The Calm before the Storage Tsunami:

Lessons Learned from Evaluating California's First Behind-the-Meter Advanced Energy Storage Projects

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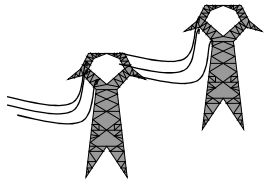
What is Energy Storage?

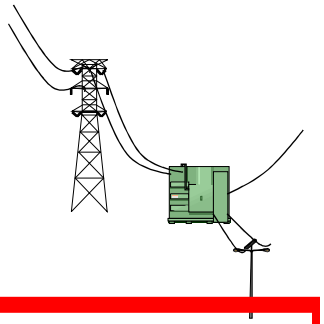
- A way to store energy; mostly batteries
  - Shift load & reduce peak demand
  - Smooth intermittency
  - Support and/or backup the grid
- Dominated by:
  - Lithium Ion Batteries – leveraged from the computer and now electric car industries
  - Flow Batteries – usually larger and use a fluid

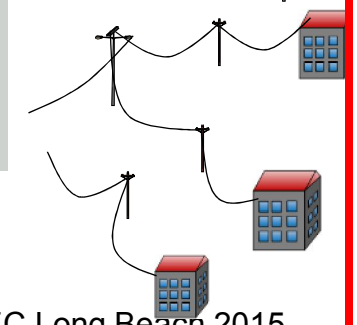
Regulatory Background

- California's Self Generation Incentive Program started to investigate including standalone storage in 2010
  - 2011 handbook enabled storage
- California Public Utilities Commission mandated 1,325 MW of storage by 2024
- Other states like Hawaii, New York, and New Jersey provide incentives for energy storage

Storage Grid Domains (Grid Interconnection	Regulatory Function	Use-Case Examples
Transmission- Connected	Generation/Market	(Co-Located Energy Storage) Concentrated Solar Power, Wind+ Energy Storage Gas Fired Generation + Thermal Energy Storage
		(Stand-Alone Energy Storage) Ancillary Services, Peaker, Load Following
	Transmission Reliability (FERC)	Voltage Support
Distribution- Connected	Distribution Reliability	Substation Energy Storage (Deferral)
	Generation/Market	Distributed Generation + Energy Storage
	Dual-Use (Reliability & Market	Distributed Peaker
Behind-the-Meter	Customer-Sited Storage	Bill Mgt/Permanent Load Shifting, Power Quality, Electric Vehicle Charging







Focus of this presentation.
Storage can also can serve as DR

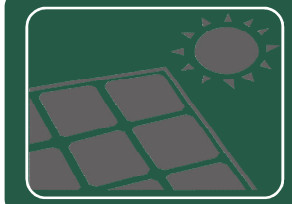
Why Storage Now?

Falling Costs

- The Tesla Effect

Rising Demand Charges

- Now make up 50% or more of commercial bills



More Intermittent Renewables

- Balance variability
- Offer the ability to line up peaks

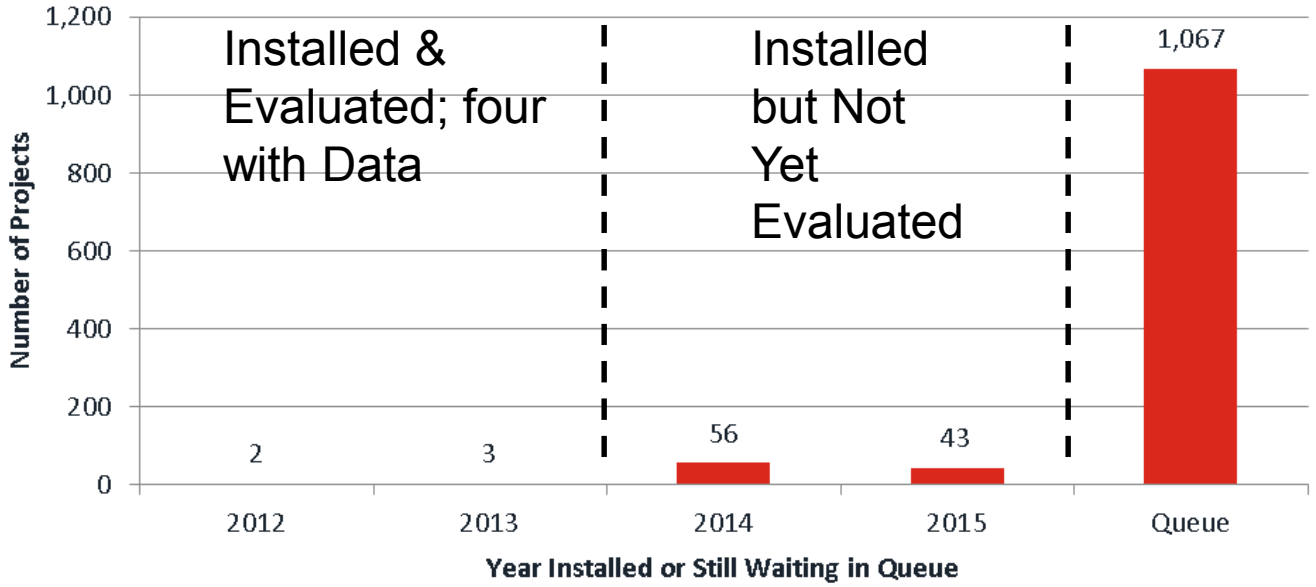
Reliability

- Power Outages
- Hurricane Sandy

The Self Generation Incentive Program (SGIP)

What can we learn from 4 sites? And why does it matter?

The Coming Tsunami for SGIP



- Only a few now; many more to come

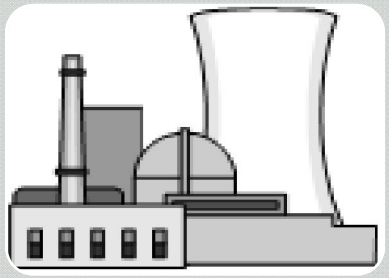
Different Pieces of Data – four sites

Charge and discharge

Facility Load (only one site)

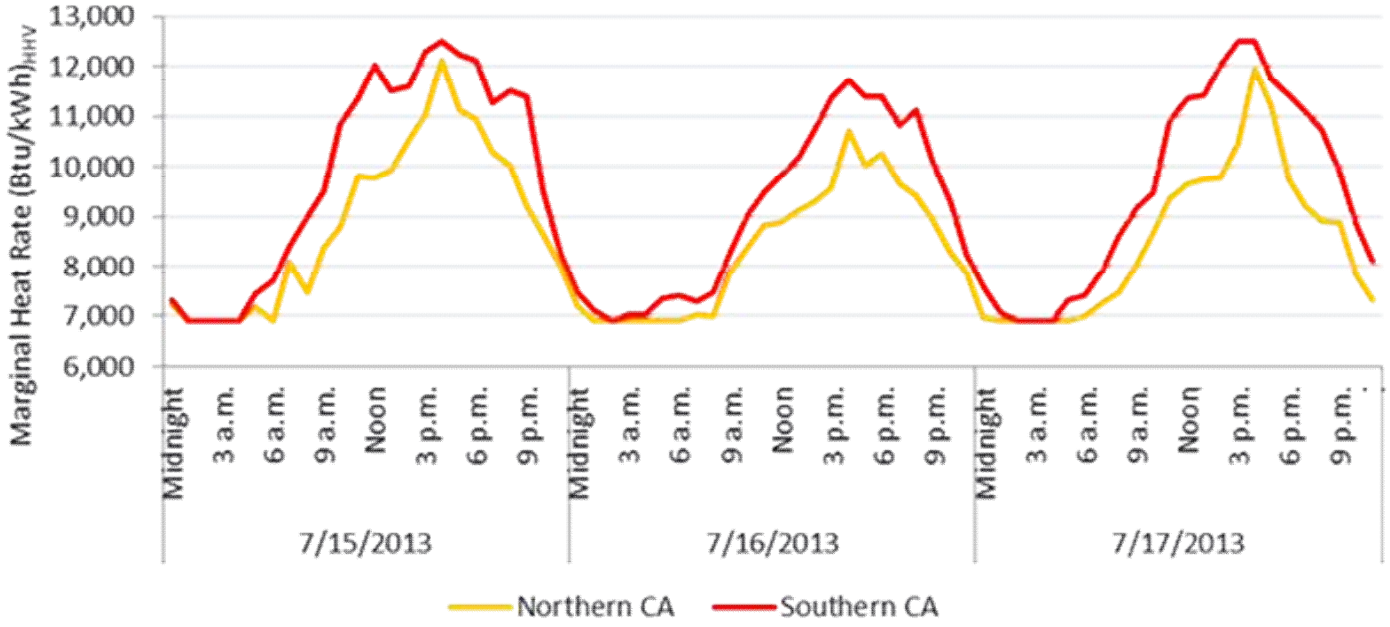
Tariffs*

(Ideally actual Bills)



Marginal Grid Emissions

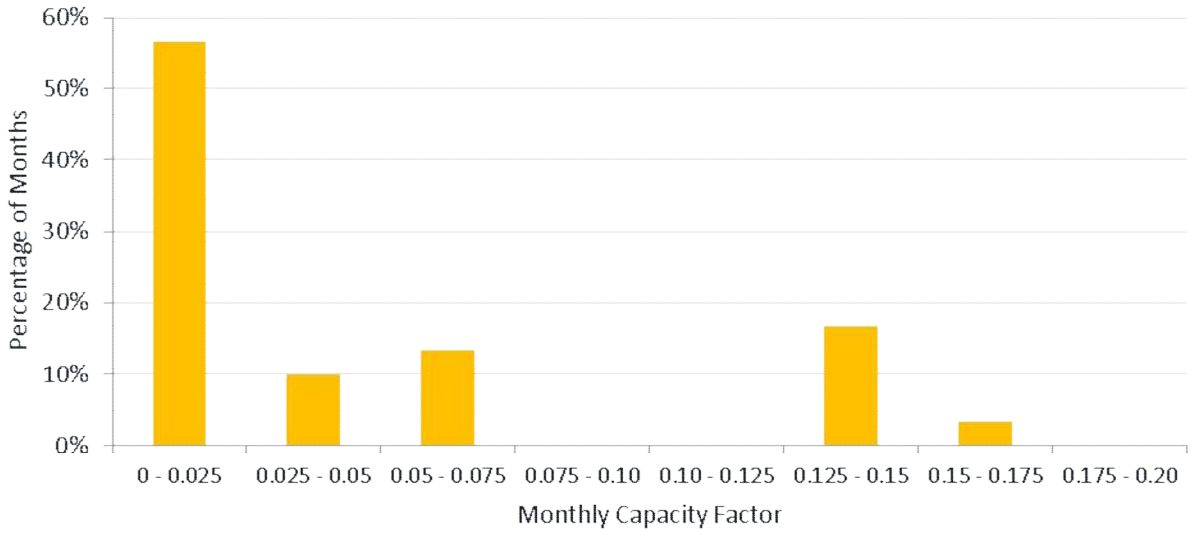
Emissions:
Can you beat the grid spread?



- Largely dirtier during the day, cleaner at night

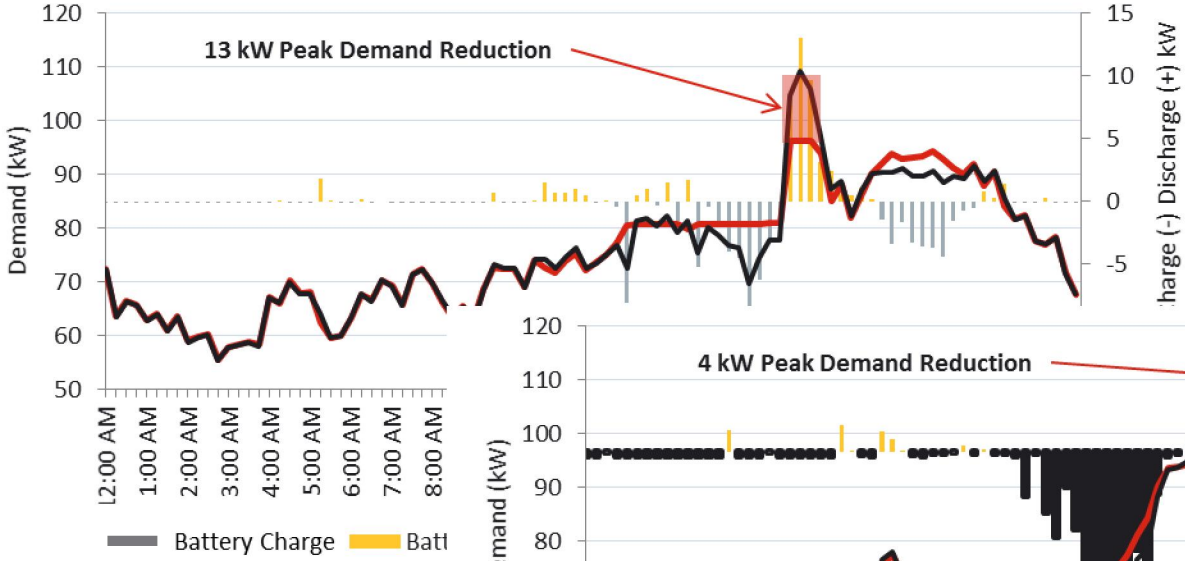
Efficiency and Capacity Factor

- 73% overall roundtrip efficiency

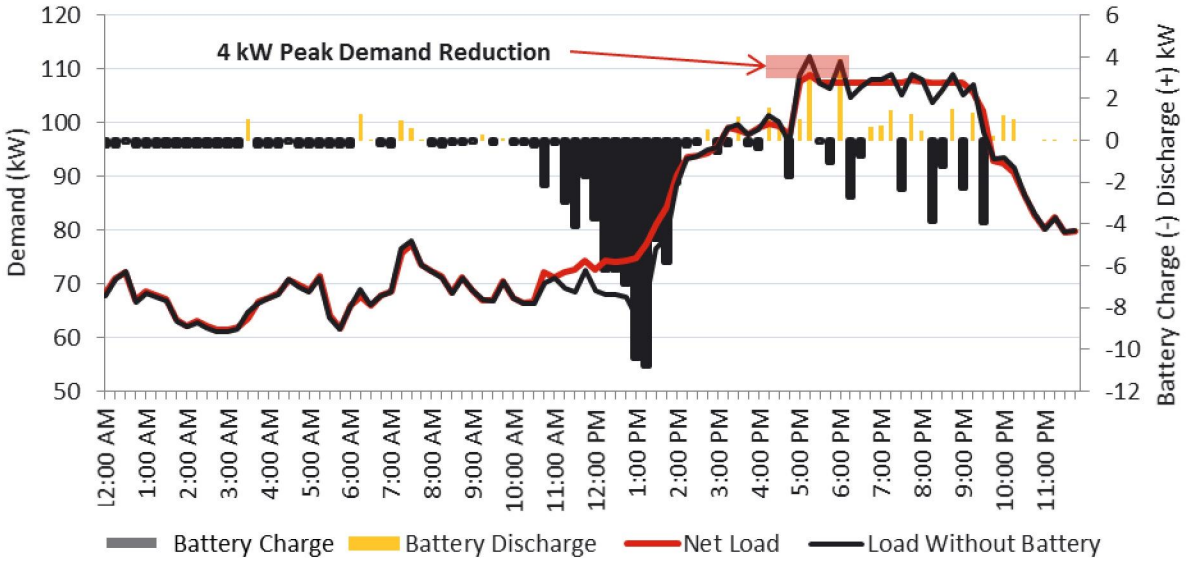


- Program target is 10 percent CF
  - Target based on 5,200 hours, so 6 percent for entire year

Adding Facility Load Data– Demand Reduction for One Site



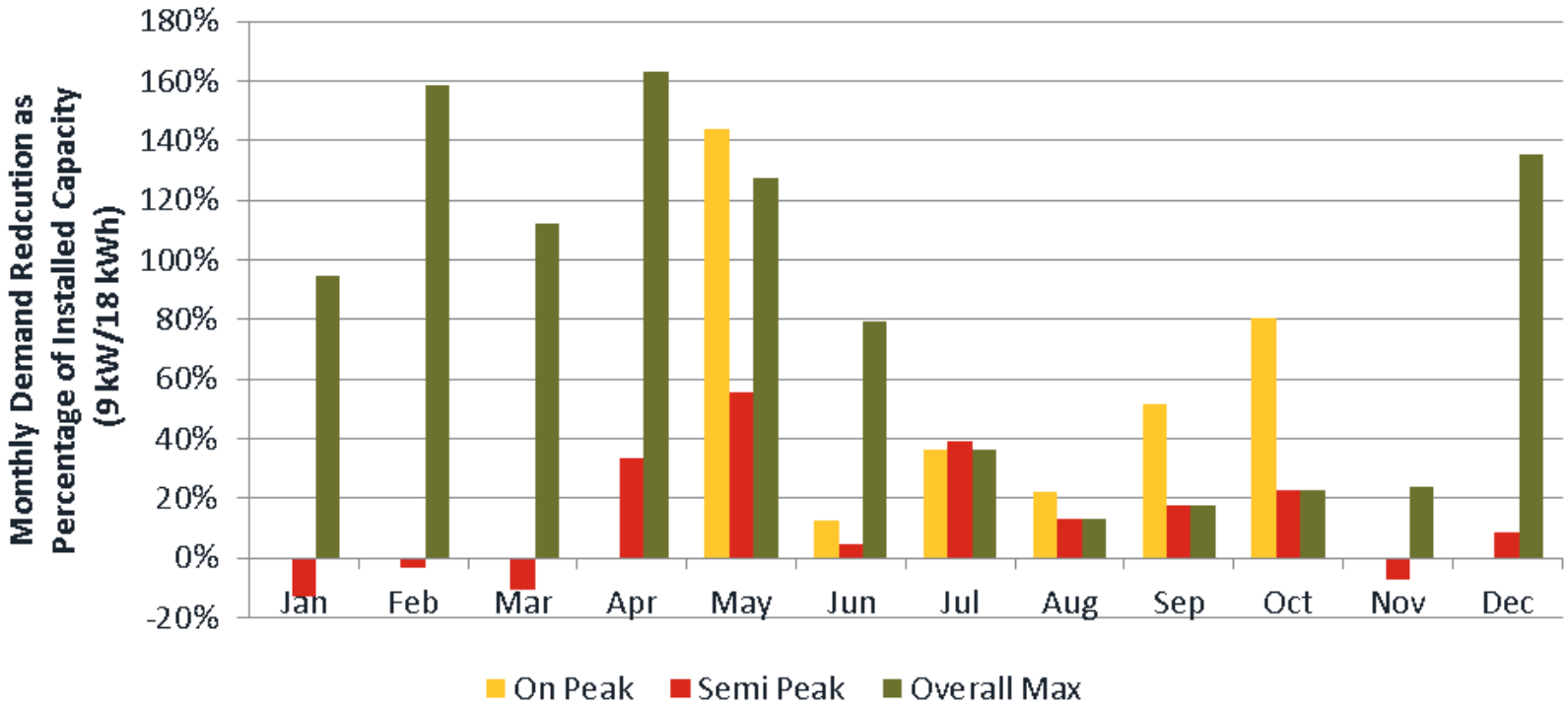
April



July

- Short Peaks are Easier to Shave

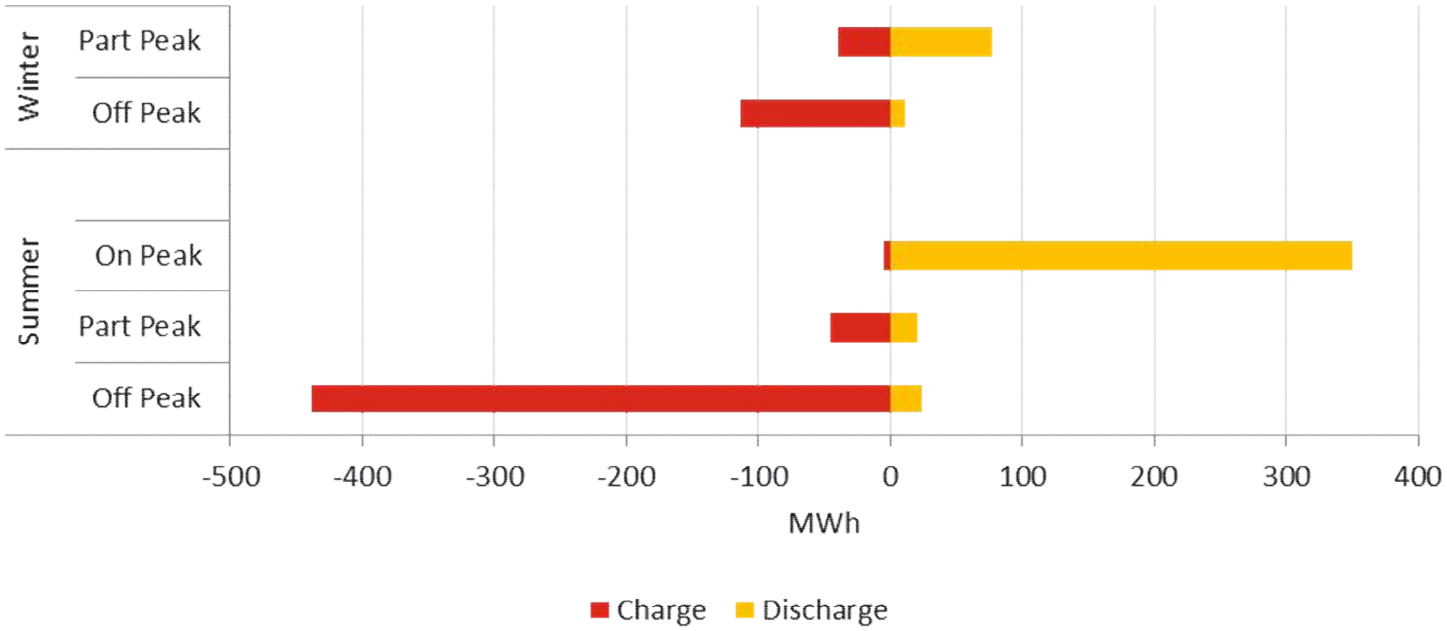
Adding Facility Load – Demand Reductions by Month



- Lots of reduction in winter, less in summer

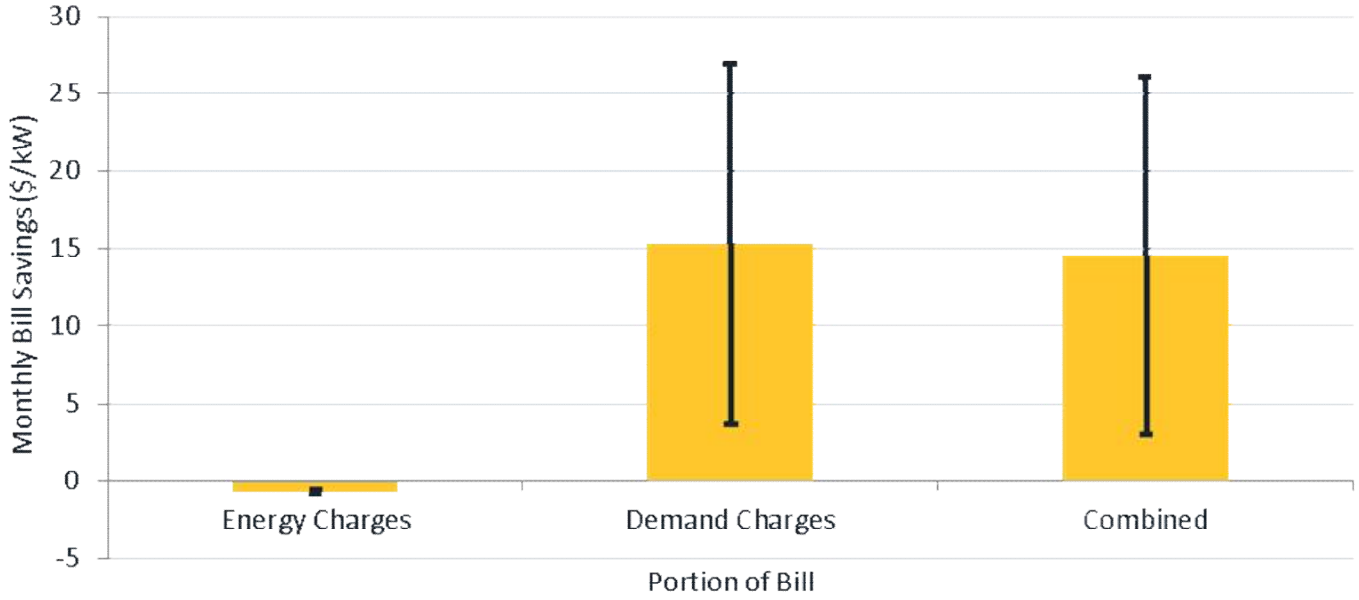
Back to Averaged Data for Four Sites

Charge and Discharge Timing*



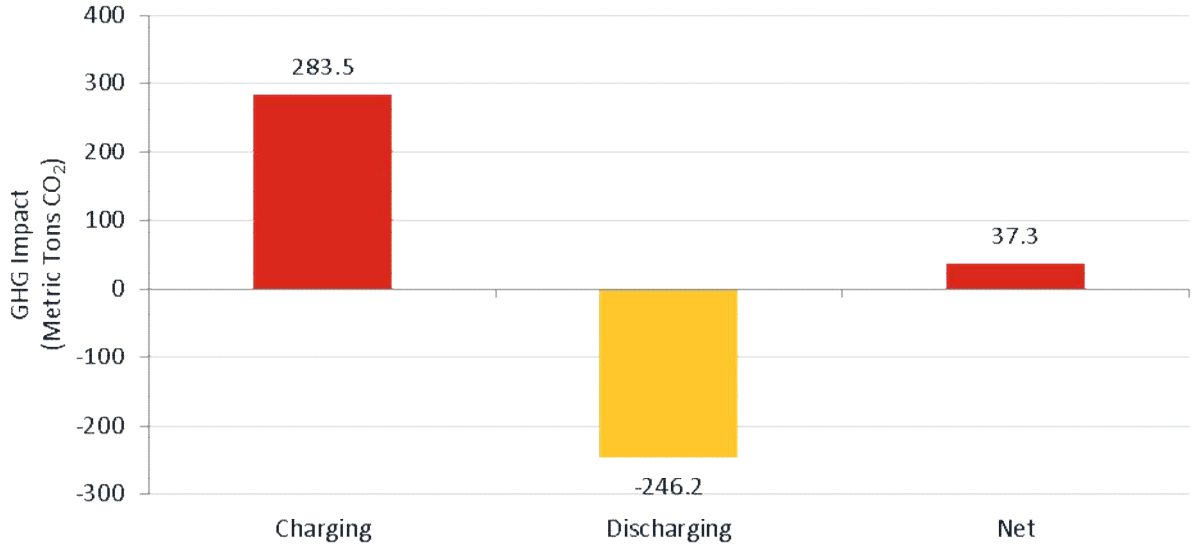
- Largely Charging off Peak
- *Based on guessed tariff

Estimated Bill Impacts*



- Use more energy, save on demand
- *Based on guessed tariff

GHG Emissions



- Not quite beating the grid yet

So what's the Takeaway?

- Bill savings are real
- Emissions are a harder nut to crack
- Match your data to your metrics

What Data, What Impact

Data	Metrics and Impacts
Charge/ Discharge Metering	Round Trip Efficiency
	Capacity Factor (utilization)
	Impact on Overall Energy Consumption
	Impact on Utility/ISO Peak Demand
Facility Load Metering	Customer Peak Demand Impact
Addition of Customer Tariff	Peak vs. Non-Peak Analysis
	Customer Bill Impacts (when combined with facility load)
Emissions Baseline	Emissions Impact
Synergistic Services Metering	Complete impact of combined systems
Ancillary Services Metering	Grid Support Impacts (may require other grid data)

Thank you

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