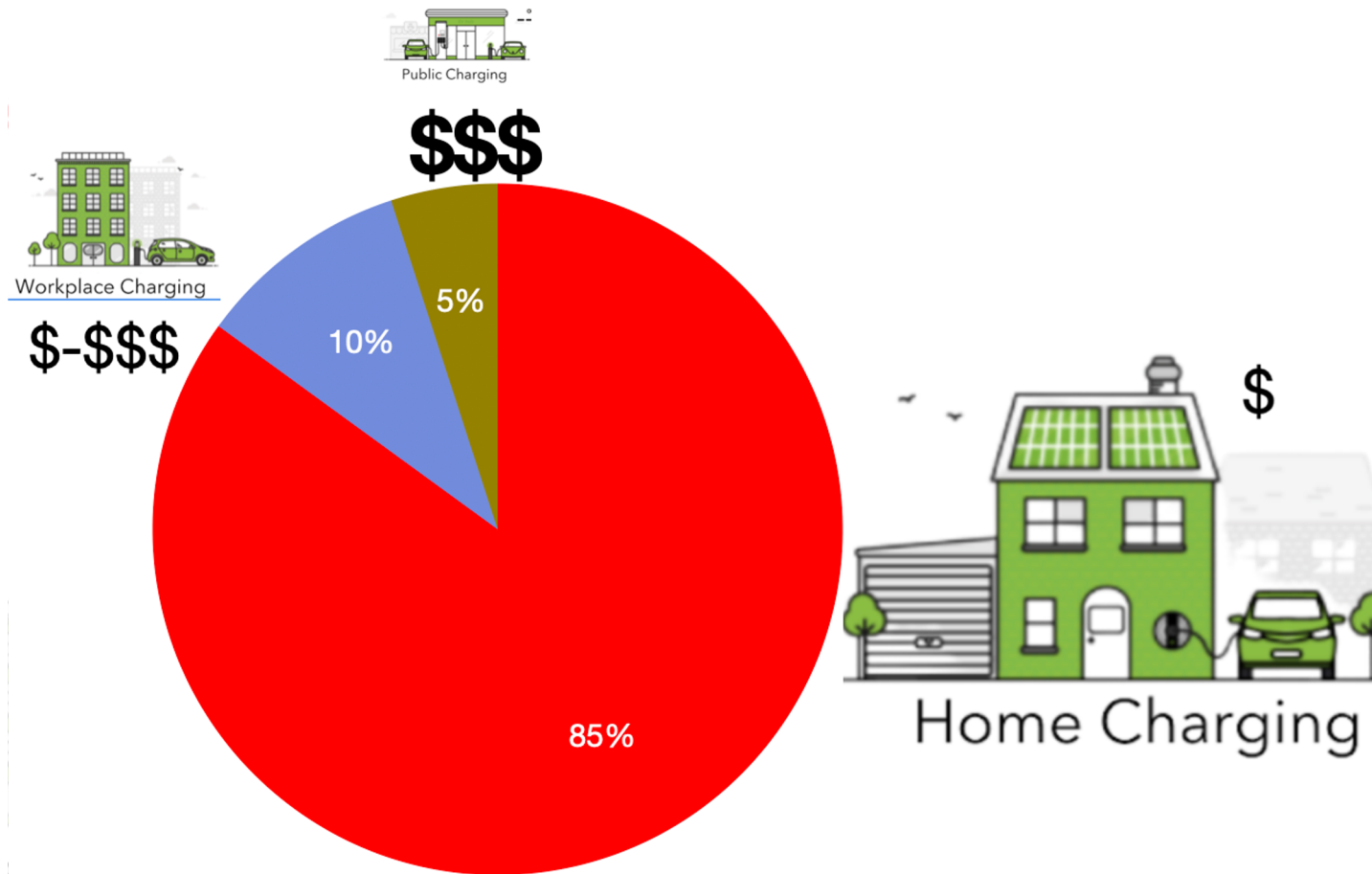
Leasing an electric vehicle is the **cheapest option** for new car buyers



Used EVs: Volume Rises, Prices Drop

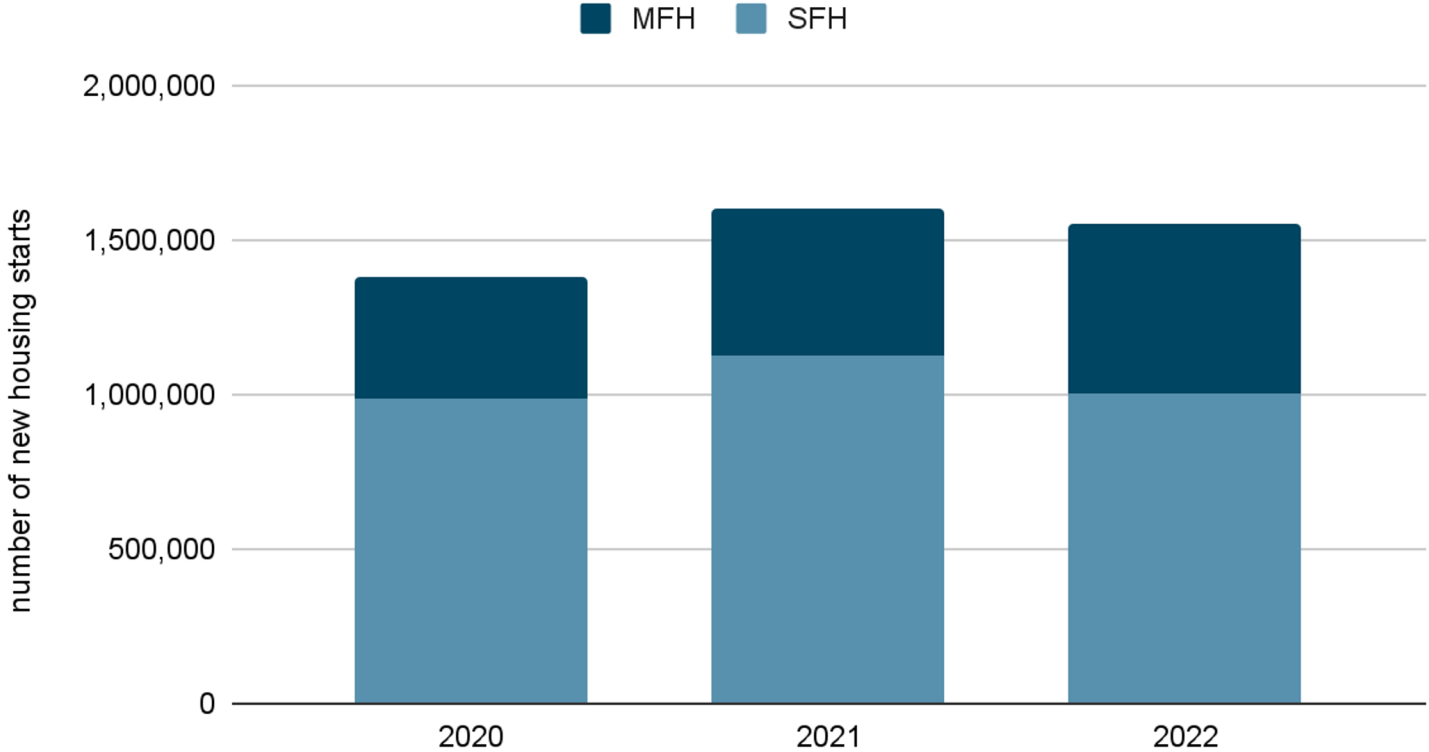


Access: “There’s No Place Like Home”



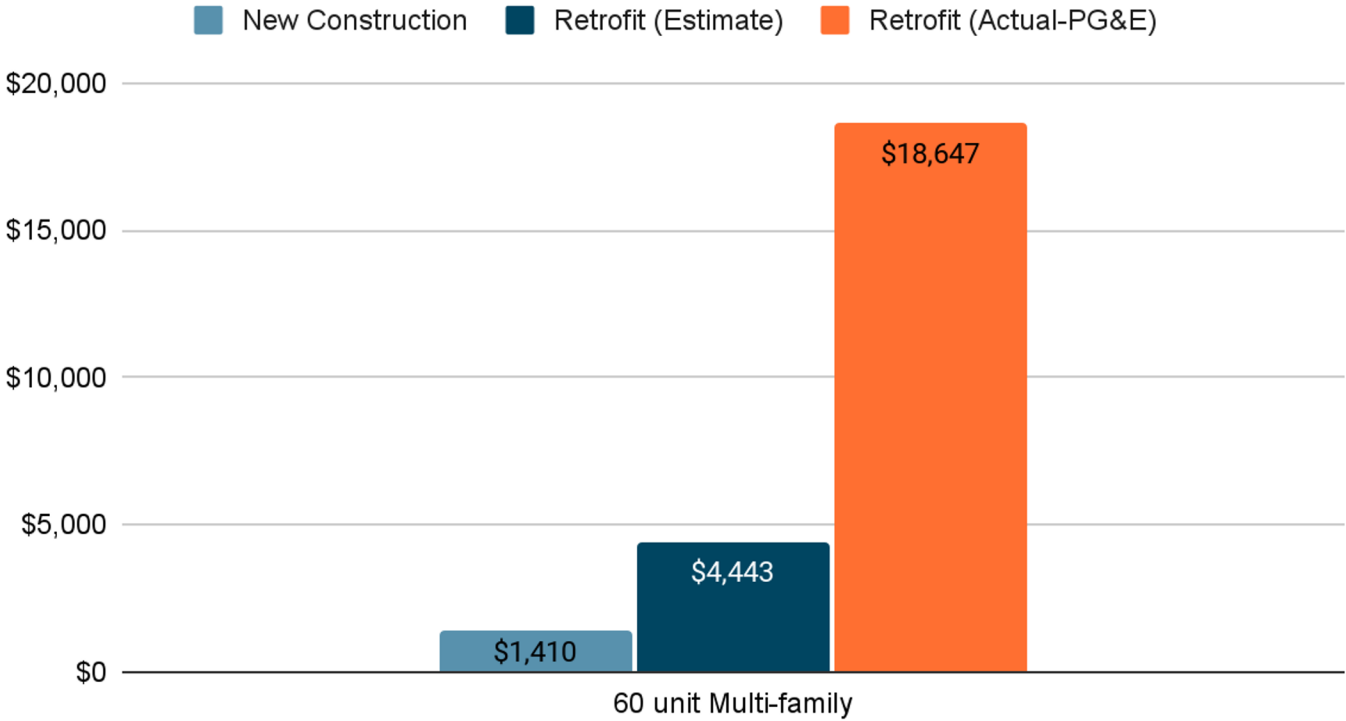
Every Year, 1.5M Potential New US Charging Stations

Multifamily vs. Single Family US New Housing Starts

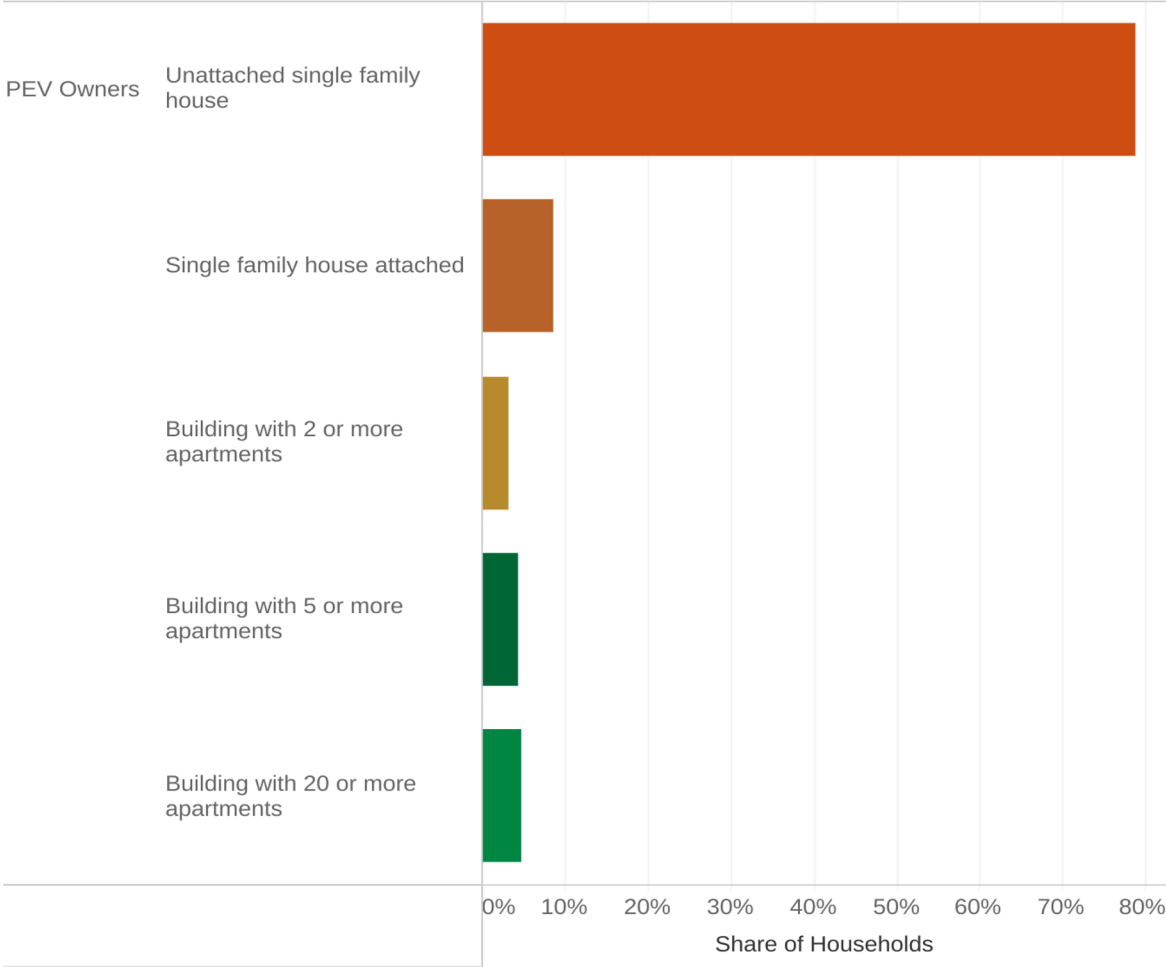


New Construction Is Least Cost Option

Make-Ready Cost per Parking Space: New Construction vs. Retrofit



California PEV Owners by Housing Type



How California Is Keeping Electric Vehicles Out ...

POLITICS 05/27/2021 05:45 am ET | Updated May 31, 2021

How California Is Keeping Electric Vehicles Out Of Reach For Apartment-Dwellers

Even in the nation's most EV-friendly state, inertia and business interests are delaying the energy transition and leaving the working class behind.

By Alexander C. Kaufman

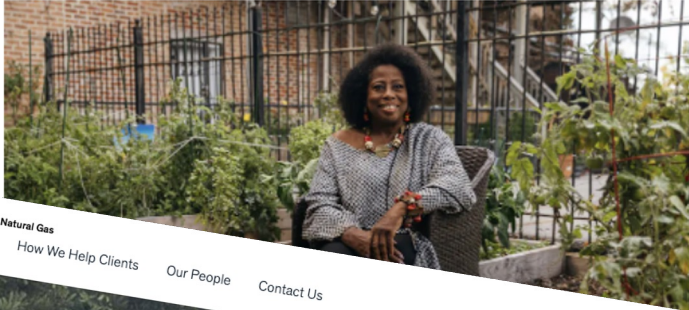


The Washington Post
Democracy Dies in Darkness

BUSINESS

Without access to charging stations, Black and Hispanic communities may be left behind in the era of electric vehicles

By Will Englund
December 9, 2021 at 7:00 a.m. EST

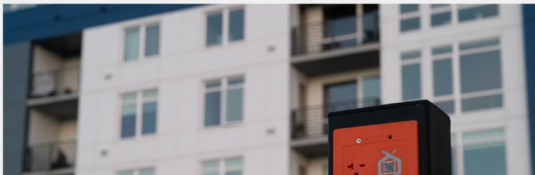


Electric Power & Natural Gas
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ons. **Grist** Follow

Why the slowest EV chargers may be the fastest way to get people into EVs

Apartments need EV charging. Supporters of trickle-slow "Level 1" chargers argue that access is more important than speed.



McKinsey & Company

How charging in buildings can power up the electric-vehicle industry

January 5, 2021 | Article



EV Infrastructure: Definitions



Definitions: Charging Equipment



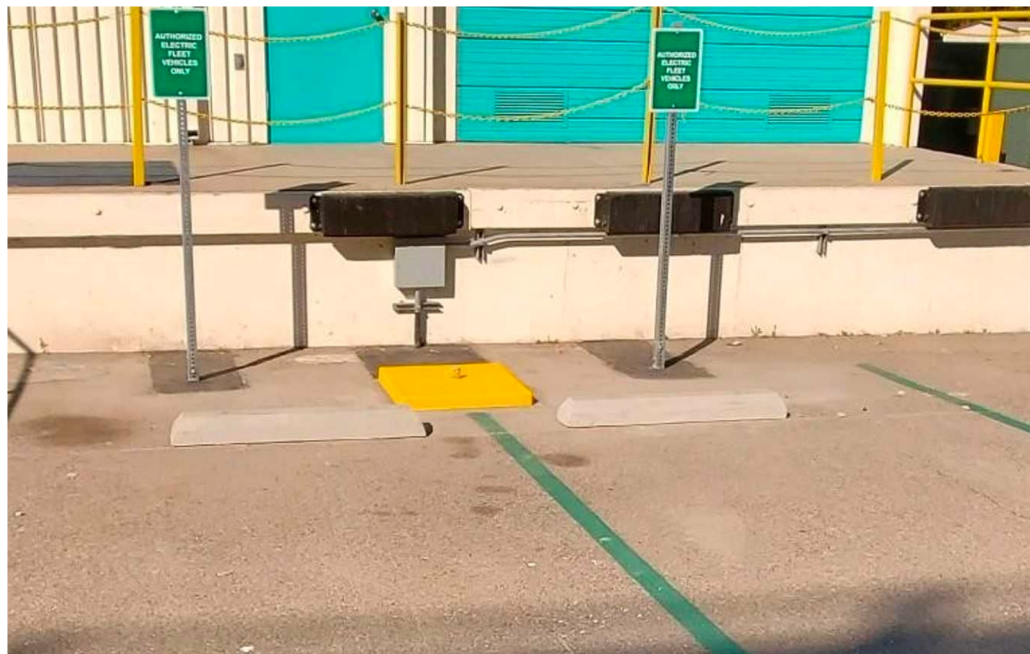
EV Supply Equipment (EVSE)

Definitions: Charging Equipment



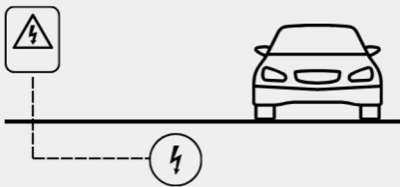
Portable EVSE Cordset

Definitions: EV Readiness

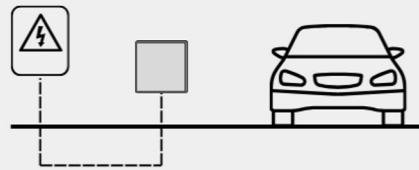


Make-Ready \neq EV Ready

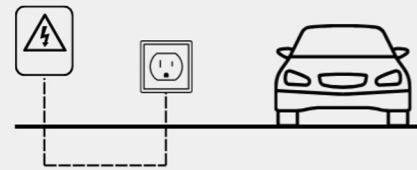
Definitions: EV Readiness



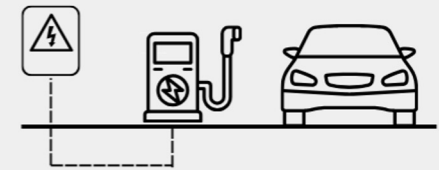
EV Capable



EV Capable +



EV Ready



EVSE Installed

- ✓ Sufficient electric panel space & load capacity for future EV charging
- ✓ Raceways for a branch Circuit to the EV space

EV Capable, plus:

- ✓ Circuit breaker and wiring, terminating in a junction box

EV Capable+, plus:

- ✓ Circuit terminates in a receptacle

EV Capable+, plus:

- ✓ Installed charging station

Definitions: Power Delivery

Level 1 (L1)

Standard household outlet 20 Amp, 120v AC
Driving distance added: 3-4 miles/hour



Low-Power Level 2 (LPL2)

20 Amp, 208/240v AC
Driving distance added: 10-13 miles/hour



Full Level 2 (L2)

Similar to a dryer outlet. 40+ Amp, 208/240v AC
Driving distance added: 25-30 miles/hour



DC Fast Charging (DCFC)

24-350kW
Driving distance added: 72-1,200 miles/hour












Best Practices for Equitable EV Ready Multi-Family Housing

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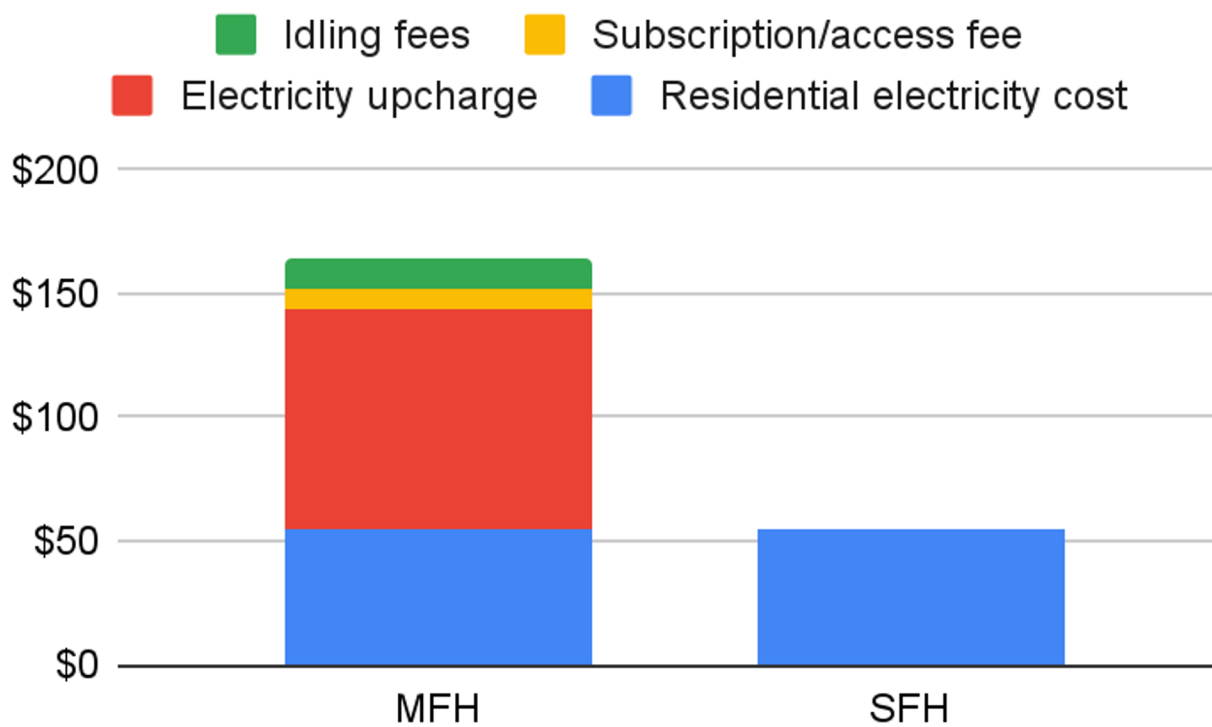
Types of Charging Access: EV Ready is sweet spot

	Sufficient panel space & load capacity for EV charging	A branch circuit & raceways	Wiring, circuit breaker & charging receptacle	Installed charging station	Can it be used by resident to charge now?
EV Capable or Capable+: actually INcapable! (Also required by code to be 40A)					No, first must get HOA or manager's approval, hire electrician, pull permit & pay for the upgrade.
EV Ready: ready to charge! (can be L1 or L2)					Yes, by using the cordset that comes with their EV (or EVSE if provided).
EVSE or EVCS: Electric Vehicle Service Equipment / Electric Vehicle Charging Station					Yes, by using the provided charging equipment from an ESVP (Electric Vehicle Service Provider). <small>21</small>

Levels of Charging Power: LPL2 is sweet spot

	Type of Outlet	Typical Circuit Breaker Size (Amps)	Voltage	Kilo-Watt Output (kW)	Miles added per hour of charging	Miles added over 10 hours
Level 1	Standard household outlet	15	120	1.4	~5.6	42-56
Low-Power Level 2	EV charging in MFH	20	208/240	3.8	~15	114-150
Level 2	Stove outlet, EV charging	40	240	7.6	30	220-300
Non-residential: Direct Current Fast Charging (DCFC)	Public & fleet charging	Varies	Varies	24-350	72-1200	N.A.

A Tale of Two EV Drivers



Direct wiring... Key to equitable rates & resilience

California's Intervening Code Cycle (taking effect on July 1), requires direct wiring!

*“EV charging receptacles in multifamily parking facilities at **assigned parking spaces** shall be provided with a **dedicated branch circuit connected to the dwelling unit's electrical panel**, unless determined as infeasible by the project builder or designer and subject to concurrence of the local enforcing agency.”*



FOUR PRINCIPLES OF EQUITY-CENTERED EV CHARGING FOR MULTI-FAMILY HOUSING

1. Provide each household unit that has parking with at least one EV Ready charging space.

Vs. requiring a certain percentage of parking spaces to be EV Ready or EV “Capable”

2. Require at least low-power Level 2 (not full L2) and **EV receptacles** (not necessarily EVSE).

This minimizes cost to builders while providing adequate power and access to residents.

3. Wire receptacle or EVSE directly to corresponding household’s panel or meter.

This allows residents to access utility rates, avoid monopolistic third-party markups, and enjoy the resilience benefits of bidirectional charging.

It requires parking to be assigned; this parking can be **unbundled**—paid for separately.

4. Install prominent signage at each EV Ready and EV Capable space.

This ensures awareness of the availability of charging so it’s not hidden.

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Case Studies: Three Code Policy Levers

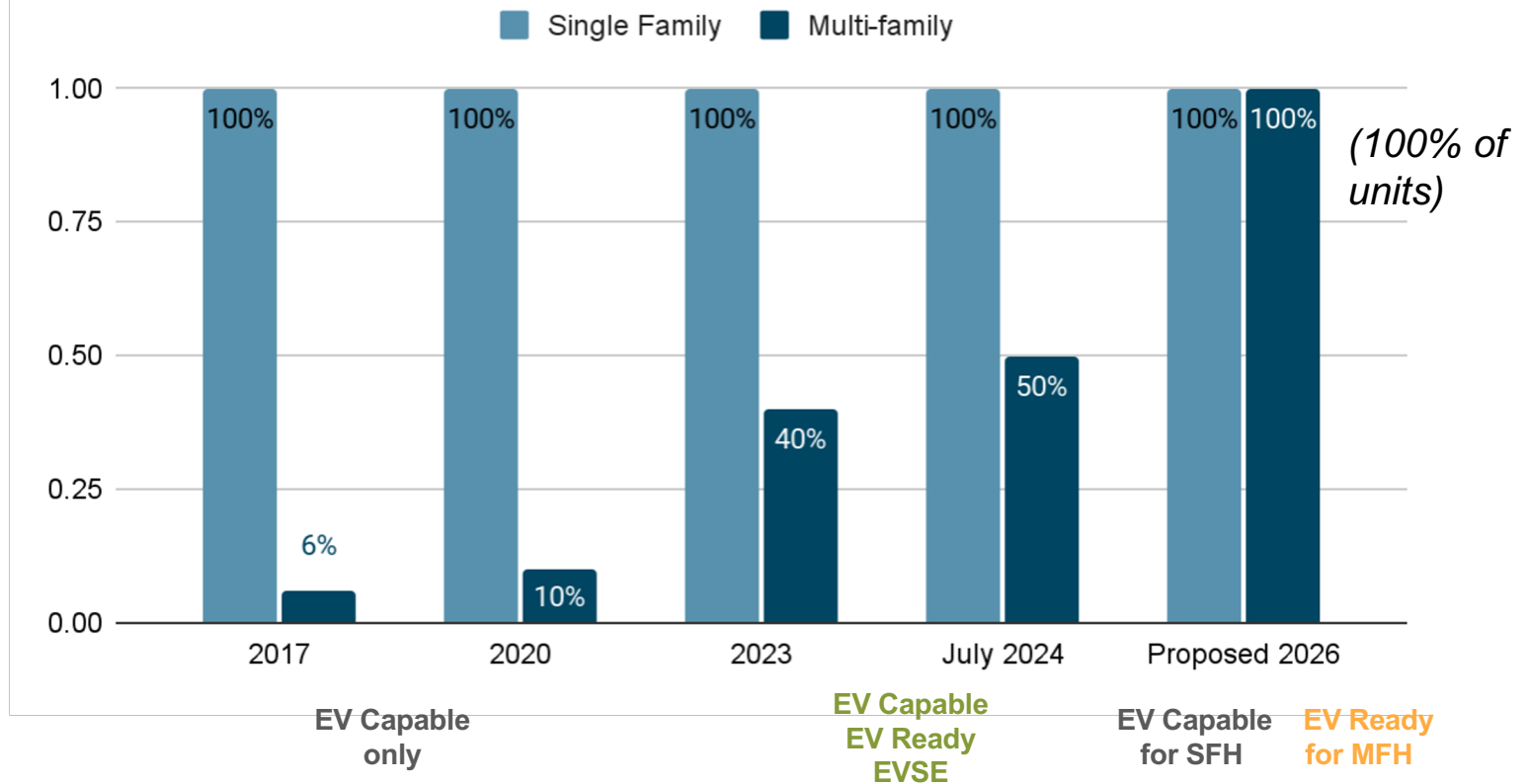


Regulatory lever: CALGreen



Evolution of CALGreen Building Code

Percentage of EV Access Required in New Construction



Local Policy Lever: City of San Jose Reach Code



San José's new EV reach code for new MFH

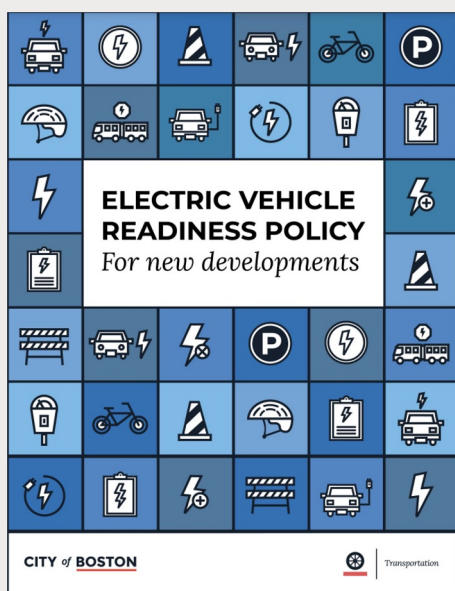
- Boosts the % of residential parking that is EV ready from 30 to 100%;
- Removes an obsolete exemption for parking lifts
- Requires all assigned parking to be directly wired to the unit's electrical meter
- Allows an inequitable exemption from the direct-wiring requirement for unbundled parking



Local Policy Lever: City of Boston, MA



Local Policy Level: City of Boston, MA



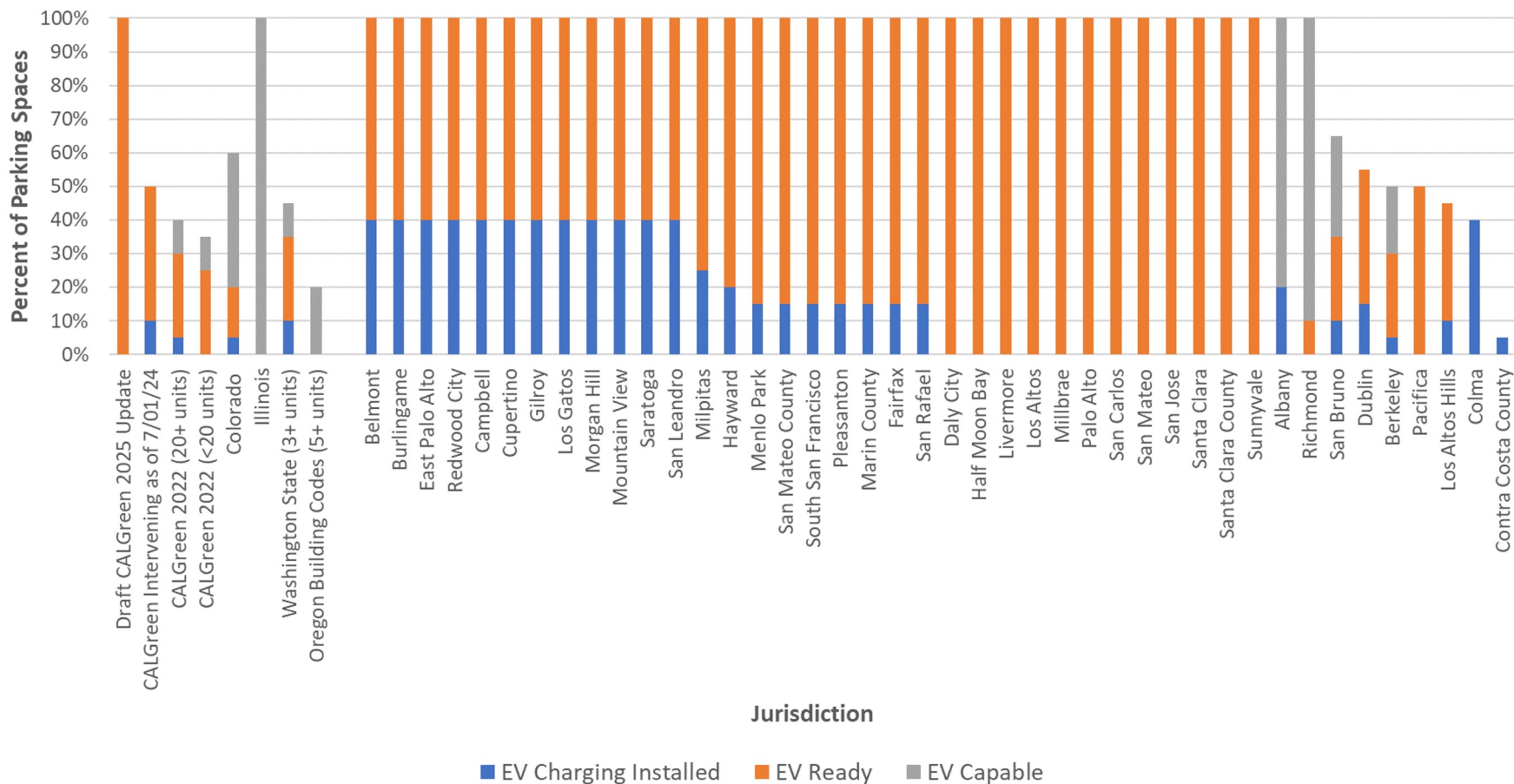
Requires EVSE-Installed L2 at 25% of parking spaces

Equivalency calculator allows for flexibility, with each parking spot equal to one point. May be offset by:

- **Level 1 Chargers**
- **DCFC (50kw, 125-150kw)**
- **EV Carshare**
- **Electric Bike Parking amenities.**

Multi-Family Residential Codes Landscape

Multifamily New Construction EV Codes Summary



Source: TRC

Legislative Lever: Illinois EV Charging Act

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Illinois EV Charging Act (2023)

- EV Capable for 100% of parking in ALL types of housing.
- Right to charge protections for MFH residents and renters



[Our work](#) [Our impact](#) [About us](#) [Get involved](#) [News and stories](#)

Illinois' new EV Charging Act brings more equitable charging to renters

By EDF Blogs / Published: June 15, 2023

By Neda Deylami

UPDATE: Since this blog's publication on June 15, 2023, the Chicago City Council has passed an ordinance aligning



State Preemption Laws Are Proliferating...

Texas: HB 2127 (2023) *“Death Star Law”* – *fortunately doesn’t affect building codes*

Missouri: HB 184 (2023) *Passed the House – died in the Senate*

Florida: SB 1084 (2024) *Passed and Approved by Governor last week*

Join EVCAC

- Join our Slack team: bit.ly/EVCACslackMay2024
- Read and share the toolkit: bit.ly/EVcodestoolkit
- Help us connect with funders and clients
- Join the National EV Codes Working Group
- Join our mailing list
- Introduce EVCAC to your networks

Email vwarheit@chargingforall.org



Thank you!

info@chargingforall.org





Equitable Transportation Electrification

May 8, 2024

Linda Khamoushian, Senior Clean Mobility Strategist

At GRID Alternatives, we envision a rapid, equitable transition to a world powered by renewable energy that benefits everyone.

We work to build community-powered solutions to advance economic and environmental justice through renewable energy.

People. Planet. Employment.

**Underserved
Communities**



**Fenceline
communities**

**Under-resourced
Communities**

**Frontline
communities**

**Disadvantaged
Communities (DAC)**



**Low-income
communities**



**Environmental Justice
communities**

**Communities
of Concern**



**Communities
of Color**

**BIPOC
communities**

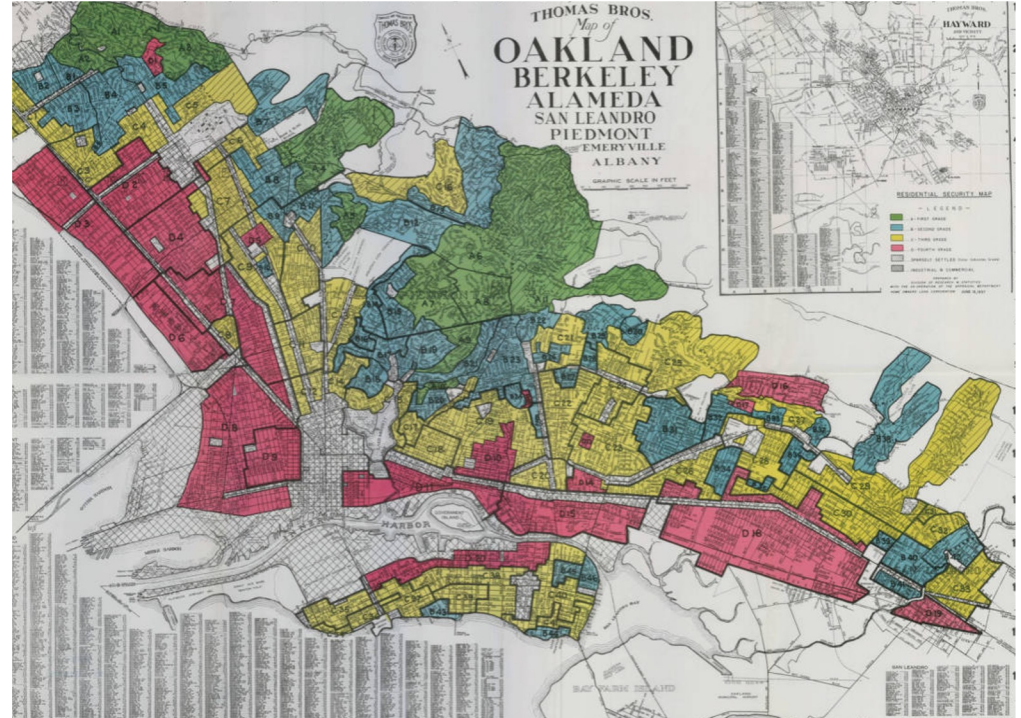
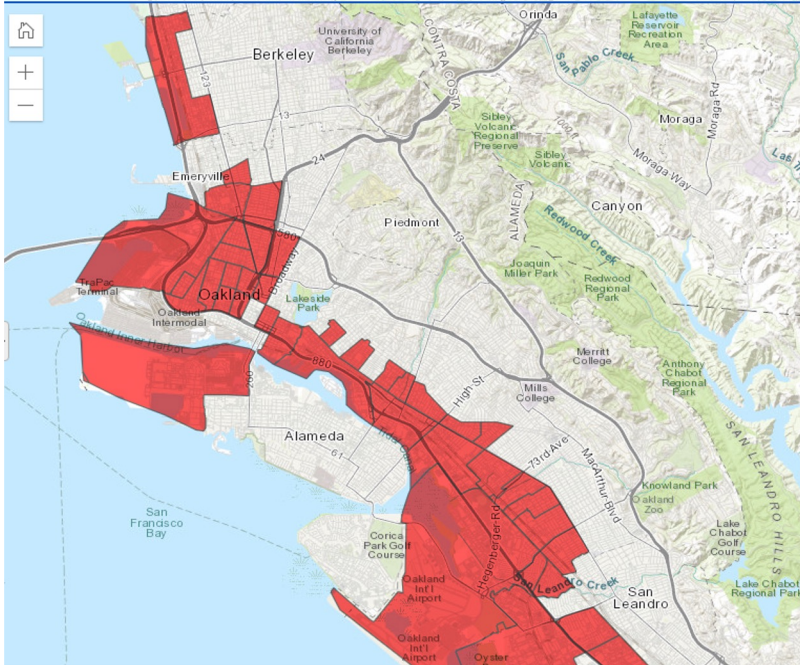


**Low-income
Households**

"Disadvantaged Communities" determinations directly tied to history of "Redlining" policies and siting of transportation infrastructure (highways) of the 1950s

CalEPA
California Environmental Protection Agency

SB 535 Disadvantaged Communities (2022 Update)



GRID Alternatives' approach to equitable clean mobility



Prioritize capacity building and wealth building opportunities: community-powered solutions



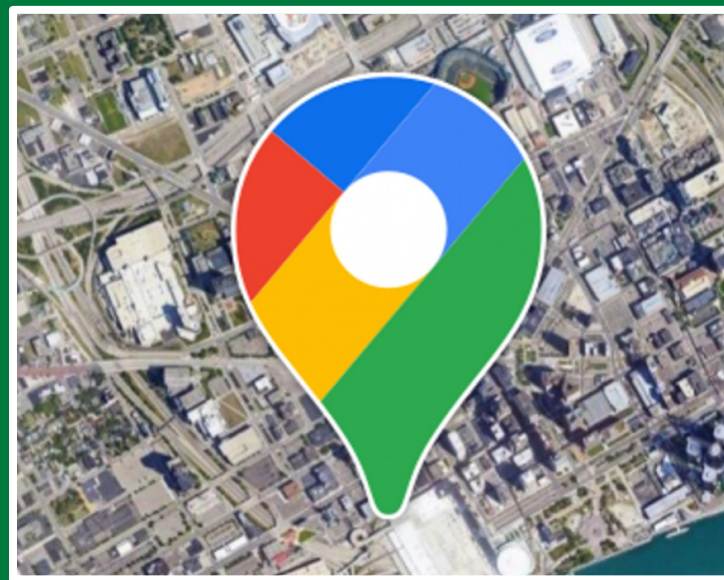
Maximize savings from transitioning off of fossil fuels: using clean, cheap solar energy to charge



Move people, not cars: mobility justice means clean public transit, e-bikes, and more

Equitable transportation electrification prioritizes people over places

By focusing on the ways people actually use transportation, and prioritizing community needs, we can build a clean transportation future for everyone.



Some of GRID's Involvement with Clean Mobility Programs from 2017 - Present:

Access Clean California

Less pollution, more power

GFO-22-614 - Reliable, Equitable, and Accessible Charging for Multi-family Housing 2.0 (REACH 2.0)

Berkeley E-Bike Equity Project
Climate benefits to Berkeley residents



DRIVING CLEAN
ASSISTANCE PROGRAM



eTRUC
California's Electric Truck Utilization Center



Prioritizing Charging \$ in EJ geographies \neq Equity Benefits



Electric Vehicle Supply Equipment (EVSE)

At-Home Chargers

Retrofit/upgrade
existing site

Incorporate into
new building/site

Public Chargers

Access, Safety,
Reliability

EVSE not just the installation of equipment (ports), it also needs:

- **Engineering**
- **Site Permitting**
- **Designated parking spaces**
- **Signage**
- **Electric supply upgrades (transformers, panels, trenching, etc.)**
- **Installation labor and materials**
- **Maintenance and Operations**
- **Network agreements**
- **Site compliance**
- **Outreach/engagement of tenants/public**
- **Data collection**

The best time to incorporate EVSE installation, is when you build a new building, but most current EVSE funding programs don't work for new construction.

- **Funding often doesn't allow for EVSE in new buildings or doesn't work with long development timetables**
- **Funding is not 100 cents on the dollar, not receiving full reimbursement and will need to pull from other sources**
- **Funding has well-intended EVSE requirements that aren't flexible to the varied types of sites and what may be needed at each site - different parking setups, available electrical power, etc.**

Yes, we need energy and building codes that make for an easier transition to electrification. However, we have to also ask:

- **Who is this new development for? Low-income residents or market-rate tenants?**
- **How does the energy code/building code requirements deter building affordable housing or not?**
- **What other transportation amenities and enhancements will accelerate equitable transportation electrification at this site?**

A better approach - dedicated, additive public dollars to incorporate EVSE into new affordable housing development



CALIFORNIA STRATEGIC GROWTH COUNCIL

GRANT PROGRAMS ▾ INITIATIVES MEETINGS & EVENTS TOOLS

Affordable Housing and Sustainable Communities

Integrating affordable homes and sustainable transportation

A better approach - comprehensive equity programming that puts tangible benefits for people at the center



DRIVING CLEAN
ASSISTANCE PROGRAM

miocar



Case Study for GRID's "Maximizing Savings" Approach: Public Charging Program for Income-Qualified Drivers



Main takeaways:

- **Successful equitable transportation electrification policies and programs require provisions for both priority places and priority people and their specific needs**
- **Energy agencies should collaborate with housing agencies to fund EVSE in new affordable housing construction, both in general, and particularly if your state adopts EVSE building code requirements for new housing development**



Thank you!