



The Future of PEV Infrastructure

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IEPR Transportation Workshop

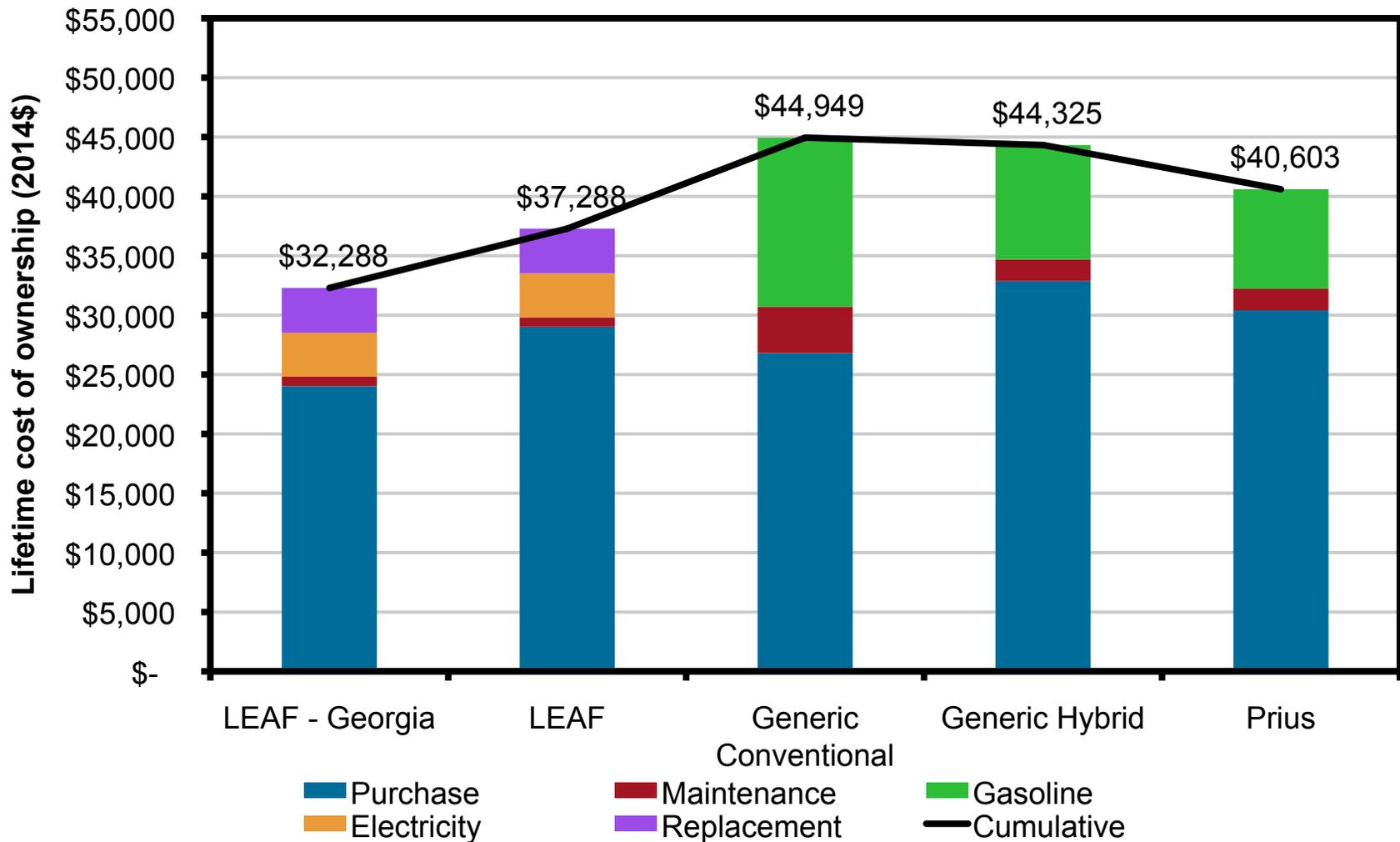
April 10th, 2014

The PEV Landscape in 2025

- PEV Adoption in CA that meets or exceeds ZEV Program targets
- Significant increase in fleet adoption (non-road and on-road)
- PEVs in many more (typically larger) vehicle platforms
- Increase in range and electric performance
- Vastly increased capabilities in connectivity and power delivery
- Superior total cost of ownership of PEVs



An Example of BEV Total Cost of Ownership 2013 Nissan Leaf

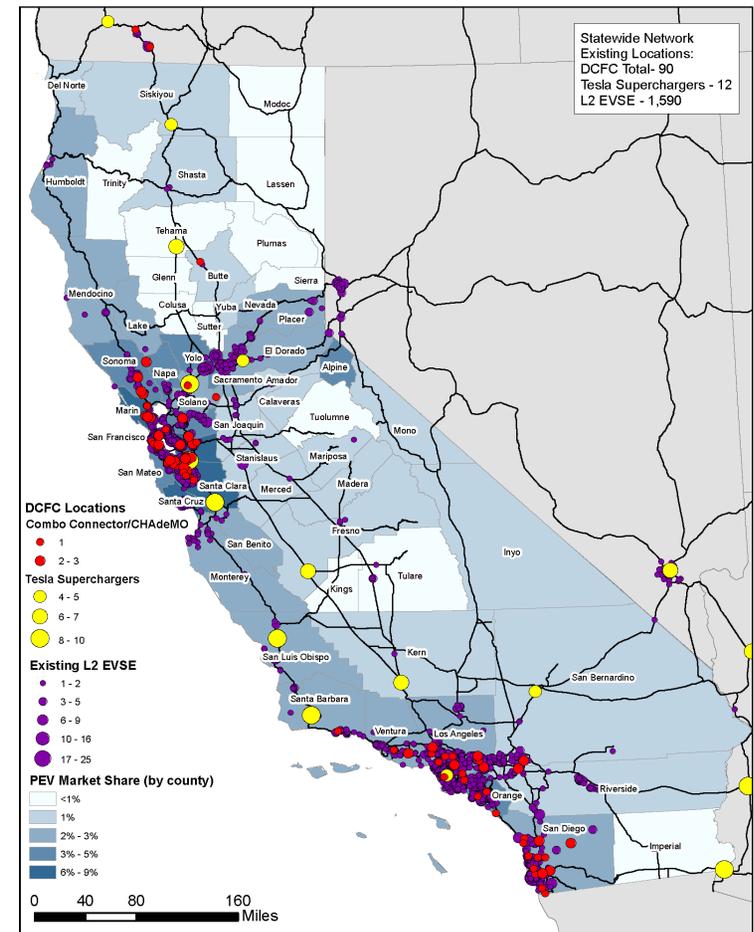


A 2025 To-Do List

Infrastructure Technology and Planning

- Elimination of the residential infrastructure barrier to PEV ownership
- Flexible and scalable public and workplace infrastructure
- Lower costs all around – installation, equipment, O&M
- EVSE that are increasingly connected—at dramatically lower costs
- Integration of PEVs—at scale—into load management programs
- More robust and resilient charging (particularly cord-and-plug connected)

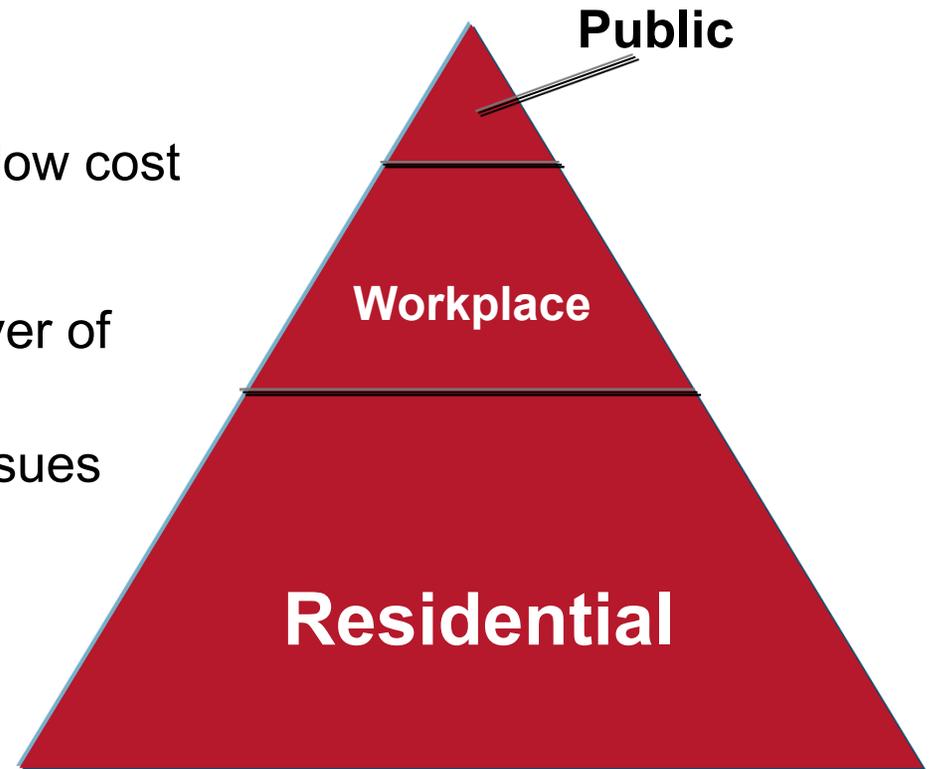
California - PEV Market Share (2013)



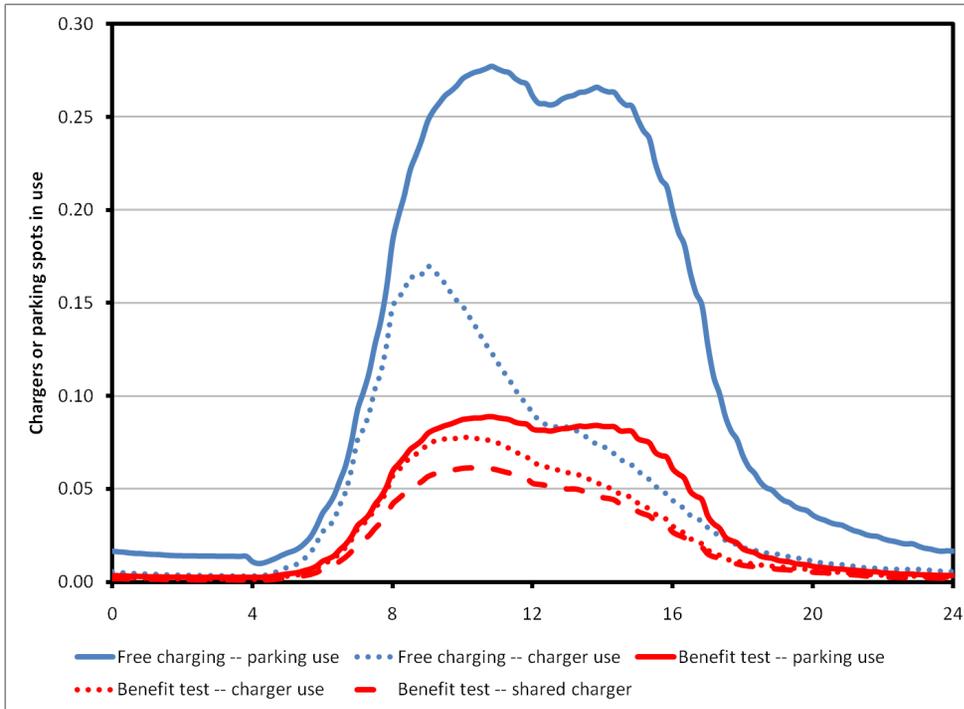
Much of tomorrow's infrastructure has not yet been invented today

What Have We Learned to Date?

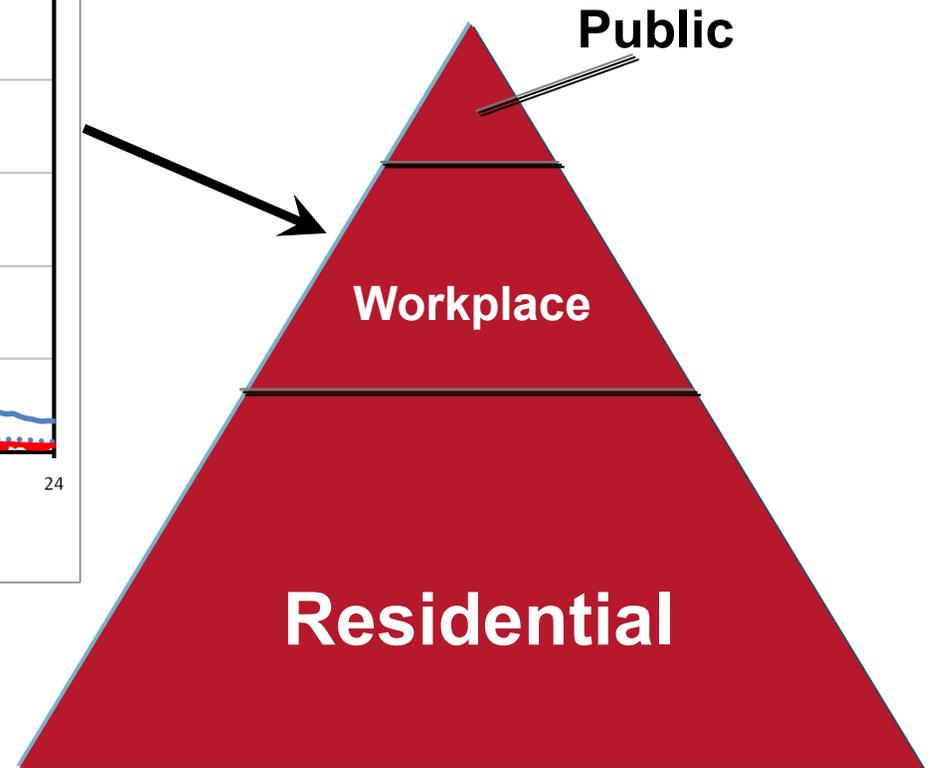
- Residential issues
 - Multi-unit and tenant dwellings
 - Relatively high initial costs
 - High adoption of Level 1 at very low cost
- Workplace
 - Potential has grown—see as driver of adoption
 - High installation costs, scaling issues
- Public Charging
 - Clustering – need to build out networks
 - Long-term sustainability of infrastructure
 - Underestimated difficulties of locating infrastructure



What Does Sufficient Infrastructure Look Like? Quantity, Location, Technology

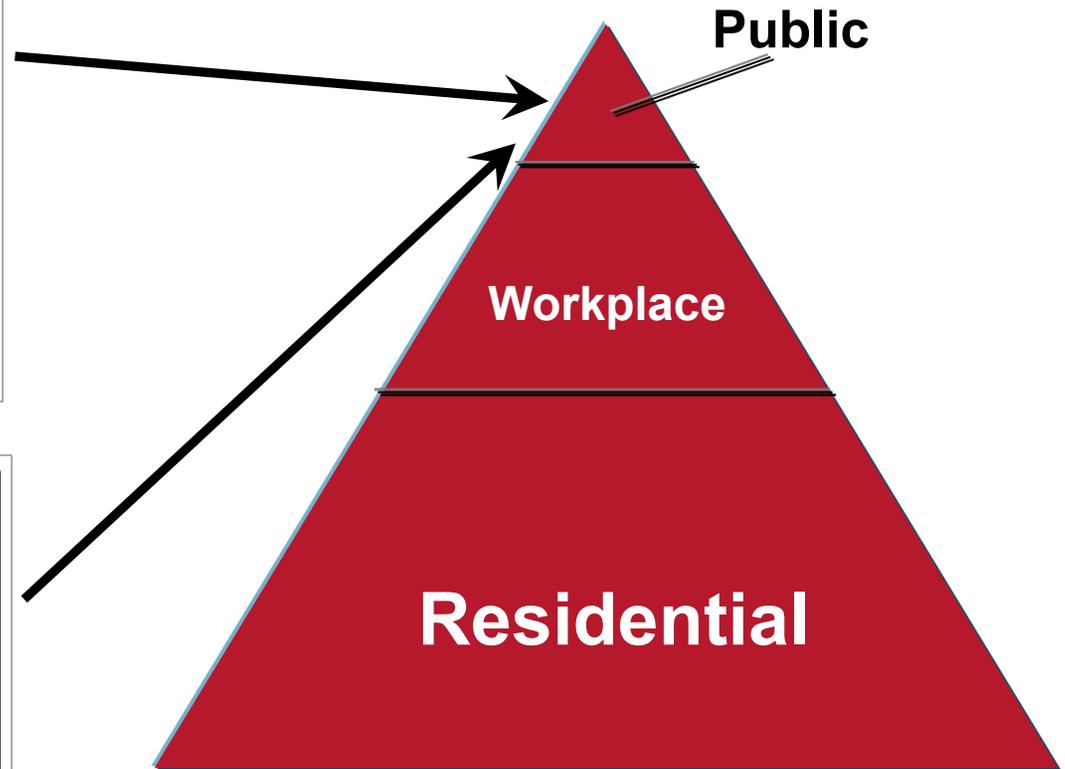
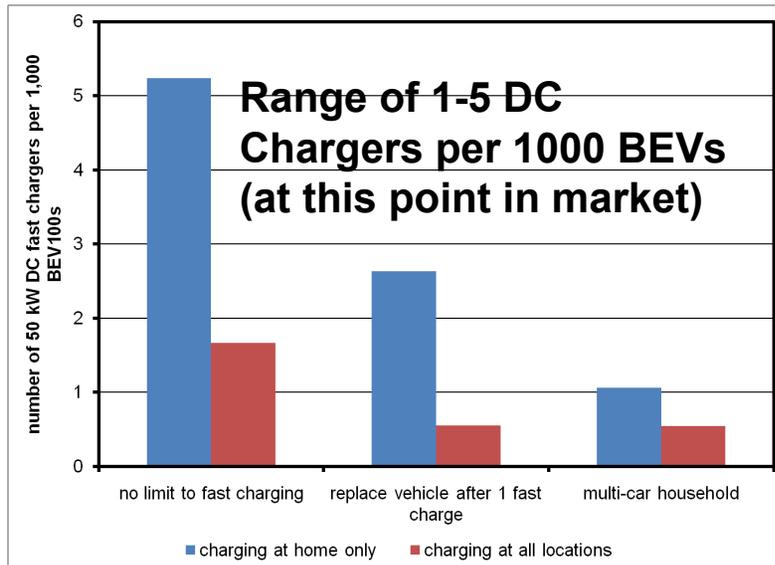
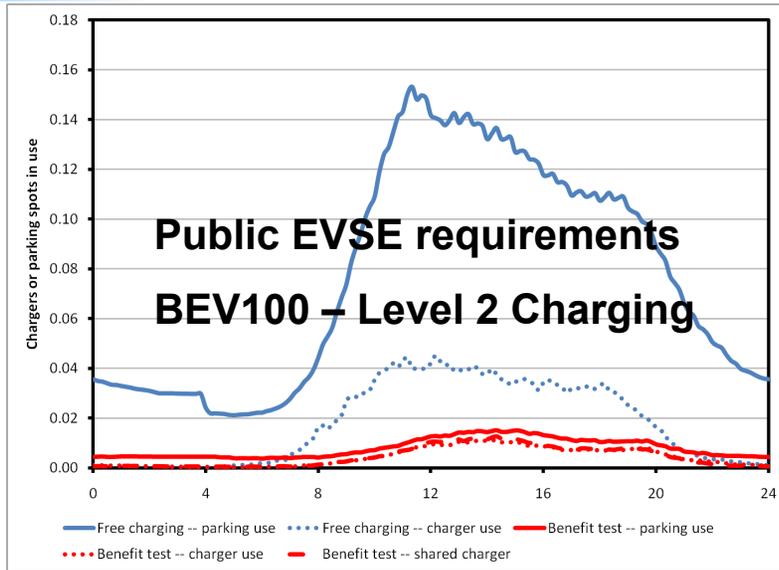


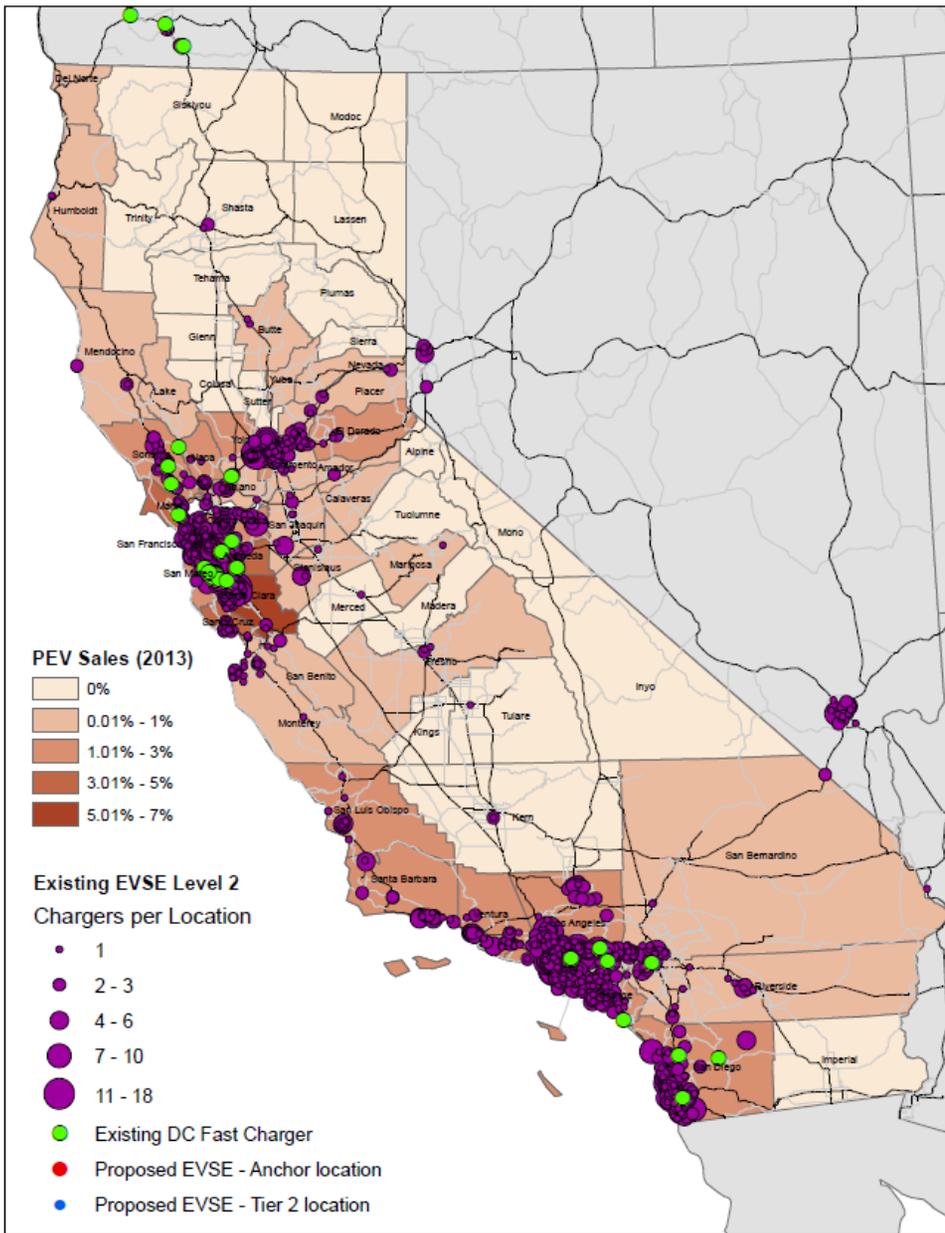
**Local workplace EVSE requirements
PHEV40 – Level 1 Charging**

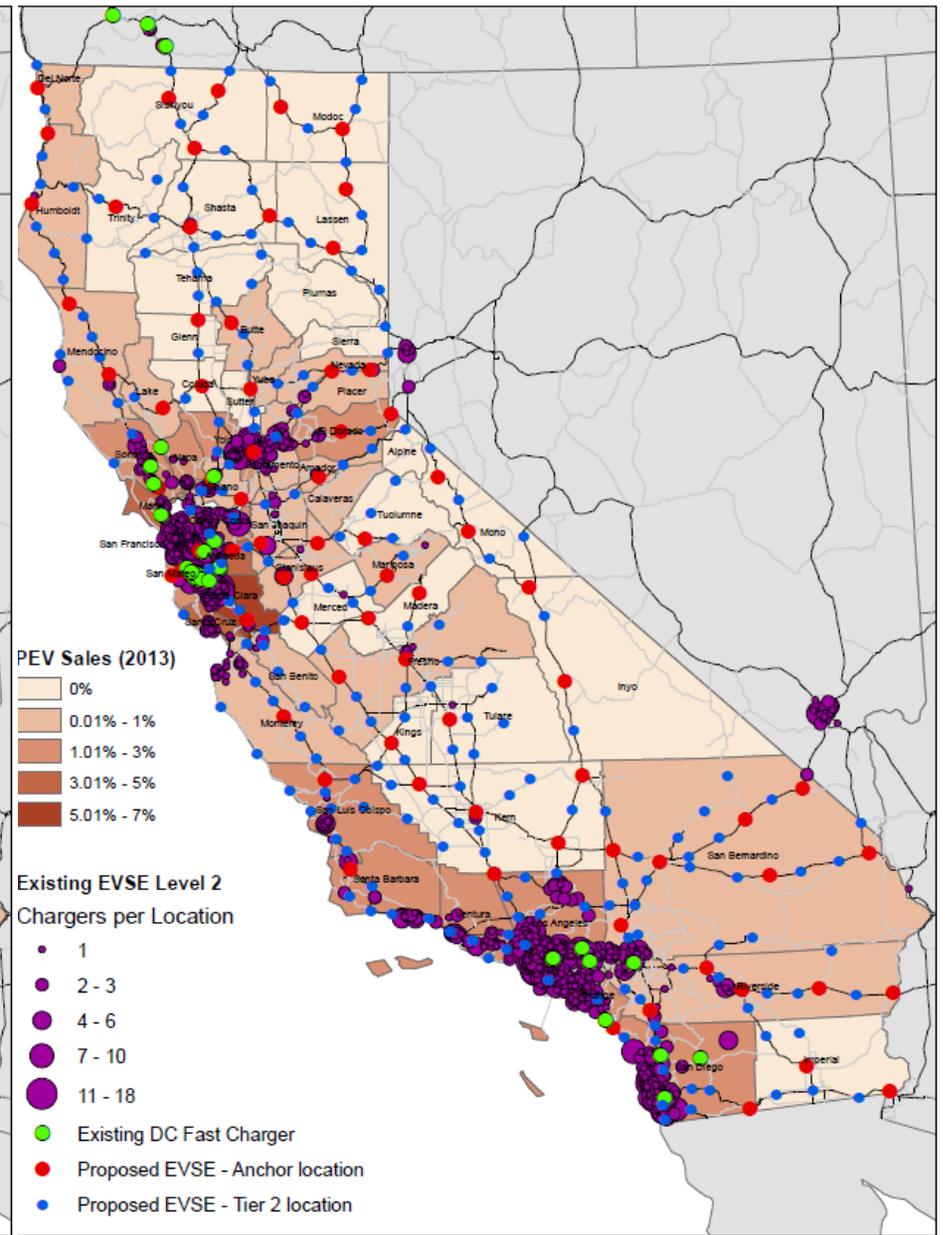
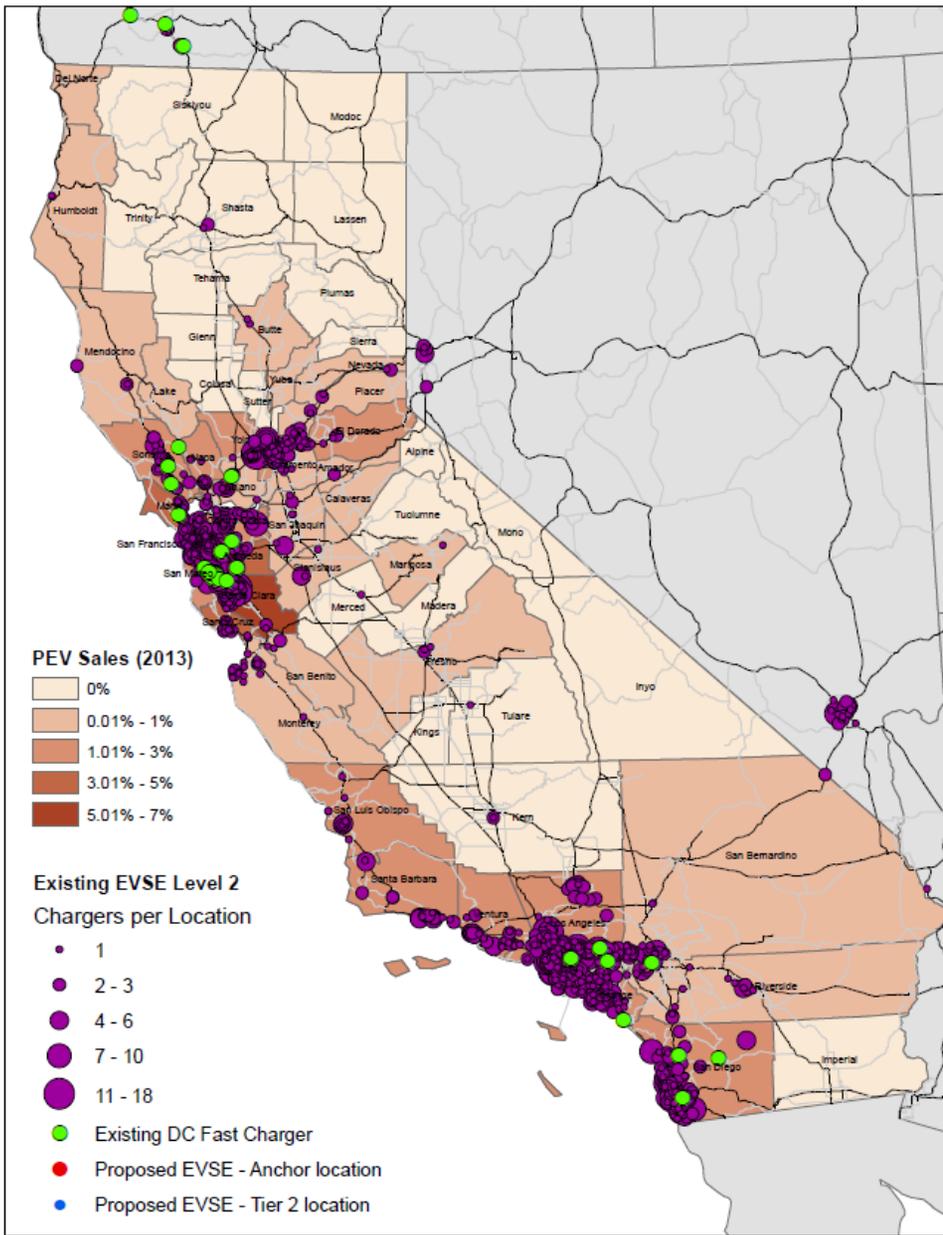


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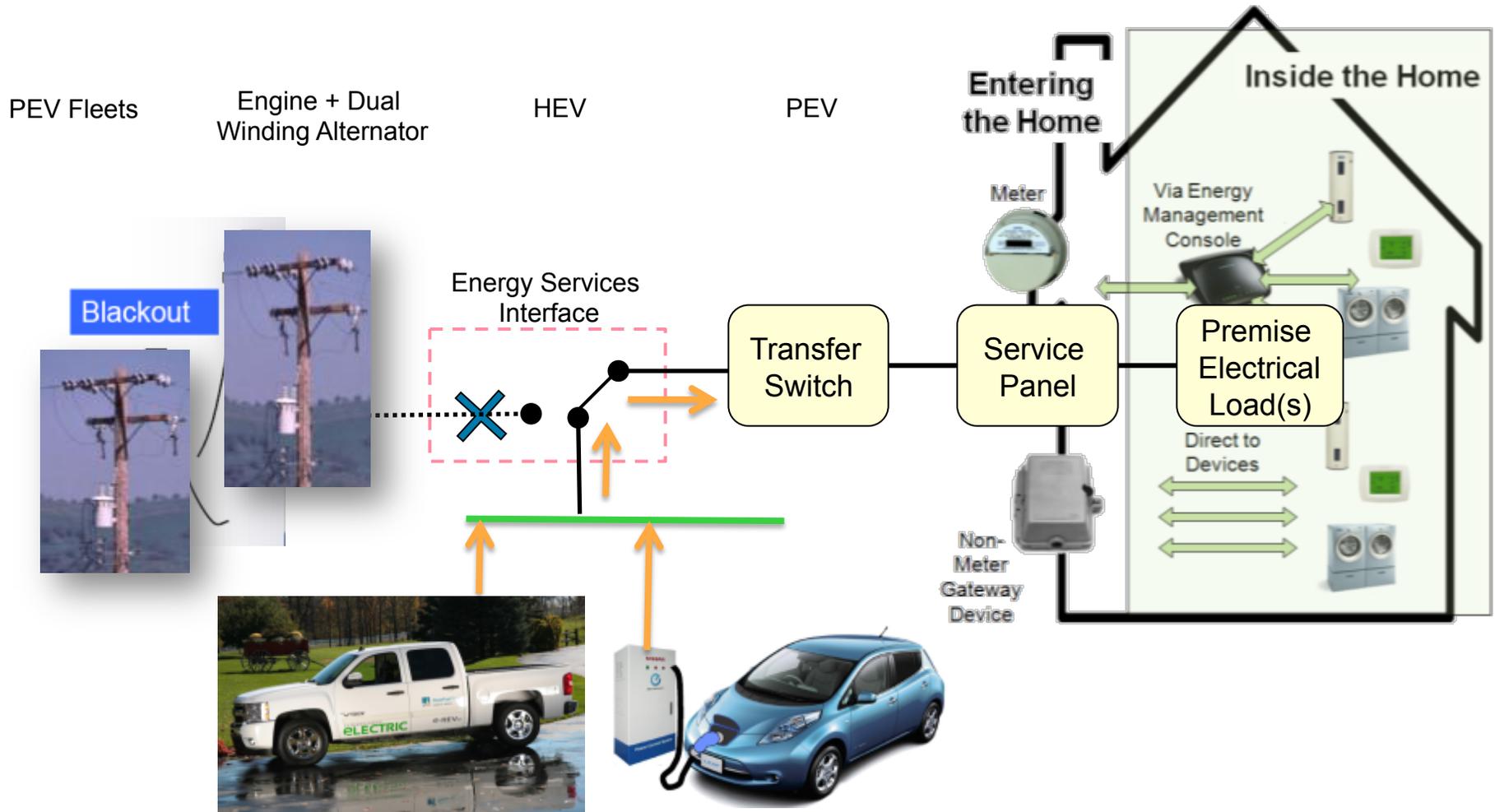
Quantity, Location, Technology







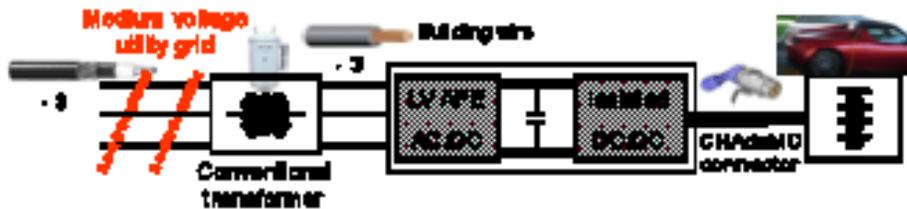
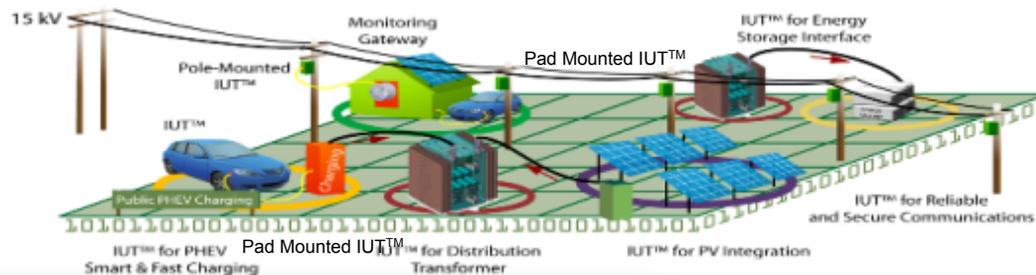
'Vehicle-to-Grid' is Here Today – How Will It Be Used?



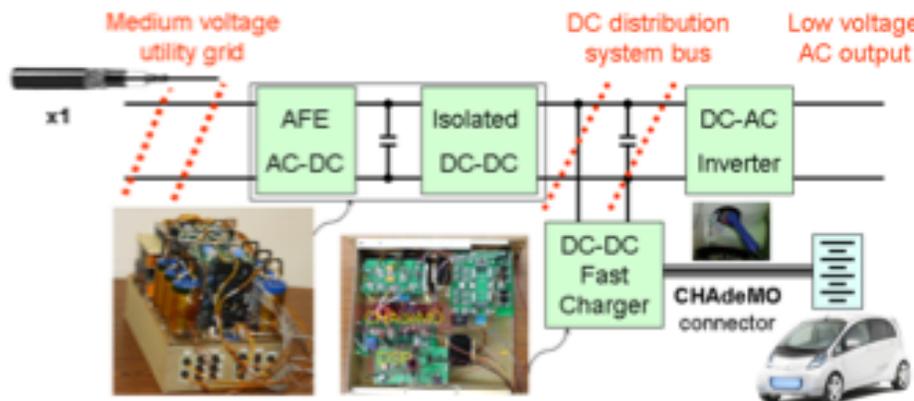
On-board Bi-directional Systems

Off-board Bi-directional Systems

Technology for an Integrated Grid Will Improve the PEV Charging Experience



(a) Conventional DC fast charger with low-voltage power electronics



(b) EPRI DC fast charger with medium-voltage IUT

- Improving options for feeding PEV infrastructure networks (public, work, MUDs) will lower costs
- Solid state transformers can integrate DC devices (PV, storage, DC charging) and mitigate demand impacts