SMUD
Electric Vehicle
Grid Impacts and Value

Summary of Past SMUD Analysis

Study	Description	Year
Original Berkheimer Analysis	Monte Carlo simulation of Distribution Transformer overloads. Team members were Jeff Berkheimer, Dave Brown, Matt Schaedler, Tim Berg, & Bill Boyce. Forecast assumption: 316,000 EVs by 2030	2011
Berkheimer-Tang Analysis	Revised Monte Carlo simulation with updated assumptions and addition of rate sensitivity. Forecast assumption: 140,000 EVs by 2030	2013
Net Revenue Analysis	Modeled impact of financial impact of EV adoption on SMUD's operations. Used distribution cost estimates from Berkheimer-Tang Analysis. Forecast assumption: 140,000 EVs by 2030	2014
EPRI EV HotSpotter Analysis of SMUD	Probabilistic service transformer overload tool baselined against the Berkheimer-Tang analysis. Added sensitivity to clustered adoption. Forecast assumption: 93,000 EVs by 2030	2016
Managed Charging Analysis	Economic modeling of opportunities for avoided wholesale energy costs and distribution impacts through utility-dispatched charging of EVs. Forecast assumption: 94,000 EVs by 2030	2018

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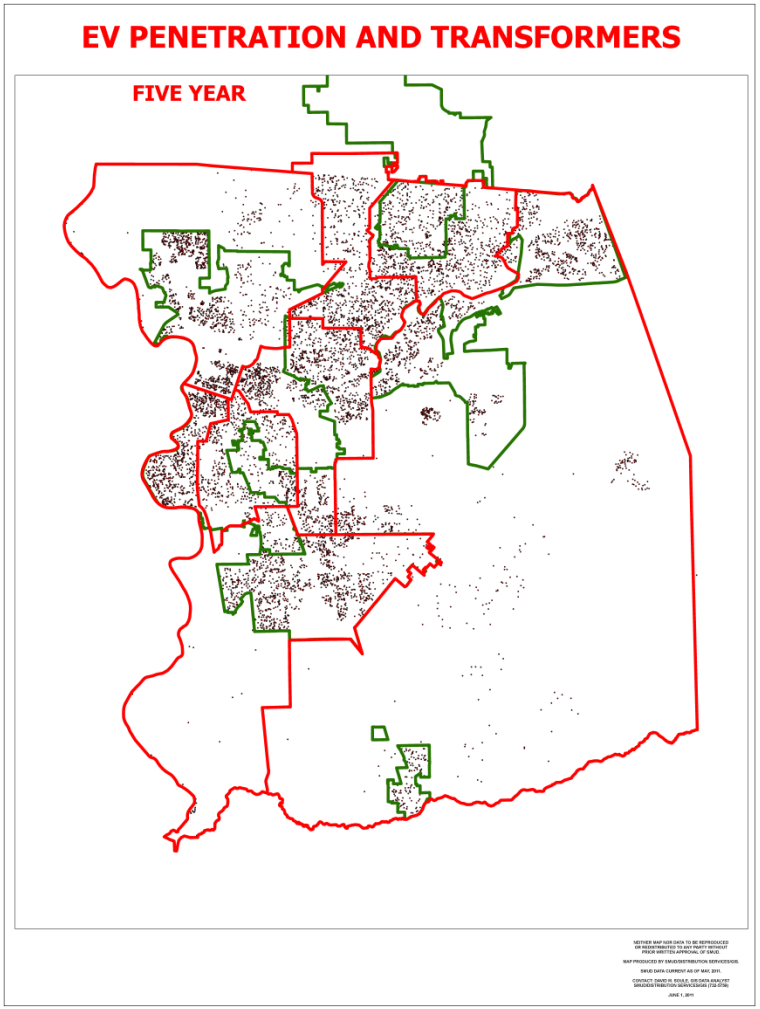
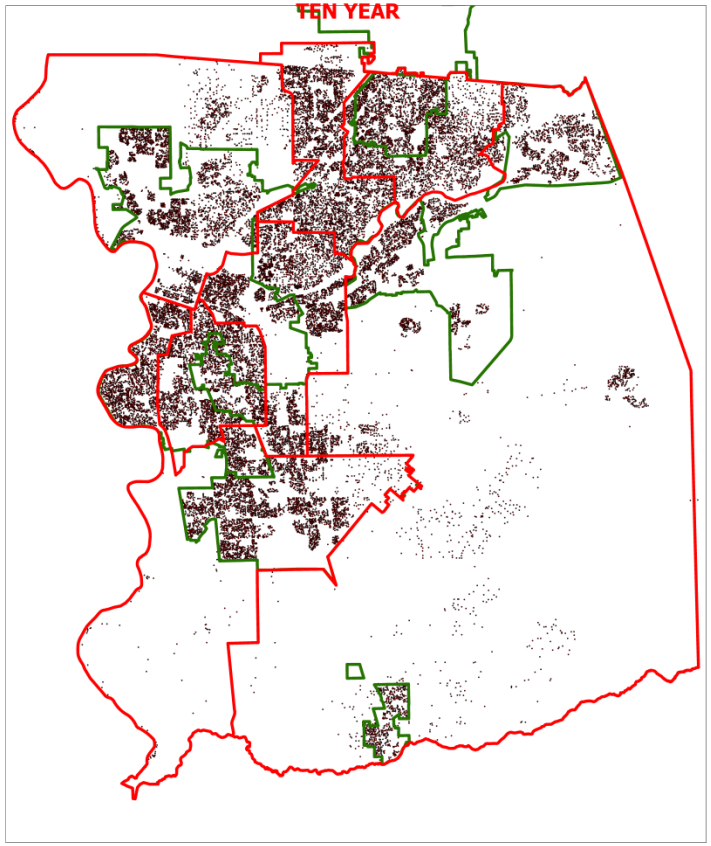
PEV Penetration plotted against SMUD Transformers





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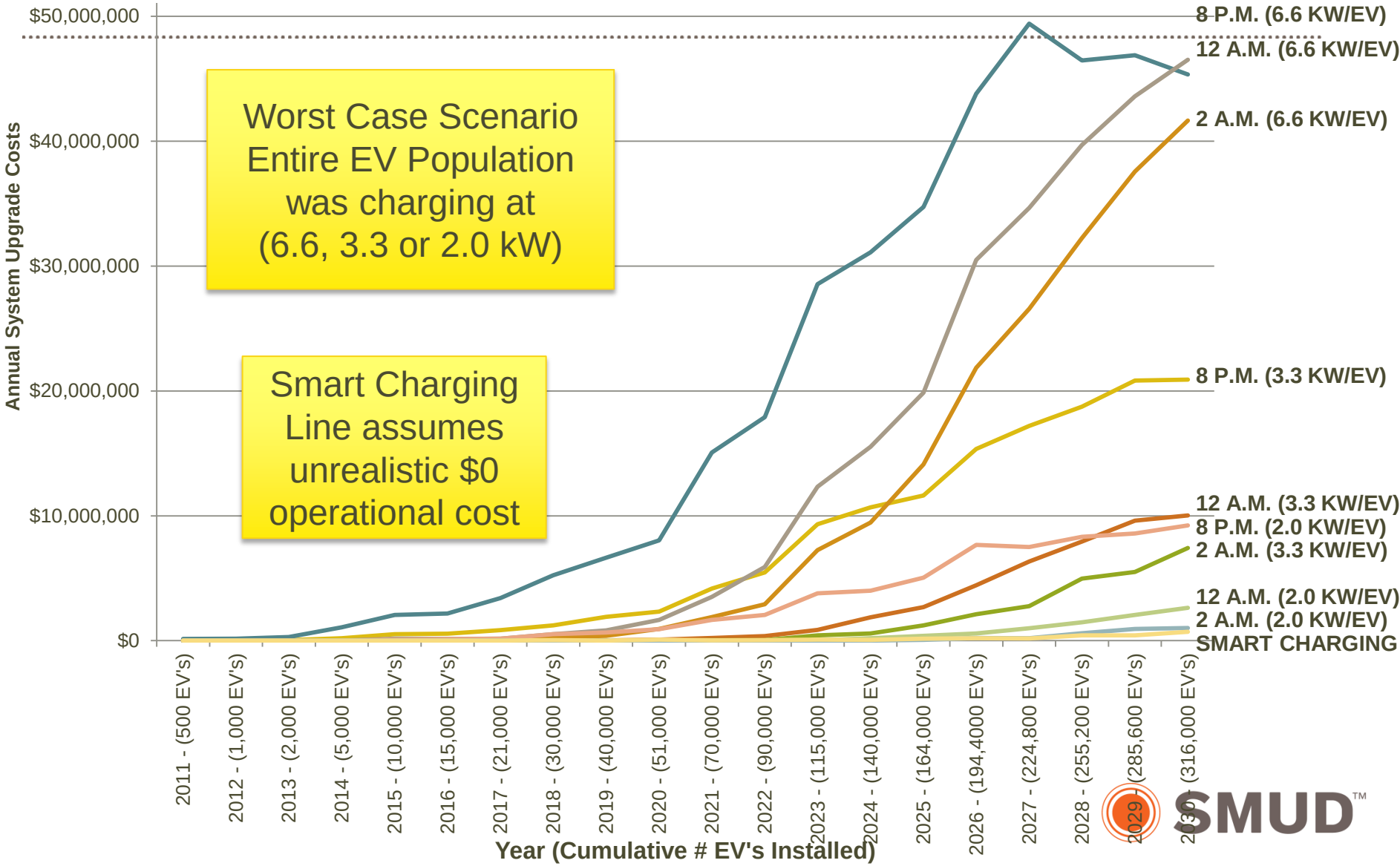
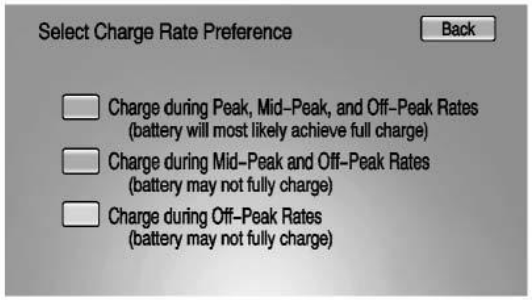
Original Berkheimer Analysis: System Upgrade Cost Sensitivity to EV Charging Rate and Time of Day

Assumptions: 100% coincidence charging and 316,000 EVs by 2030



Options for Smart Charging

- Smart Chargers
- Smart Vehicles (telemetry)
- Smart Kiosks controller)
- Facility Controllers
- Self Managed Charging



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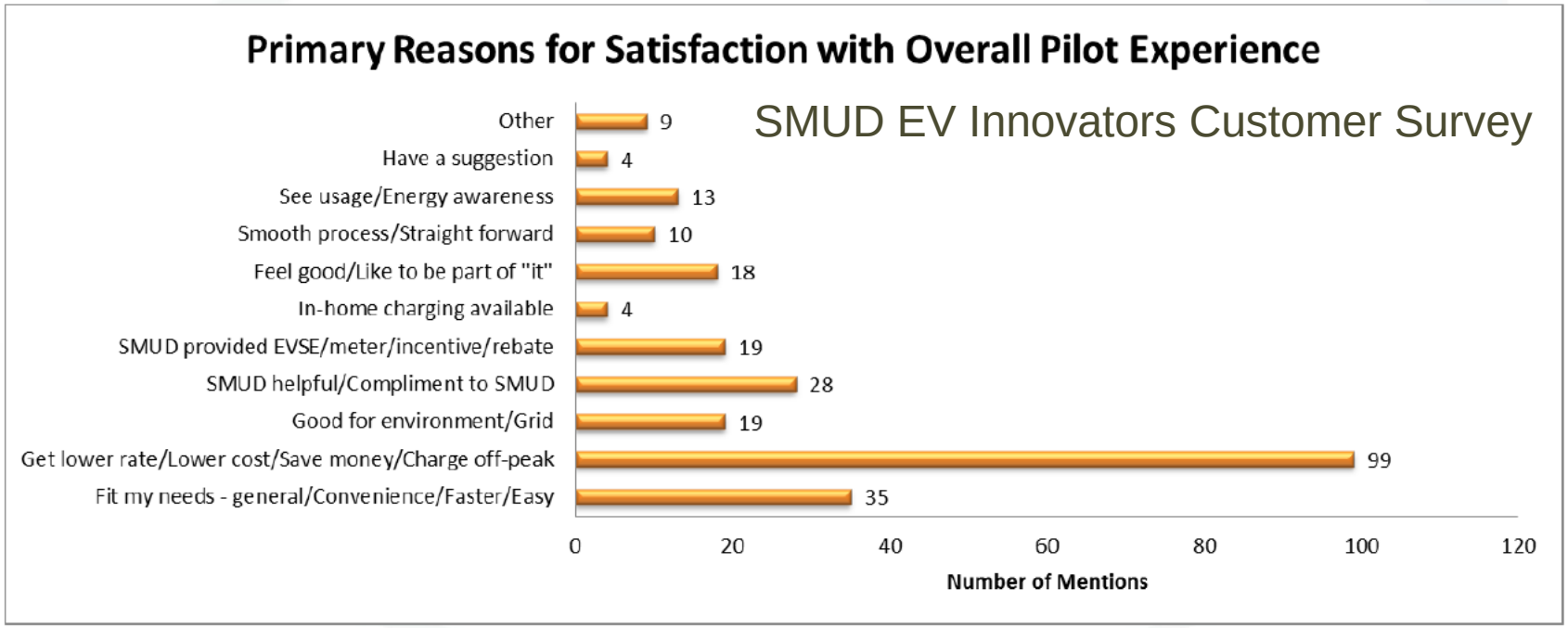
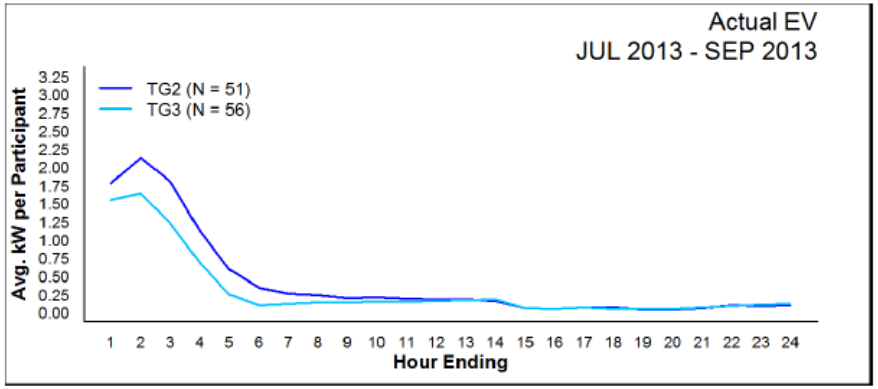
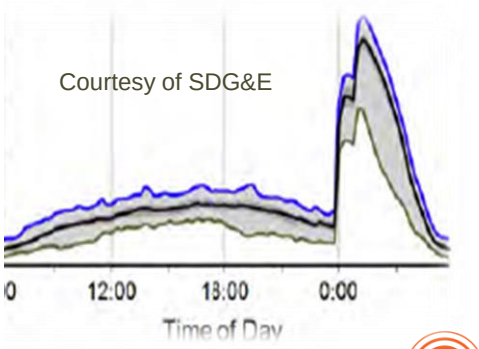
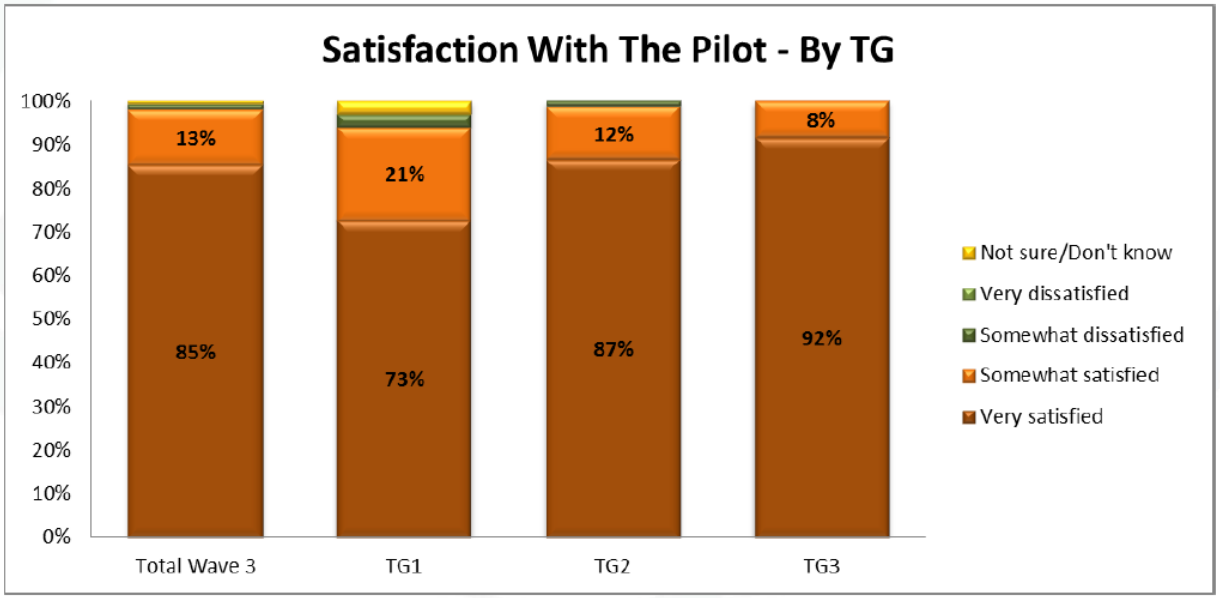
Customers are motivated by saving money







SMUD EV Innovators showed Flexibility



- Critical Peak Pricing R&D Program 15 Days a Year
  - $3.8/kW residential demand charge for charging above 2.0kW on CPP days
  - Day ahead notification
- Results
  - TG1 94% Customer Satisfaction with Whole-house TOU
  - TG2 98% Customer Satisfaction with Customer Control
  - TG3 99+% Customer Satisfaction with Utility Control

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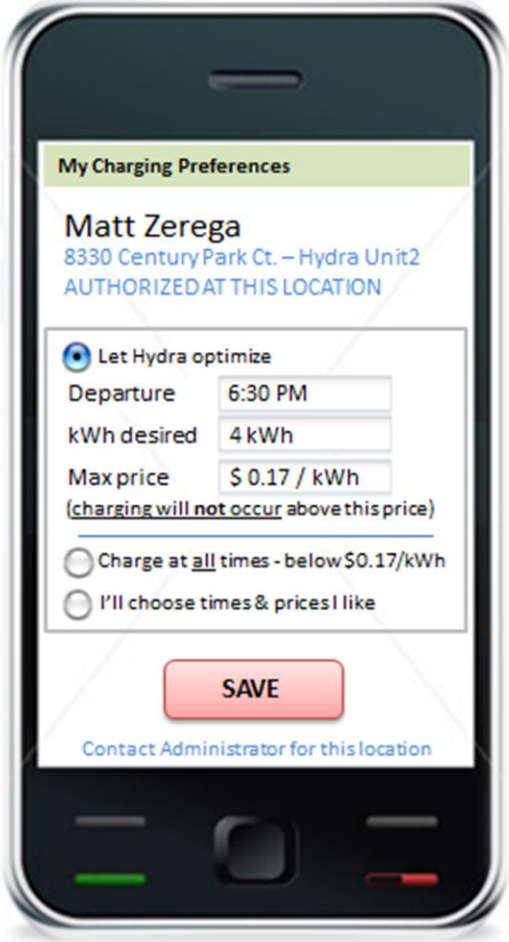
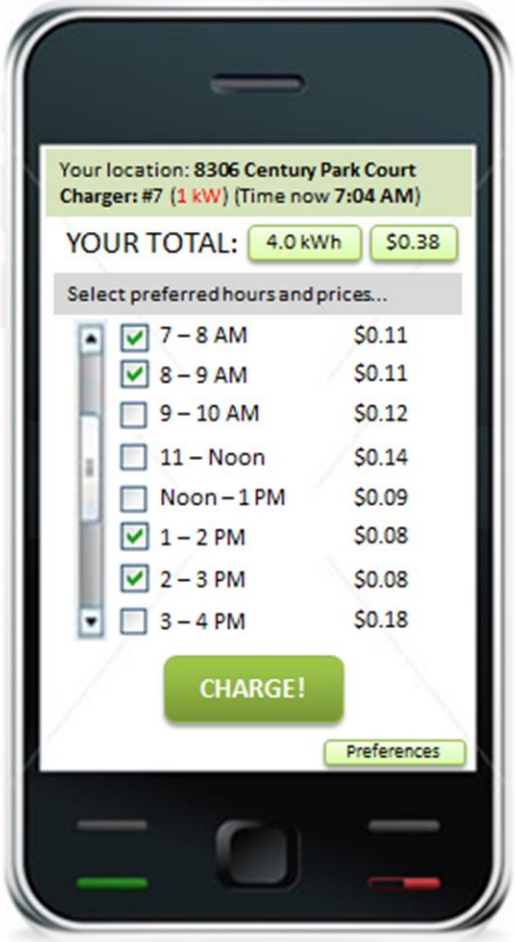
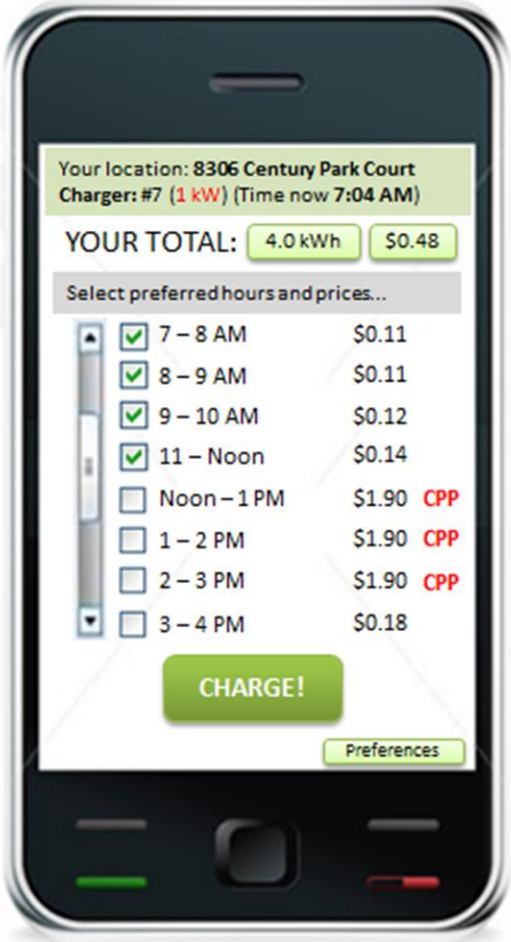
SDG&E Vehicle Grid Integration Rate App





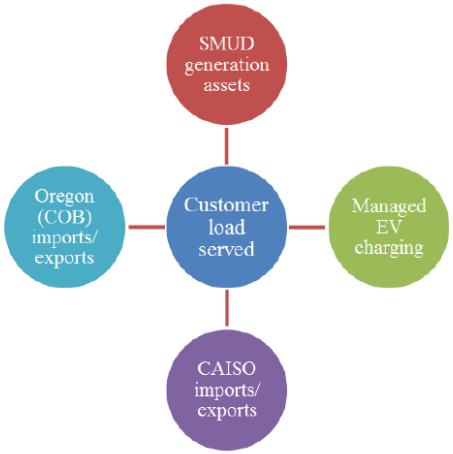


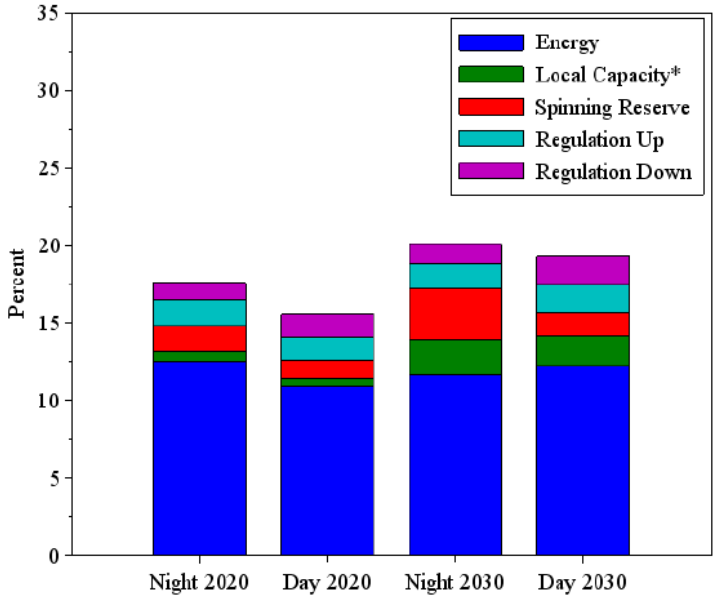
Basic settings – "set & forget"

Advanced settings – choose hourly prices

SMUD Value of Managed Charging

IEEE DOI 10.1109/ITEC.2018.8450258





- SMUD case for a vertically integrated utility
- Plexos® Production Cost Model
  - Hourly energy prices over a 24/7/365
  - Assumes 50% Renewables by 2030
  - 44,000 Vehicles (very low)
- Assumptions
  - EV was grid connected at all times
  - 3 modes of charging
    - No-charge (battery full)
    - Charge at Level1
    - Charge at Level 2
  - Guaranteed 3 hours of L2 charging and 3 hours of Level 1 charging to meet normal traction energy demand / vehicle usage
- 15% to 20% value against normal charging costs

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Summary

- Residential EV Grid impacts appear manageable
- Managed / Smart Charging could further reduce impacts but needs to be low cost
- Customers appear to be very flexible with charging behavior to achieve cost savings
- Value from managed charging is modest at the current time

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