Rate Design for Public DCFC

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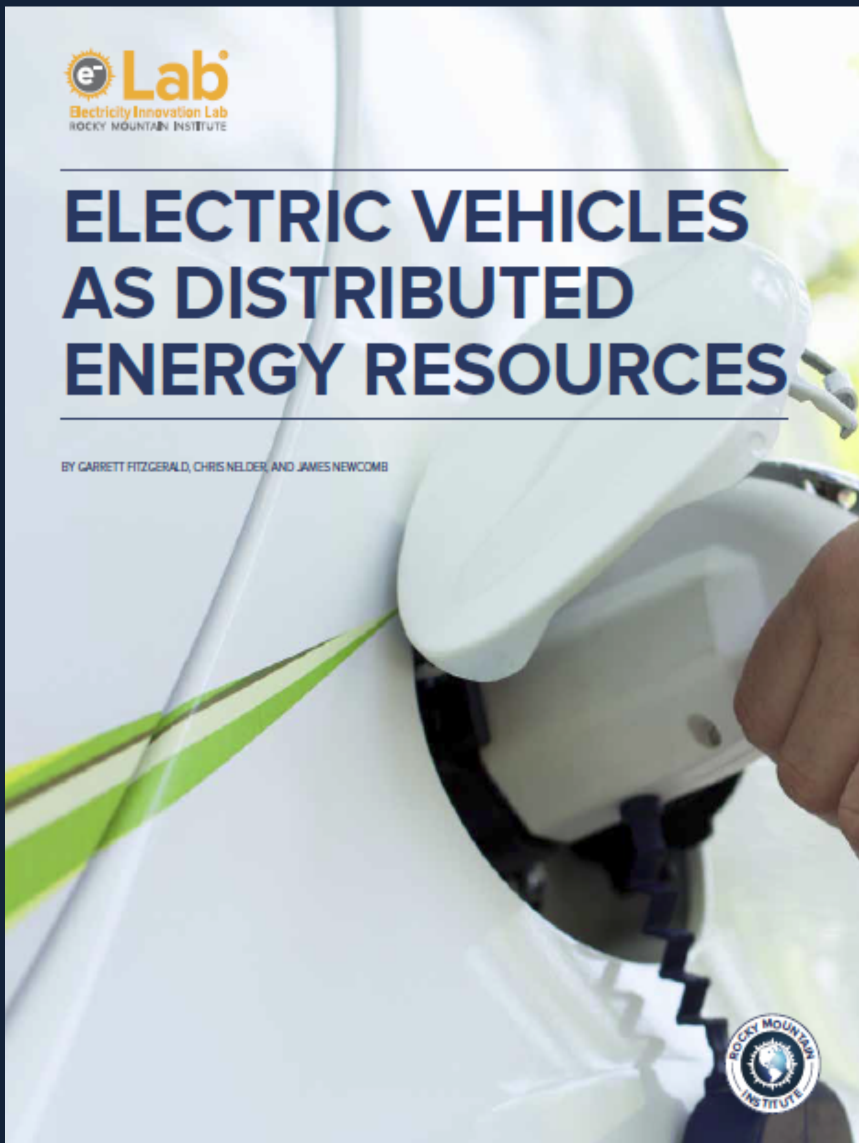
Our June 2016 report on VGI



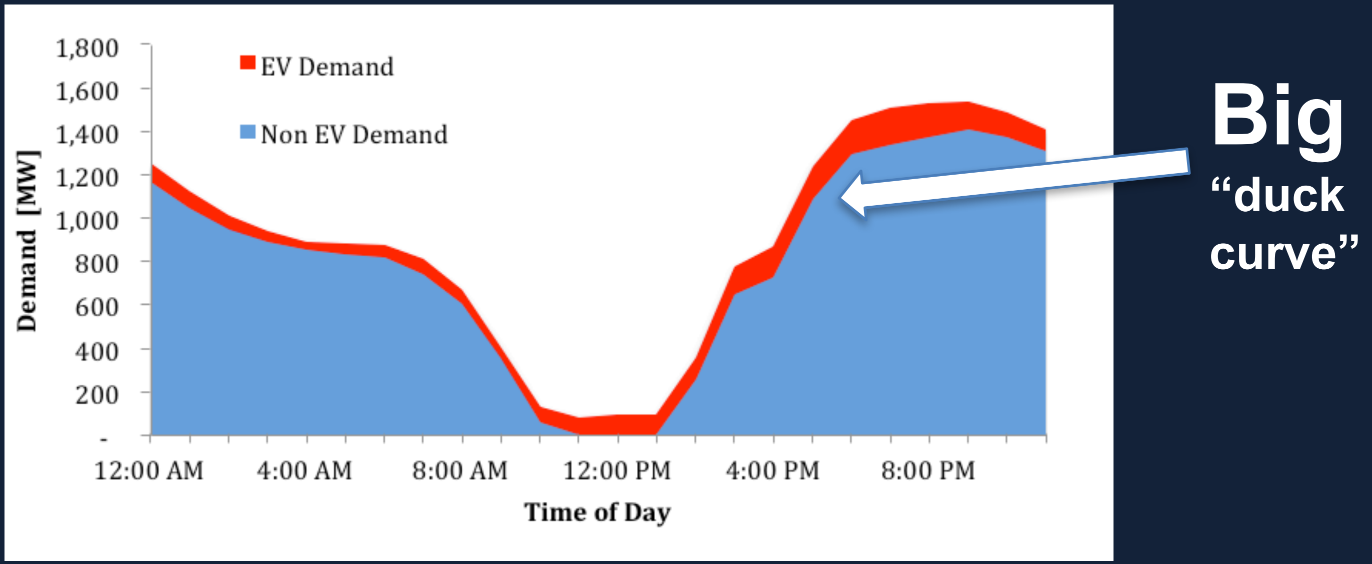
- Explored using TOU rates to shift EV charging loads from peaks to valleys
- Time-varying rates are key, but must be implemented early
- EVs can maximize renewable generation and flatten load profile
- Regulators should create performance-based incentives for high utilization of chargers and use of EVs to optimize existing grid assets and avoid new investment
- Remove regulatory uncertainty

A Dynamic Grid Resource

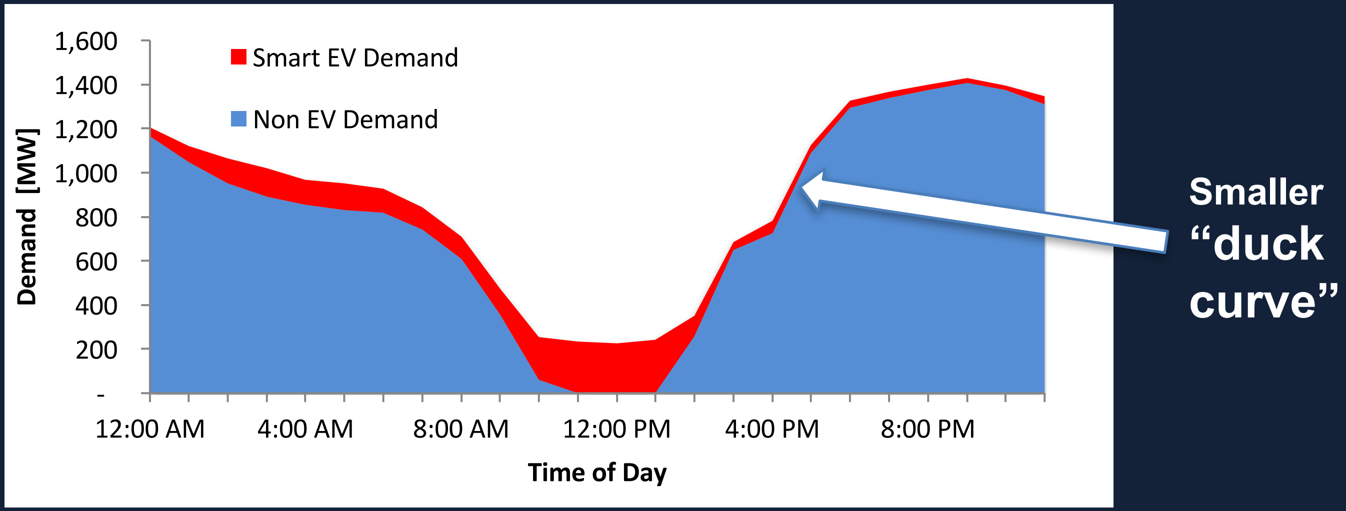
Controlled charging of electric vehicles (not V2G) can deliver many benefits:

- Optimize existing grid assets and extend their useful life
- Avoid new investment in grid infrastructure
- Supply ancillary services, such as frequency regulation and power factor correction.
- Absorb excess wind and solar generation
- Reduce emissions
- Reduce electricity and transportation costs
- Reduce petroleum consumption

Pressed Duck

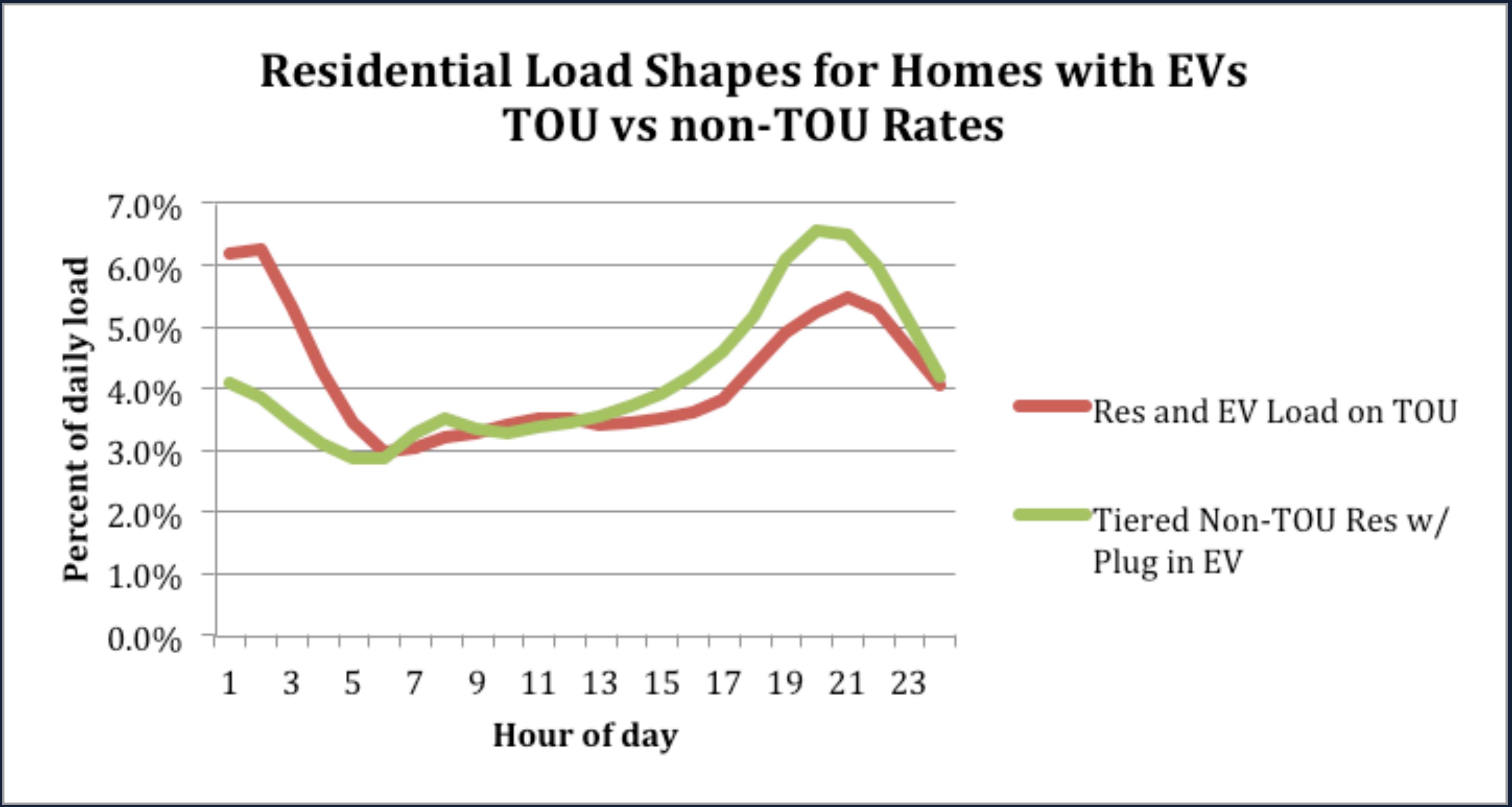


Projected HECO demand with 23% EV penetration with uncontrolled EV charging



Projected HECO demand with 23% EV penetration and optimized charging

TOU Rates Are Effective at Shifting Demand



Results of SDG&E tariff design pilot

SUMMARY

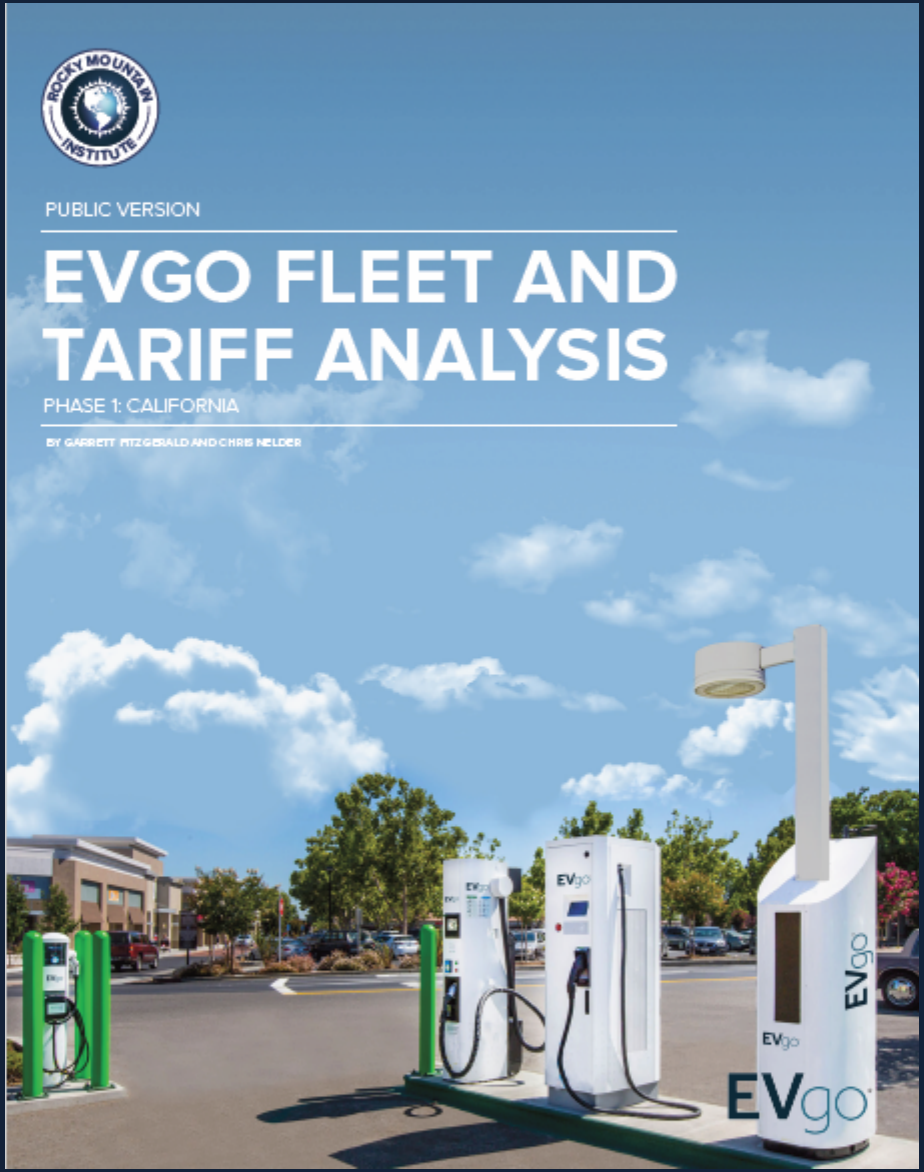
If we integrate EVs proactively and intelligently, we can:

- minimize new investment in grid infrastructure
- optimize existing grid assets and extend their useful life
- enable greater integration of variable renewables (wind and solar PV) without needing new gas generation for dispatchable capacity, while reducing curtailment of renewable production
- improve energy security
- reduce electricity and transportation costs
- reduce petroleum consumption
- reduce emissions of CO2 and conventional air pollutants
- provide multiplier benefits from increased money circulating in the community
- supply ancillary services to the grid, such as frequency regulation and power factor correction

If we integrate EVs reactively and badly, it will:

- shorten the life of grid infrastructure components
- require greater investment in gas-fired peak and flexible capacity
- make the grid less efficient
- make the grid less stable and reliable
- increase the unit costs of electricity for all consumers
- inhibit the integration of variable renewables, and increase curtailment of renewable generation when supply exceeds demand
- increase grid power emissions

Our March 2017 report for EVgo



- Analyzed every charging session in 2016 from all 230 of EVgo's DCFC in California.
- Modeled DCFC load profiles against multiple tariffs in SDG&E, SCE and PG&E territory under four future EV adoption scenarios.
- Critically evaluated the role of demand charges in DCFC operating costs.
- Sought to understand the business case for public DCFC owners/operators.

Findings: Demand Charges

- **Tariffs with high demand charges are definitely problematic for public DCFC with low utilization**

Category	Host Type A	Host Type B	Host Type C	Host Type D
Utilization	15%	8%	8%	4%
SCE ToU EV 4 (actual)	$1,933	$1,817	$1,762	$1,682
SCE ToU EV 8 (proposed)	$808	$648	$569	$461
SDG&E AL-ToU Commercial (actual)	$3,313	$3,219	$3,178	$3,114
SDG&E Public Charging GIR (proposed)	$501	$329	$255	$138
PGE A-6 ToU (actual)	$484	$322	$260	$150
PG&E A-10 (actual)	$1,318	$1,197	$1,147	$1,065

Findings: Demand Charges

- **Demand charges can make up a very high percentage of the charger's monthly bill if utilization rates are low.**

Tariff	Host Type A	Host Type B	Host Type C	Host Type D
SCE ToU EV 4 (actual)	70%	75%	77%	81%
SCE ToU EV 8 (proposed)	0	0	0	0
SDG&E AL-ToU Commercial (actual)	88%	91%	92%	94%
SDG&E Public Charging GIR (proposed)	0	0	0	0
PGE A-6 ToU with Option R (actual)	0	0	0	0
PG&E A-10 (actual)	67%	73%	76%	81%

Findings: Demand Charges

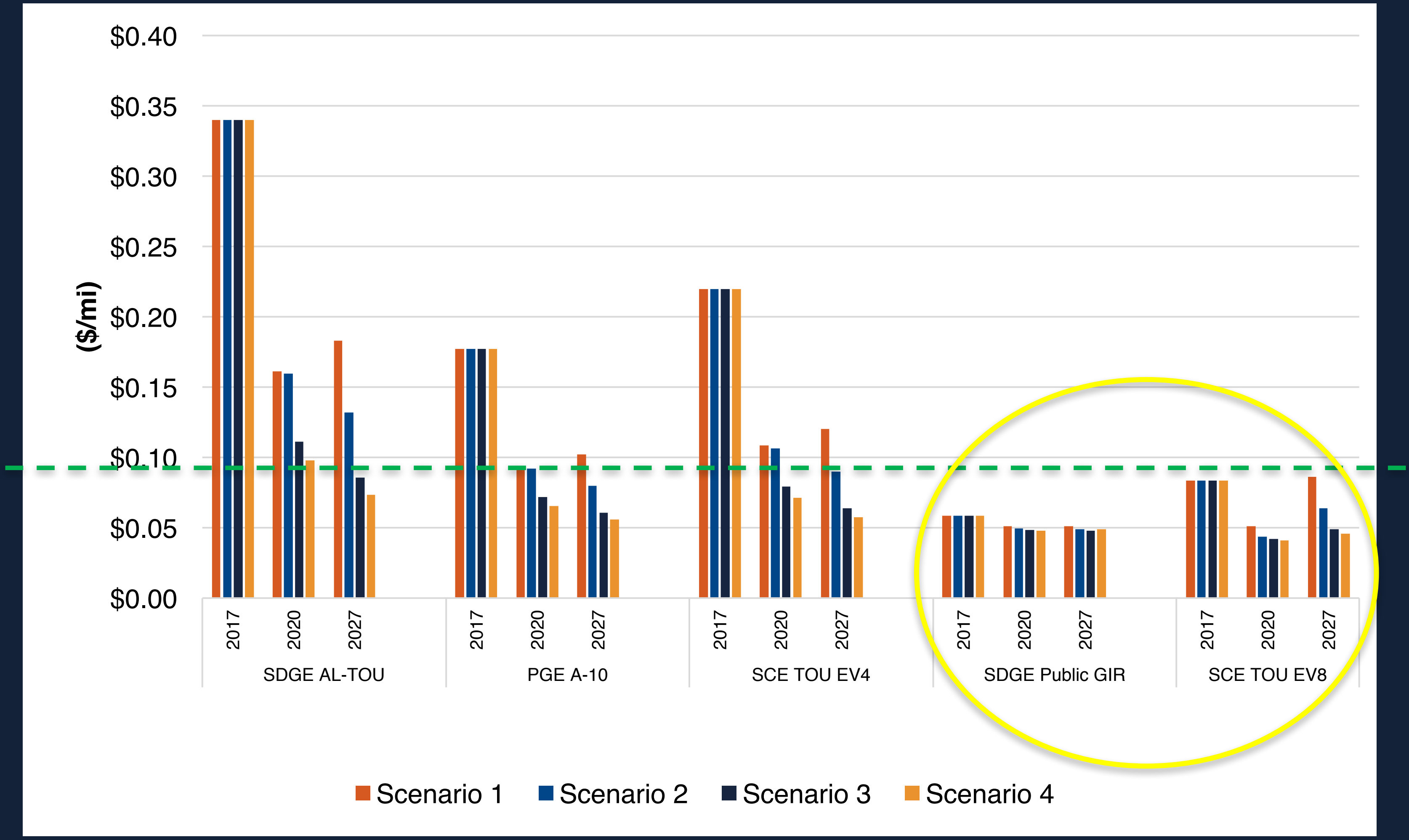
- **Tariffs that de-emphasize demand charges are more favorable to DCFC operators.**

SCE	Fixed	Energy	Demand	Total
TOU EV4	$220	$278	$1,362	$1,938
TOU EV 8 without demand charges	$330	$478	$0	$808
TOU EV 8 with demand charges in year 11	$330	$368	$792	$1,490

SDG&E	Fixed	Energy	Demand/Dynamic	Total
AL-TOU	$116	$279	$2,545	$2,941
Public GIR	$0	$452	$115	$567

The Goal: ICE Parity

- **Public EVSE should aim for ICE parity: gasoline equivalent cost of $0.29/kWh, or $0.09/mile or less**



Public DCFC Rate Design Issues

- As regulators begin to focus on EV-grid, it is critical that tariffs support public charging infrastructure.
- Most existing tariffs are not designed for DCFC operators and are not suitable:
  - Do not accurately reflect the true cost of service
  - Are not consistent across utilities
  - Lack appropriate price signals for effective integration of EVs onto the grid
- DCFC utilization varies by host type, and increasing utilization eases issues with demand charges.

→ **We need tariffs that create a better business case for DCFC owners & operators**

Rate Design Recommendations

Tariffs that enable profitable public DCFC operation should have the following characteristics:

- **Time-varying volumetric rates** which recover most utility costs
- Limited or **no demand charges**. If demand charges are necessary, they should be designed to only recover location-specific costs of connection to the grid, not upstream costs.
- **Low fixed charges**, which primarily reflect routine costs for things like maintenance and billing
- The opportunity to **earn credit for providing grid services**
- **Rates that vary by location** and promote a more efficient use of existing grid infrastructure

What if Public Charging Becomes Ubiquitous?

Most planners assume that most vehicles will charge at home using Level 2 chargers...but what if public Level 3 charging becomes widely available?

DISRUPTORS

- Vehicle range increasing (200+ mi)
- Use patterns changing (all-purpose)
- Chargers getting more powerful (400 kW)
- MaaS could popularize renting, not owning

DIFFERENT CHALLENGES

- Less overloading risk from clusters of Level 2 chargers in residential neighborhoods
- TOU a less effective tool
- Opportunity for utilities to use EVs to soak up midday solar
- Would flatten the duck curve

PUBLIC / WORKPLACE CHARGING SCENARIO

- Charging at home could become secondary & use on-board Level 1 system
- On-peak/daytime charging would increase
- Public/workplace Level 3 chargers could be lower total capital outlay if heavily used
- High utilization rates would make chargers more profitable for private charging companies, so better maintained, more available

What's the no-regrets strategy?

Public fast-charging is future-proof

Public fast-charging advantages

- Critical for fleet vehicles, autonomous or not
- Useful for fleets *and* personally owned vehicles
- Supports buses and other mass transit
- The more available DCFC are, the better for widespread EV use

HOWEVER…

- DCFC can't provide grid benefits like Level 2 can.
- A mix of both Level 2 and DCFC is best

Thank you

Questions?