
Turning EVs into Grid Assets

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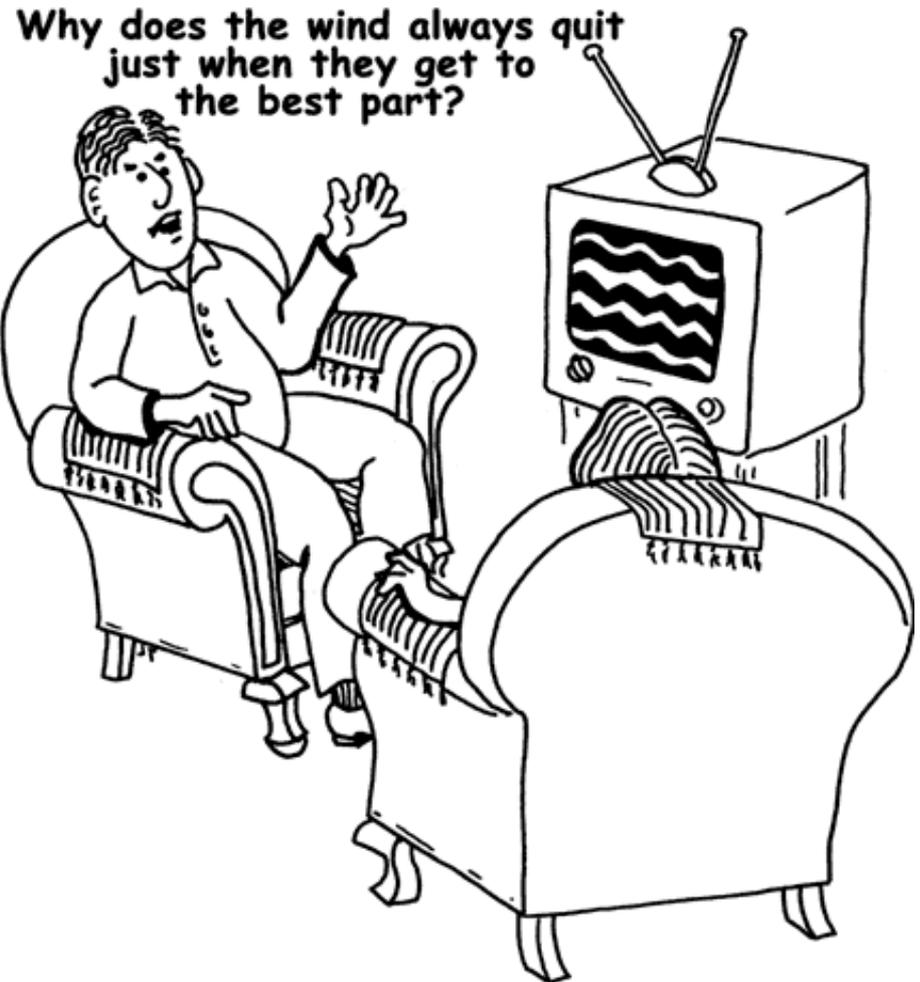


States Have Set Ambitious Clean Energy Goals

- **Renewables**
 - *e.g. New Mexico: 100% x 2045*
- **Storage**
 - *e.g. New York: 3 GW x 2030*
- **EVs**
 - *e.g. California: 5 million ZEVs x 2030, 250K EVSE x 2025*

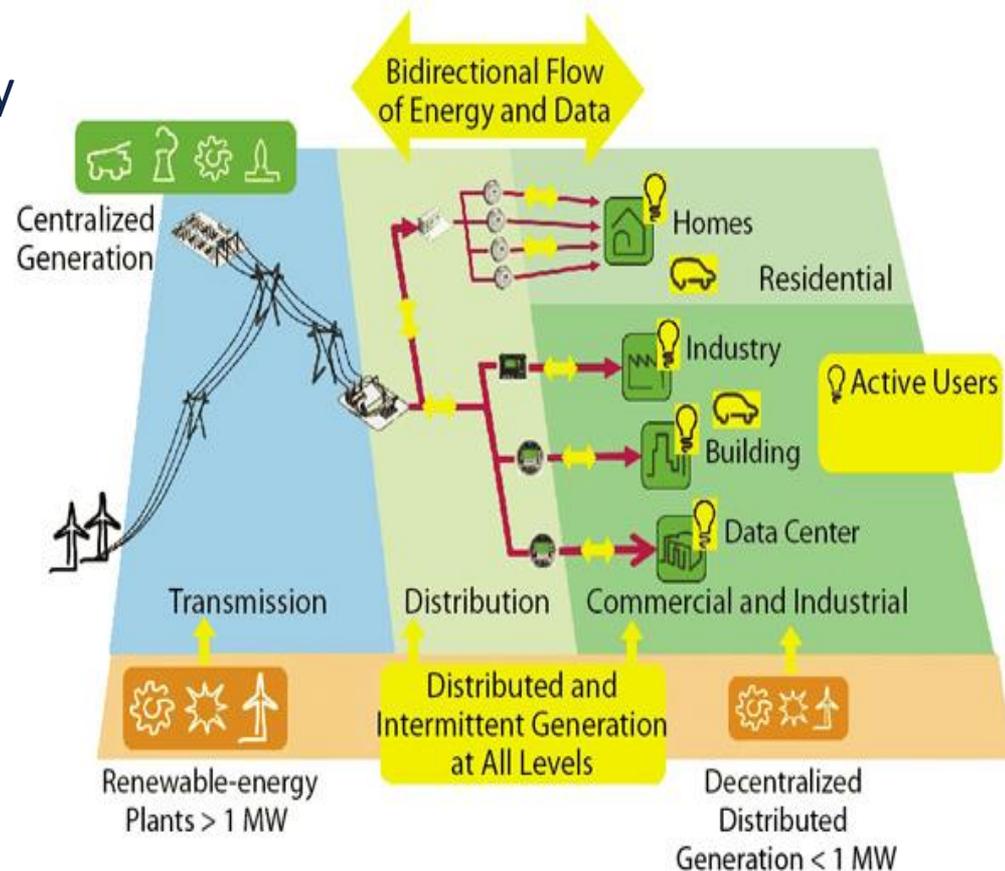


One Problem....



Other Arising Issues....

- Decrease in Controllable Supply
 - Balancing
 - Transmission
 - Congestion
- Increase in On-Peak Load
- Need for more Flexibility in Load Side



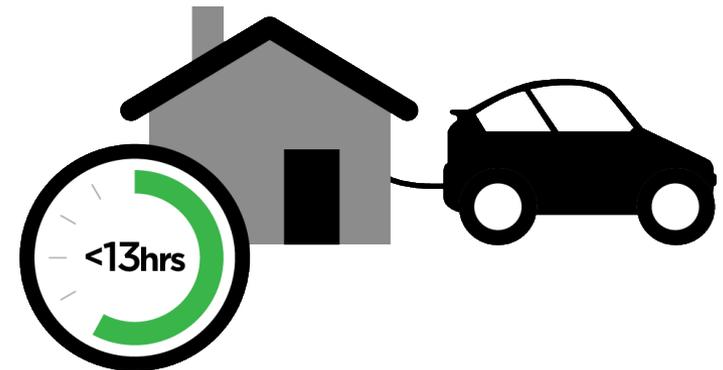
Vehicle-Grid Integration: Untapped Potential

VGI Capabilities:

- Assist with **renewable integration**
- Help with **cost-effective grid management**
- **Scale up EV uptake**, and reduce cost of ownership

Plug-in EVs (PEVs) can enable this via a combination of:

- Thoughtful placement of EVSE
- V1G = Smart charging
- V2G = Bi-directional smart charging



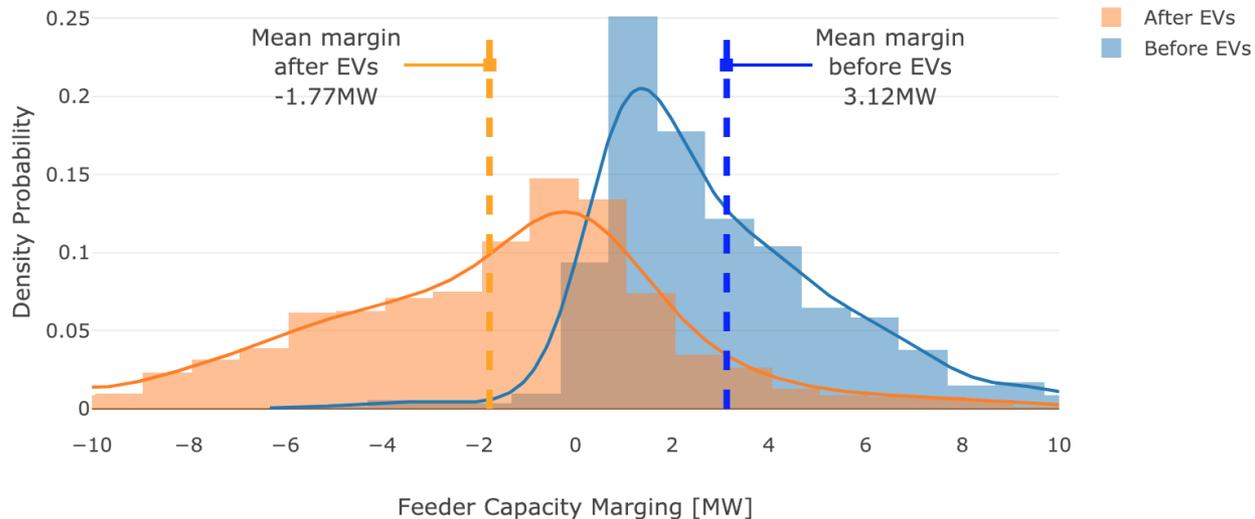
EV Impact on Distribution Grid Study

- **Objective:** Evaluate impact on grid feeders at 100% EV penetration.
- **Measurements:** Voltage Stability, Available Capacity (Overloading).
- **Data:** 50 feeders from PG&E, Charging data from ChargePoint, EV and Grid models validated with real data

Expanded Results to all 3000 PG&E Feeders



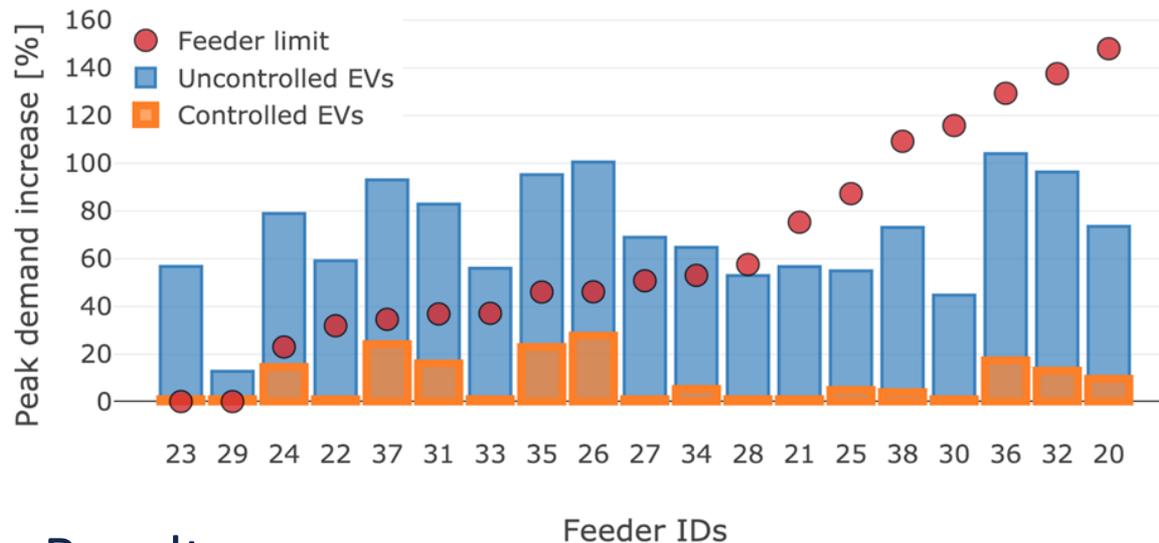
EV Impact on Distribution Grid Study



Intermediate Results

- 68% of feeders will violate their maximum feeder head capacity, voltage limit, or line loading limit with 100% EVs.
- This would require the utility to address by either grid upgrades, storage or load shedding.

EV Impact on Distribution Grid Study

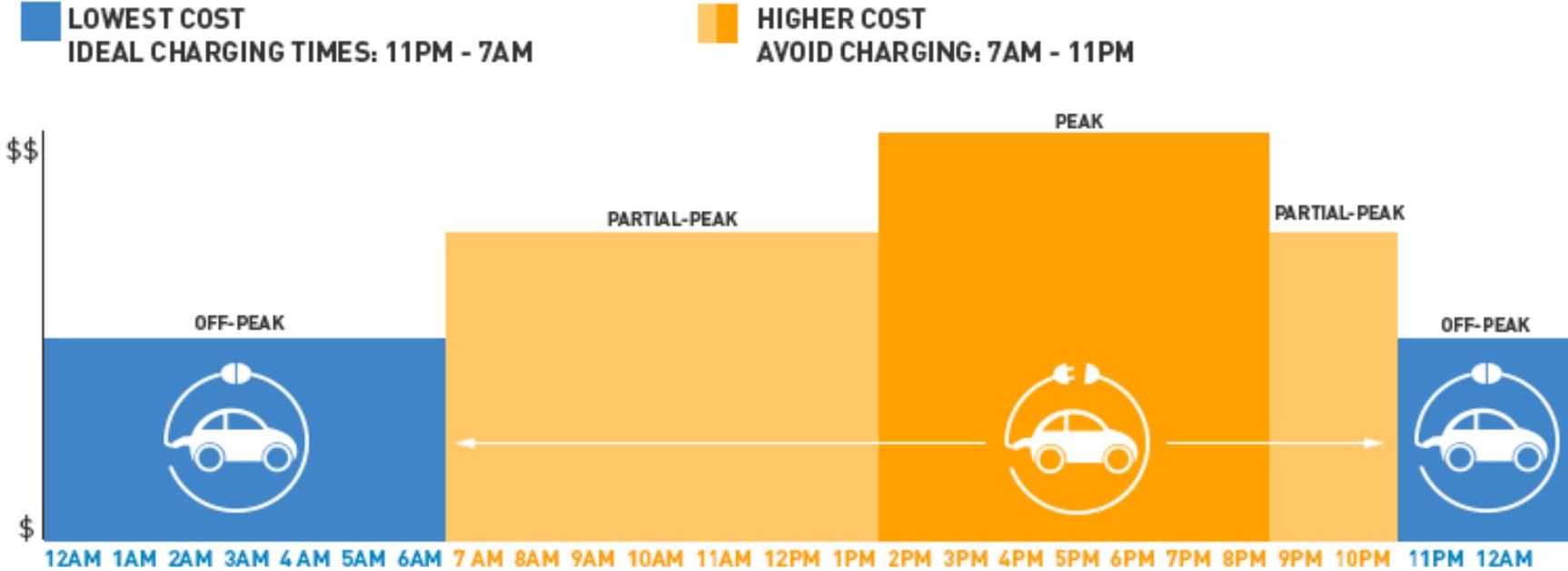


Main Results:

- *If nothing is done, utilities will face large problems with voltage stability and overloading*
- *If control 28% of the EVs with smart charging all grid issues can be addressed*
- *Controlling EVs to charge at off-peak avoids all distribution grid issues*
- *We need to get EV customers on TOU rates*

Paper to be published in IEEE Electrification Magazine!

Getting Customers on TOU Rates



Automatic Subscription to TOU Rate

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Let's not forget about the technical details...

Making Headway with some Progressive EV TOU Rates in USA



But utility metering is too expensive!

Many Low-Cost Metering Solutions

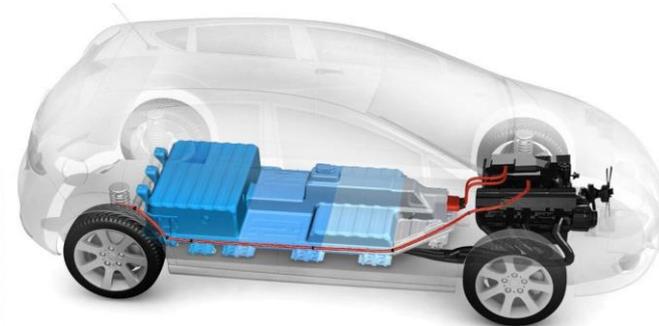
Solutions:

- Offer rebates
- Sub-metering
- 3rd party metering

Pilot Programs:

Electric Vehicle Sub-Metering Pilot

PG&E, SCE, & SDG&E

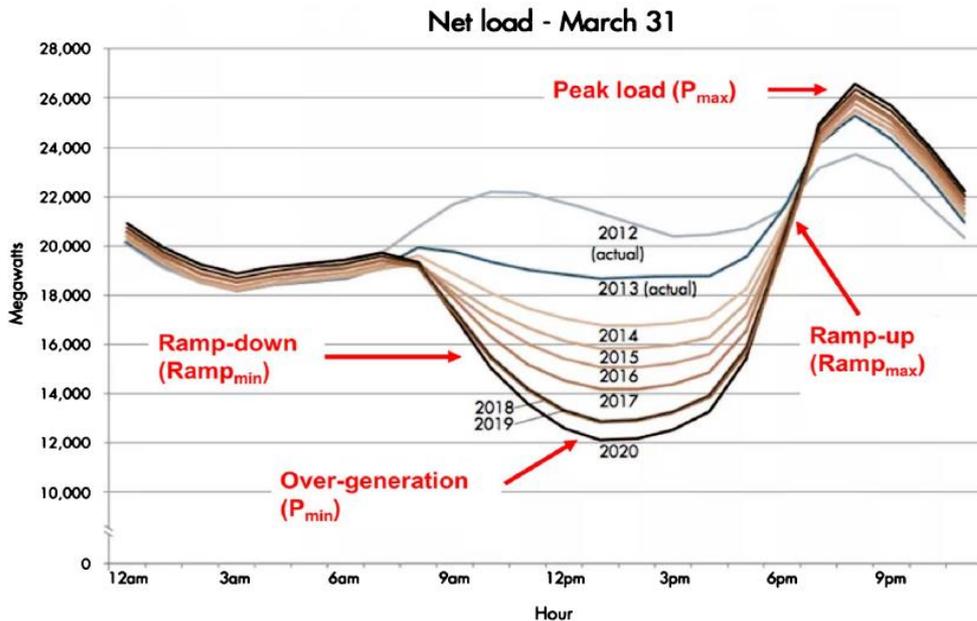


Creating Business Opportunities for VGI



- Storage Mandates: Allow VGI to participate
- Access to Wholesale Market Prices

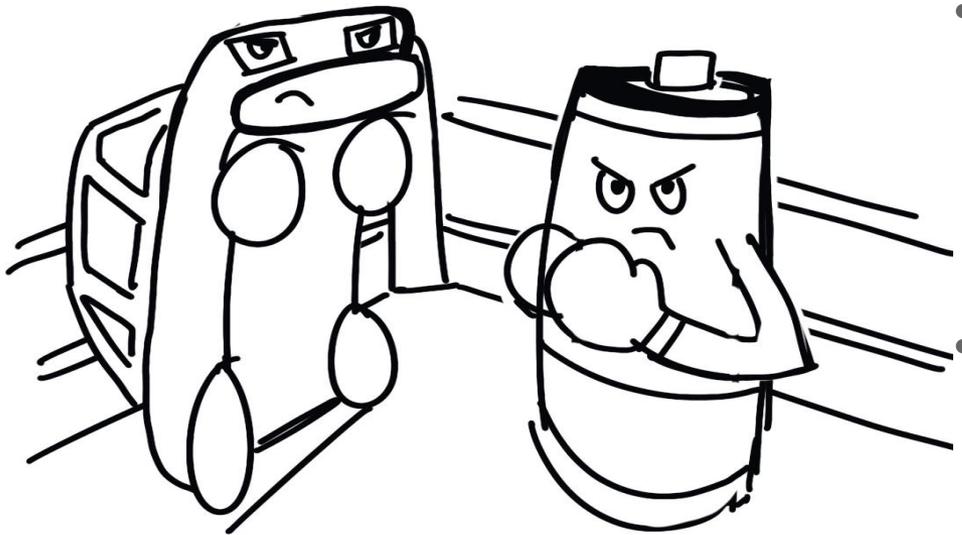
VGI as Storage: Let's fix that duck curve



	New York	California
2030 Goal	3 GW	3 GW
V1G Potential	744 MW	~1 GW
V2G Potential	2.3 GW	~5 GW

V1G is currently ineligible to participate in storage mandate in NY and California.

VGI as Storage is Cost Effective



How Much Savings?

- V1G system-wide investment of ~\$150 million, compared to \$1.45-\$1.75 billion for stationary (non-EV) storage would cost.
- V2G is worth \$12.8 to \$15.4 billion in equivalent stationary storage.

LBNL Study shows without impacting driving V1G and V2G can provide storage....at 1/10th the cost.

Aligning Stakeholder and Societal Incentives

Utilities making large headway with:

- TOU Rates
- E.g. in California \$1.1 Billion in PUC-approved transportation electrification programs

...But VGI is lagging.

Utility Performance Incentive Mechanisms could ensure this.



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Thank you

