PLUG-IN ELECTRIC VEHICLE INFRASTRUCTURE FOR CALIFORNIA: DEPLOYMENT AND INTEGRATION

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Plug-In Electric Vehicle Infrastructure for California: Deployment and Integration

- Electrification must accelerate past prior charger installation rates and forecasted battery improvements to mitigate climate change and air pollution.
- Utility charging programs must simultaneously accommodate the diversity of cities and leverage scale to ensure production and investment efficiency.
- Smart charging is commercially viable today. It is crucial to cost-effectively enable large investments and to renewably power millions of PEVs.
- U.S., European, and Asian OEMs will deploy ISO/IEC 15118. Reciprocal investments by charging manufacturers and utilities are essential to avoid stranded assets and to pave the way for more seamless driver experiences.
- The Energy Commission leads the development of new technologies and analysis-based policies that will expedite installations and enable innovation.

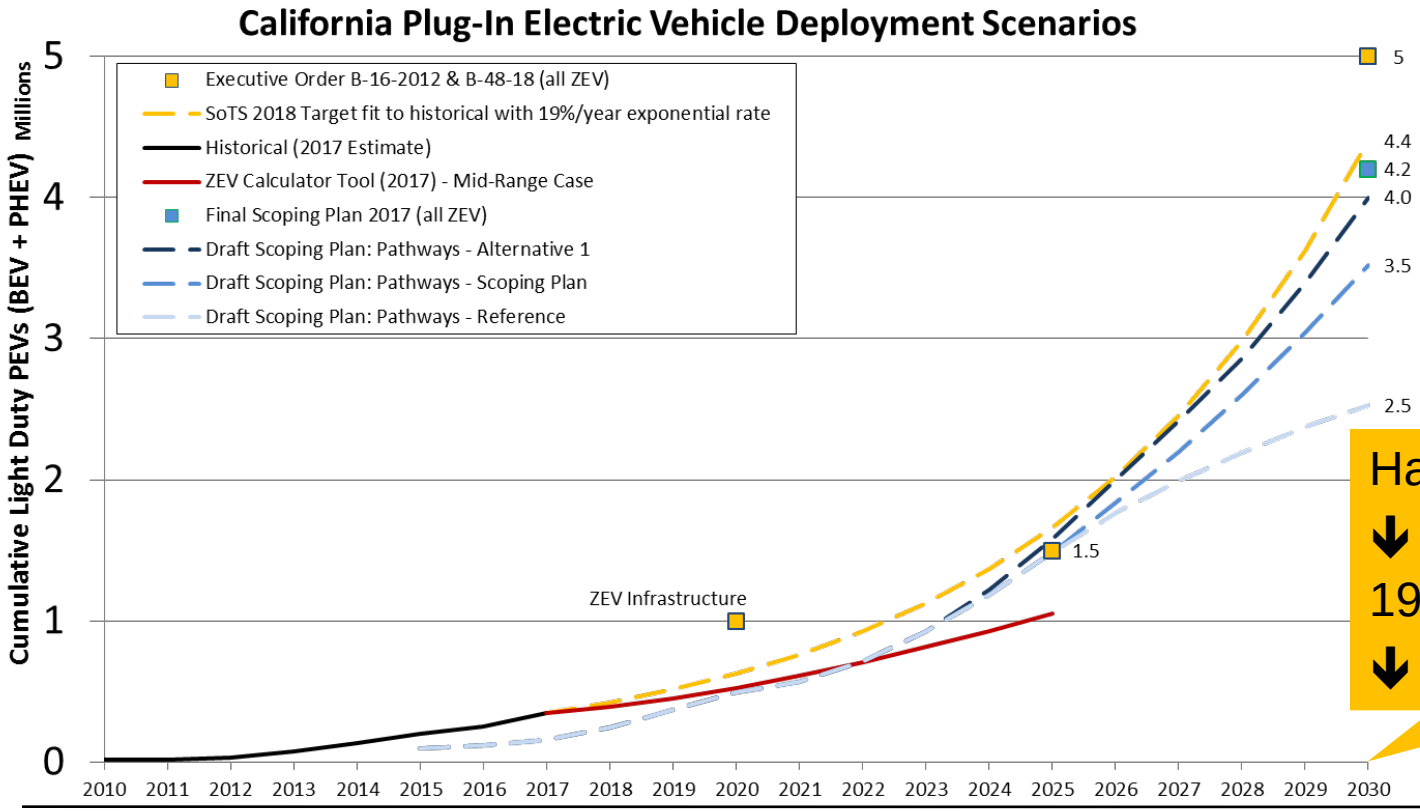
As staff, the analysis and statements herein do not reflect the opinion of Commissioners or the California Energy Commission.

Electric transportation deployments and grid integration research aim to reduce more than half of CA's greenhouse gas emissions.

The Energy Commission supports California's public and private deployment of grid-integrated Plug-In Electric Vehicles and chargers.

- Validate innovative charging and vehicle technology with world-leading researchers and industrial partners;
- Accelerate the commercialization of viable and interoperable products through market analysis and planning, policy development, and customer programs;
- Harness technological and programmatic capabilities to positively impact electric system operations and infrastructure; and
- Timely achieve emissions reduction targets.

Over 350,000 PEVs are on California's roads today, and Governor Brown's Executive Order calls for 5 Million by 2030.

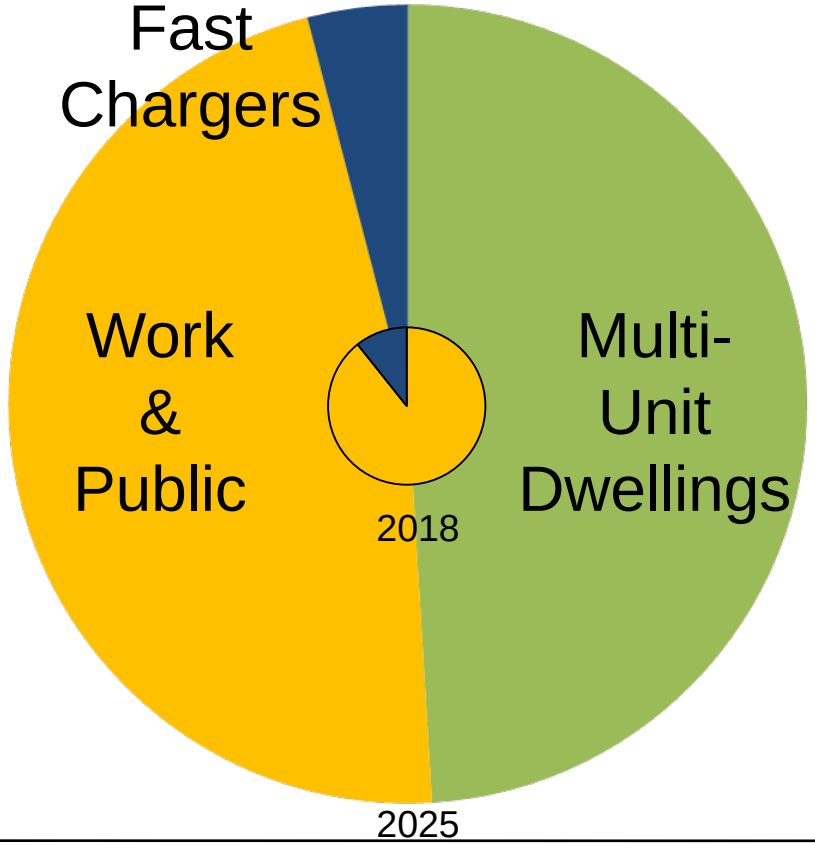


Halve Petroleum Use

⬇ GHG 40% below 1990 levels

⬇ Air Pollution ~80%

California will work with the private sector to spur construction of 250,000 Chargers, including 10,000 DC Fast Chargers by 2025.

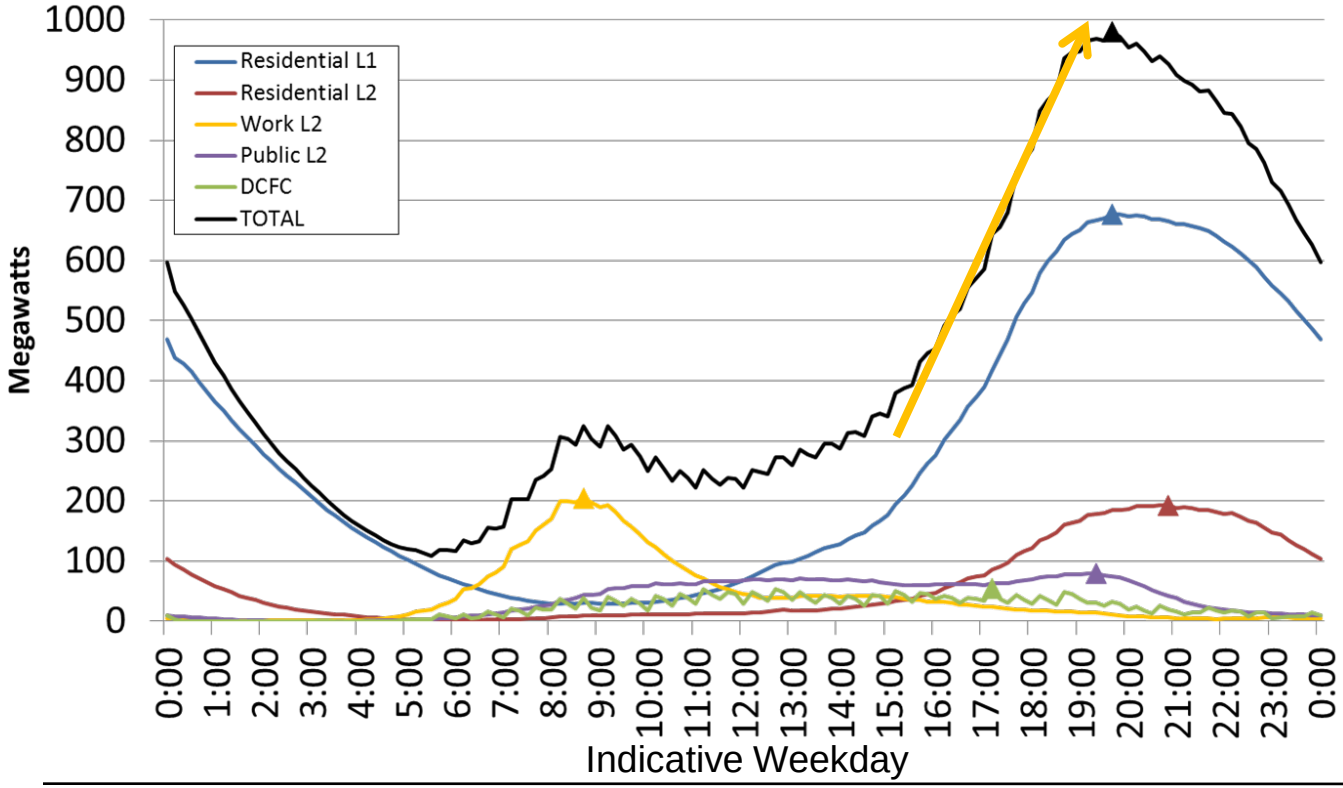


Requires 20x ↑ installation rate

- EV Service Providers
- Automakers
- CA Programs: CEC & ARB
- Air Districts
- Local Governments
- Utilities + Energy Providers
- Electrify America
- NRG/EVgo

CEC Staff Report: California Electric Vehicle Infrastructure Projections: 2017-2025

The first of CEC's ongoing needs assessments using EVI-Pro finds that by 2025, PEV charging adds 1 GW of load at 8p on weekdays.



Level 1 at home contributes ¾ of the additional 505 MW max. 3 hour ramp between 3:40-6:40 pm.

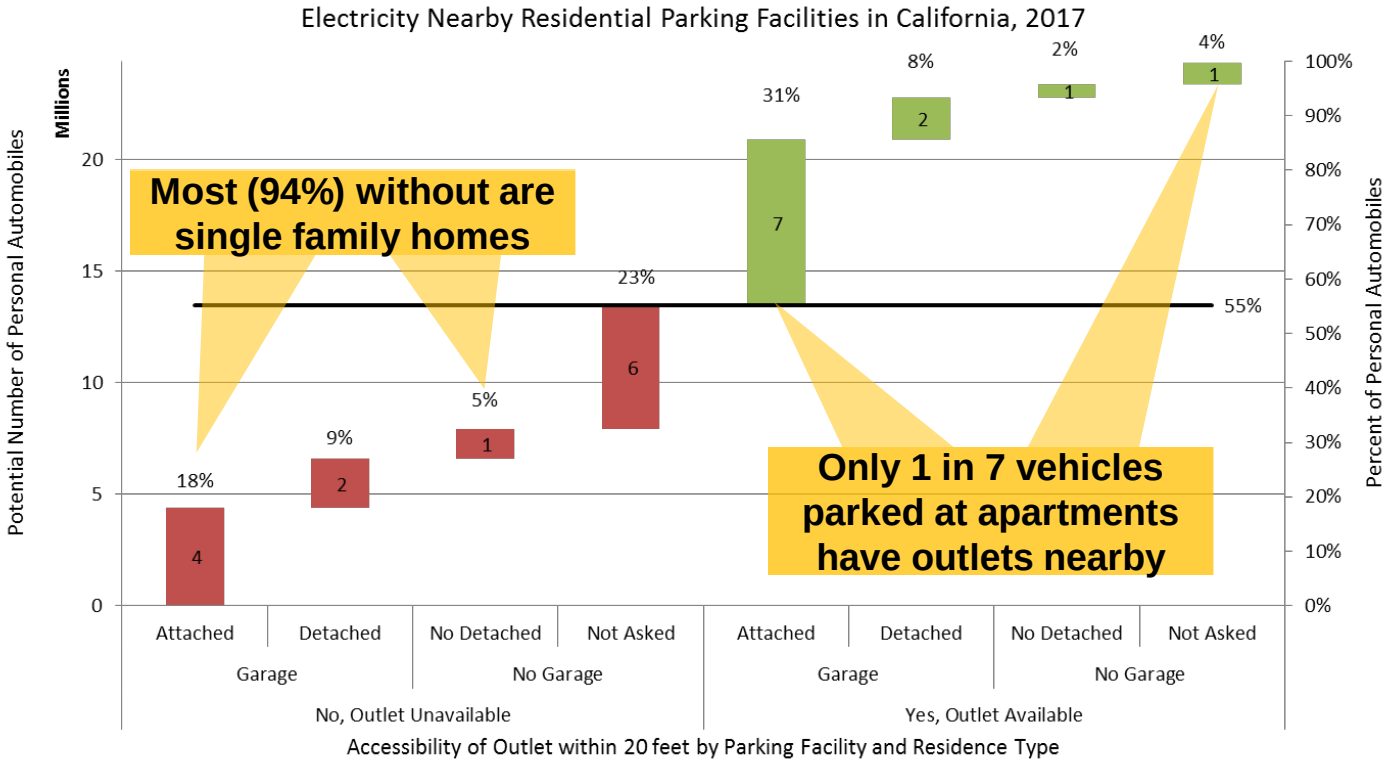
Approximately equal to the 2018 CAISO Super-Peak Flexible Capacity Need.

Electricity policy changes and vehicle power trends will create new challenges, requiring the use of networked smart chargers.

~¾ of CA residential customers will default to Time Of Use Rates in 2019 and charging load has increased +1 kW since 2011.

Impact	Level 1	Non-Networked Level 2
Distribution Grid	Coincident Home and PEV load overloads transformer "Timer Spike"	Uncoordinated charging in neighborhood "Adoption Clusters" worsens Timer Spike
Meeting Travel Requirements	Delay until after 12a prevents batteries from fully recharging	Bundled with 200+ mi BEVs & PHEVs with higher power to reduce range anxiety
Renewables Integration	Most residential charging does not coincide spatiotemporally with solar	

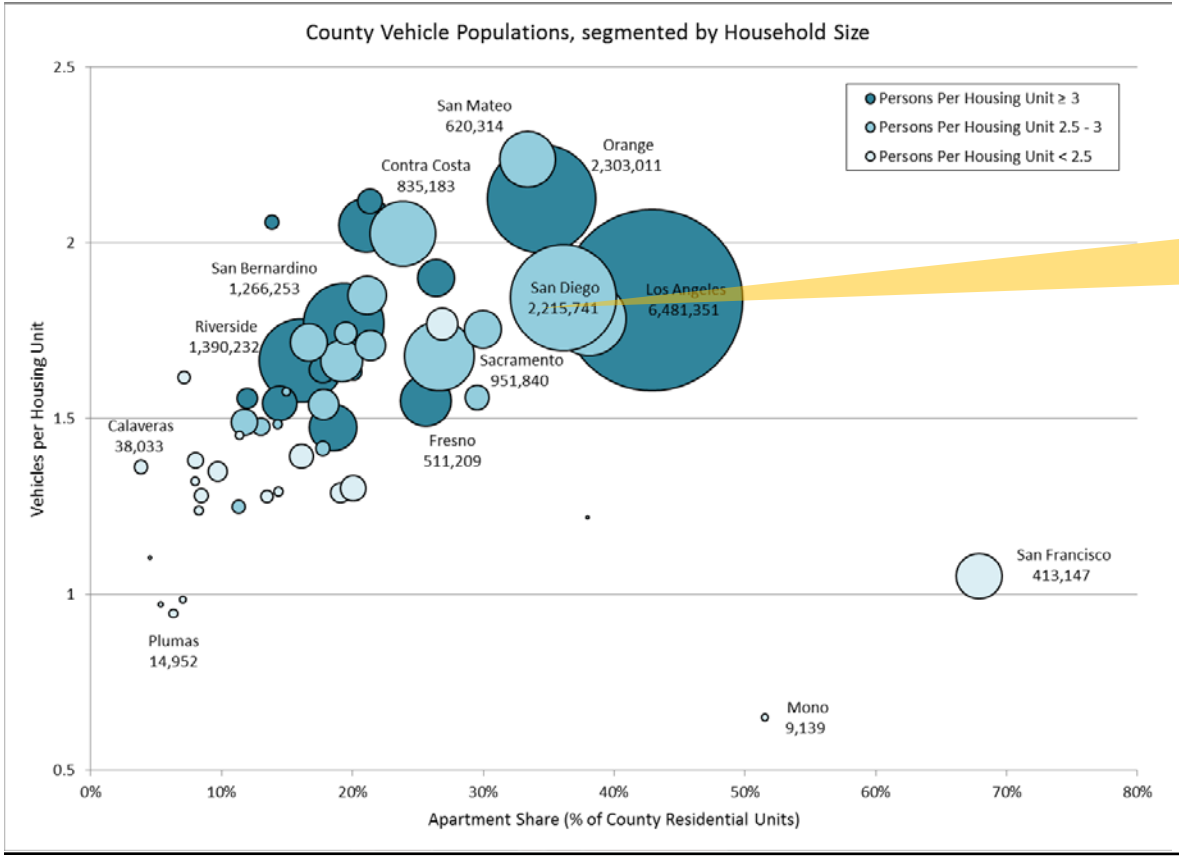
Half of cars lack electricity nearby their home parking space so the grid will need to be extended there, at work, and in the public.



The CEC's Default Scenario is a first estimate of need and is based on county travel and housing data.

By using highly-local parking datasets, demand for non-residential charging will likely expand.

Charging infrastructure programs must reflect the diversity of the local built environment to quickly gain customer uptake.



San Diego:
2.2 M automobiles
1.8 cars / housing unit
2.8 people / household

Statewide and utility-class or territory averages are not locally robust.

New policy, technology, and market-based solutions are needed.

EV-Smart Grid Interoperability Center vision for global interoperability is where any PEV can plug into any EVSE, anywhere, anytime.

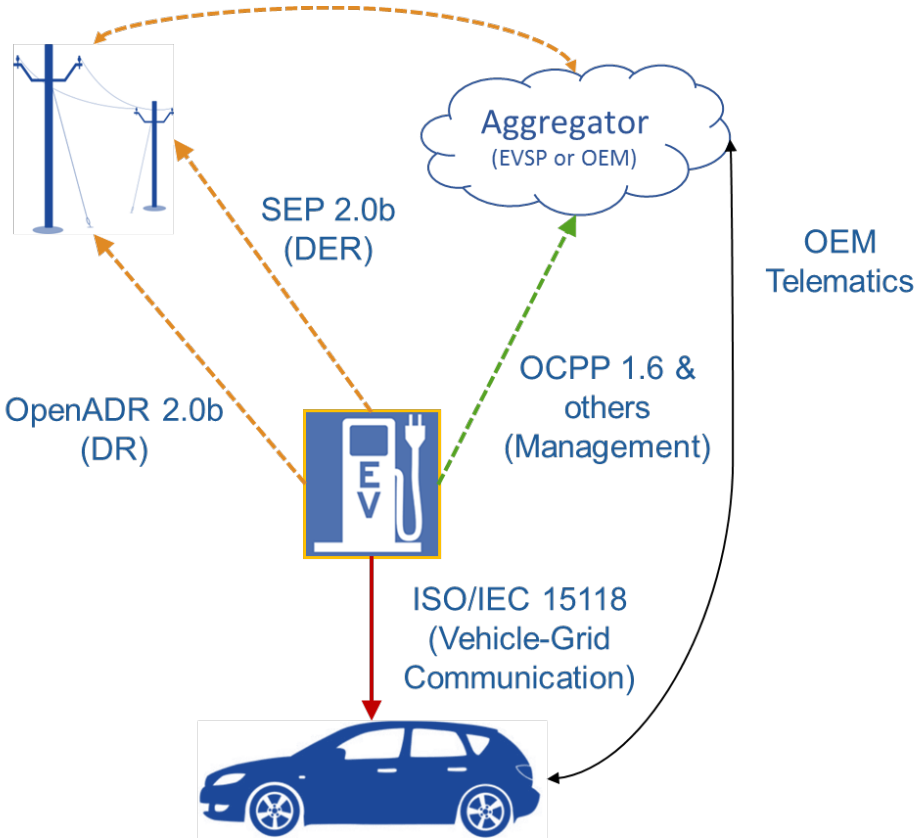
Codes & standards are *essential* for:

- *Interoperable PEVs, EVSE, and communication networks*
- Sending industry *predictable investment requirements for them to achieve scale economies*

ISO/IEC 15118 is paramount to customer interoperability and vehicle-grid integration.

Multiple ways for utilities to communicate Demand Response and Distributed Energy Resource (DR, DER) commands for charging exist, including via Aggregator network asset management and OEMs.

However, bidirectional high-level communications between *both* the EVSE and PEV via ***ISO/IEC 15118*** is critical to ease authentication *across* service networks and charger locations, and to harmonize the automation of smart charging *regardless* of utility, rate design, or aggregation algorithm.



ISO/IEC 15118 is proven for today's use cases, and "Is a key enabler for realizing new prospective business models" in the future.

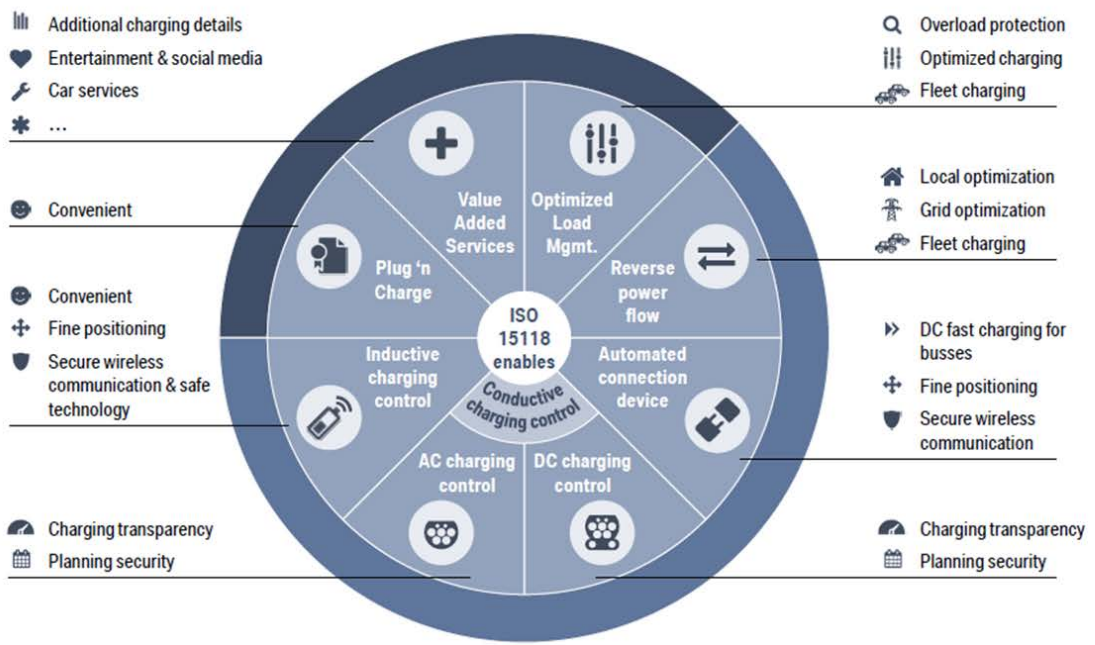
ISO 15118 – ENABLES NEW OPPORTUNITIES.

New Biz Models

Customer Friendly

AVs

Driver Confidence



V1G

V2G

Heavy Vehicles

High power Fast Chg

Adapted from BMW and Electrify America

Diverse organizations complete installations, supply components, intend to deploy, highlight, and/or recommend ISO/IEC 15118.

National Platforms

Vehicles

Chargers

Electrical Components & Software

Smart EVSEs are economic today and their value will grow– enabling innovation, efficient investments, and cleaner grids.

Non-exhaustive values of smart charging

- 1 month payback for $5-25 commodity hardware, if -$0.10/kWh arbitraged.
- Sharing reduces magnitude of CA network, saving ~$1-2 B (EVSE), 2025.
- U.S. DCFC compatibility improves use, reduces compliance costs $61B, 2015.
- Shifting from peak to morning & daytime saves CAISO $700 M, 2030.
- Balancing new solar under a 50%+ RPS requires stationary storage purchases costing ~$600 M by 2026, and $2B by 2030.
- Stringent GHG reductions require longer duration storage. If aggregations of dischargeable V2G can substitute for storage, could avoid ~$10B by 2030.
- Automating charging response to distributed solar on highly-efficient buildings reduces voltage and frequency fluctuations (unquantified).
- Newly-enabled business models (unquantified).

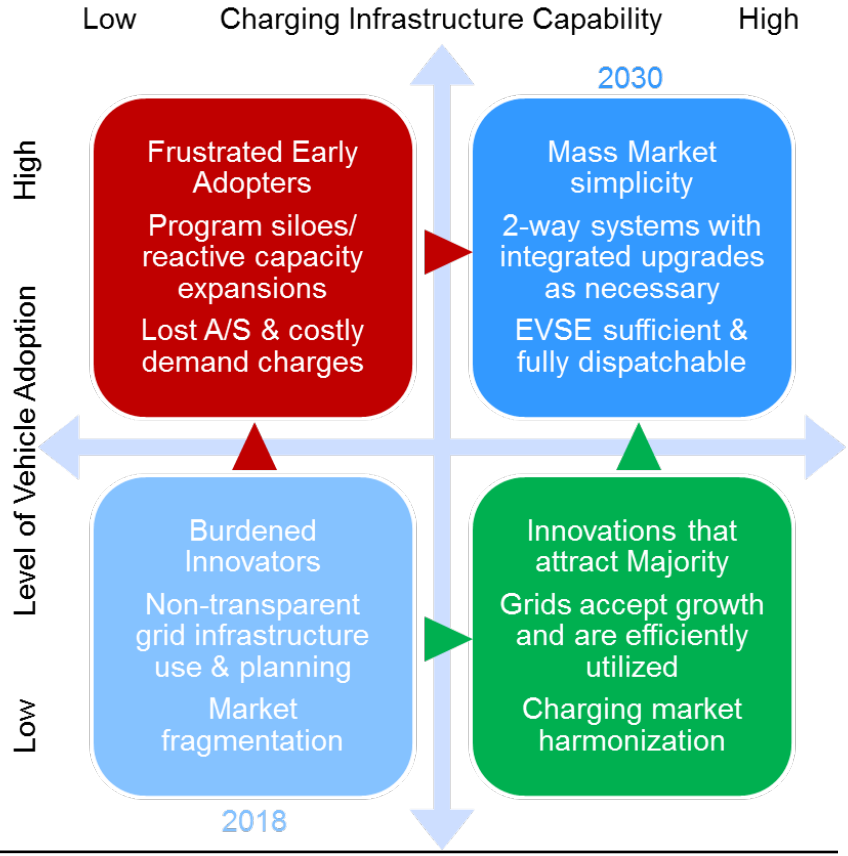
While high-level communications components are commoditizing, charging services are differentiating to fit into cityscapes.

Plug-and-Charge avoids downloading an app for that, and that, and…?

Envision Solar	Freewire Technologies	CityLift Parking	Ebee Smart Technologies
Distributed solar + storage, w/ optional grid interconnection Deployable within minutes in spaces without the costs of grid upgrades, pavement excavation	2nd life EV battery storage based Level 2 or DC Fast Charging Mobile and capable of charging 5 to 10 vehicles daily, or 2-5x utilization of pedestal chargers	Automated garage ready for full electrification ~90% less egress space per stall and 50% lower cost vs. conventional garages	Lamp post or power pole mounted charging Complementary to cities' efforts for efficient LED lighting upgrades

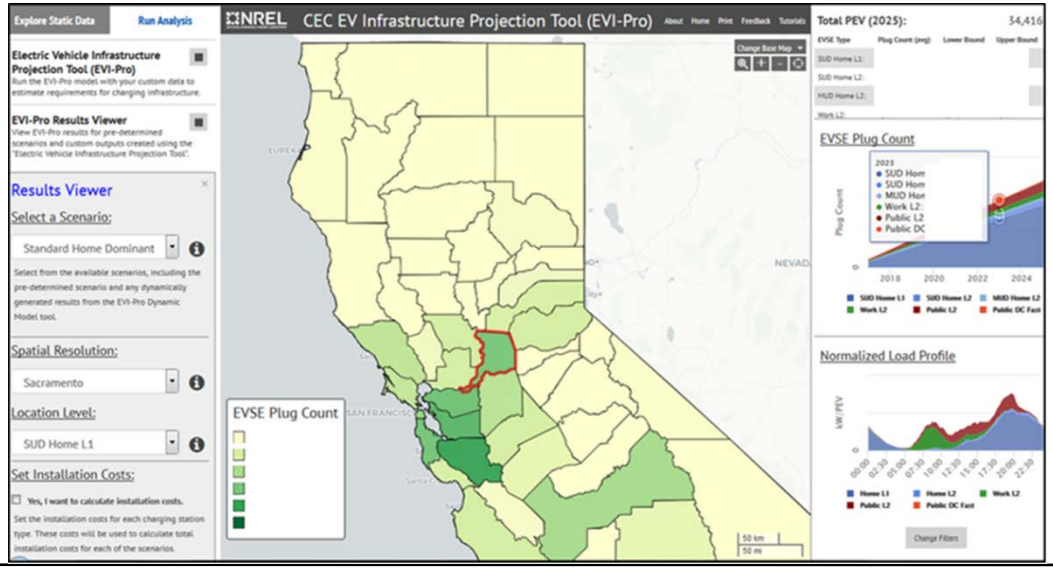
Seamless charging interfaces will mitigate grid upgrade cost, customer confusion, and other barriers to PEV adoption.

To rise to Governor Brown's call to confront climate change, can we afford to continue with the status quo or should we zealously commit to using the best technologies we have to accelerate progress down a better path?



Forthcoming CEC publications will help automakers and other stakeholders plan and integrate millions of PEVs in CA.

- California Electric Vehicle Infrastructure Projections: 2017-2025
- Plug-In Electric Vehicle Charging Infrastructure Deployment Strategy
- California Vehicle-Grid Integration Roadmap (Update)
- Transportation Electrification Research Roadmap



Contributors and References

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CEC Staff Report: California Electric Vehicle Infrastructure Projections: 2017-2025

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Thank you

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