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Plug-in Electric Vehicles:
21st Century Energy Efficiency

Northwest Energy Coalition
Clean and Affordable Energy Conference
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About E3

- E3 is an electricity consulting firm founded in 1989 in San Francisco
- Clients span local, state and federal government, small and large public and investor-owned electric utilities, and energy technology companies
- Research and practice area in long term CO2 pathways and utility impact of clean transportation (electric and gas)
- Approximately 30 staff in energy economics, distributed resources, policy implementation, and resource planning

Presentation Overview

- Key policy questions
- Highlights of studies for California utilities
- Learnings from Seattle City Light assessment of electrification options
- Policy implications

Threshold questions for regulators

- ***Is promoting EV adoption in the public interest?***
- ***Is public funding needed to promote EV adoption?***
- ***What is best done by utilities vs. left to the competitive market?***
- ***What is the appropriate level of utility ratepayer funding?***
- ***How to maximize flexibility and minimize grid and customer costs?***

PEV Grid Integration: Issues

- **Do we need new power plants or transmission lines to support PEV charging?**
- **What are the opportunities to exploit the latent flexibility in PEV charging load to balance out fluctuations in renewable energy generation?**
- **Will EV charging overload local distribution circuits?**
  - New upgrades needed?
  - Safety/Reliability affected?
- **Can PEV charging be timed to coincide with rooftop solar generation?**

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HIGHLIGHTS FROM CALIFORNIA

About the California Transportation Electrification Assessment

- **Sponsors:**
  - Pacific Gas & Electric
  - Southern California Edison
  - San Diego Gas & Electric
  - Sacrmamento Municipal Utility District
- **Study conducted in multiple phases:**
  - Phase 1: Environmental benefits and barriers to adoption
  - Phase 2: LDV grid impacts, costs and benefits
  - Phase 3: Goods and people movement grid impacts, costs and benefits

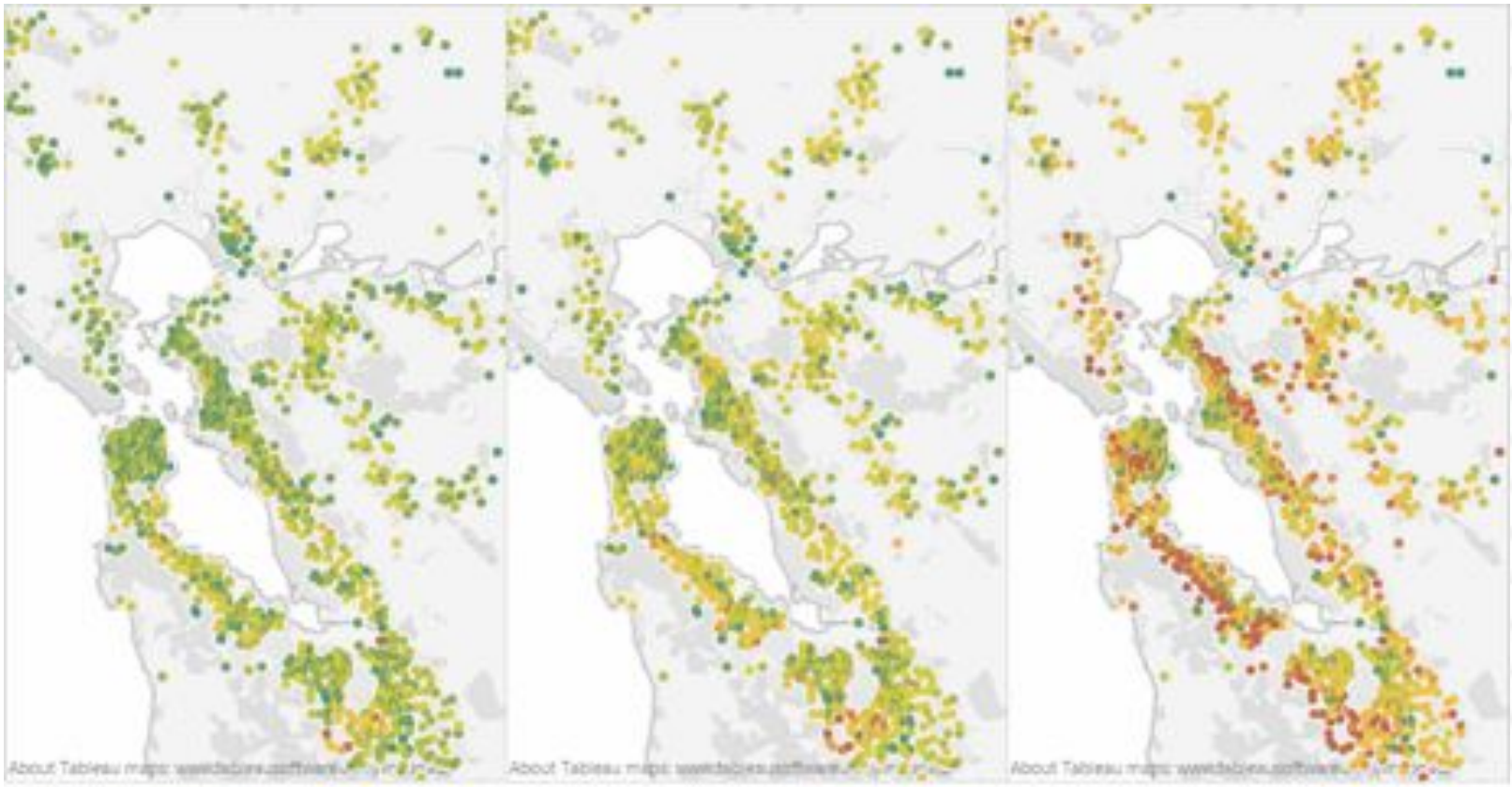
http://www.caletc.com/wp-content/uploads/2014/09/CalETC_TEA_Phase_1-FINAL_Updated_092014.pdf
http://www.caletc.com/wp-content/uploads/2014/10/CalETC_TEA_Phase_2_Final_10-23-14.pdf

Distribution grid impacts from PEV charging are modest in the near term

Feeder and substation utilization

"ZEV most likely" vehicle adoption and TOU rates

2010 2020 2030



% Utilization

0.000 1.500

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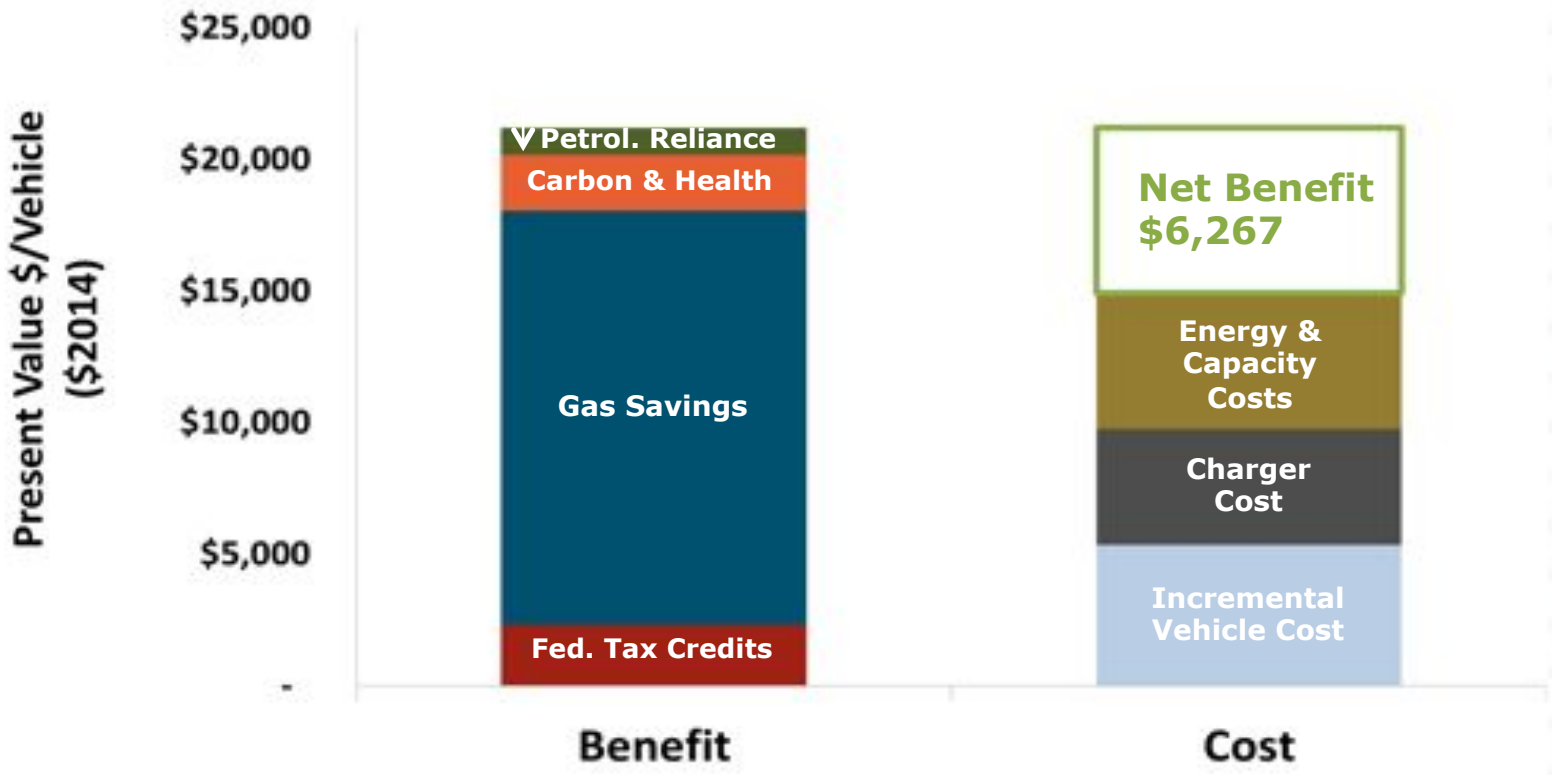
Transportation electrification is fundamentally energy efficiency

Net Societal Benefits from PEV Charging Load

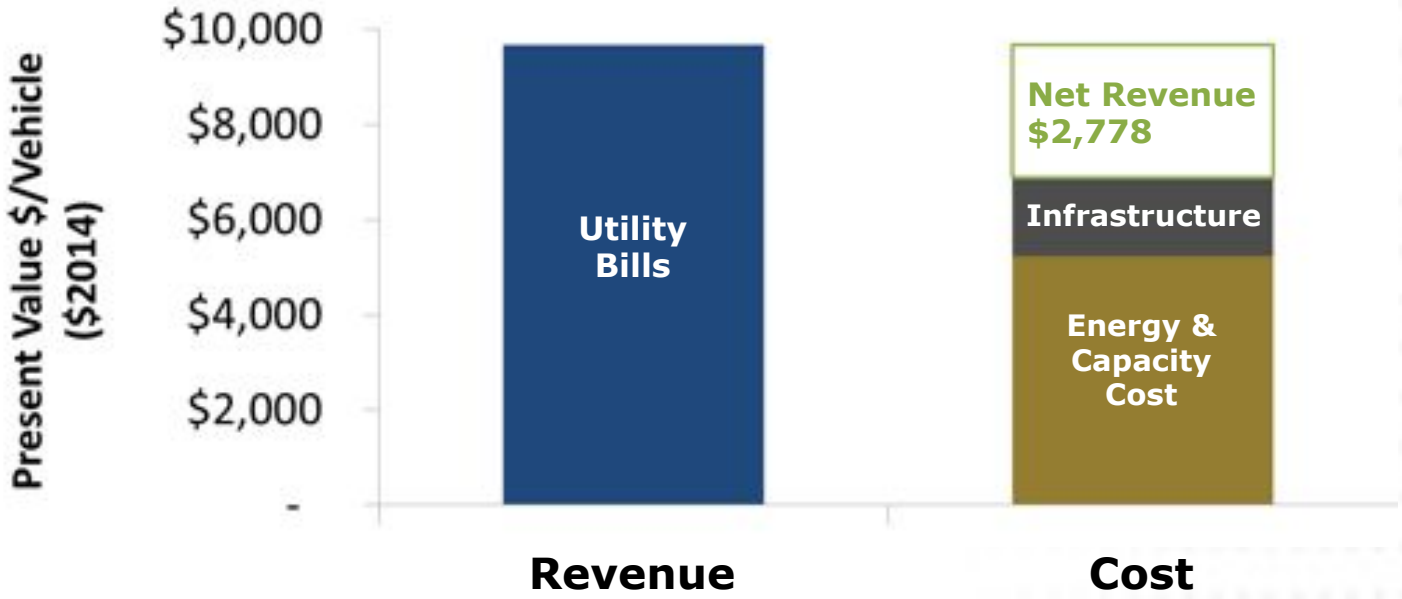
Illustrative results for California Utilities



- **PEVs use primary energy more efficiently than conventional vehicles**
- **Costs and benefits span the power and transportation sectors, complicating policy**

PEV load benefits ALL utility ratepayers

Net Revenues from PEV Charging Load
Illustrative results for California Utilities



- **Utility rates are higher than the marginal cost of delivered energy in most hours**
- **PEVs are unique in providing environmental and customer benefits while putting downward pressure on rates**

Smart charging lowers costs of PEV grid integration: Pilots needed!

+ Rate design:

- Time of use rates
- Dynamic rates (SDG&E's proposed VGI pilot)
- Demand charges

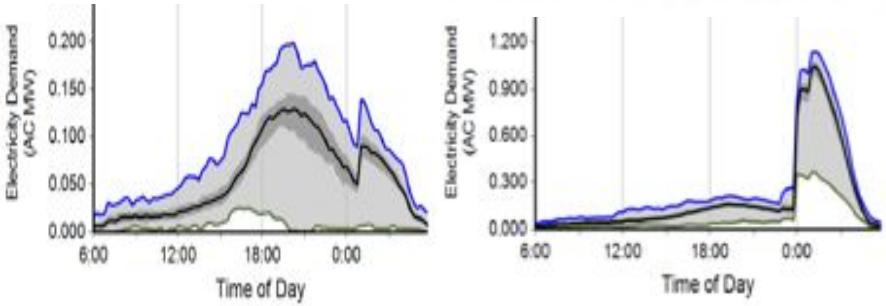
+ Demand response:

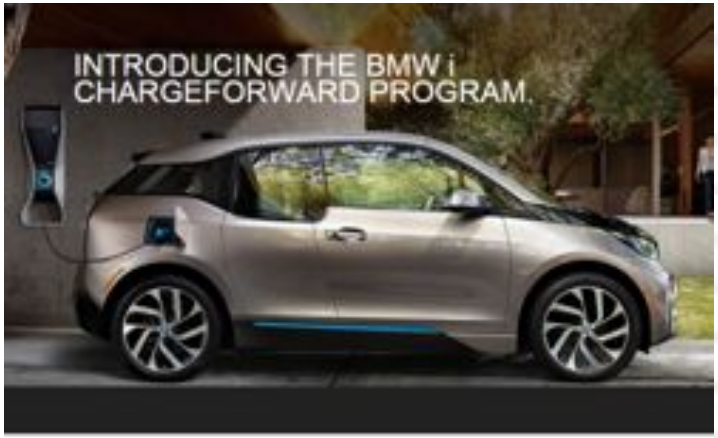
- The utility or a third party directly controls when a vehicle charges: (PG&E/BMW pilot)
- Designed to test extent of driver cooperation
- Customer is paid for performance and can over-ride if necessary

Charging behavior responds to rates!

Washington DC
(No Time Varying Rates)

San Diego
(TOU Rates)





GET UP TO $1,540* FOR CHARGING YOUR BMW i3.

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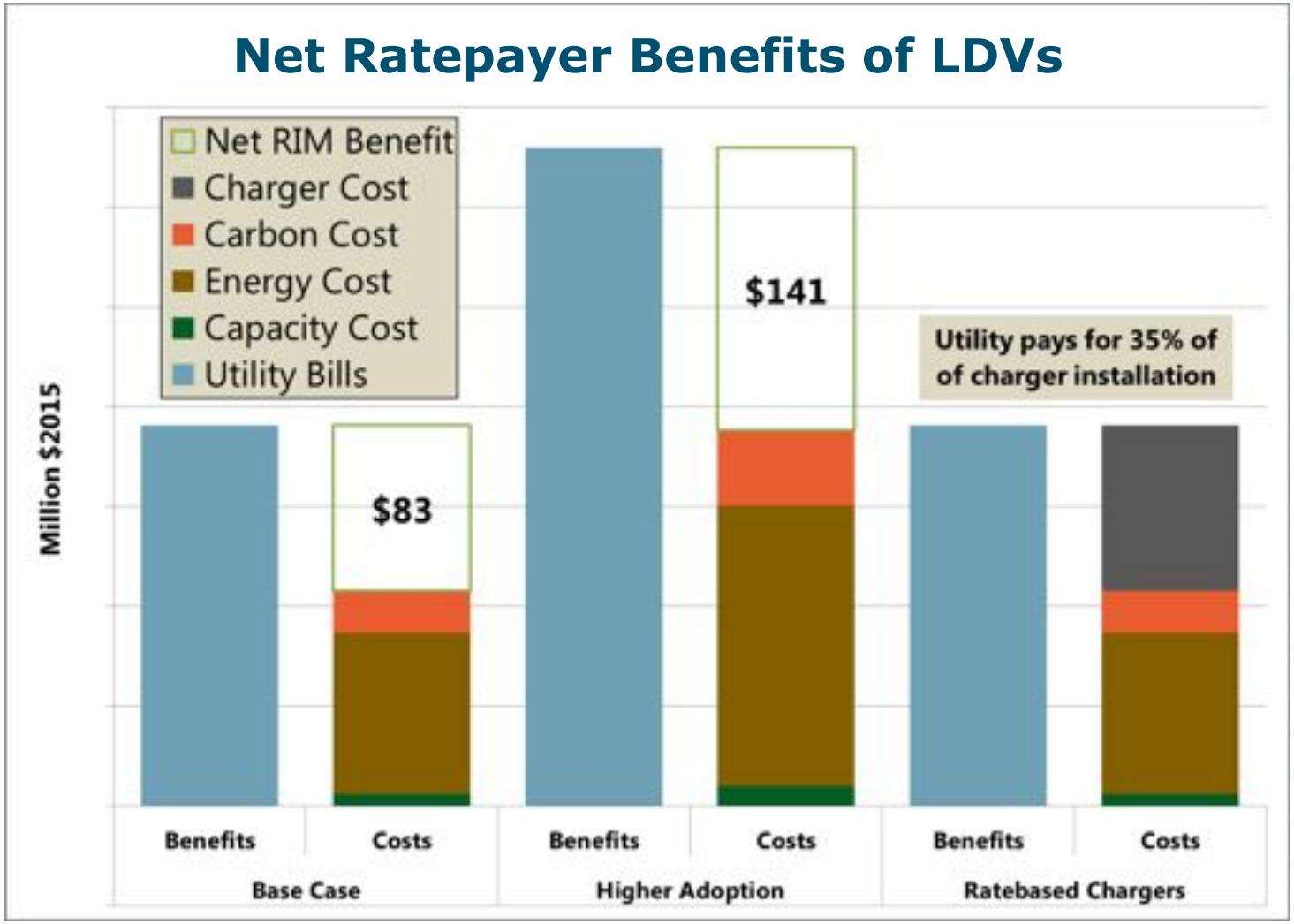
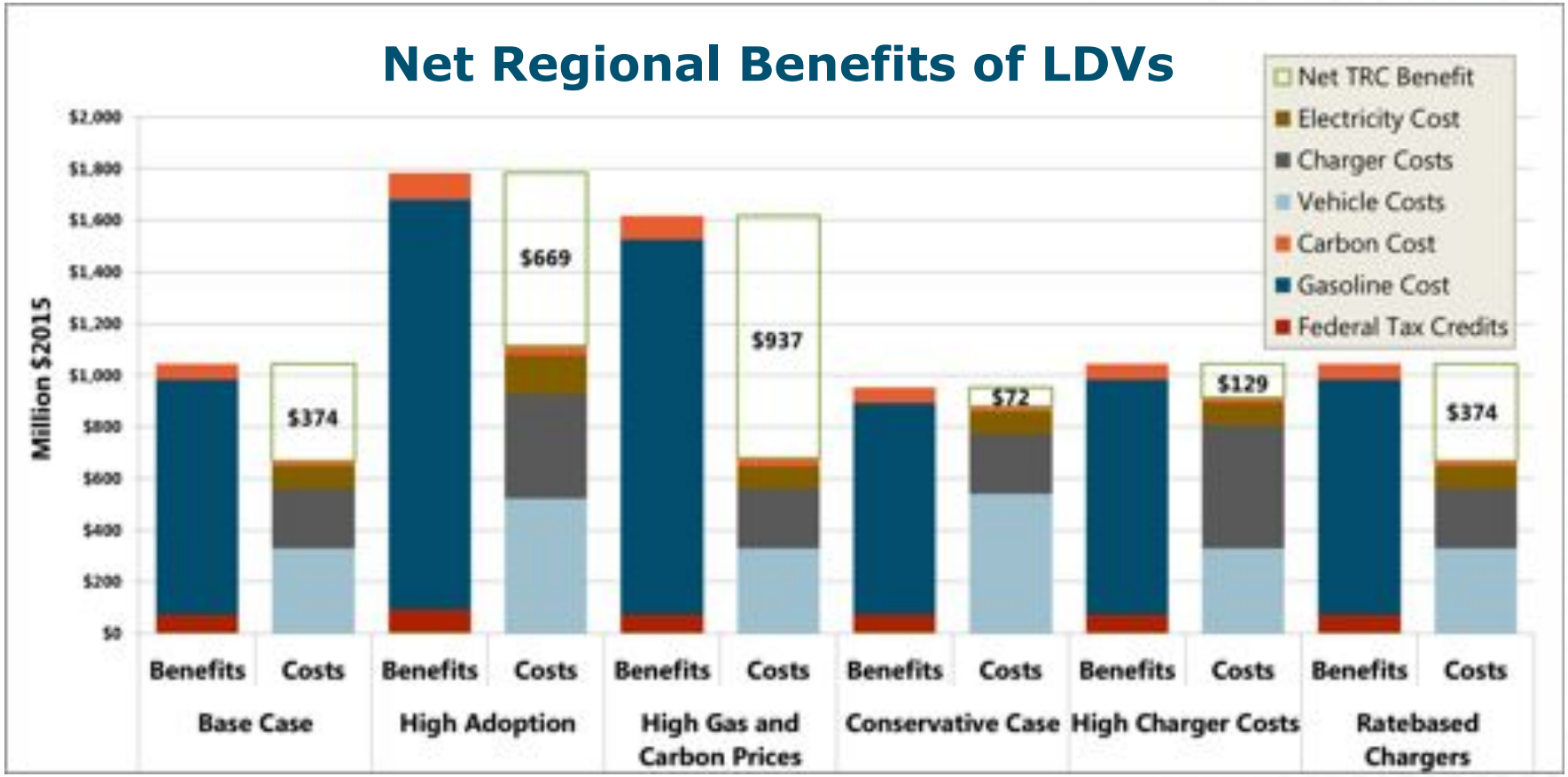
SEATTLE CITY LIGHT: ASSESSMENT OF ELECTRIFICATION OPTIONS

Seattle City Light: Net ratepayer benefits of LDVs

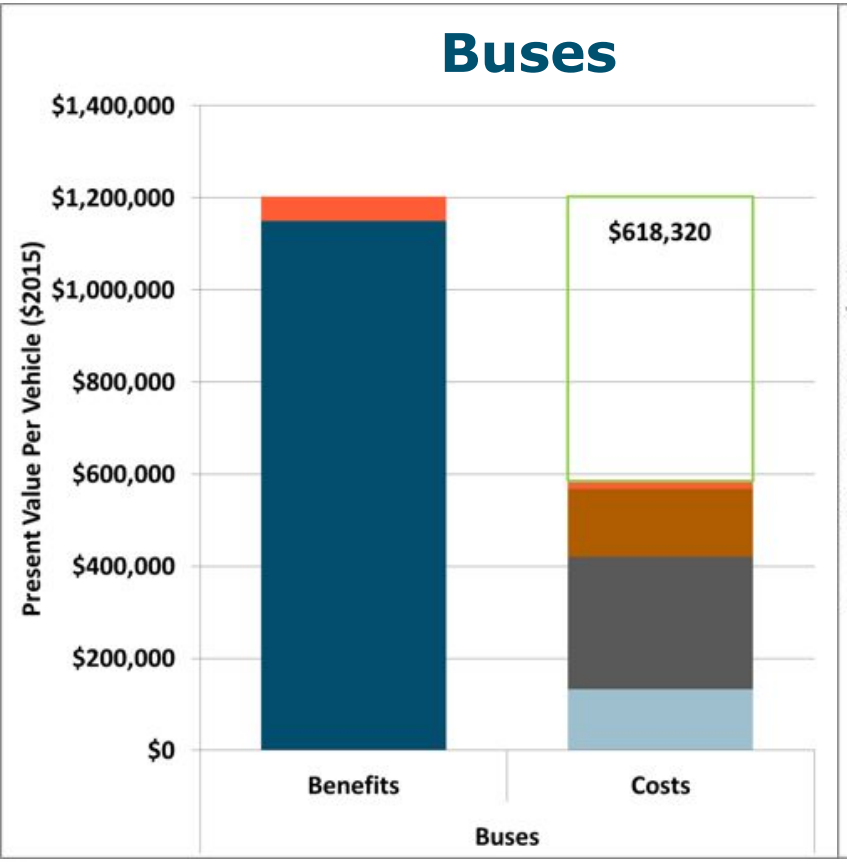


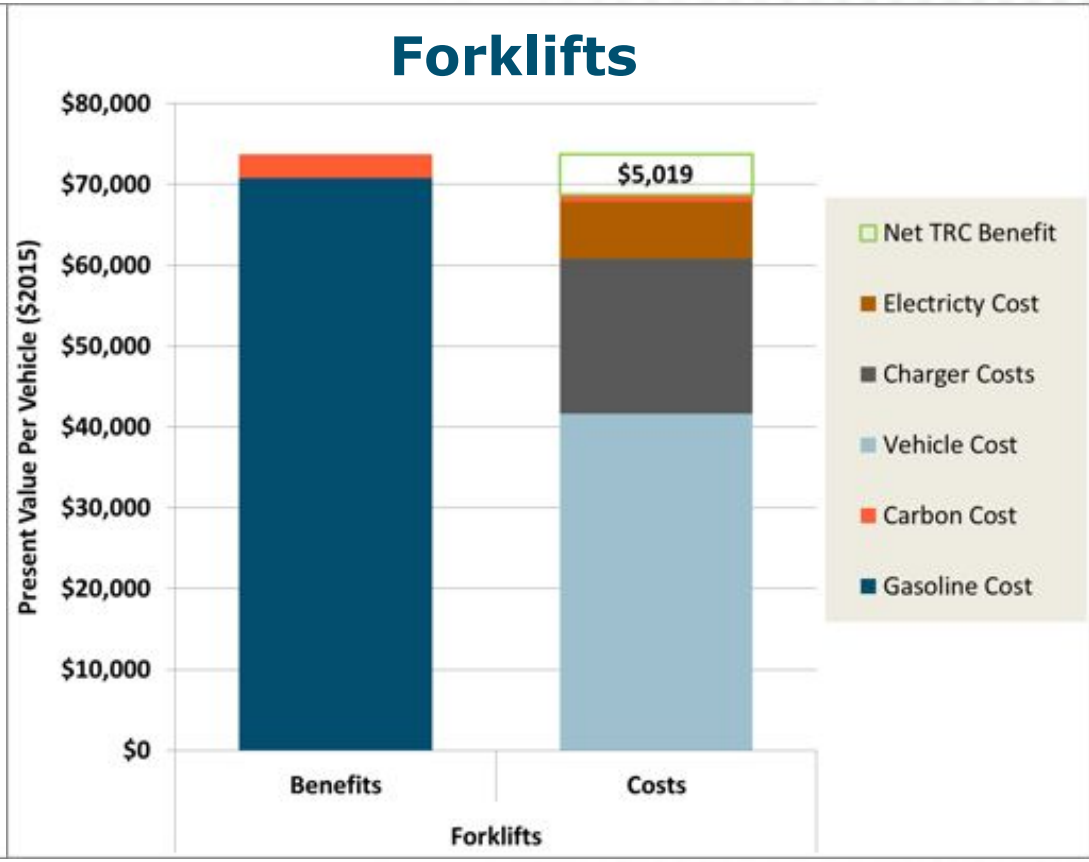
Net Regional Benefits of LDVs Under Multiple Scenarios



Societal Benefits of Electrifying Busses and Forklifts

Present Value Per Vehicle





Crowd-sourced PlugShare data on chargers identifies gaps

- **Most complete data base of charger locations: all providers**
- **Drivers rate and review their experience**
- **Highlights maintenance problems**
- **Identifies sites with unmet charging demand**

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POLICY IMPLICATIONS FOR REGULATORS

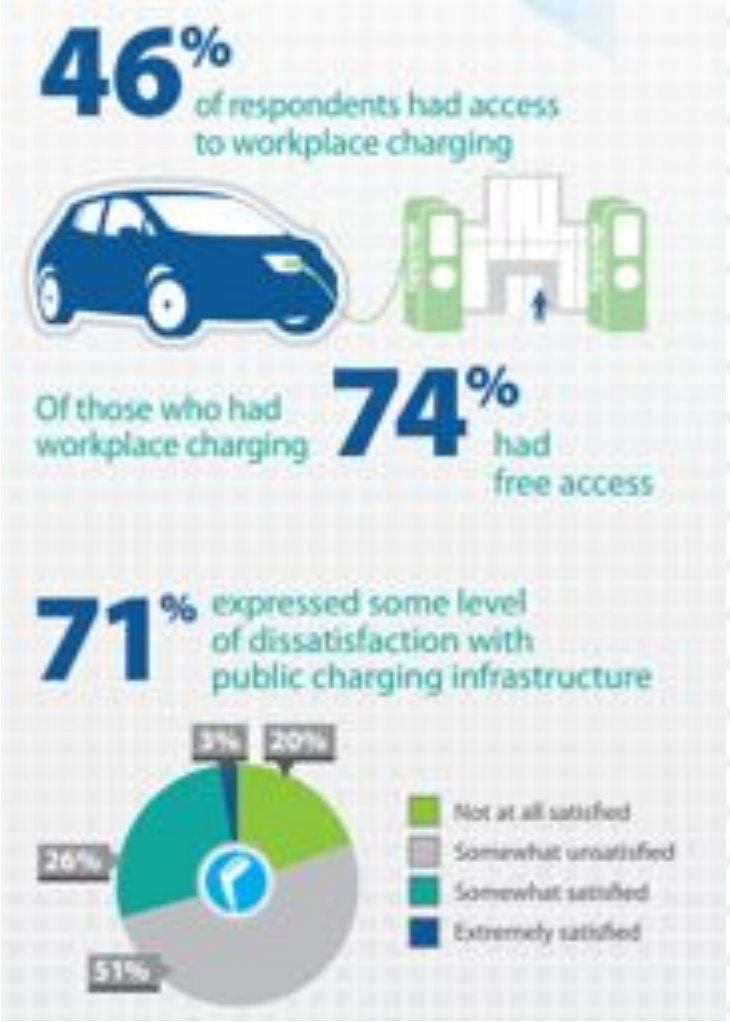
Utility and Ratepayer Perspective: PEVs are the opposite of PV and EE

GHG & Emissions	↓	↓	↓
Total Energy Consumption	↓	↓	↓
Utility Infrastructure	↓ ↑	↓	↑
Retail Rates	↑	↑	↓

+ **PV and EE shift costs to other ratepayers**
+ **EVs increase utility asset utilization → lower rates**

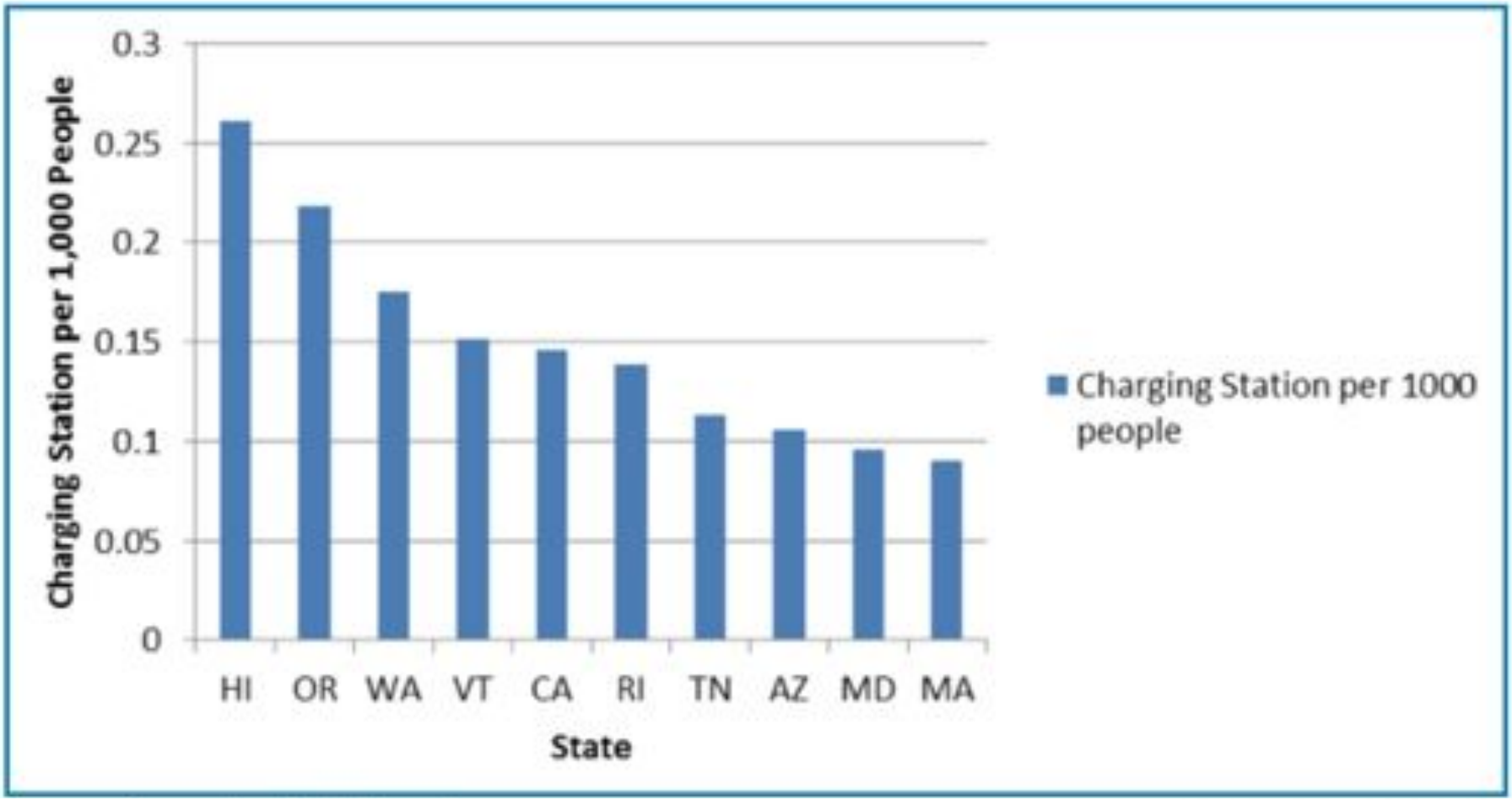
Widespread EV adoption requires extensive charging infrastructure

- **CA's ZEV Mandate requires 1.5 million zero-emissions vehicles on the road by 2025**
- **Historically, most EV adopters**
  - Own their homes
  - Charge their EVs primarily at home
- **Meeting the ZEV Mandate will require reliable, well-placed public charging infrastructure**
  - Reduce range anxiety
  - Accommodate EV drivers who do not have access to home charging



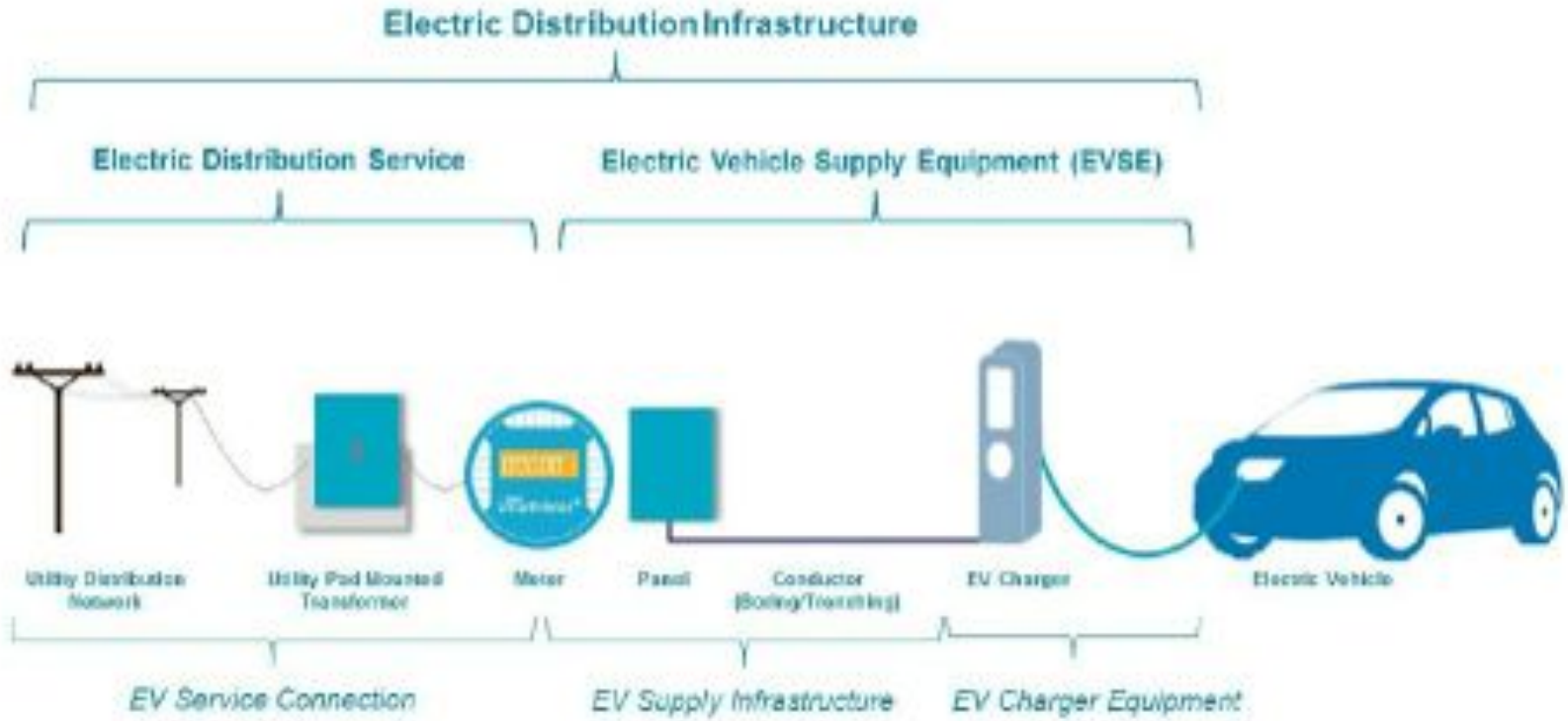
Graphic is part of the February 2014 PEV Owner Survey by the Center for Sustainable Energy

OR and WA are national leaders in EV charging infrastructure



Source: UCLA Luskin School of Public Affairs, March 2015, *State of the States' Plug-in Electric Vehicle Policies*, http://innovation.luskin.ucla.edu/sites/default/files/EV_State_Policy.pdf

California utilities envision different roles to support electrification



SDG&E	Smartphone app controls charging	Duplicates functions built into the car
PG&E	Utility owns chargers	Competes directly with EVSPs
SCE	Utility does make-readies & provides rebate for chargers	Enables competitive EVSP market

Source of diagram: PG&E application (A15-02-009), p. 4.

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Thank You

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