2019 EPRI Electric Transportation

CPUC EV Workshop

Dan Bowermaster
Program Manager, Electric Transportation
dbowermaster@epri.com
Office: (650) 855-8524
Mobile: (650) 701-5099

San Francisco, California
May 9, 2019

Contents

I. What do we know? A snapshot of the EV market

II. What has EV research observed or concluded so far?

III. Key considerations and looking ahead

I. What do we know? Quick facts about the US Electric Vehicle market

More than 1.19M EVs on the road in the US

361,000 EVs sold in 2018 (up 81% over 2017 sales; Q4 up 120%)

2018 EV-related annual energy sales: 2.1 TWh (up 35% from 2017)

41 EV models today in the US, anticipated ~130 by 2023 (1/3 SUVs or crossovers)

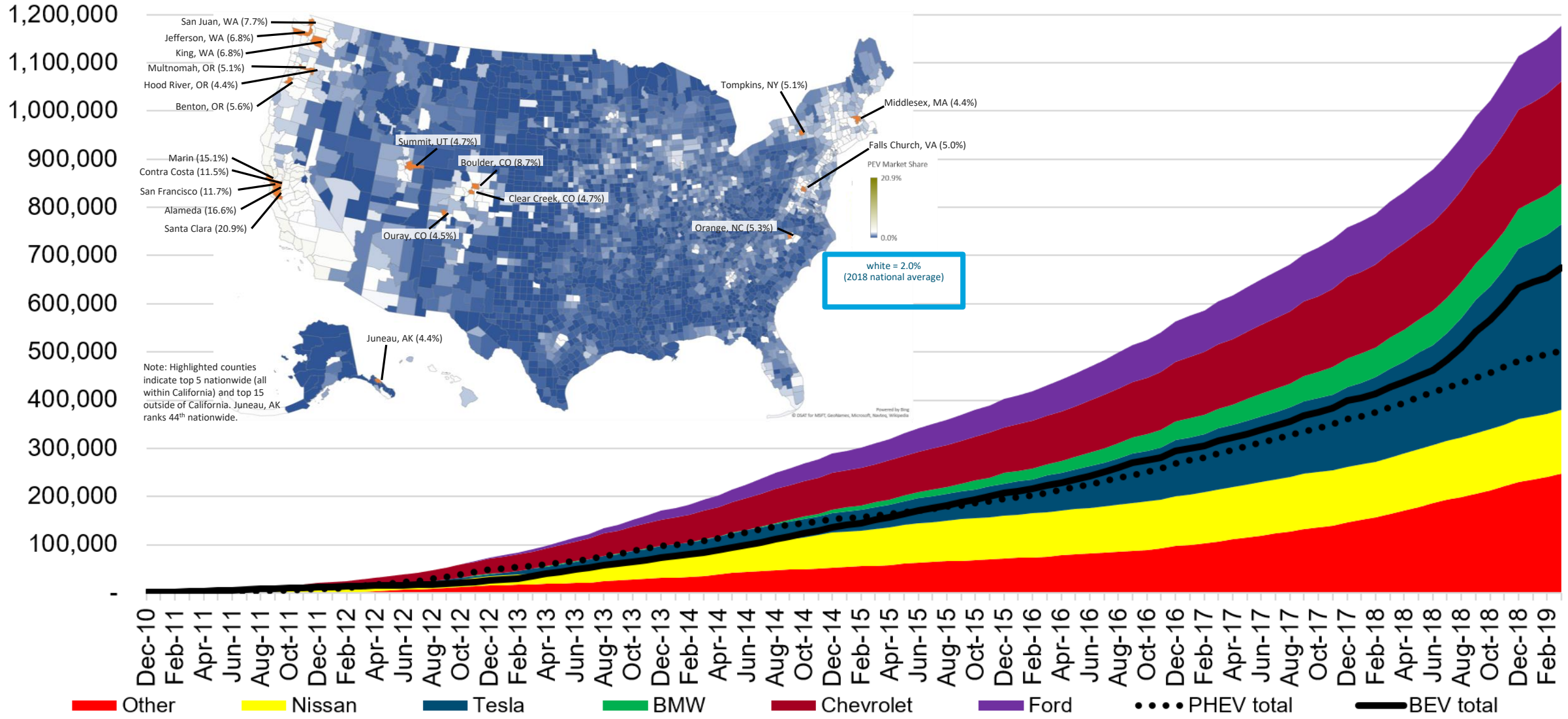
$300B+ being invested globally by automotive industry

Each EV is about 2,500 kWh each year in additional, largely flexible load

Notes: assumes a conservative 2,500 kWh per EV per year. Actual is closer to 2,800 kWh. See SRP report: Electric Vehicle Driving, Charging, and Load Shape Analysis: A Deep Dive Into Where, When, and How Much Salt River Project (SRP) Electric Vehicle Customers Charge

There are 1.19M EVs on the road in the US (through April 2019)

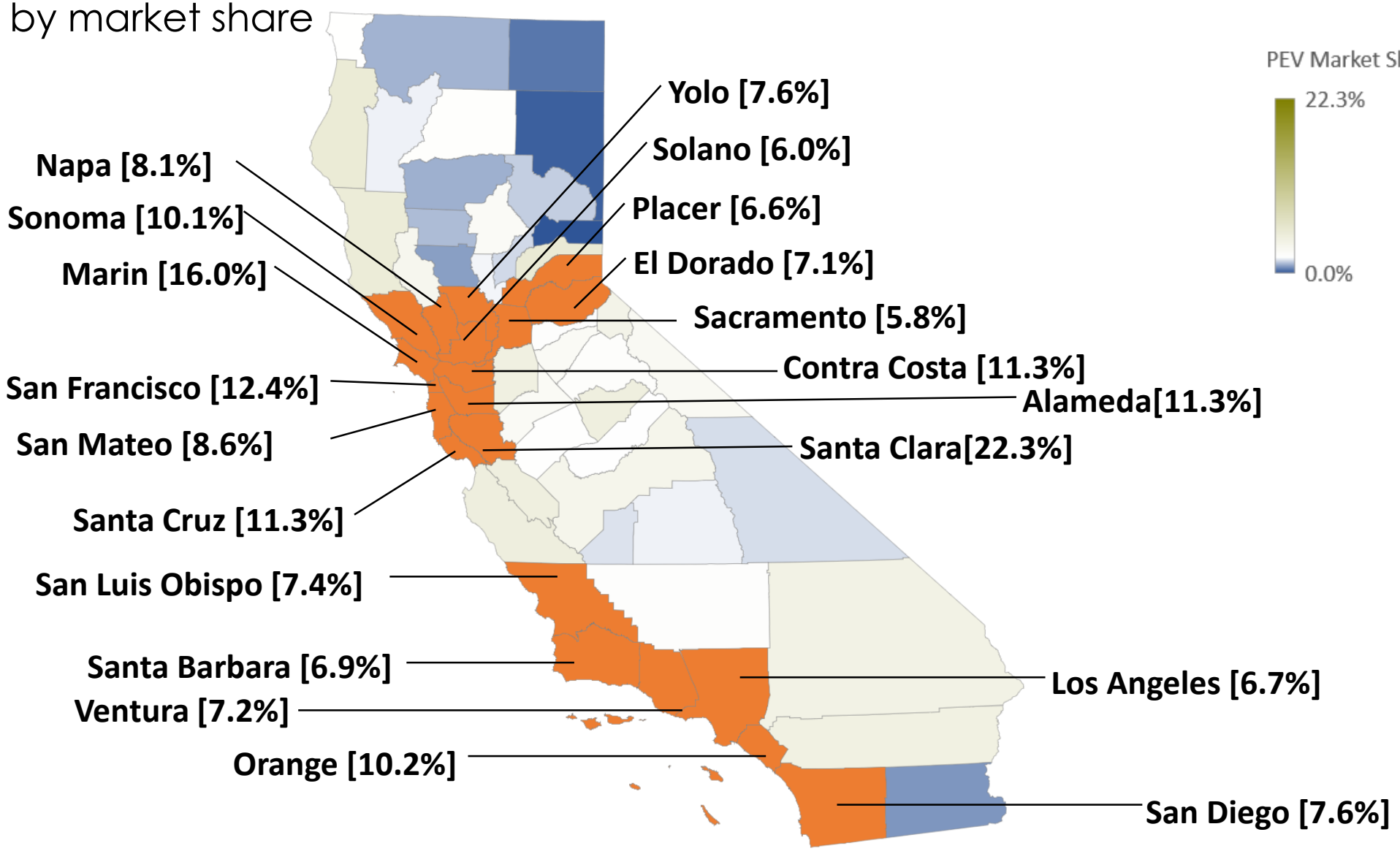
Cleaner air, decreased GHG, and lower rates via 2.1 TWh (through Dec 2018) from EVs



Notes: assumes a conservative 2,500 kWh per EV per year. Actual is closer to 2,800 kWh. See SRP report: Electric Vehicle Driving, Charging, and Load Shape Analysis: A Deep Dive Into Where, When, and How Much Salt River Project (SRP) Electric Vehicle Customers Charge

CA's EV market share > 8.2% (Feb. 2019)

Top 20 counties by market share



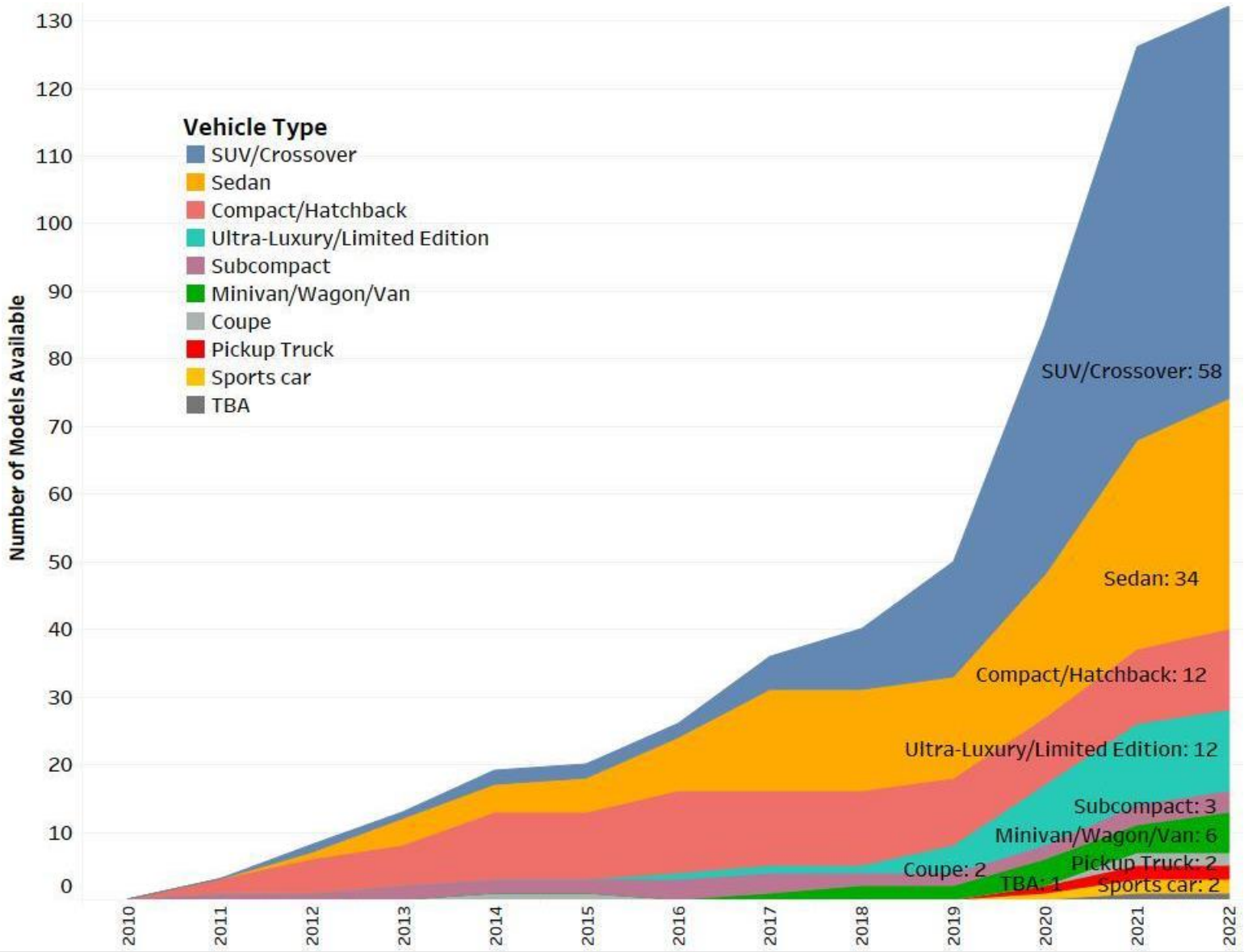
9 counties in CA have EV market shares > 10% and Santa Clara has a EV market share > 22%

Here come the electric crossovers, SUVs, buses, and trucks

Source: Dan Bowermaster, Los Angeles, December 2017; Louisville 2016, Rob Schurhoff New York 2019

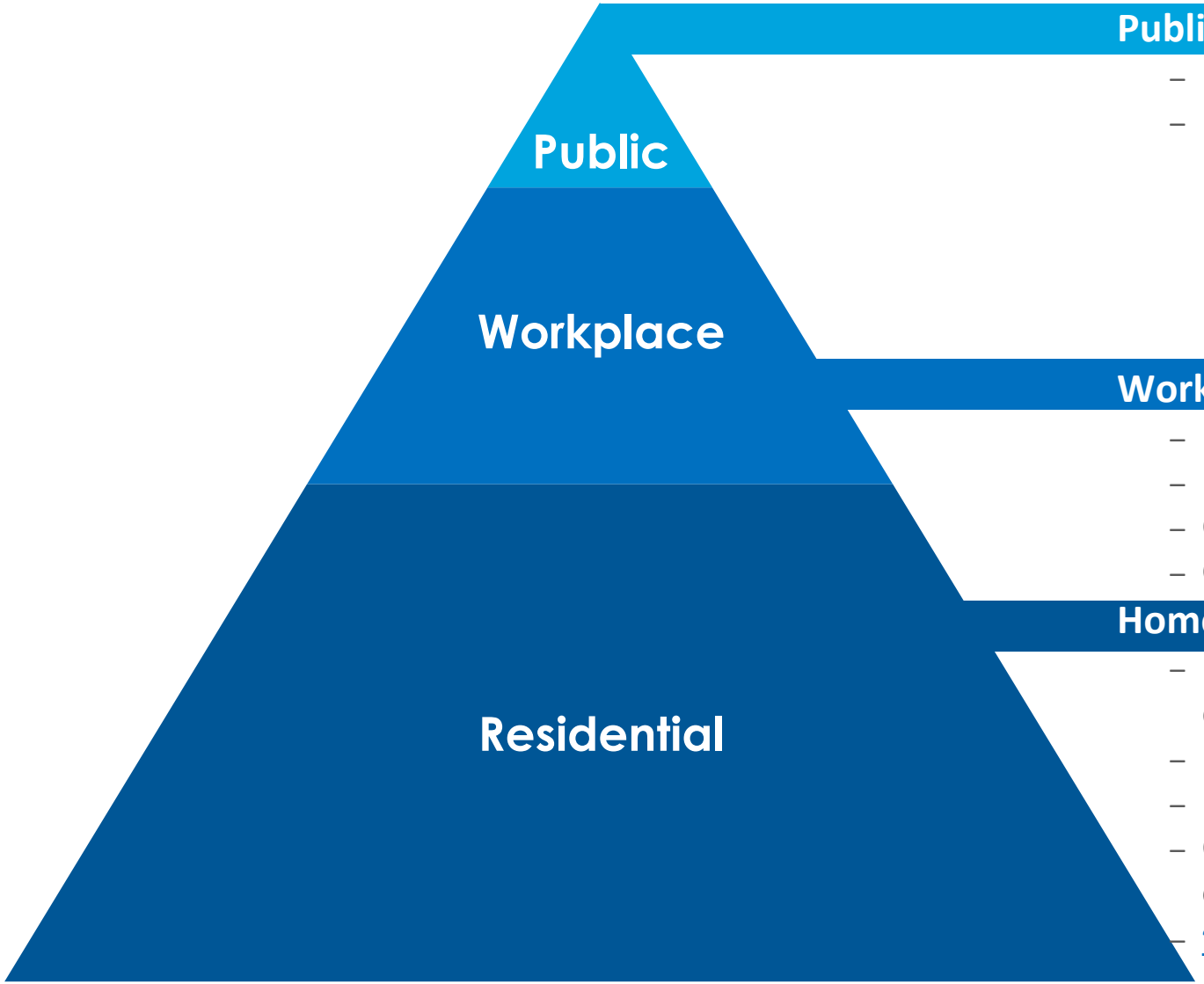
Customer choice increasing with ~130 EVs on market by 2023

Average BEV driving range increasing to 264 miles



The bulk of EV charging will be done at home and work (AC)

Public charging is largely DC fast charging



Public (DC) charging (~5-10%) – *SRP, 2018 3%*

- Necessary for adoption
- Four challenges:
  1. Separate networks
  2. Different plugs
  3. Infrastructure costs, rates, utilization
  4. Increasing power levels

Workplace charging (~15%) – *SRP, 2018 16%*

- Extends electric range of PHEVs, short- range BEVs
- Minimal distribution grid impacts
- One plug
- Challenges with parking and accessibility

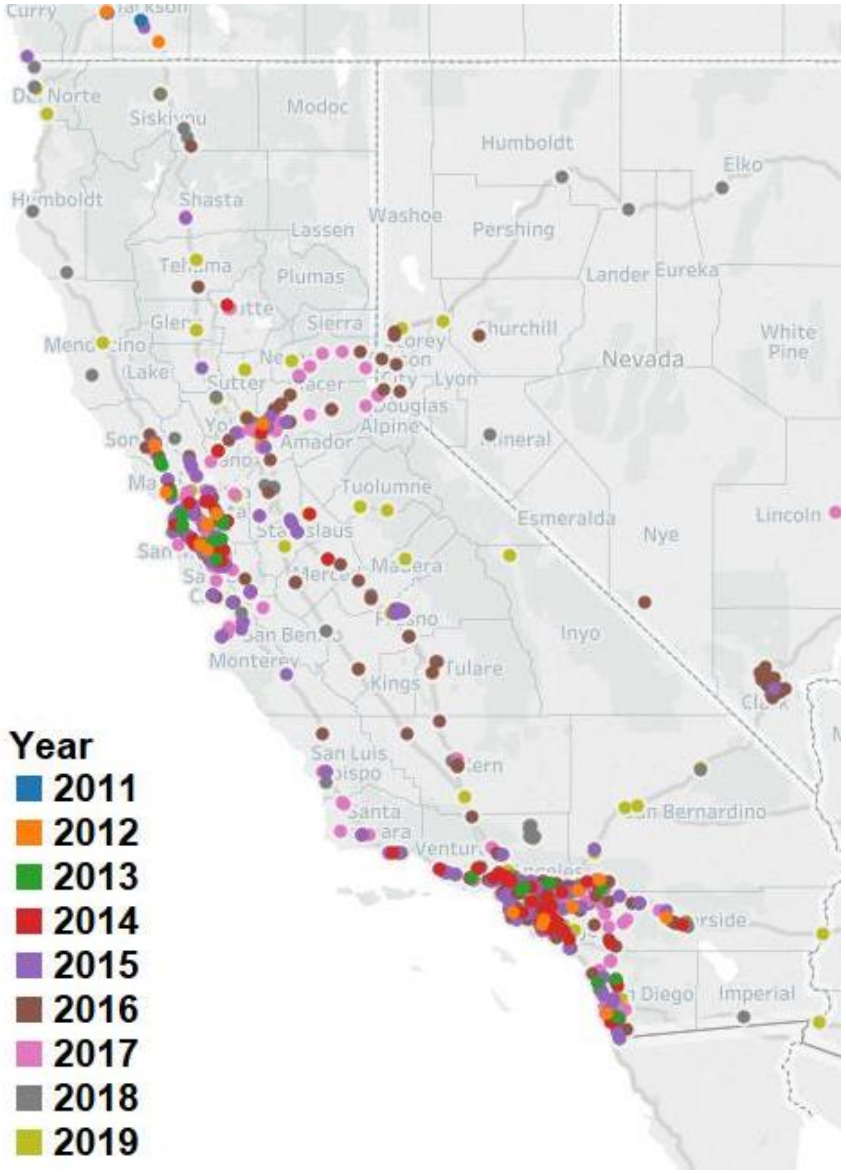
Home charging (75-80%) – *SRP, 2018 81%*

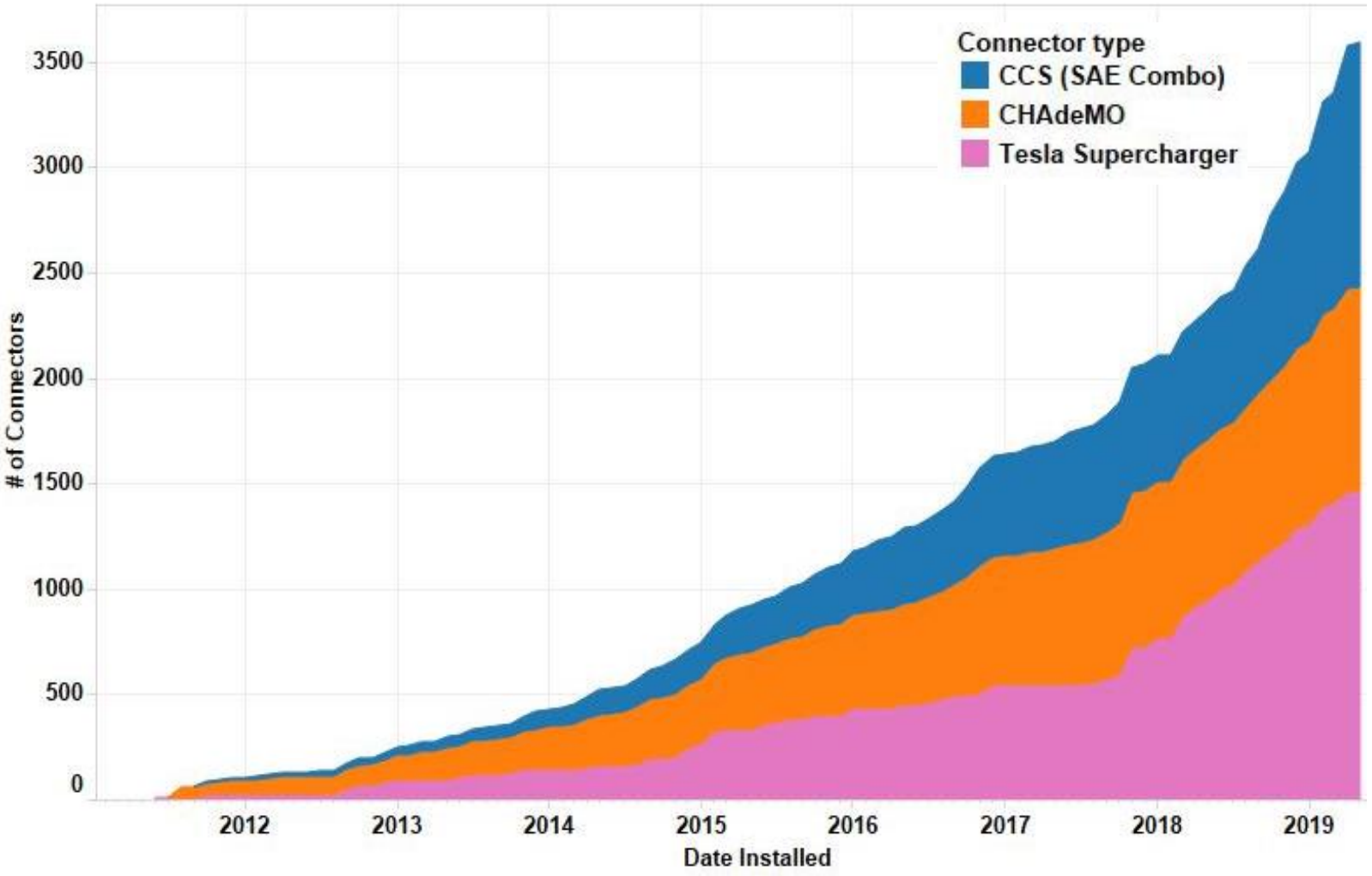
- Many customers charge at 120V AC or use an existing 240V dryer outlet
- Minimal distribution grid impacts
- Existing infrastructure companies serve this market
- Opportunities for TOU rates, smart charging, and further customer study
- ~2,800 kWh/residential EV/year

The EPRI Charging pyramid, M. Duvall, EPRI, circa 2007

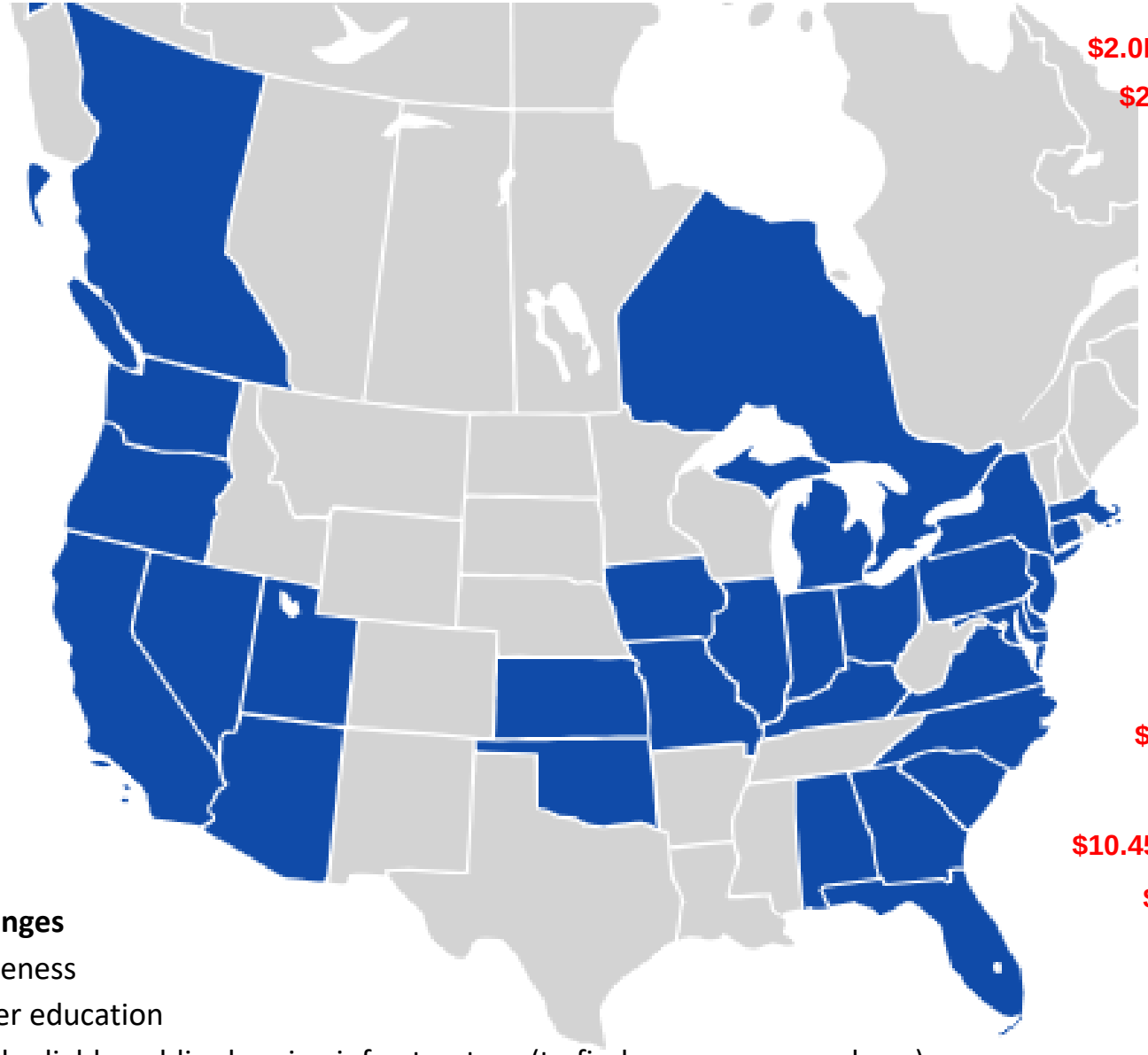
Electric Vehicle Driving, Charging, and Load Shape Analysis: A Deep Dive Into Where, When, and How Much Salt River Project (SRP) Electric Vehicle Customers Charge

Public DC fast charging infrastructure increasing across California





Utilities are proposing ~$3.7B in EV charging infrastructure



Hawaiian Electric	$1.2M (0/12)
Seattle City Light	$2.8M (0/2)
Avista	$4.2M (245/5)
Puget Sound Energy	$2.5M (~5,000/0)
PGE	$3.4M
Pacific Power	$4.6M
PG&E	$130M $253M
Southern California Edison	$22M $573M $760M
SDGE	$45M
Sempra Energy utility	$244M
NV Energy	$15M
TEP	$10.2M
Rocky Mountain Power	$10M
DTE Energy	$13M
Consumers Energy	$10M
Hydro Québec	$2.0M (1,175/107)
Ontario	$20M (200/300)
conEdison	$25M
Eversource Energy	$45M
nationalgrid	$25M
New York Power Authority	$250M
Narragansett	$11M
delmarva power	$1.7M
atlantic city electric	$14.9M
pepco	$15M
PSE&G	$300M
ipl	$3.7M
AEP	$10.5M $0.1M
Ameren	$18M
KCP&L	$20M (920/16)
LG&E KU	$0.5M (0/9)
Georgia Power	$10.45M (2,400/37)
Alabama Power	$1.5M (137/0)
Gulf Power	$0.4M
Duke Energy	$8M $76M

Legend [Budget $ (L2/DCFC)]
Make-ready / rebate
Utility-owned
Hybrid

Updated: 4/15/2019

Key Challenges

- EV awareness
- Customer education
- Easy and reliable public charging infrastructure (to find, access, use, and pay)

Details: North American Utility Electric Transportation Charging Infrastructure Program Overview – 2018 status

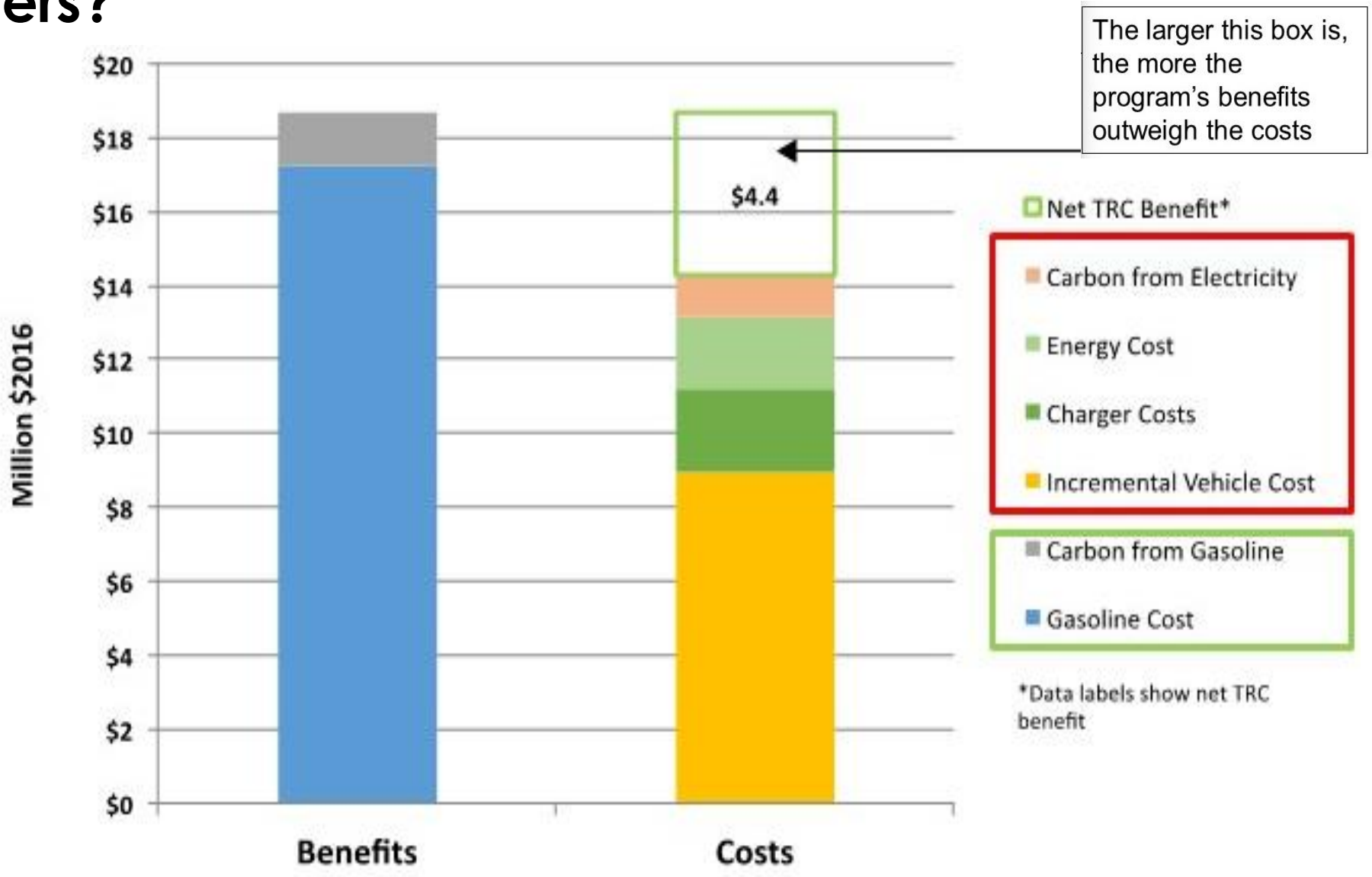
II. Five principle cost tests used in energy efficiency

How do they apply to Electric Transportation?

Test	Acronym	Key Question Answered	Summary Approach
Participant cost test	PCT	Will the participants benefit over the measure life?	Comparison of costs and benefits of the customer installing the measure
Program administrator cost test	PACT	Will utility bills increase?	Comparison of program administrator costs to supply-side resource costs
Ratepayer impact measure	RIM	Will utility rates increase?	Comparison of administrator costs and utility bill reductions to supply-side resource costs
Total resource cost test	TRC	Will the total costs of energy in the utility service territory decrease?	Comparison of program administrator and customer costs to utility resource savings
Societal cost test	SCT	Is the utility, state, or nation better off as a whole?	Comparison of society's costs of energy efficiency to resource savings and non-cash costs and benefits

Source: Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects.

TRC Example – Is EV Charging Infrastructure Good or Bad for Ratepayers?



Source: The Value of Transportation Electrification: Three Preliminary Case Studies of Impacts on Utility Stakeholders

Adoption - What does it take for a customer to buy an EV?

- Automotive OEMs need to design, build, and market EVs
- Dealers need to stock and market EVs
- Customers need to be aware of, consider, and be able to buy EVs
  - Does it meet my needs?
  - Do I like it?
  - Can I afford it today?
  - How do I fuel it?

Of the top 25 best-selling cars, only one has a plug-in option today

Workplace charging as a market enabler

How to scale EV charging infrastructure at lowest possible cost?

What else have we seen so far?

Key research observations on valuing utility actions, including EV charging infrastructure

1. Numerous factors affect the overall cost/benefit comparison for utility EV programs
2. Decreasing battery costs and gasoline prices have a large impact in addition to being highly variable
3. Potentially significant ratepayer benefits across the country, but more detailed analysis based on local market data required
4. In thinking about utility program design, the main difficulties are estimating the effect of utility programs on the market
5. It is also difficult to estimate the magnitude of social costs and benefits especially in markets without supporting policies
6. Traditional approaches to regulatory justification may not capture the valve of EVs

Correlation does not mean causation

III. Key Questions for EV charging infrastructure and utility actions

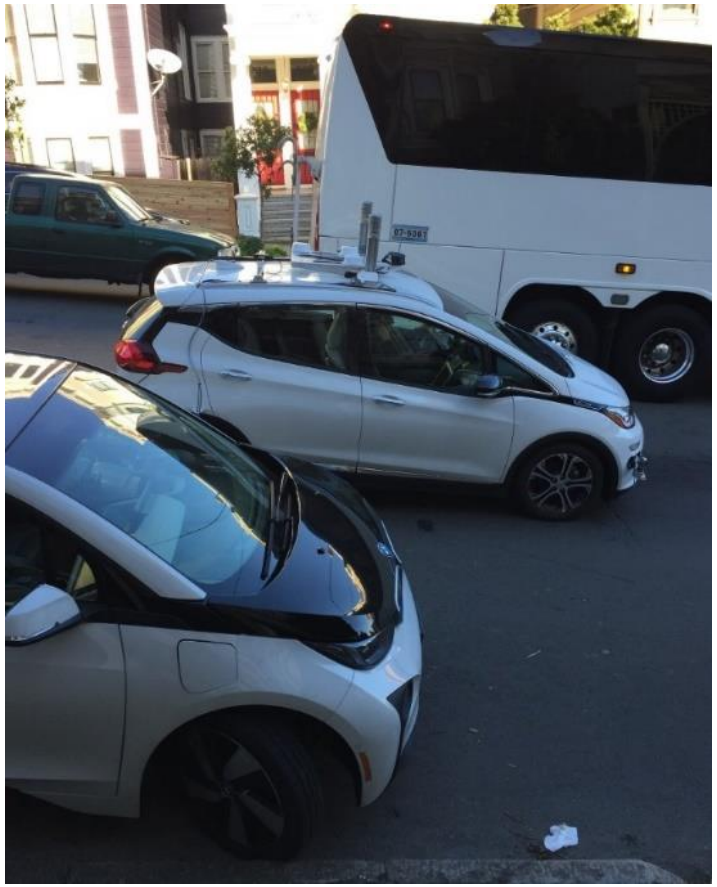
Actions range from basic customer education, to facilitating easy, seamless grid connection, to rate-basing infrastructure deployment

1. What is the optimal long-term approach to deploying and operating EV charging infrastructure?
2. Transportation electrification could represent a net benefit to all utility customers. How is this calculated?
3. How can utilities' work that speeds up the EV market and amplifies these benefits be measured?
4. How can safety and reliability be ensured for all customers, especially for EV drivers outside of metro areas?
5. What lessons were learned from previous electrification efforts?

Looking ahead to 2040

Numerous key questions remain

- What will the transportation market of 2040 look like?
- What is the utility's role in transportation in 2040?
  - Education? Fueling? Infrastructure?
- Will individual car ownership be the prevailing model?
- How much will individual EVs comprise the market?
- What will the impact of autonomous EVs be?
- Will buses evolve into smaller electric shuttles?
- What about last-mile technologies such as scooters?
- How will these electric vehicles of all sizes fuel?
- How can utilities speed up this transition?



Together...Shaping the Future of Electricity