Distributed Energy Resource Grid Integration

Sacramento Plug-in Electric Vehicle Collaborative

1/21/20

Powering forward. Together.

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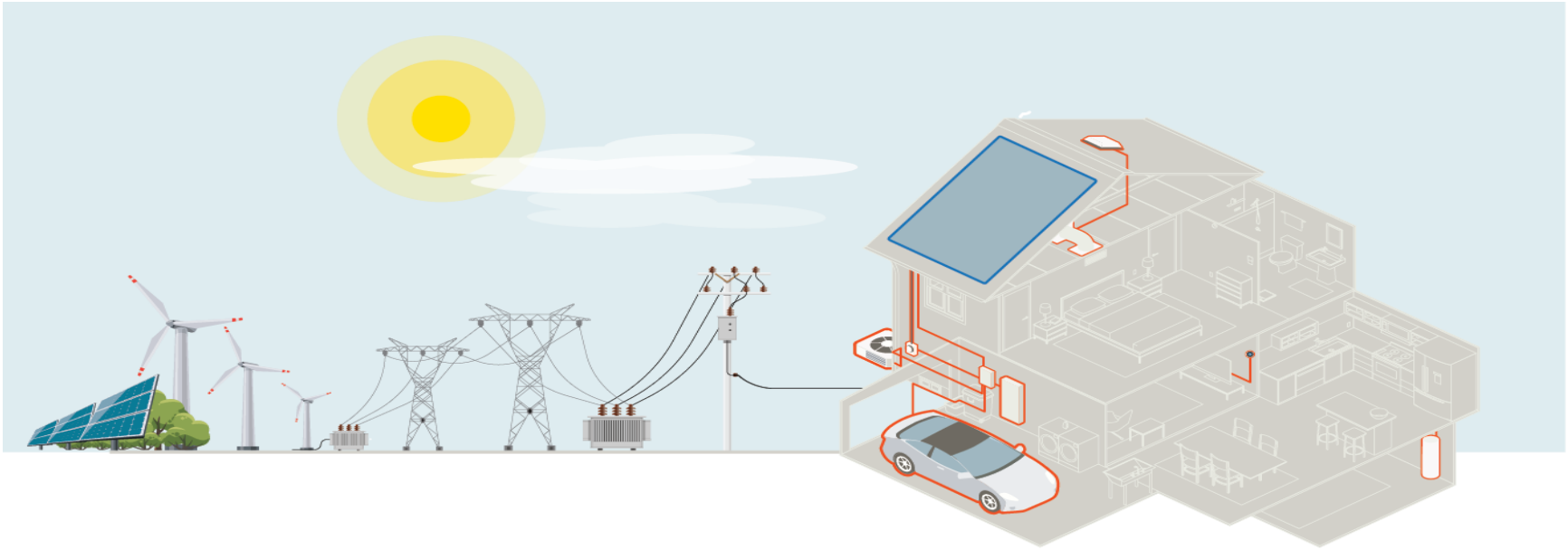
DERs and Grid Integration



- SMUD design standards plan for 5kW of peak load contribution per home
- Increasing DER adoption creates opportunities, and risks if not managed
- The addition of EVs and Building Electrification, could cause significant infrastructure upgrade costs without load flexibility
- Goal is to integrate these new loads and renewables as much as possible onto our existing grid

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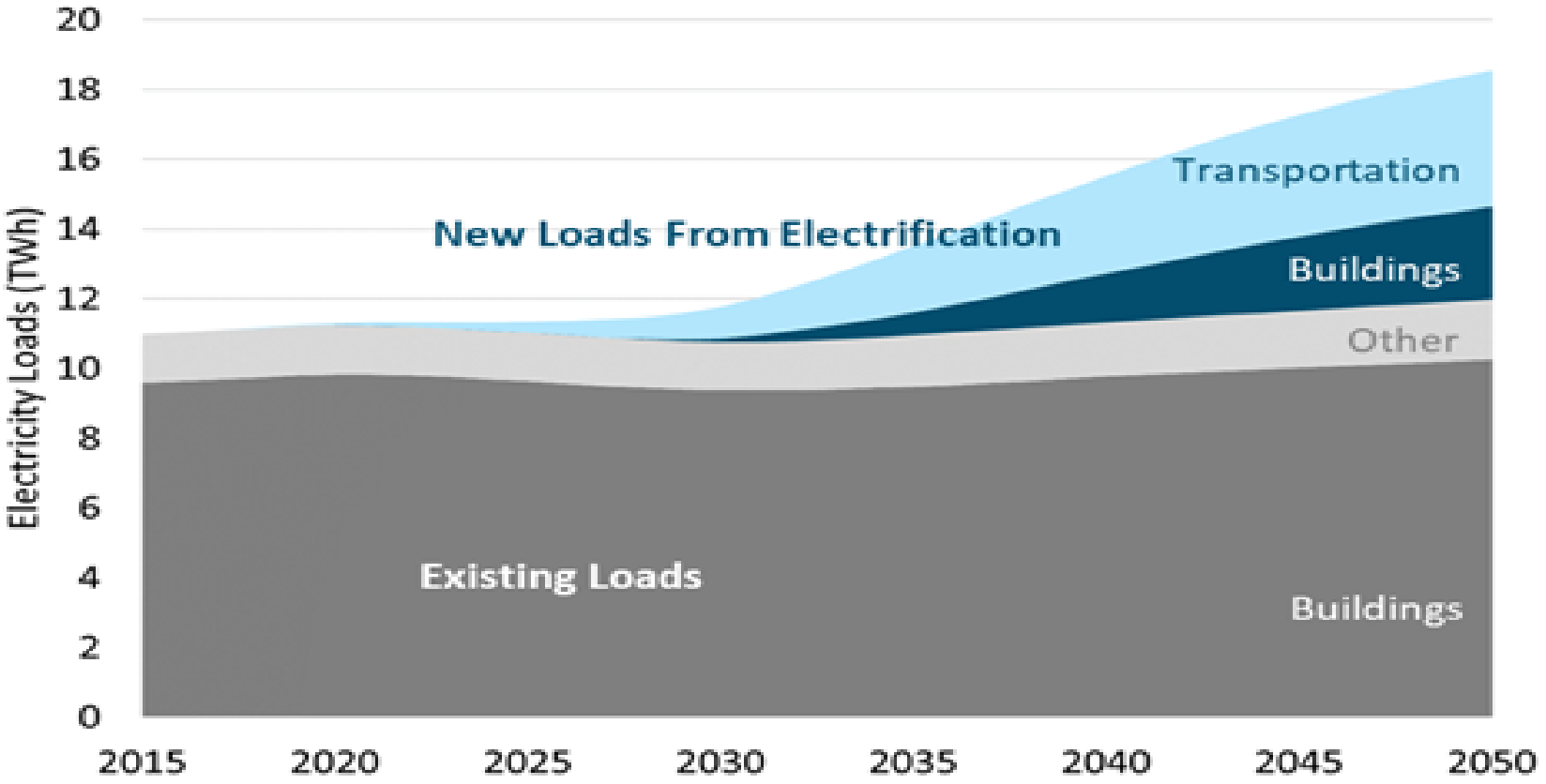
Post IRP Forecasted Load Growth



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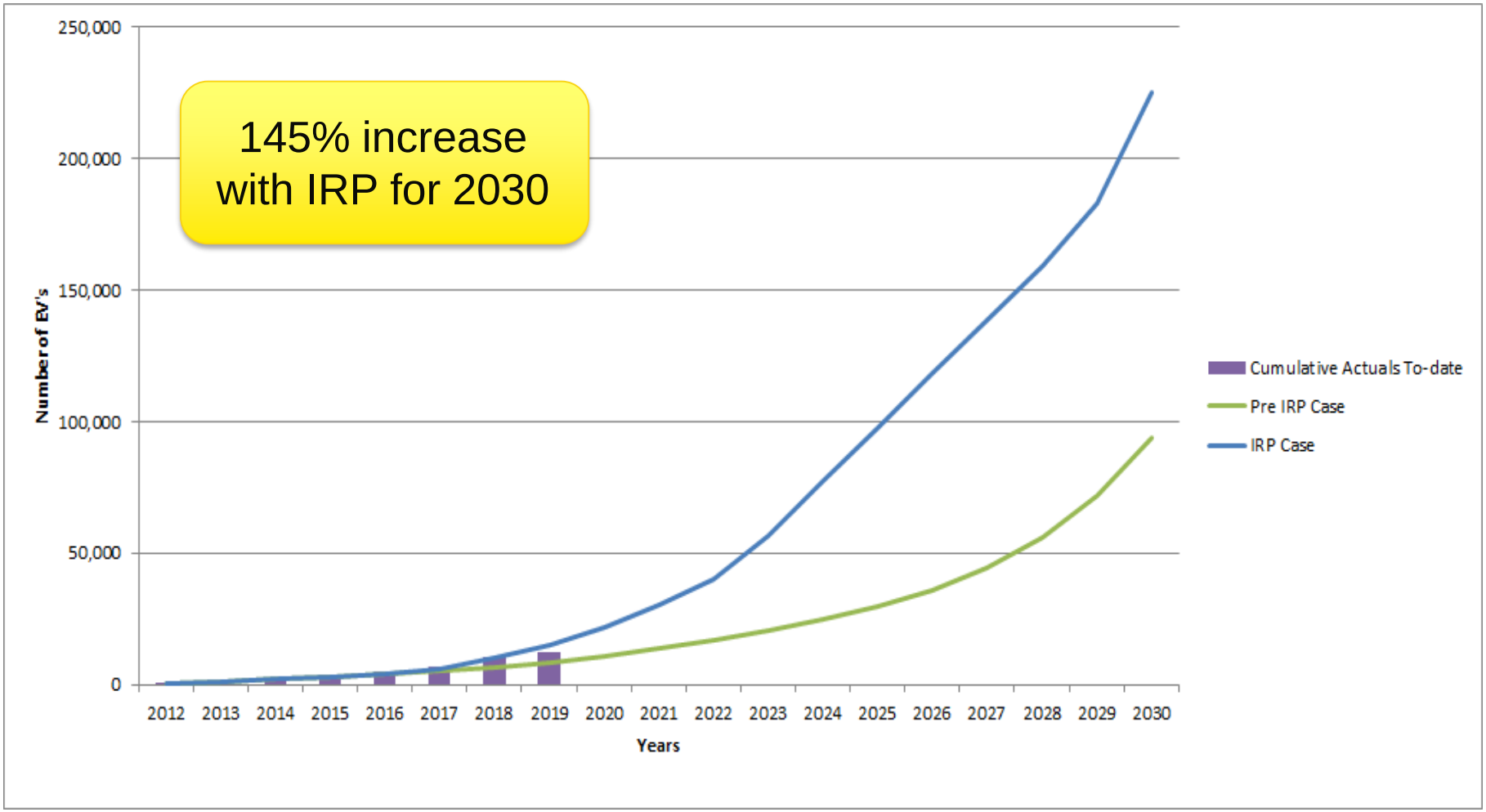
Transportation Electrification



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Light Duty EV Evolution

- Largest residential loads will be EVs
- Subcompact → full-size long-range EVs creating options for for higher charging levels (19kW Tesla option)
- DCFC 50kW → 450kW
- 60% participating in our EV rate
- Opportunity for alignment with solar curtailment mitigation and avoiding possible new midnight peak
- Autonomous testing in CA

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Medium & Heavy Duty EVs

- Interest and model availability increasing for electrification of commercial medium and heavy duty vehicles
- Class 8 Trucks: 1.5MW charging or higher
- West Coast Corridor Truck Charging – Electrifying I-5
- Fleet electrification: charge management and future-ready (V2G)
- Integrated solutions for customer load management

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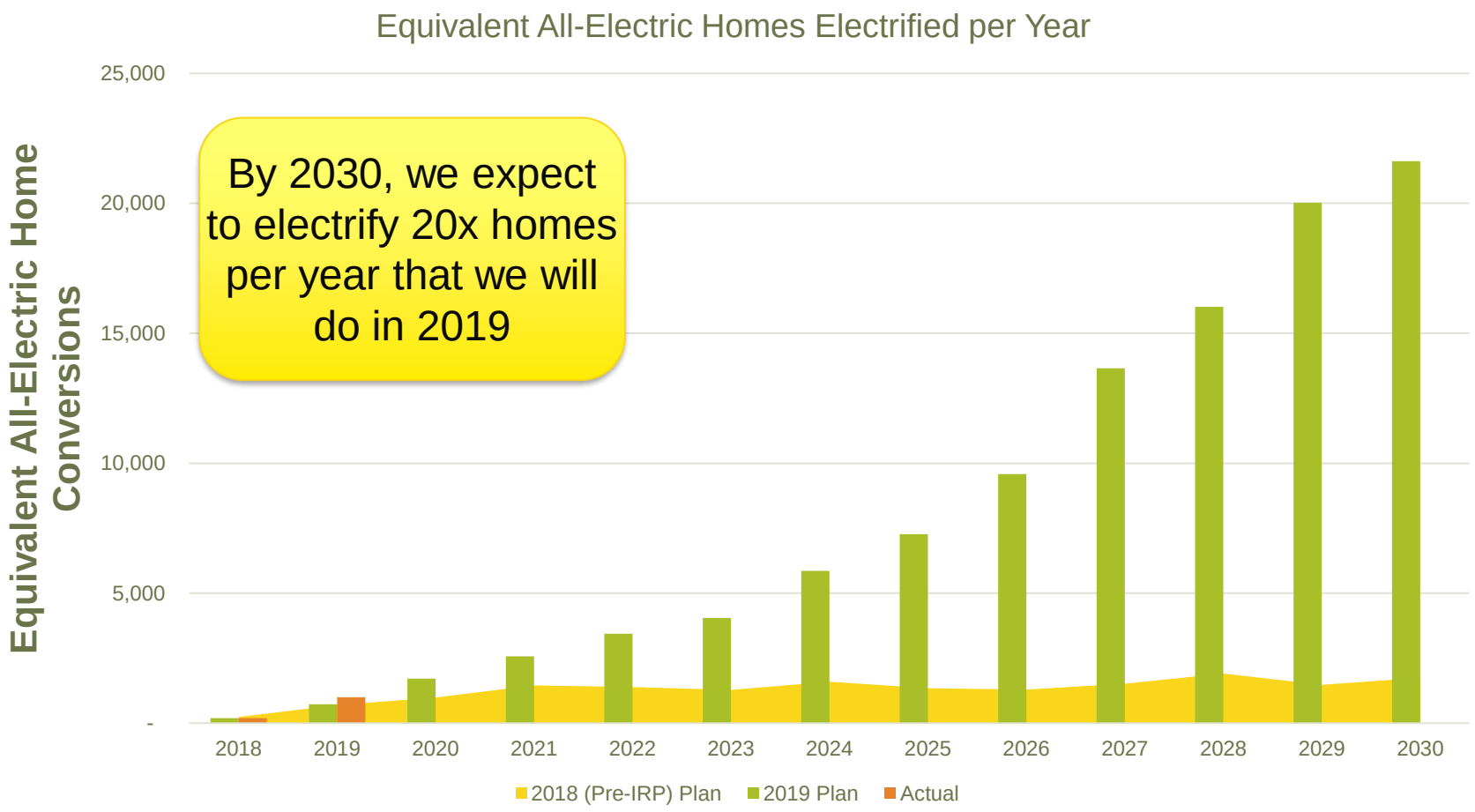
Building Electrification Forecast



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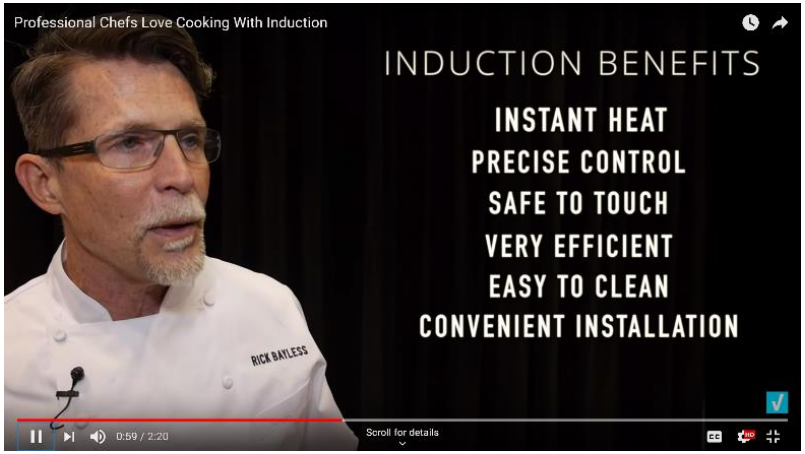
Building Electrification

- Momentum building based upon decarbonization
  - Built Environment TAC
  - 50+ Municipalities considering ordinances
  - CPUC unanimously opened up $1B EE funding for electrification
- New LAX terminal all-electric, even restaurants
- Load management needed to avoid more costly upgrade options
  - Customer panel considerations
  - Utility infrastructure needs



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Battery Storage Evolution

- Battery storage will help provide operational flexibility
- Declining prices in line with 2023
- LADWP “Record Setting Low Solar Power Price”
- Leveraging the value of storage: Grid & Customer

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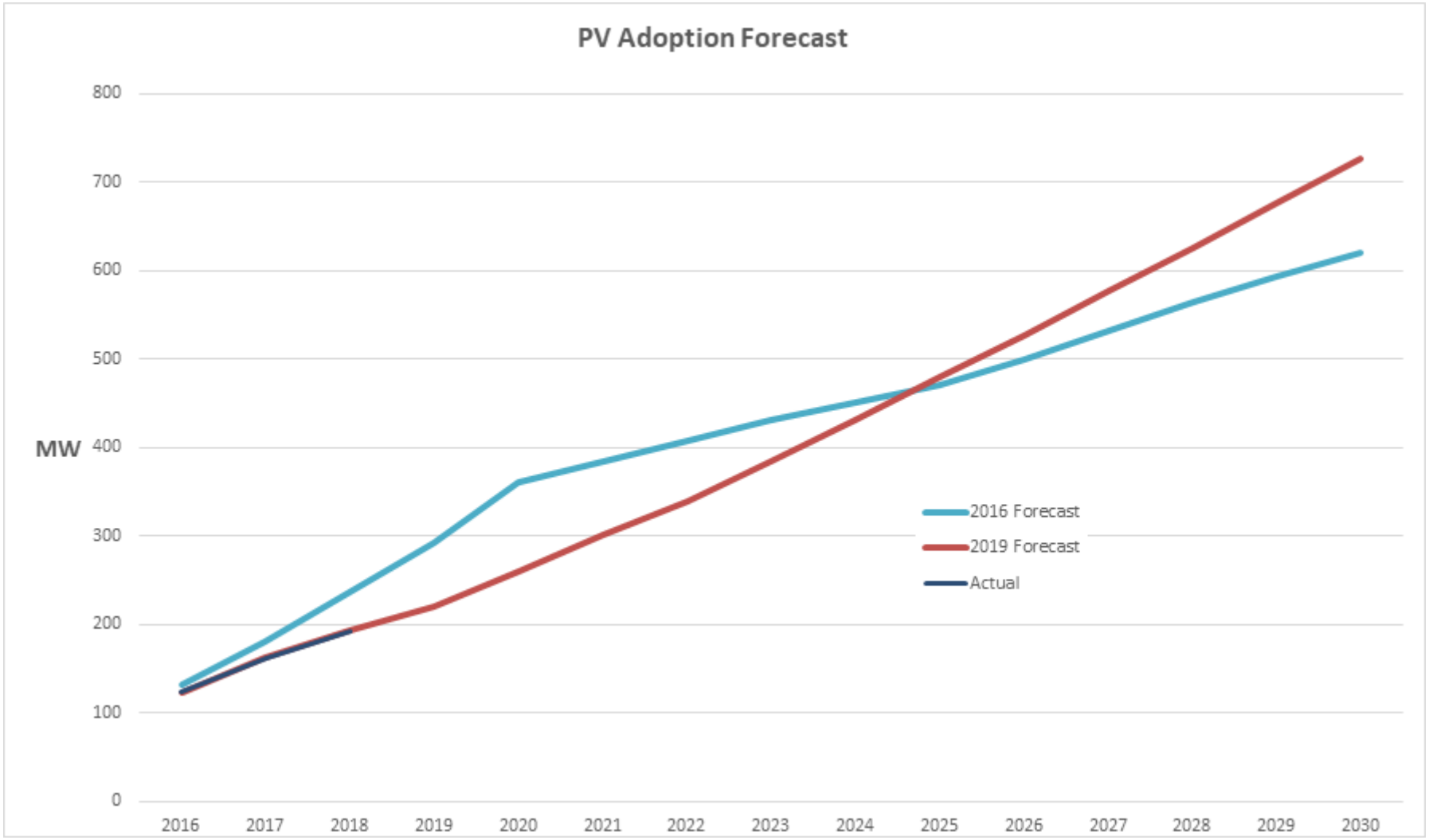
PV Forecast



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DER Challenges and Opportunities from within the control room

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Operational Considerations

Challenges	Opportunities
Localized Voltage Issues from over generation (PV)	Offset over generation conditions (EVs & Storage)
Resource Variability (PV)	Reduction of peak load (Demand Management, Storage)
Overloaded equipment (EV and Building Electrification)	Deferred or reduced capital investments
	Reduction of losses

Tools/Technology Gaps
Modeling of DERs
Forecasting of DERs
Visibility and control

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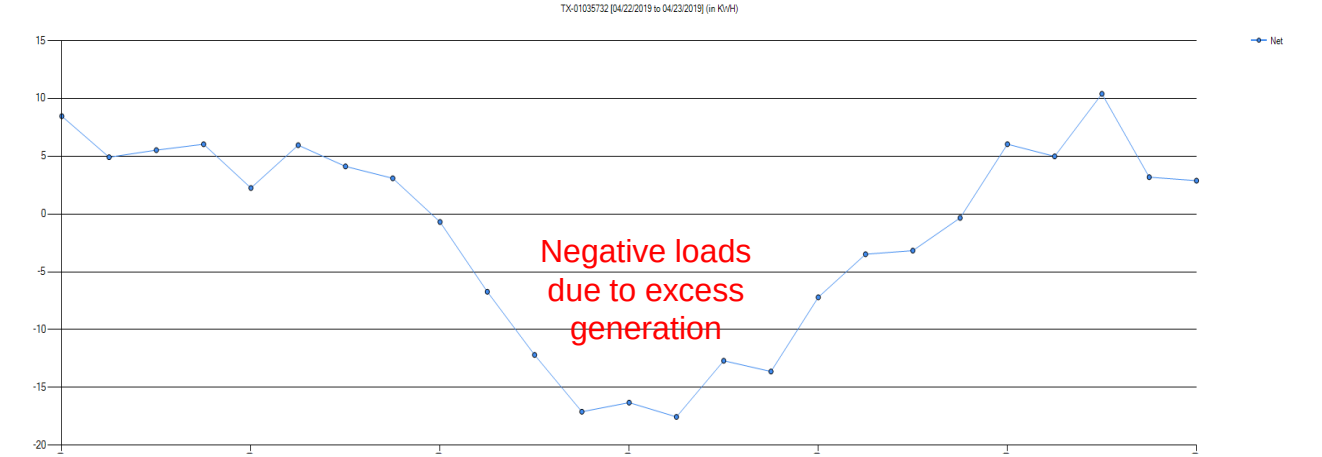
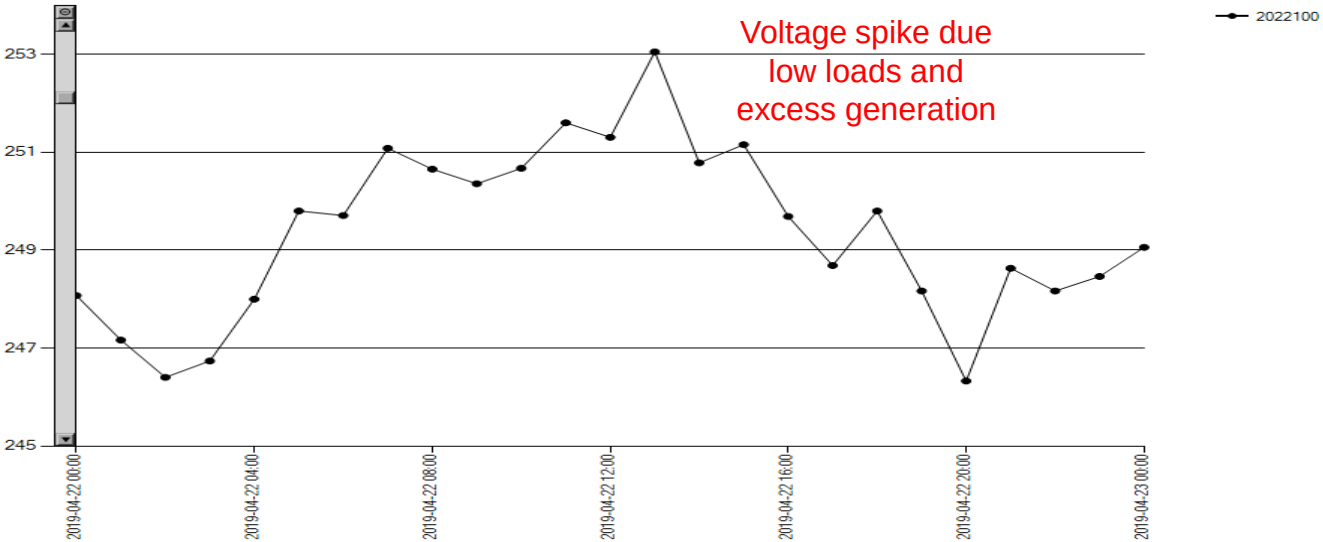
PV: Power Quality

Transformer Loading



Meter Voltage



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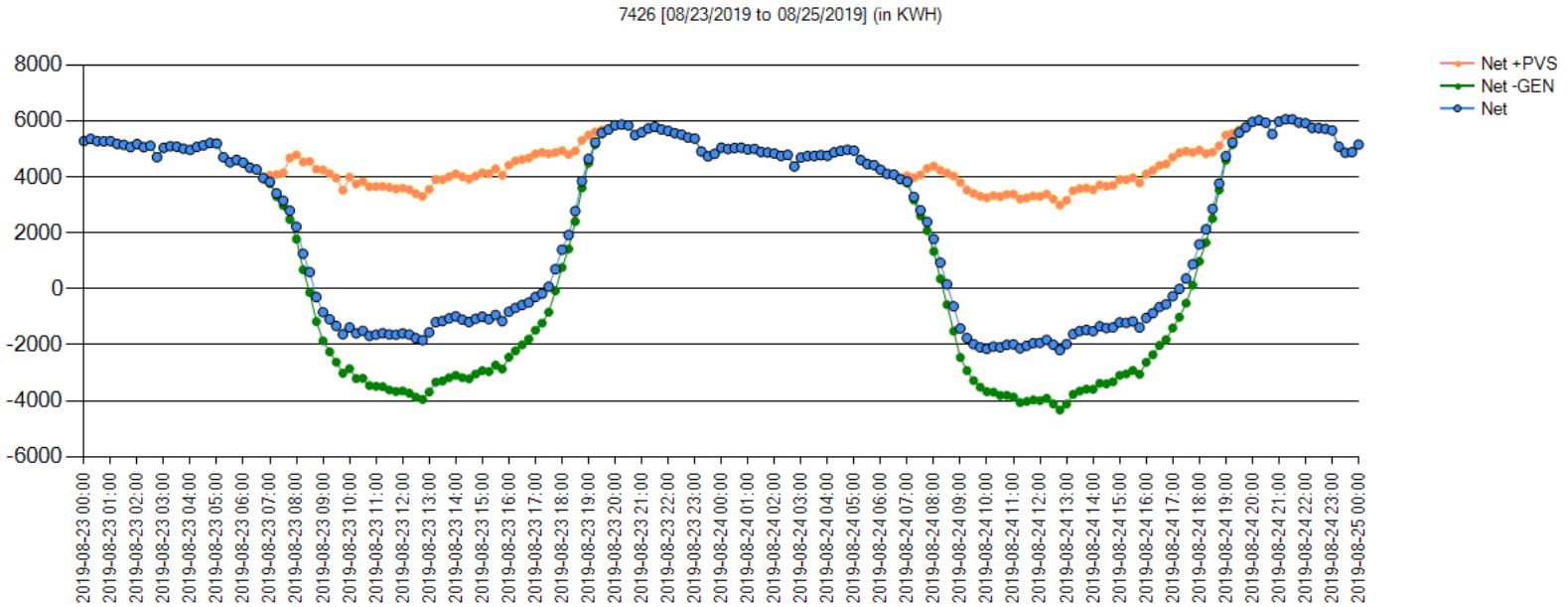
PV: Hidden Load
Powerline-Elkhorn Substation



- System load (green line) is what was visible to the operators
- Actual customer usage (orange line) is the amount of load we need to be prepared to serve if solar production is impacted by cloud cover
- “Hidden load” is the difference between the green line and the orange line

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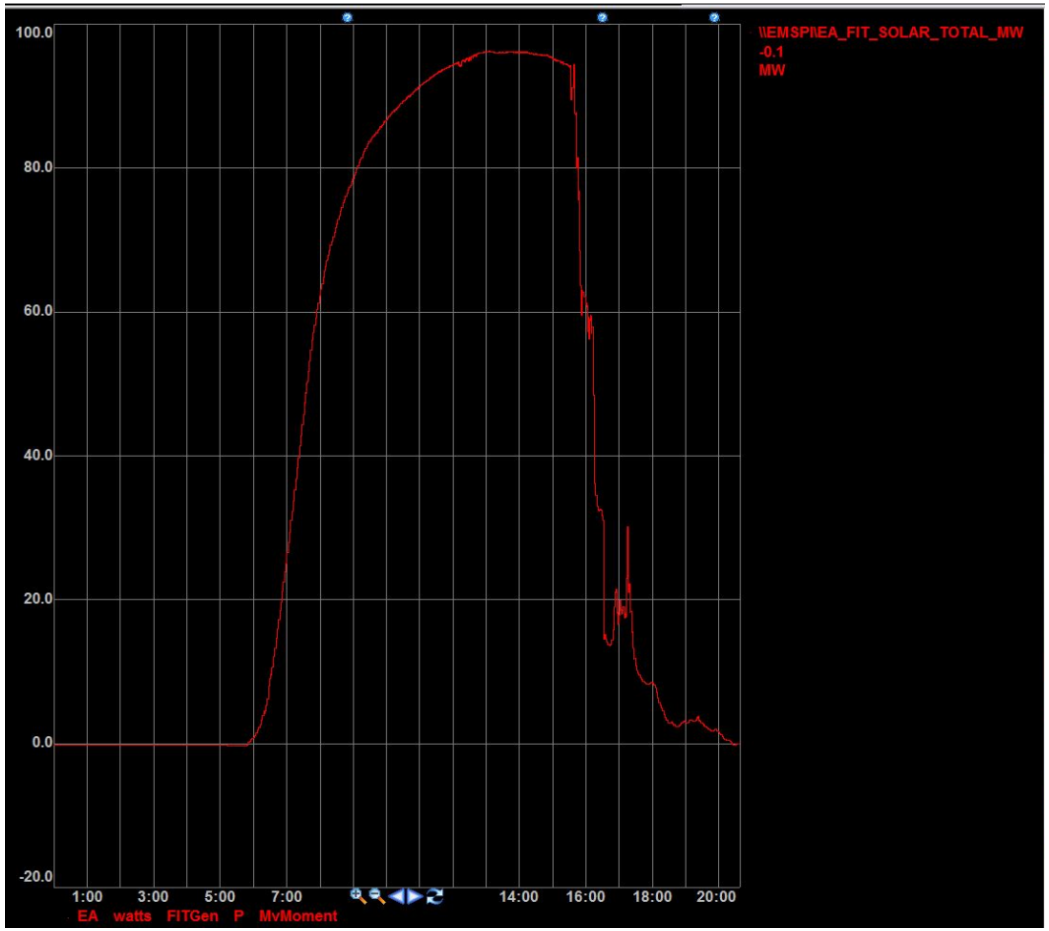
PV: Resource Variability
Cloud Coverage Impact

- Thunder Storm
  - Loss of 40 MW in 15 minutes
    - equivalent to 330A in 69kV
  - Impacts to switching



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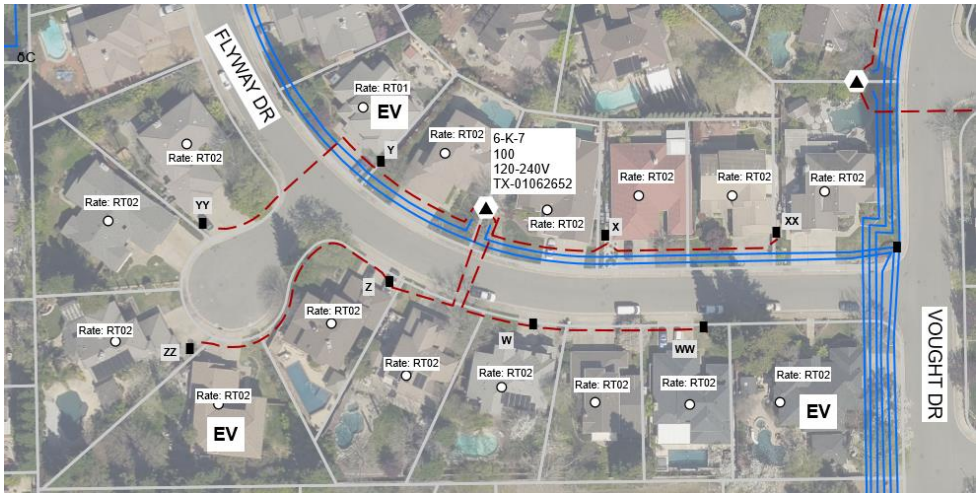
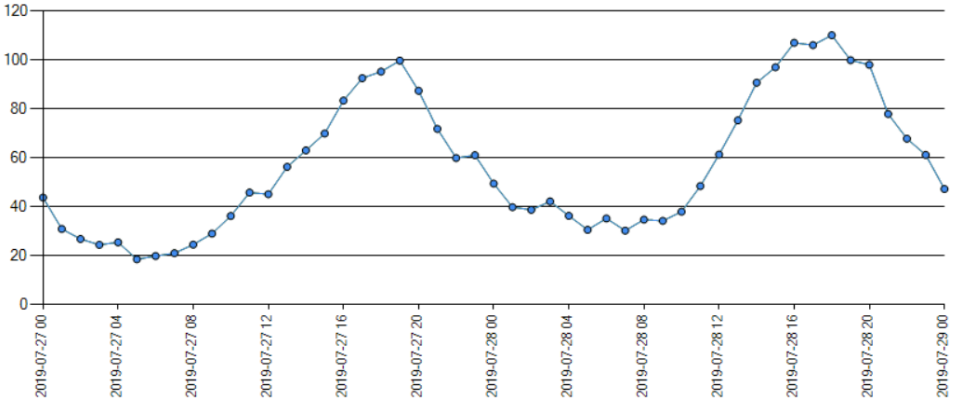
Overloaded Equipment Transformer Loading





100kVA padmount transformer

- Serving 16 customers
- Design assumption of 5kW per home
- Originally built with 75kVA transformer

Overloaded in July

- 5pm – 8pm on July 28th

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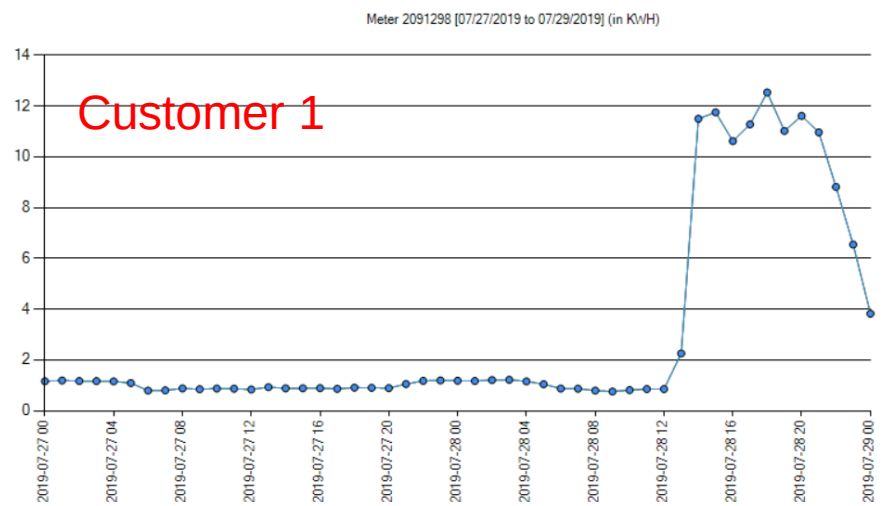
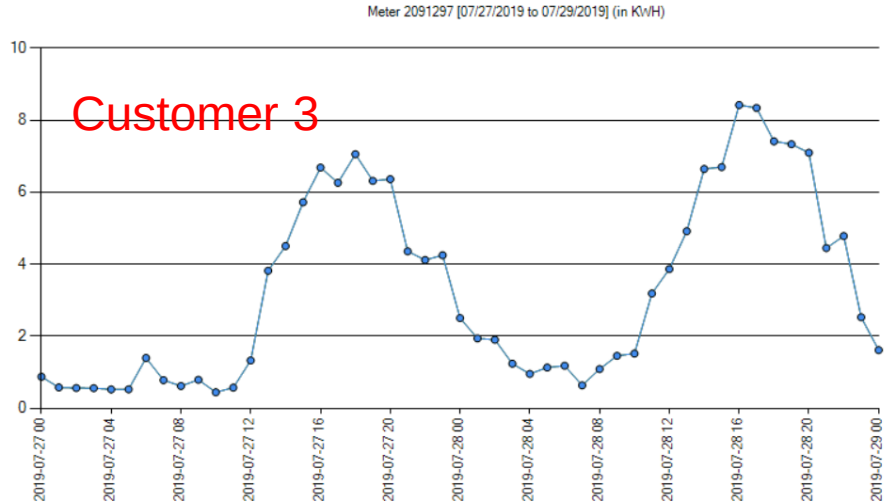
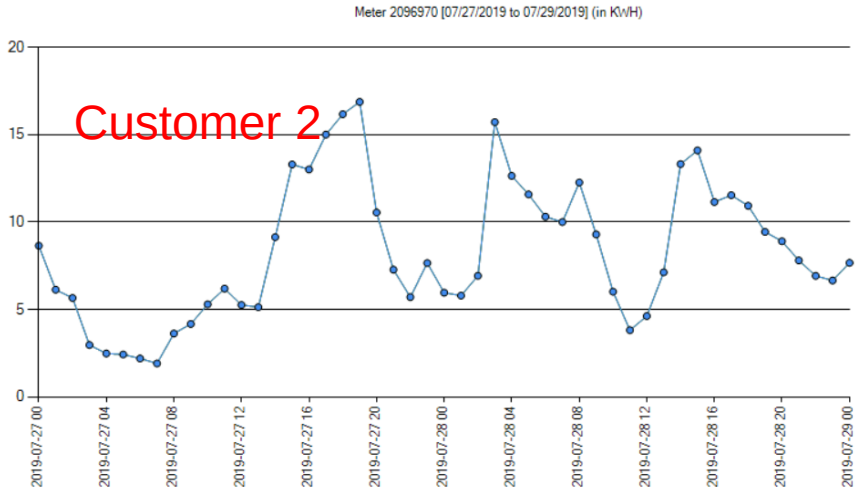
Overloaded Equipment Metered Usage







EV Customer 1
- Peak usage of 12.5kWH at 5pm on 7/28

EV Customer 2
- Peak usage of 16.5kWH at 7pm on 7/27
- 15.5kWH on 7/28 at 3am
- 14.5kWH on 7/28 at 3pm

EV Customer 3
- Peak usage of 8.5kW at 4pm on 7/28

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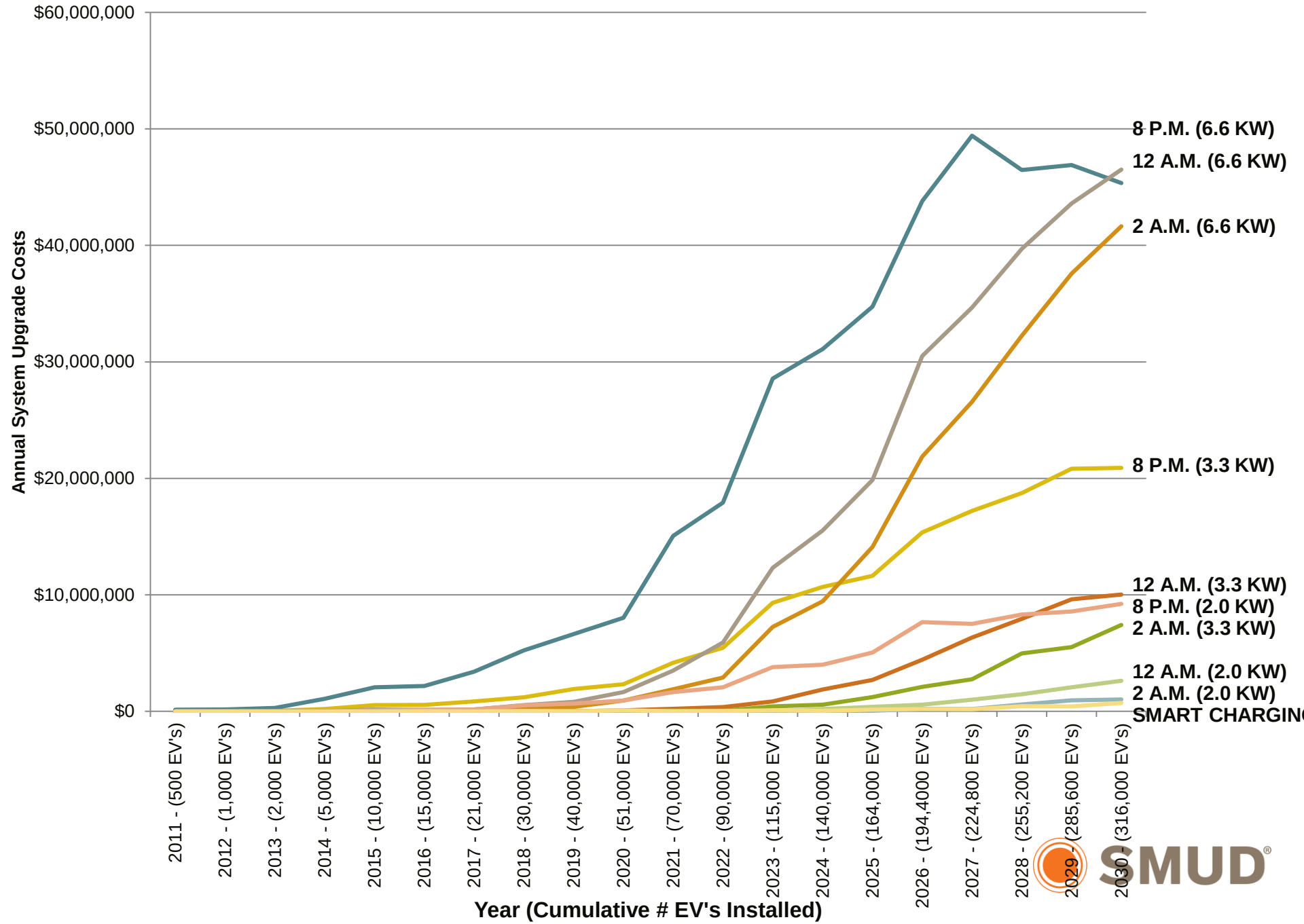
Annual System Upgrade Costs Vs. EV's Installed



Commercial EV Charging is exposed to Demand Charge Barriers (high load / low energy)

- Demand Charges are rate mechanisms that key on maximum load per month
- Designed to help customers reduce electricity through put costs by separating energy costs from grid impact wear and tear costs
- DCFC / Large Commercial Charging loads vulnerable given low energy utilization

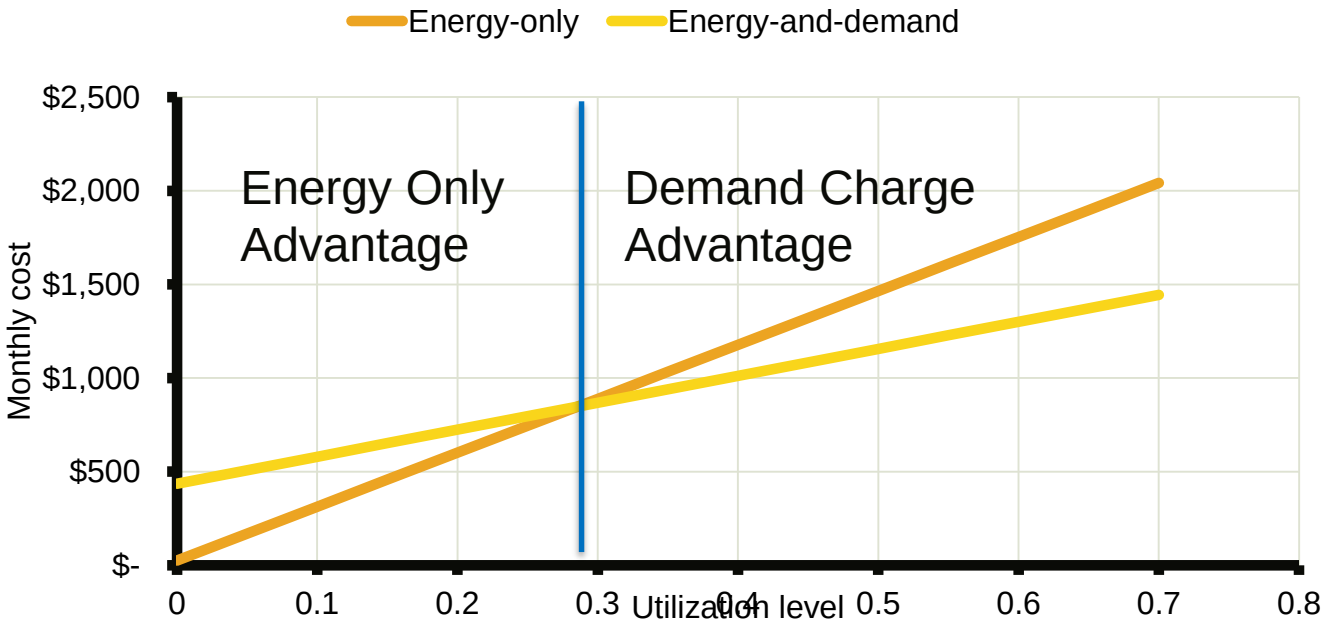


Chart courtesy of the Electric Power Research Institute (7-2014 ARB Workshop)

SMUD has a few options to address demand charges

- Low Energy Commercial Rate for uses less than 7300kWh/month (Approximately 15 DCFC charges / day at 16kWh each)
  - For Loads between 20kW and 299kW
  - No demand charges if lower than 7300kWh/month
  - Approximately $0.138 when calculated across all seasons and assumes 75% of charging occurs off-peak (*SMUD GSN_T Rate)

- New Storage Shares product addresses demand charges for higher loads (Greater than 299kW)
  - SMUD builds and installs a grid scale battery storage facility and lets customers buy “shares” from that facility
  - SMUD builds the facility where we need it
    - Reduces customer capital costs
    - Provides more benefits to the grid/utility/all customers

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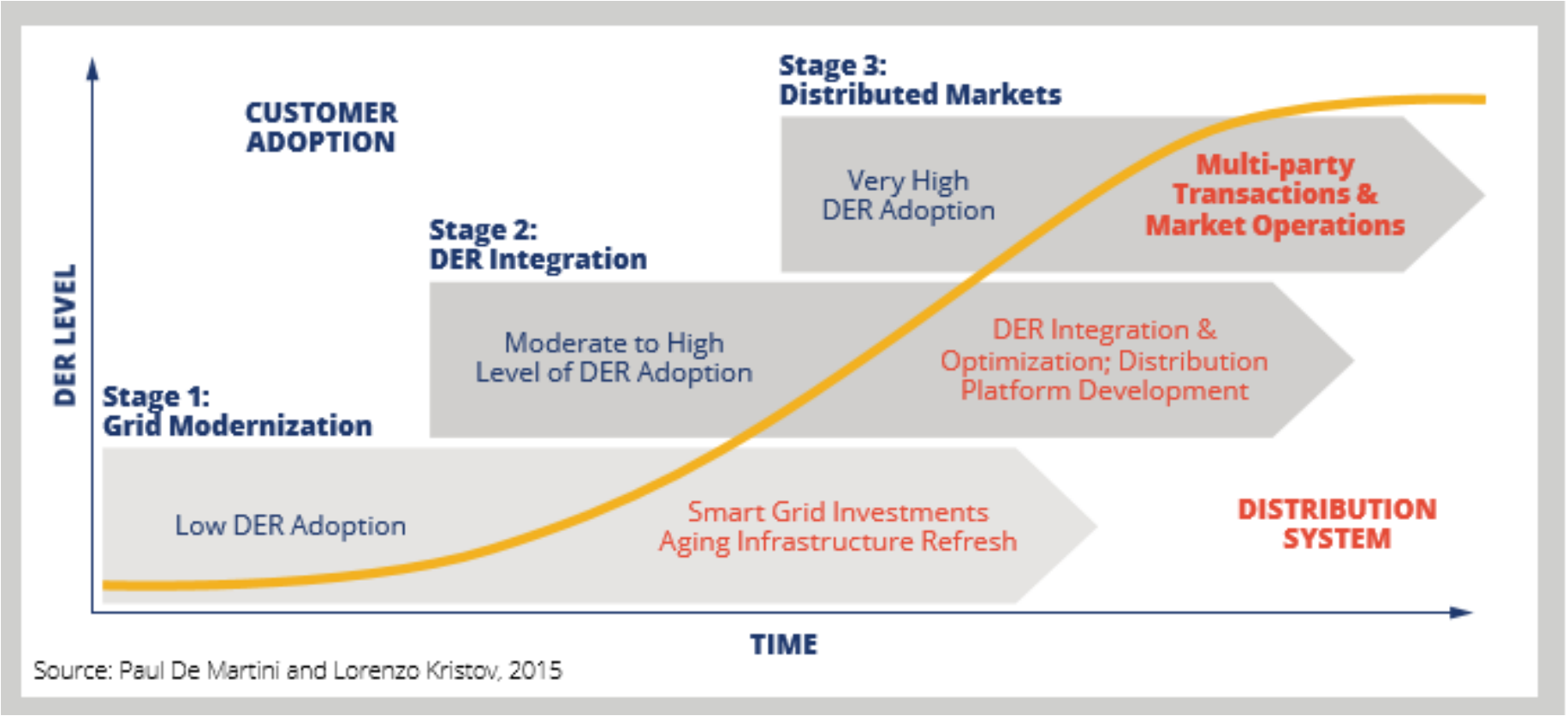
Evolution of the Distribution System



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Questions?

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