A Plug for Effective EV Rate Design

April 19, 2018

Panelists

Melissa Whited

Avi Allison

Moderator: Pat Knight

Webinar Logistics

- The webinar is being recorded and will be circulated to all attendees, along with the slides
- All attendees have been muted on entry and will remain muted throughout the webinar
- Please send any questions on the content of the webinar to webinar@synapse-energy.com
- During the Q&A session, the panelists will answer written questions that have been sent to webinar@synapse-energy.com
- Please use the chat feature only to notify the host if you are having a technical issue with the WebEx software or audio

Who we are

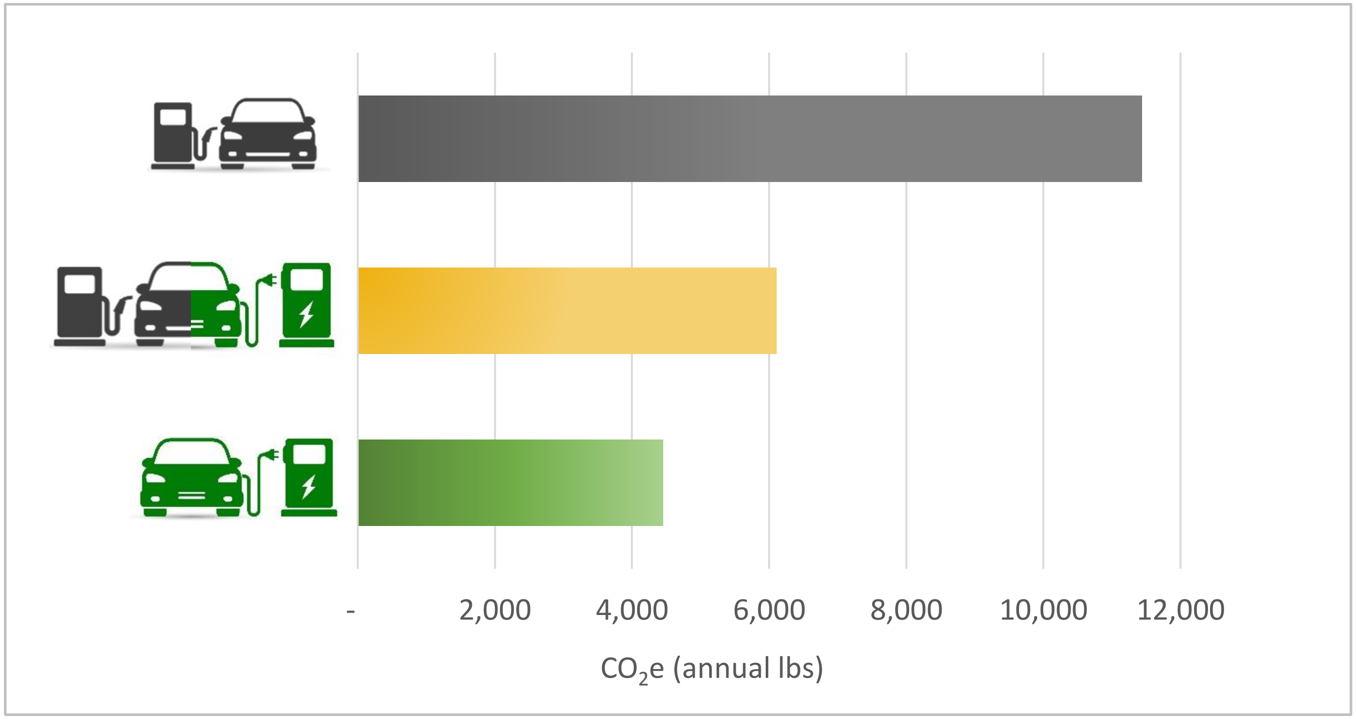
Synapse Energy Economics

- Founded in 1996 by CEO Bruce Biewald
- Research and consulting firm specializing in energy, economic, and environmental topics
- Services include economic and technical analyses, regulatory support, research and report writing, policy analysis and development, representation in stakeholder committees, facilitation, trainings, and expert witness services for public interest and government clients
- All non-confidential publications and open-source tools available for free at www.synapse-energy.com

Why Do We Care About EVs?

Emission Benefits

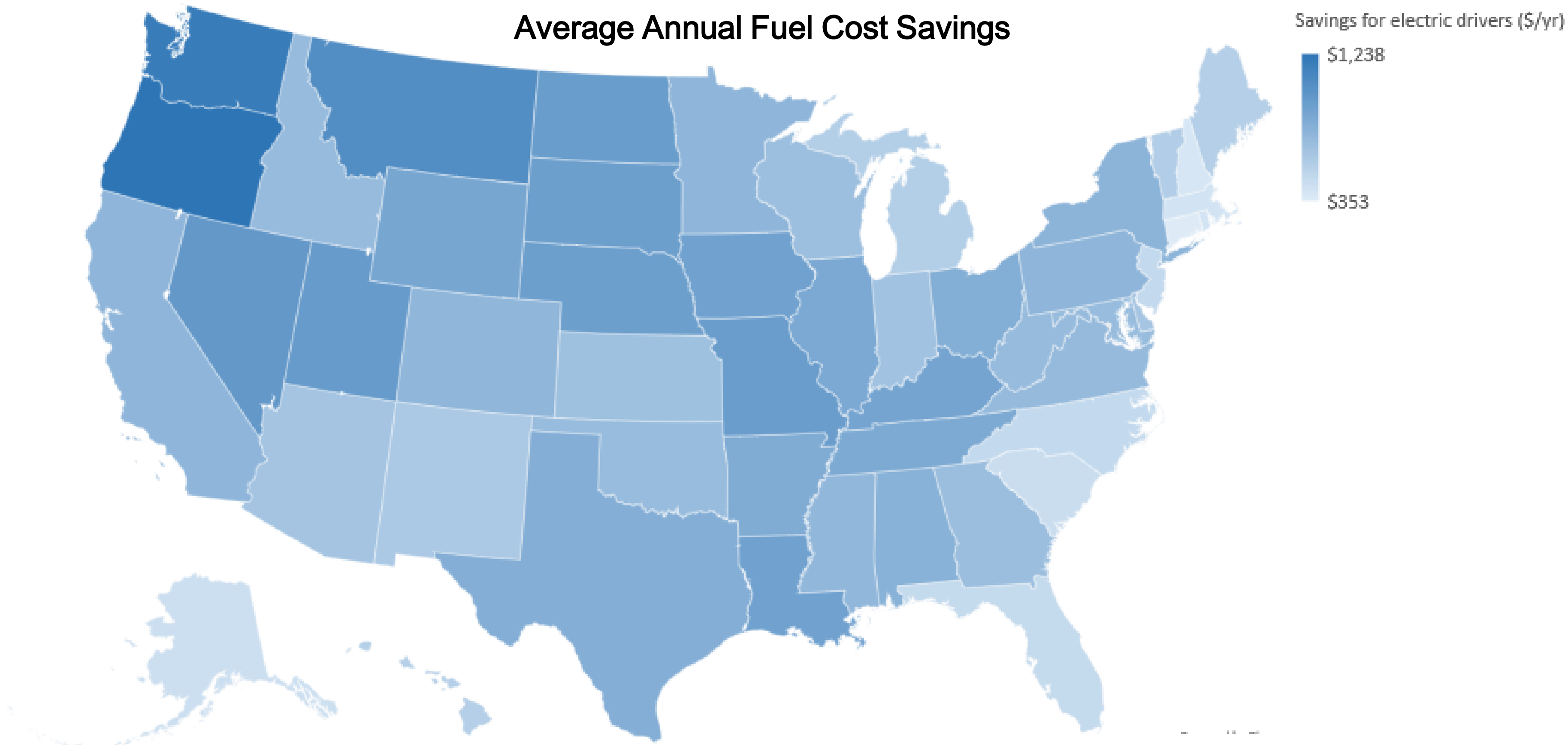
- Electric vehicles can provide significant emissions reductions



Source: DOE Alternative Fuels Data Center
https://www.afdc.energy.gov/vehicles/electric_emissions.php

Fuel Savings

- EVs are less expensive to operate than gasoline cars in all 50 states

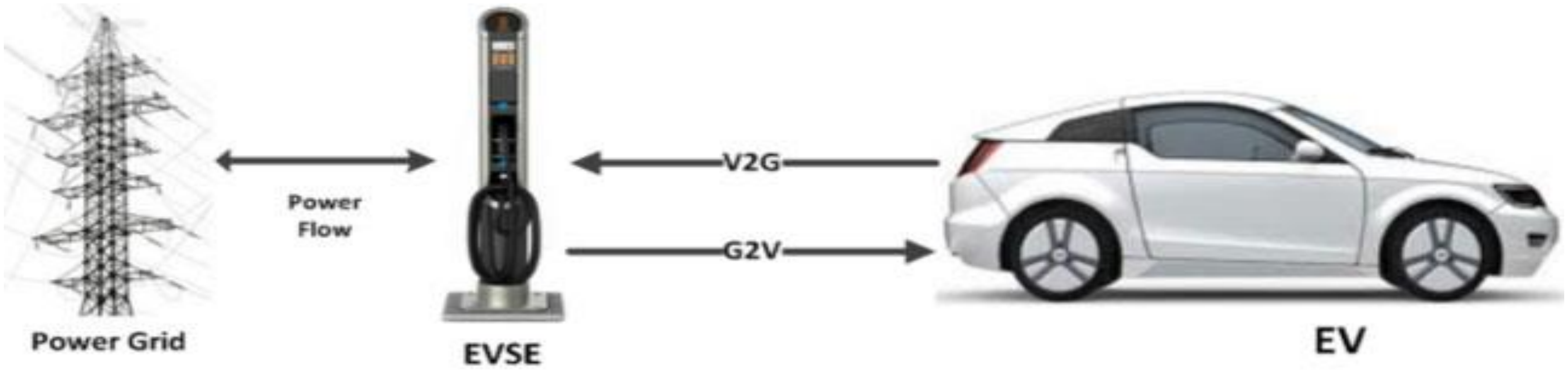


Source: Plugless Power
https://www.pluglesspower.com/learn/driving-electricity-cheaper-gas-50-states/

Grid Benefits

- Increasing sales at times of high supply and low demand = more efficient use of grid
  - Helps utilize excess low-cost renewable generation
  - Spreads fixed costs over higher volume of sales => lower rates

- EVs are mobile batteries
  - In addition to traditional demand response (reducing peak load), could be used to provide power and ancillary services back to the grid

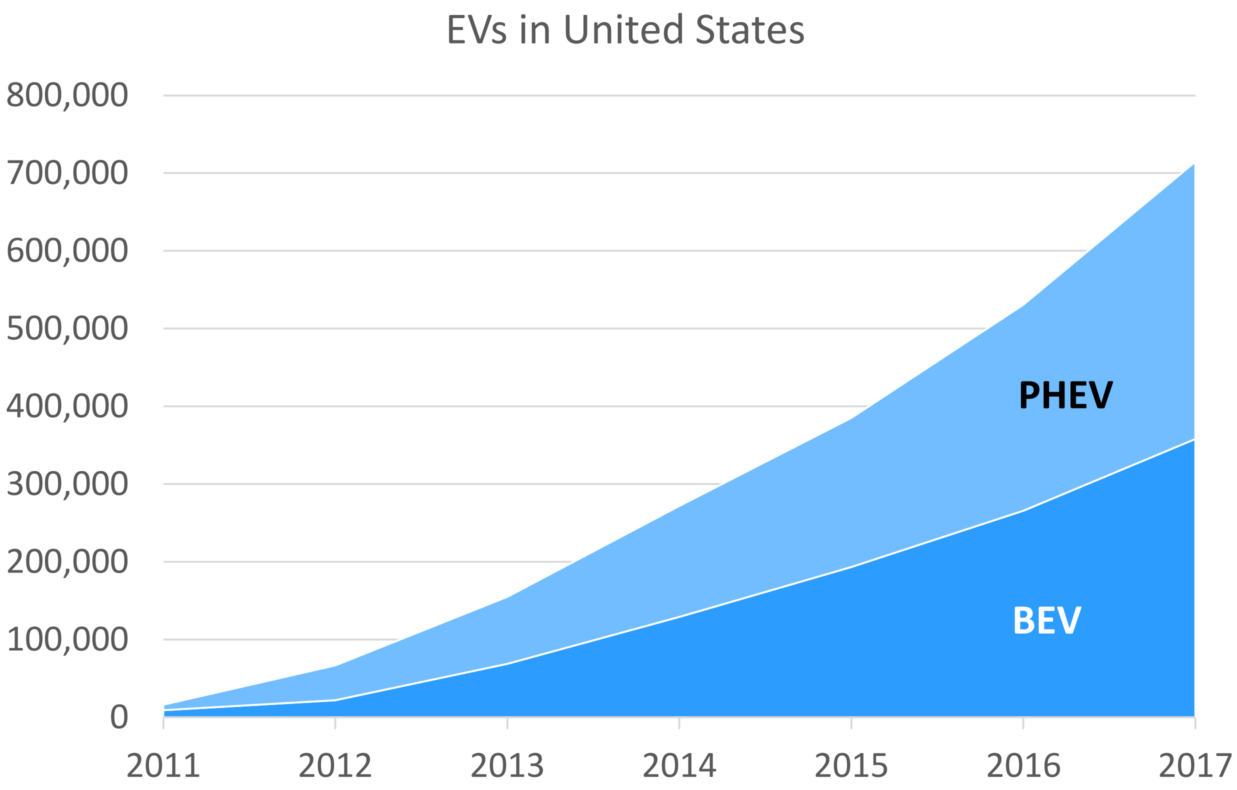


Source: UCLA SMERC
http://smartgrid.ucla.edu/projects_evgrid.html

Do We Need to Plan for EVs?

Where We Are Today

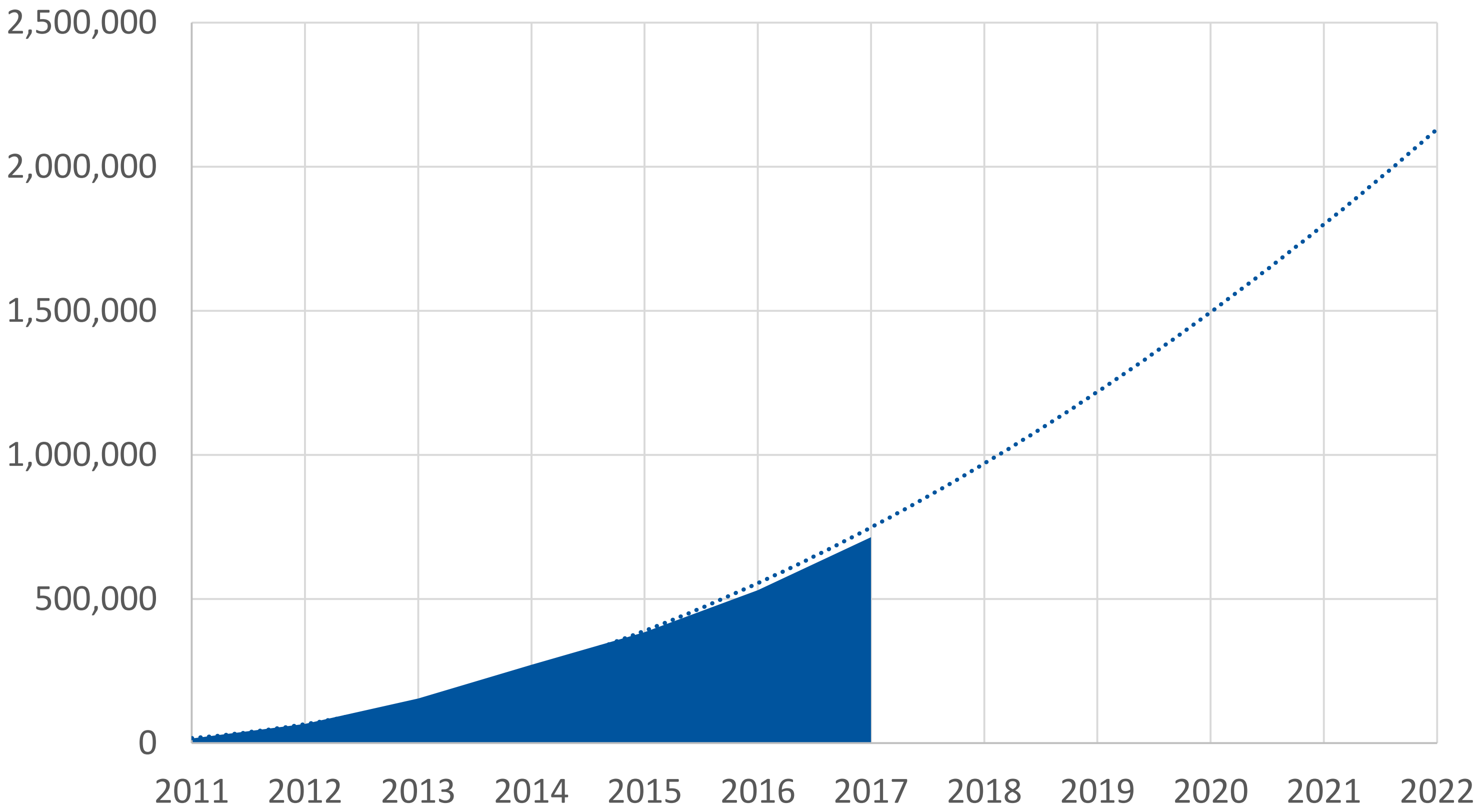
- EV sales are rapidly increasing



Data Source: Auto Alliance

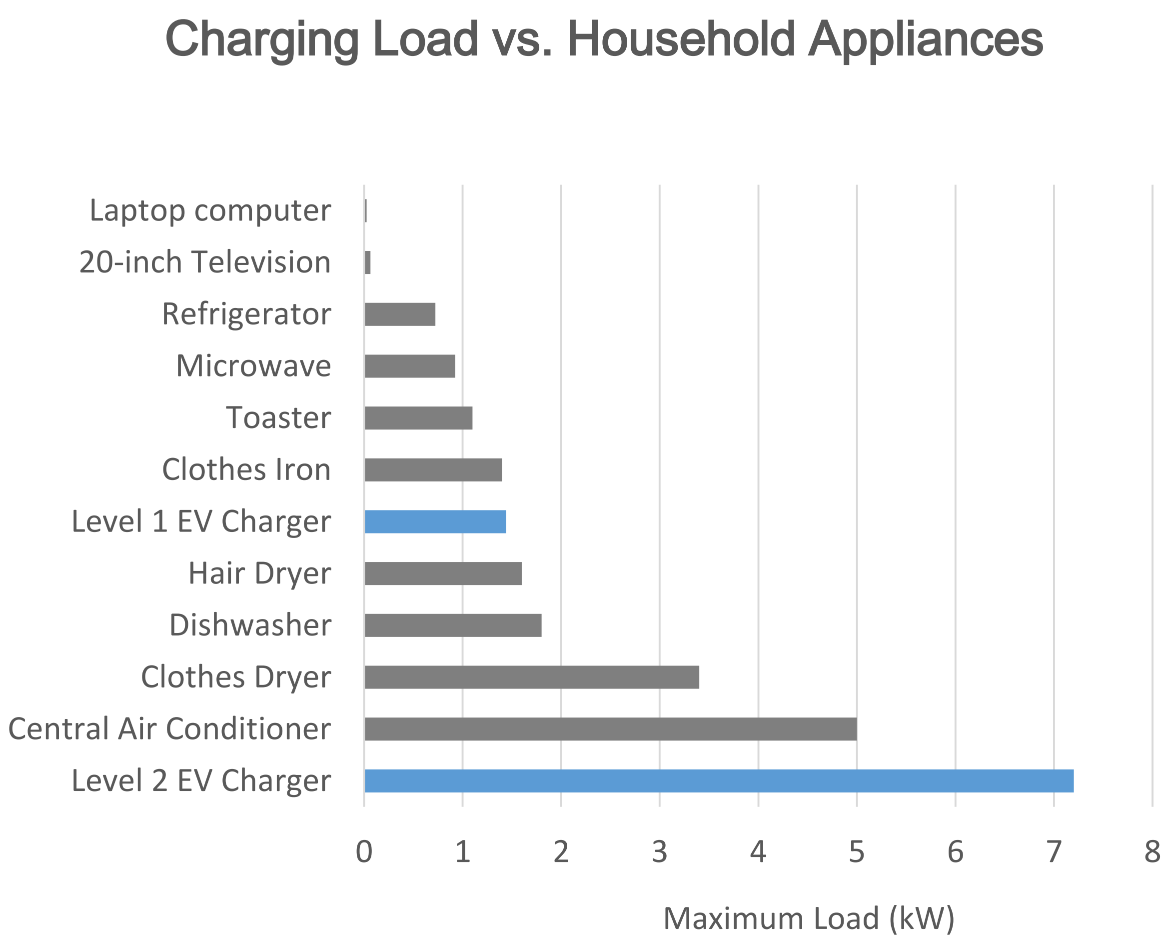
Where We Will Be Soon

- Following the trend: In less than five years, there could be more than 3x the number of EVs on the road and on the grid



Why EV Rates?

EVs Can Double a Household's Peak Demand



EV Charging Load Can Present Grid Challenges

New York

- **215 MW** – Potential demand of all EVs in New York using a 7 kW (Level 2) charger in 2017
- **230 MW** – Expected peak demand reduction from energy efficiency in New York in 2017 *(NYISO Power Trends 2017)*

California

- **2,282 MW** – Potential demand of all EVs in California using a 7 kW (Level 2) charger
- Equivalent to **5%** of system peak demand

Images by Ted Grajeda from the Noun Project

A Problem that Can Be Avoided

EVs are Flexible Load

- With most electricity uses, electricity must be drawn from the grid at time of desired energy service
- With EVs, there is temporal disconnect between consumption of grid electricity and use of energy service
  - EV drivers don't care when their car draws from the grid, as long as the battery is charged when it's time to drive
  - Opportunity to incentivize EV drivers to charge at socially beneficial times
- EVs sit parked about 80% of time → plenty of time to shift charging

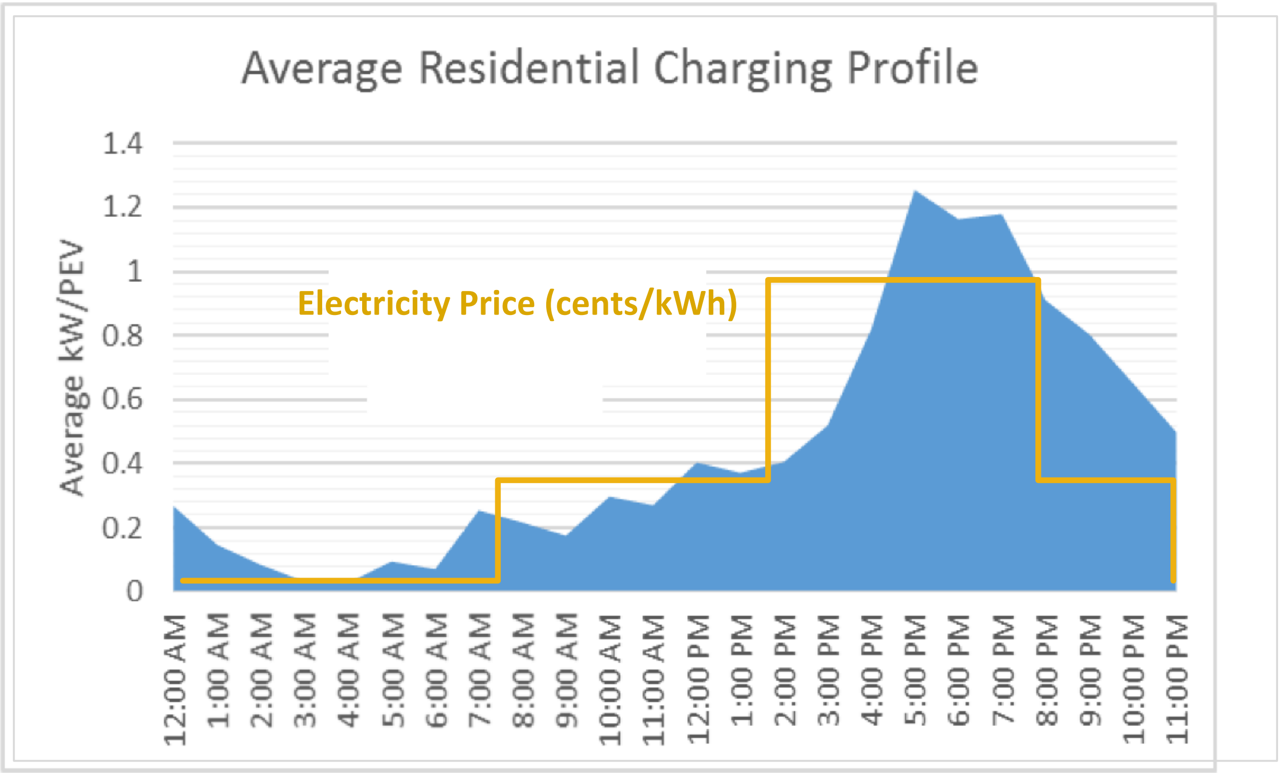
Price Signals for EV Drivers

Effective price signals can:

1. Avoid grid upgrades by encouraging customers to charge off-peak
2. Integrate renewables and lower emissions by charging when renewable energy production is high
3. Encourage customer adoption through low-cost charging options

Rate Options

Option 1: Time-of-Use Rates



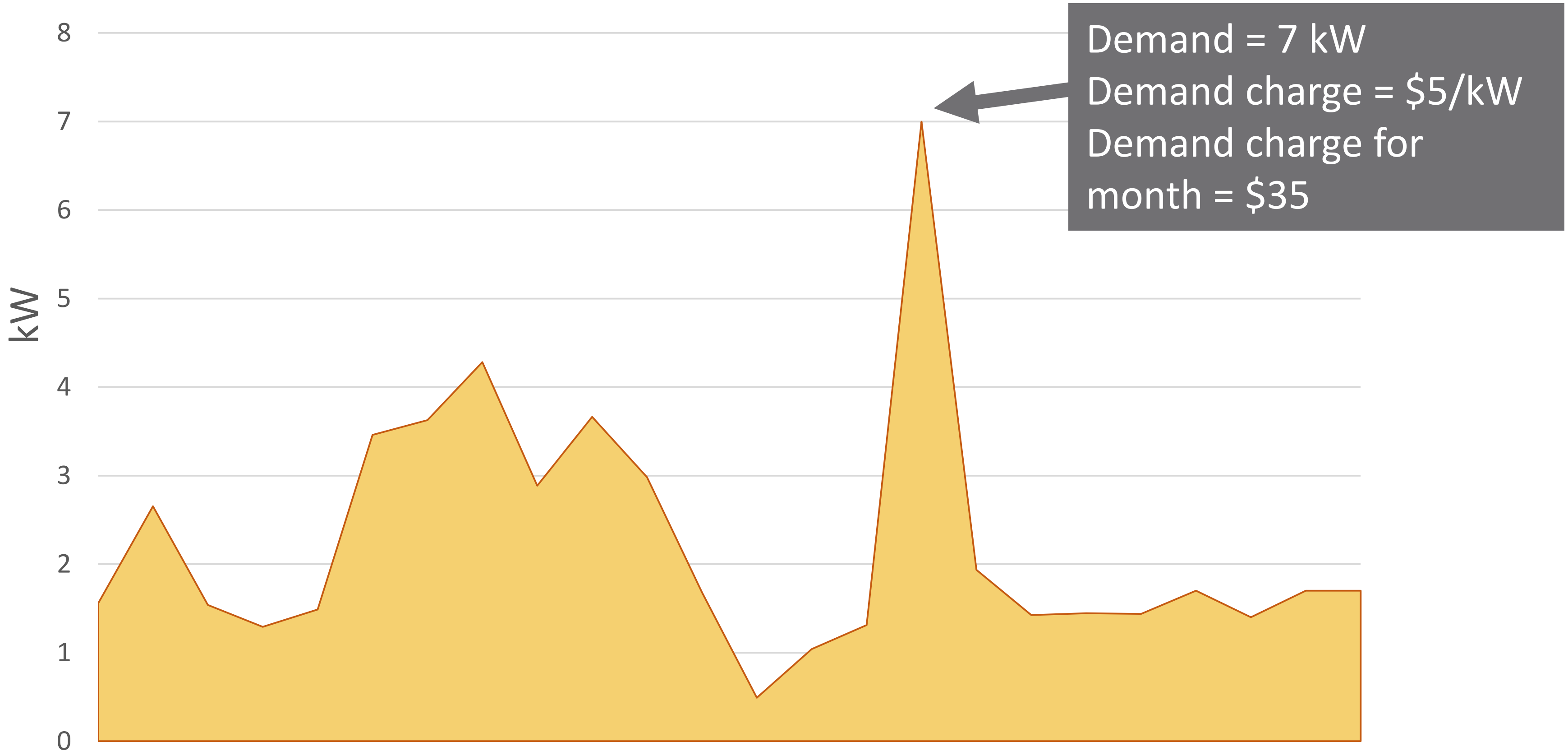
Source: Avista Corp., Avista Utilities Quarterly Report on Electric Vehicle Supply Equipment Pilot Program, Docket No. UE-160082, February 1, 2017, p. 11.

Option 2: Critical Peak Pricing

- Critical Peak Pricing focuses high prices on limited number of peak hours throughout the year

Option 3: Demand Charges

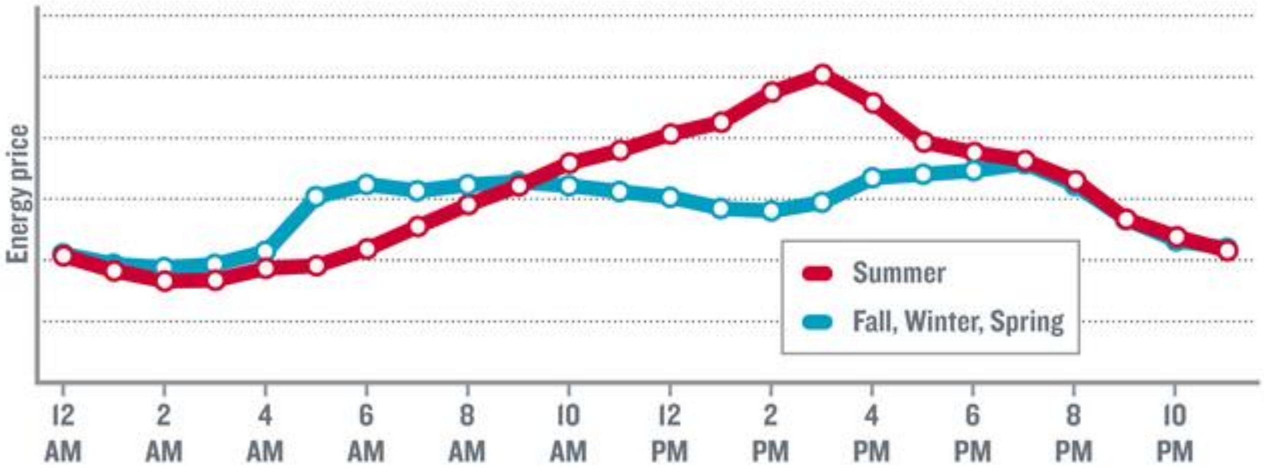
- Demand charges are typically applied to a customer's individual maximum demand during the month, regardless of when it occurs.



Option 4: Hourly Pricing

- Hourly pricing determined dynamically based on market clearing prices
  - Examples: Commonwealth Edison, SDG&E pilot

Typical Hourly Prices Under ComEd Program



Source: ComEd. https://hourlypricing.comed.com/live-prices/

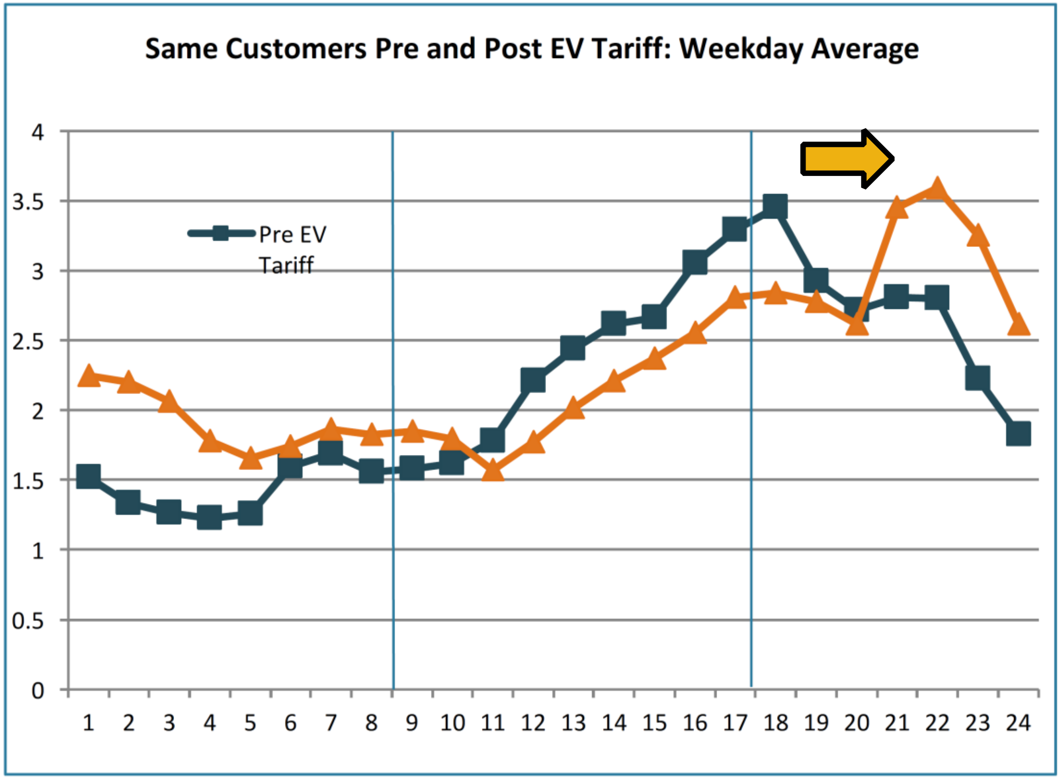
Whole House vs. EV Only

- Whole-house rates target EV customers, but apply to customers' total electricity usage
- EV-only rates exclusively apply to EV charging

Evidence from the Field

Data Show that Time-Varying Rates Work

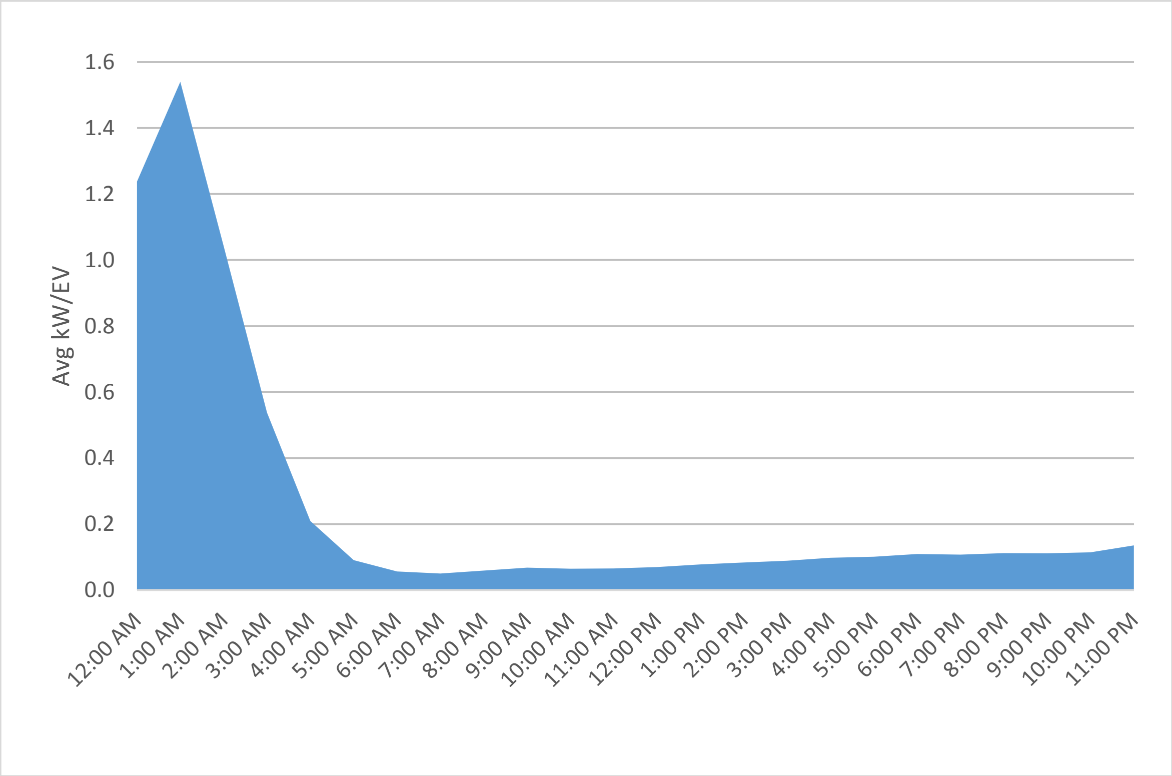
Whole-House TOU Rate at BGE: August residential customer load pre- and post- time-varying rates shows clear shift in peak



Source: BGE Electric Vehicle Off Peak Charging Pilot, presentation by John Murach, 2017

More Evidence: SDG&E

SDG&E average EV-only load profile after time-varying rates

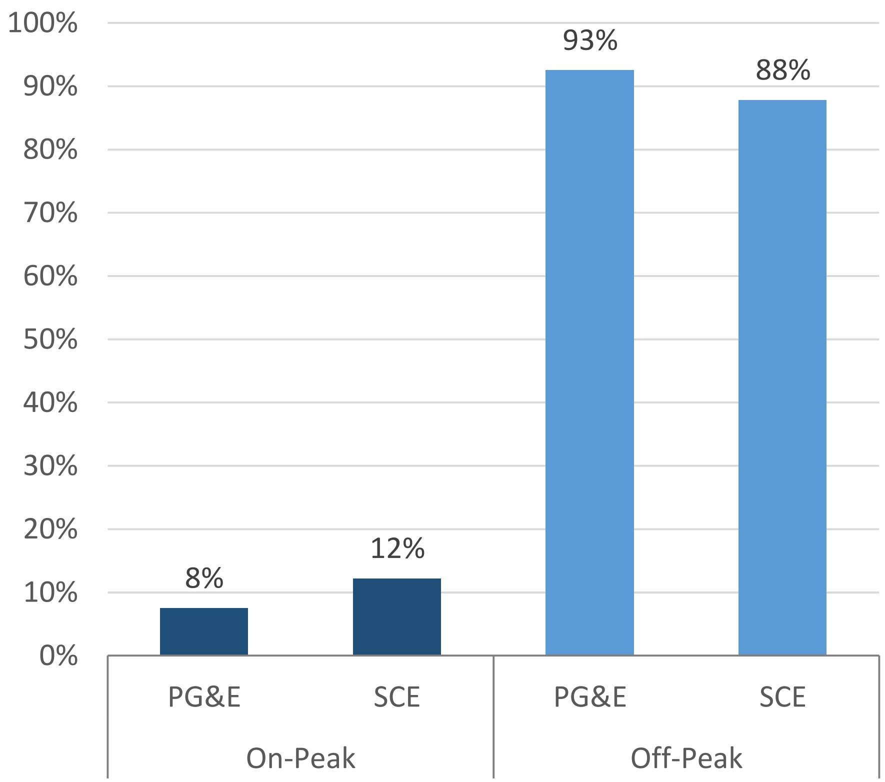


Source: San Diego Gas & Electric, Docket 17-01-020, June 2017

(NYISO Power Trends 2017)

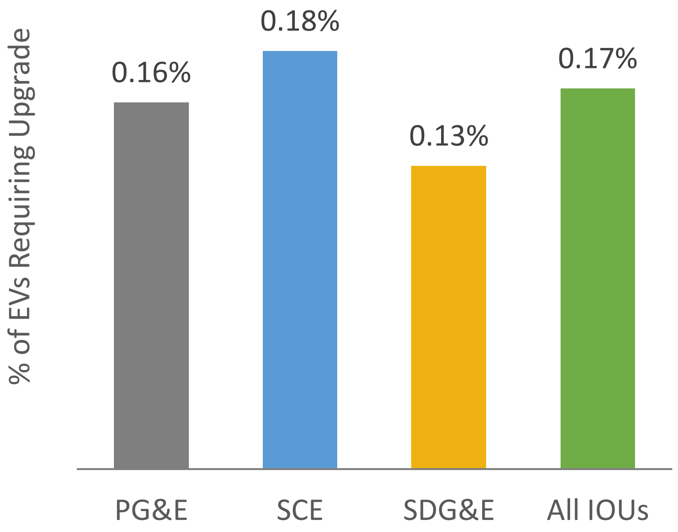
More Lessons from California

- EV TOU rates have effectively encouraged off-peak charging in California
- Approximately **90%** of EV charging occurs off-peak for customers on an EV-only rate.



EV Rates Can Successfully Minimize Grid Impacts

- Approximately 50% of EVs are in California.
- Very few California EVs have required distribution system upgrade
- Necessary upgrades have <u>not</u> imposed substantial costs: less than 0.01% of distribution capital costs



Synapse Analysis of Joint Utilities Load Research Report, Dec 2017.

Designing EV Rates

Determining TOU Periods

- TOU periods determined by layering component marginal costs
- Heat maps of aggregate costs guide setting of TOU periods and ratios
- TOU periods need not be the same across classes, if different classes have different peaking patterns

Marginal Energy Cost

Columns: Hour Ending (PPT)
Rows: Months

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
January	0.049	0.048	0.047	0.047	0.048	0.050	0.058	0.062	0.049	0.046	0.045	0.044	0.041	0.042	0.043	0.046	0.057	0.081	0.077	0.071	0.063	0.060	0.055	0.051
February	0.048	0.047	0.047	0.047	0.048	0.050	0.059	0.053	0.047	0.044	0.043	0.043	0.042	0.042	0.043	0.044	0.049	0.067	0.076	0.073	0.065	0.060	0.054	0.050
March	0.047	0.046	0.046	0.046	0.046	0.047	0.052	0.049	0.045	0.040	0.037	0.032	0.027	0.030	0.038	0.040	0.042	0.050	0.062	0.079	0.069	0.061	0.056	0.049
April	0.046	0.044	0.044	0.044	0.045	0.047	0.051	0.044	0.040	0.035	0.032	0.030	0.028	0.029	0.036	0.038	0.040	0.044	0.050	0.069	0.071	0.058	0.052	0.047
May	0.046	0.045	0.044	0.044	0.045	0.047	0.047	0.043	0.039	0.037	0.037	0.037	0.036	0.037	0.038	0.040	0.041	0.045	0.047	0.063	0.071	0.062	0.054	0.048
June	0.047	0.045	0.045	0.045	0.046	0.047	0.046	0.042	0.039	0.038	0.038	0.039	0.038	0.039	0.040	0.042	0.044	0.050	0.048	0.065	0.074	0.070	0.057	0.049
July	0.049	0.046	0.045	0.045	0.045	0.047	0.046	0.043	0.040	0.041	0.042	0.044	0.046	0.049	0.053	0.056	0.060	0.073	0.059	0.096	0.079	0.070	0.060	0.053
August	0.049	0.047	0.046	0.046	0.046	0.048	0.050	0.045	0.043	0.042	0.042	0.043	0.044	0.046	0.049	0.053	0.060	0.074	0.065	0.092	0.080	0.067	0.059	0.053
September	0.049	0.047	0.046	0.046	0.046	0.049	0.055	0.049	0.044	0.042	0.042	0.042	0.043	0.045	0.048	0.050	0.057	0.073	0.090	0.106	0.074	0.062	0.057	0.051
October	0.048	0.047	0.046	0.046	0.046	0.048	0.054	0.054	0.045	0.042	0.041	0.041	0.042	0.043	0.045	0.046	0.048	0.062	0.073	0.079	0.067	0.060	0.056	0.050
November	0.049	0.047	0.047	0.047	0.047	0.049	0.055	0.050	0.046	0.044	0.044	0.043	0.043	0.044	0.045	0.048	0.061	0.089	0.076	0.068	0.063	0.059	0.054	0.050
December	0.050	0.048	0.048	0.048	0.048	0.050	0.057	0.057	0.049	0.047	0.046	0.046	0.045	0.045	0.046	0.048	0.060	0.084	0.077	0.073	0.066	0.062	0.059	0.052

+ Marginal Generation Capacity Cost

Columns: Hour Ending (PPT)
Rows: Months

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
January	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
February	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
March	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
April	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	-	-	-
June	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.002	0.004	0.007	0.010	0.165	0.164	0.009	-	-
July	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	0.011	0.031	0.002	-	-
August	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.003	0.008	0.007	0.054	0.621	0.214	0.004	-	-
September	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.003	0.023	0.107	0.249	2.665	1.789	0.441	0.019	0.000	-
October	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.000	0.000	0.004	0.011	0.002	0.000	0.000	0.000	-
November	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
December	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

+ Marginal Distribution Capacity Cost

Columns: Hour Ending (PPT)
Rows: Months

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
January	0.002	0.001	0.001	0.001	0.001	0.003	0.007	0.006	0.006	0.005	0.003	0.002	0.003	0.003	0.004	0.006	0.006	0.024	0.018	0.015	0.010	0.007	0.008	0.005
February	0.002	0.001	0.001	0.001	0.001	0.002	0.006	0.007	0.006	0.005	0.004	0.004	0.004	0.005	0.004	0.005	0.006	0.014	0.015	0.013	0.008	0.007	0.007	0.005
March	0.002	0.000	0.001	0.001	0.000	0.002	0.005	0.005	0.004	0.002	0.003	0.002	0.002	0.002	0.003	0.004	0.006	0.008	0.010	0.010	0.010	0.008	0.006	0.004
April	0.002	0.001	0.001	0.001	0.001	0.001	0.004	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.006	0.011	0.008	0.010	0.009	0.009	0.007	0.005
May	0.004	0.001	0.001	0.001	0.001	0.001	0.003	0.003	0.003	0.002	0.002	0.003	0.003	0.003	0.004	0.006	0.009	0.020	0.013	0.015	0.016	0.012	0.008	0.006
June	0.005	0.002	0.001	0.001	0.002	0.001	0.002	0.003	0.003	0.005	0.004	0.006	0.004	0.008	0.010	0.016	0.020	0.028	0.020	0.021	0.022	0.021	0.017	0.010
July	0.009	0.005	0.003	0.002	0.003	0.004	0.007	0.007	0.009	0.009	0.012	0.013	0.012	0.019	0.025	0.029	0.043	0.088	0.060	0.043	0.036	0.032	0.024	0.015
August	0.011	0.005	0.003	0.003	0.003	0.006	0.009	0.008	0.009	0.011	0.013	0.014	0.016	0.024	0.031	0.049	0.071	0.095	0.065	0.047	0.040	0.032	0.025	0.017
September	0.007	0.003	0.002	0.002	0.002	0.004	0.010	0.008	0.008	0.009	0.010	0.011	0.015	0.019	0.026	0.040	0.059	0.101	0.044	0.046	0.036	0.025	0.021	0.015
October	0.003	0.001	0.000	0.001	0.001	0.003	0.005	0.005	0.005	0.004	0.004	0.004	0.003	0.006	0.008	0.015	0.022	0.039	0.024	0.030	0.017	0.011	0.008	0.006
November	0.002	0.001	0.001	0.001	0.001	0.002	0.005	0.005	0.004	0.004	0.004	0.004	0.004	0.004	0.006	0.006	0.009	0.045	0.024	0.014	0.009	0.007	0.007	0.005
December	0.003	0.001	0.001	0.001	0.001	0.003	0.006	0.006	0.006	0.005	0.004	0.004	0.003	0.004	0.005	0.006	0.007	0.041	0.025	0.019	0.013	0.009	0.008	0.006

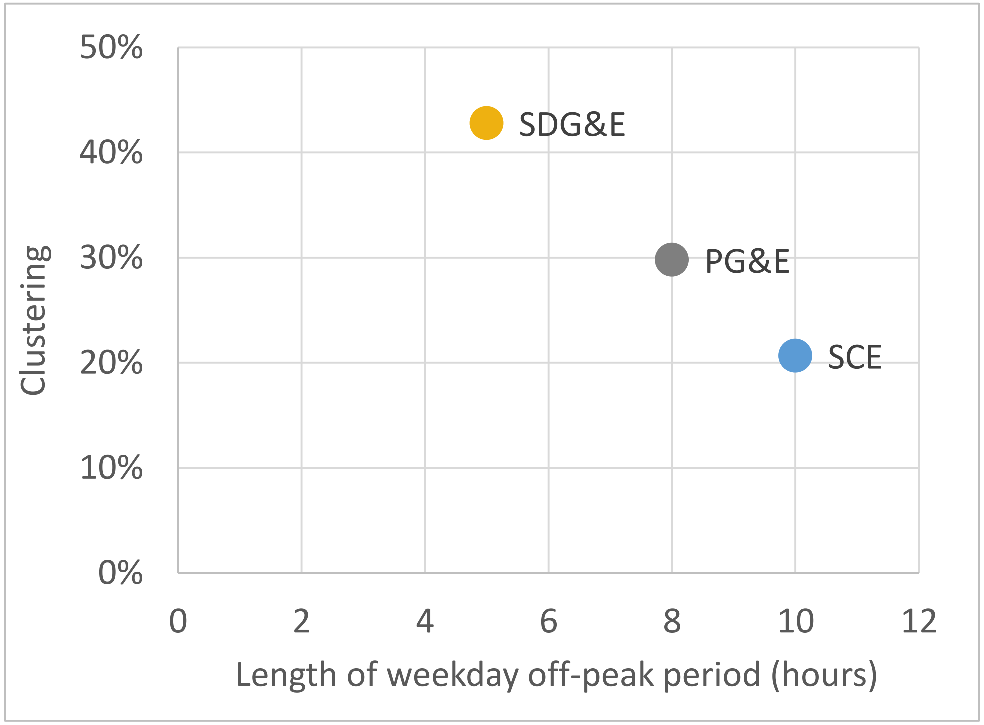
= Total Cost

Columns: Hour Ending (PPT)
Rows: Months

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
January	0.051	0.049	0.048	0.048	0.049	0.053	0.069	0.078	0.055	0.050	0.048	0.046	0.044	0.045	0.047	0.057	0.099	0.169	0.115	0.086	0.074	0.067	0.063	0.056
February	0.050	0.048	0.047	0.048	0.049	0.052	0.064	0.060	0.053	0.049	0.047	0.047	0.046	0.047	0.047	0.051	0.084	0.162	0.133	0.086	0.072	0.067	0.061	0.055
March	0.049	0.046	0.046	0.046	0.046	0.049	0.057	0.054	0.049	0.042	0.039	0.034	0.029	0.033	0.041	0.044	0.065	0.131	0.155	0.103	0.078	0.070	0.062	0.053
April	0.048	0.045	0.045	0.045	0.046	0.048	0.055	0.047	0.042	0.036	0.033	0.032	0.030	0.031	0.039	0.041	0.046	0.102	0.170	0.087	0.080	0.067	0.059	0.052
May	0.050	0.046	0.045	0.045	0.046	0.049	0.050	0.046	0.042	0.039	0.039	0.039	0.039	0.040	0.043	0.045	0.050	0.106	0.156	0.088	0.087	0.073	0.062	0.054
June	0.052	0.047	0.046	0.046	0.047	0.049	0.048	0.046	0.043	0.044	0.044	0.045	0.043	0.047	0.051	0.059	0.066	0.112	0.157	0.215	0.194	0.097	0.074	0.059
July	0.058	0.051	0.048	0.047	0.048	0.050	0.053	0.050	0.049	0.050	0.054	0.057	0.058	0.068	0.077	0.086	0.102	0.203	0.218	0.145	0.134	0.103	0.084	0.068
August	0.060	0.052	0.049	0.049	0.049	0.054	0.058	0.053	0.052	0.053	0.055	0.057	0.059	0.070	0.080	0.104	0.146	0.235	0.249	0.511	0.248	0.101	0.084	0.070
September	0.056	0.050	0.048	0.048	0.048	0.052	0.065	0.057	0.052	0.051	0.052	0.054	0.058	0.064	0.076	0.104	0.185	0.381	1.844	1.225	0.374	0.099	0.079	0.066
October	0.051	0.048	0.047	0.047	0.047	0.051	0.060	0.062	0.050	0.045	0.045	0.045	0.046	0.049	0.052	0.061	0.089	0.180	0.173	0.111	0.084	0.071	0.064	0.056
November	0.050	0.048	0.048	0.048	0.048	0.051	0.060	0.055	0.050	0.048	0.048	0.047	0.047	0.048	0.051	0.079	0.157	0.200	0.099	0.082	0.072	0.065	0.061	0.056
December	0.053	0.049	0.048	0.049	0.049	0.054	0.063	0.063	0.055	0.051	0.050	0.050	0.049	0.049	0.051	0.054	0.122	0.255	0.107	0.092	0.080	0.072	0.067	0.058

Addressing Clustering

- Size of EV load creates potential for new peaks if EVs charge at same time
- Longer off-peak periods increase diversity of charging times
- In future, utility direct control programs could mitigate clustering issues



Clustering expressed as class peak as % of sum of individual peaks. Synapse Analysis of Joint Utilities Load Research Report, Dec 2017.

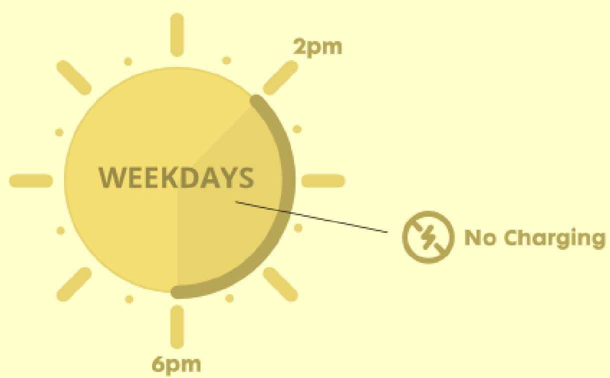
Residential EV Rate Design

Residential Customers

Understandability, simplicity, and predictability are key

- Time-of-Use (TOU) rates are more accessible to residential customers than more advanced time-varying rates
  - Set it & forget it technologies, simplicity, customer familiarity.

ConEd's SmartCharge Rewards™ Program features simple TOU periods

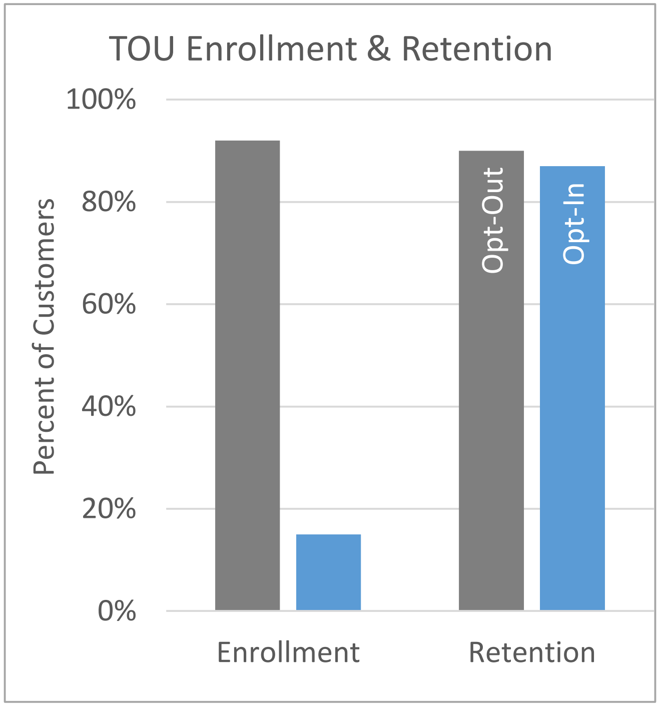


EV-Only or Whole-House TOU?

- Offering a separately-metered EV rate may encourage additional customer enrollments
  - Customers may prefer EV-only rate relative to a whole-home rate
- EV-only rates require submetering technology
  - Options include second meter, stand-alone submeter, in-car device, and Level 2 EVSE-integrated submeter
  - These technologies currently involve high up-front costs and ongoing data management fees

Combating Customer Inertia

- Must overcome the "default effect" or "status quo bias"
- **Opt-Out:** Historically, TOU enrollment is 6x higher under default (opt-out) enrollment than opt-in
  - Goal: Eventually move to default enrollment in EV rate
- **Opt-In:** Under opt-in framework, need **education & incentives,** such as:
  - Customer enrollment bonuses
  - Dealership training



Source: Customer Acceptance, Retention, and Response to Time-Based Rates from the Consumer Behavior Studies; Smart Grid Investment Grant Program; November 2016

Customer Incentives

- Entice EV owners to identify themselves and establish a communication line with utility

SRP Delivering water and power™

My Account | Pay Bill | Outages

MY ACCOUNT | RESIDENTIAL ELECTRIC | BUSINESS ELECTRIC | WATER | COMMUNITY | ABOUT US | CONTACT US

EV owners, sign up and pocket **$50**

Join SRP's electric vehicle (EV) community to connect with fellow EV enthusiasts, help drive the use of electric vehicles, and be on the list for future focus groups, surveys and more. Sign up below and upon approval you'll receive a gift card to Amazon.com within 20 business days.

To join, you must:

- Reside in a SRP residential account household.
- Own or lease a qualified electric vehicle (as listed in form). Only electric vehicles that can travel on the freeway at highway speeds are eligible. Licensed or unlicensed vehicles such as electric golf carts and neighborhood electric vehicles such as the GEM, Columbia, E-Z-Go, Peapod, etc. are not eligible for the gift card.
- Complete the online form. NOTE: SRP customers are eligible to receive one gift card, per vehicle. A form must be completed for each electric vehicle. SRP employees are not eligible for the gift card offer.
- Submit a scanned PDF or photo of your Arizona automobile registration.

Sign up today

Questions?

Call us at (602) 236-8888 for more information.

Education, Training, & Incentives

- Utility outreach on rate designs
- Dealership training
- Utility performance incentives could target enrollment of EVs on TOU rates

When asked how much it would cost to charge an EV, only about **19%** of salespeople gave reasonably accurate answers.

Source: https://chargedevs.com/features/are-auto-dealers-the-evs-worst-enemy/

Public & Workplace EV Rates

Demand Charges

- For DC fast chargers, demand can be high but energy consumption low. At low penetrations, the economics do not pencil out.
- Example: One DCFC with two 50-kW ports (with potential for 100 kW demand)

	Customer Charge	Energy Charge	Demand Charge	**16** charging sessions/month		**60** charging sessions/month	
				Annual Bill	Cost/ session	Annual Bill	Cost/ session
High Case	$70	$0.08	**$20**	$25,608	$133	$27,720	$39
Mid Case	$70	$0.08	**$6**	$8,808	$46	$10,308	$14

- Demand charges make it difficult for charging station hosts to pass through costs to users.
- For small and medium commercial customers, demand charges from EVs can have a large impact on electricity bills, discouraging installation of EV charging stations.

Recommendations

- Remove/reduce demand charges, at least temporarily
- Minimize variability of rates from utility to utility, especially for DC Fast Charge vendors.

Key Take-Aways

Key Take-Aways

- EVs can provide many benefits to grid & society
- Even in California, grid impacts from EVs are minor
  - But important to plan for the future
- Time-varying rates work
  - Can help to avoid grid upgrades and encourage EV adoption
- Residential customers:
  - TOU rates provide the right combination of simplicity and efficient price signals
  - As technology improves, more complex rates could be considered
  - Need for education & outreach – combat customer inertia
- Public & workplace charging
  - Demand charges can be a key barrier

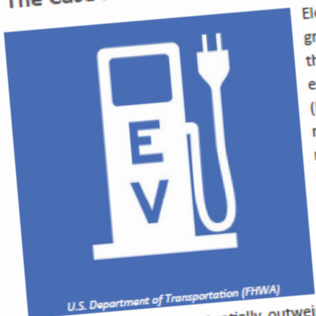
Synapse Energy Economics

A Plug for Effective EV Rates

March 2, 2017

By Avi Allison and Melissa Whited

The Case for Supporting EVs



Electric vehicles (EVs) provide a tremendous opportunity to reduce greenhouse gas (GHG) emissions and save money at the same time. In the United States today, EVs generally result in substantially fewer GHG emissions compared to gasoline-powered internal combustion engine (ICE) vehicles.[1] EVs are also typically cheaper to operate than ICEs. A recent Synapse analysis found that replacing ICEs with EVs powered by renewable energy is one of the most cost-effective ways for states in the Northeast to cut GHG emissions.[2]

However, the environmental, health, and economic benefits of EVs are not guaranteed. When powered primarily with coal-fired electricity, EVs can *increase* emissions of GHGs and local air pollutants.[3] And chargin EVs during times of peak electricity demand could result in high electric system costs, potentially outweighing the operational energy savings associated with EVs. It is therefo well worth encouraging EV owners to charge their vehicles at times when electricity is cheap and clean.

The Role of Rate Design

Electricity rates play a crucial role in fostering the adoption of EVs and encouraging existing EV customers to c their vehicles in an environmentally and economically efficient manner. Unfortunately, standard electricity ra little to encourage EV adoption or optimal charging times. In fact, current time-invariant rates and demand may even directly discourage efficient charging practices.

Rethinking Rates for EVs

In addition to their potential to cut costs and emissions, EVs have at least two important characteristic them apart from most other uses of electricity. First, they represent relatively large loads. As shown i home EV charging systems can draw nearly 50 percent more power than even the most energy-intensive appliances. If charged during a time of peak demand with a standard Level 2 charger, an EV's loa equivalent to that of an entire household.[4]

Second, EVs are effectively storage devices. When EVs draw electricity from the grid, that ele immediately used to propel the vehicle. Instead, the electricity is stored in the vehicle's battery for l people do not care so much about precisely when and where their EV gets charged, as long as the when it is needed. This is very different from most major residential electricity uses (think of air c opens up the possibility of encouraging efficient charging without inconveniencing consumers.

Residential Rates Fall Short

Most residential electricity rates include a fixed charge and an energy charge. Fixed charges a month regardless of the quantity of electricity consumed. The energy charge commonly takes th

Electric Vehicles Still Not Crashing the Grid:

Updates from California

March 2018 Update | Avi Allison and Melissa Whited
Prepared on behalf of the Natural Resources Defense Council

Can the Grid Handle Electric Vehicles?

Plug-in electric vehicles (EVs) offer a key opportunity to reduce harmful emissions and save consumers money at the same time. EVs are responsible for far fewer greenhouse gases and local air pollutants than conventional vehicles and become cleaner as more renewable electricity is added to the grid. In addition, EVs are generally much cheaper to operate than conventional vehicles.

However, the recent increase in the popularity of EVs has prompted concerns that the current electric grid may not be able to handle the spikes in household electricity consumption associated with EVs. This would necessitate costly upgrades to electric distribution infrastructure, and possibly even expensive increases in generation and transmission capacity.

Real World Data

Fortunately, starting in 2012, state regulators required California's largest investor-owned electric utilities to publish an annual "load research" report, which contains troves of data:

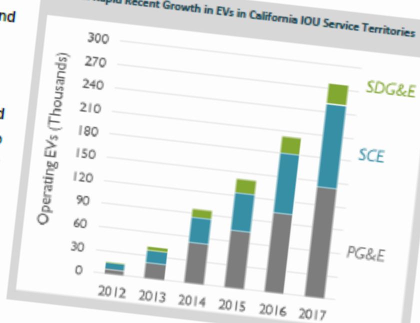
- First, it assesses the degree to which EVs in the utilities' service territories have required costly service line or distribution system upgrades.
- Second, it evaluates the extent to which time-of-use electric rates—which charge customers different energy prices based on the time of day— incentivize EV owners to charge during low-cost, off-peak times.

The results are in. According to the sixth and most recent EV load research report, EV-driven electric system upgrades have been exceedingly rare, and time-of-use (TOU) rates have been highly effective at encouraging off-peak charging.

California as the Test Bed

The utility load research reports are particularly useful because they provide data for a region that is at the forefront of the current growth in the EV industry. As of March 2018, there were more than 370,000 EVs in the state, accounting for almost half the U.S. market. During the five years between the publication of the first and most recent load research reports, the utilities' collective estimate of the number of EVs in their service territories grew by a factor of 16 (see Figure 1).

Figure 1. Rapid Recent Growth in EVs in California IOU Service Territories



California electric utilities are managing load associated with approximately one car for every 40 residential customers. However, EVs are much more concentrated than that ratio suggests. All three utilities have found that EVs tend to cluster in certain neighborhoods. This clustering would likely exacerbate any tendency for EVs

Questions?

webinar@synapse-energy.com

Want to team up with us?

Synapse provides:

- Economic and power system modeling
- Research and report writing
- Policy analysis and development
- Representation in voting and stakeholder committees
- Economic and technical analysis
- Expert witness services
- Regulatory support
- Facilitation and trainings
- Development of analytical tools

Contact Information

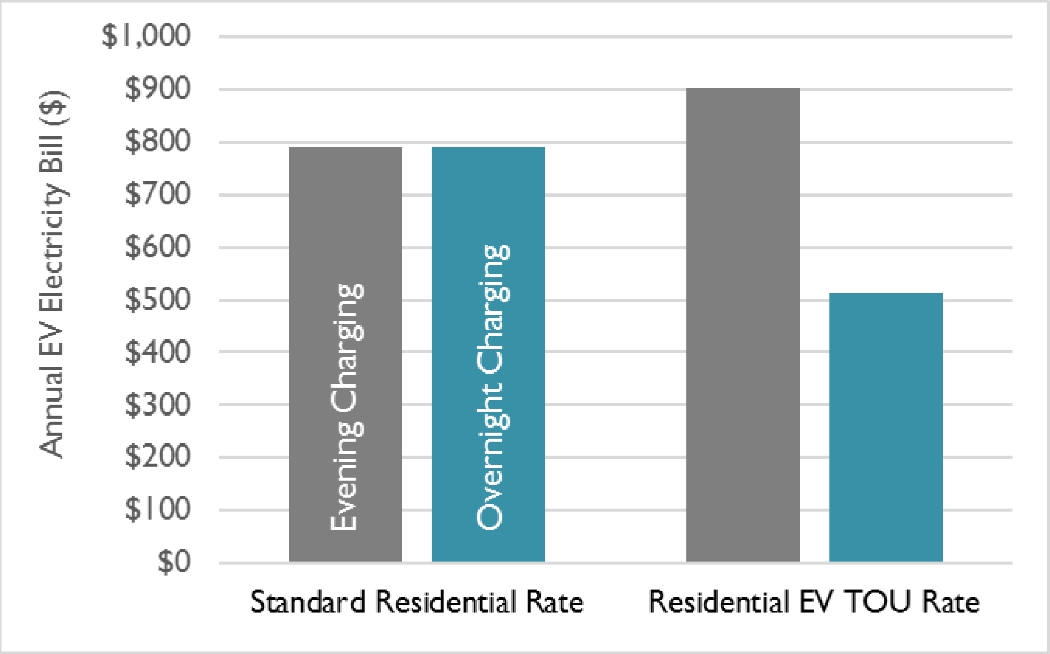
Melissa Whited, mwhited@synapse-energy.com

Avi Allison, aallison@synapse-energy.com

Appendix

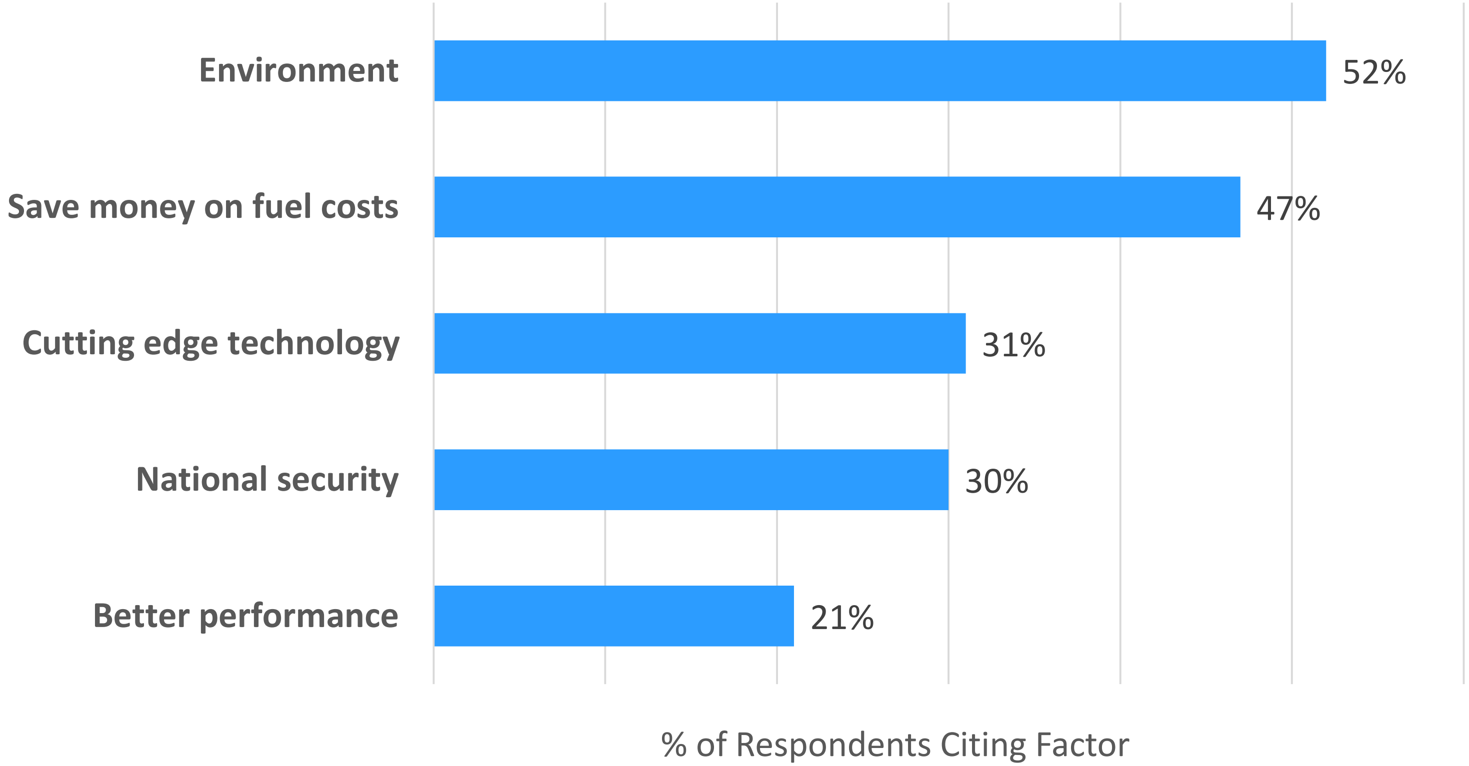
Savings from Charging on TOU Pricing

- TOU rates can incentivize off-peak charging



Sources: *Synapse; Southern California Edison; U.S. Department of Energy*

Factors motivating customers to buy EVs



Source: Singer, Mark. The Barriers to Acceptance of Plug-In Electric Vehicles: 2017 Update. NREL. 2017.

EV policy goals

- Eight ZEV MOU states have set targets of 3.3 Million EVs on the road by 2025
- This may increase adoption beyond the current trend