SolarCity

Solar + Storage and Multi-Use Applications

Clean Energy Standard

Technical Conference on Energy Storage

May 26, 2016

Agenda

1. Behind-the-meter solar+storage can support "*Multi-Use Applications"*, providing value to the bulk system, distribution system, and customers, and supporting CES and REV goals.

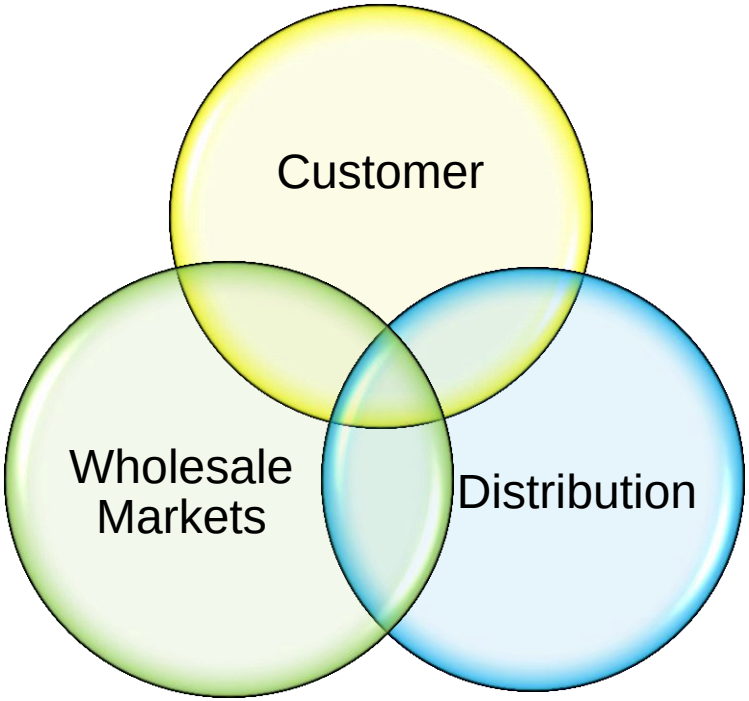
2. Only a subset of *Multi-Use Applications* are commercially viable at this time, due to various barriers.

3. A storage incentive could help animate the market in the near-term, while these barriers are overcome and storage costs come down.

Multi-Use Applications for Solar+Storage

- Solar+Storage can provide multiple services to the bulk system, distribution system, and customers.
- Enabling multi-use applications is crucial to support CES and REV.

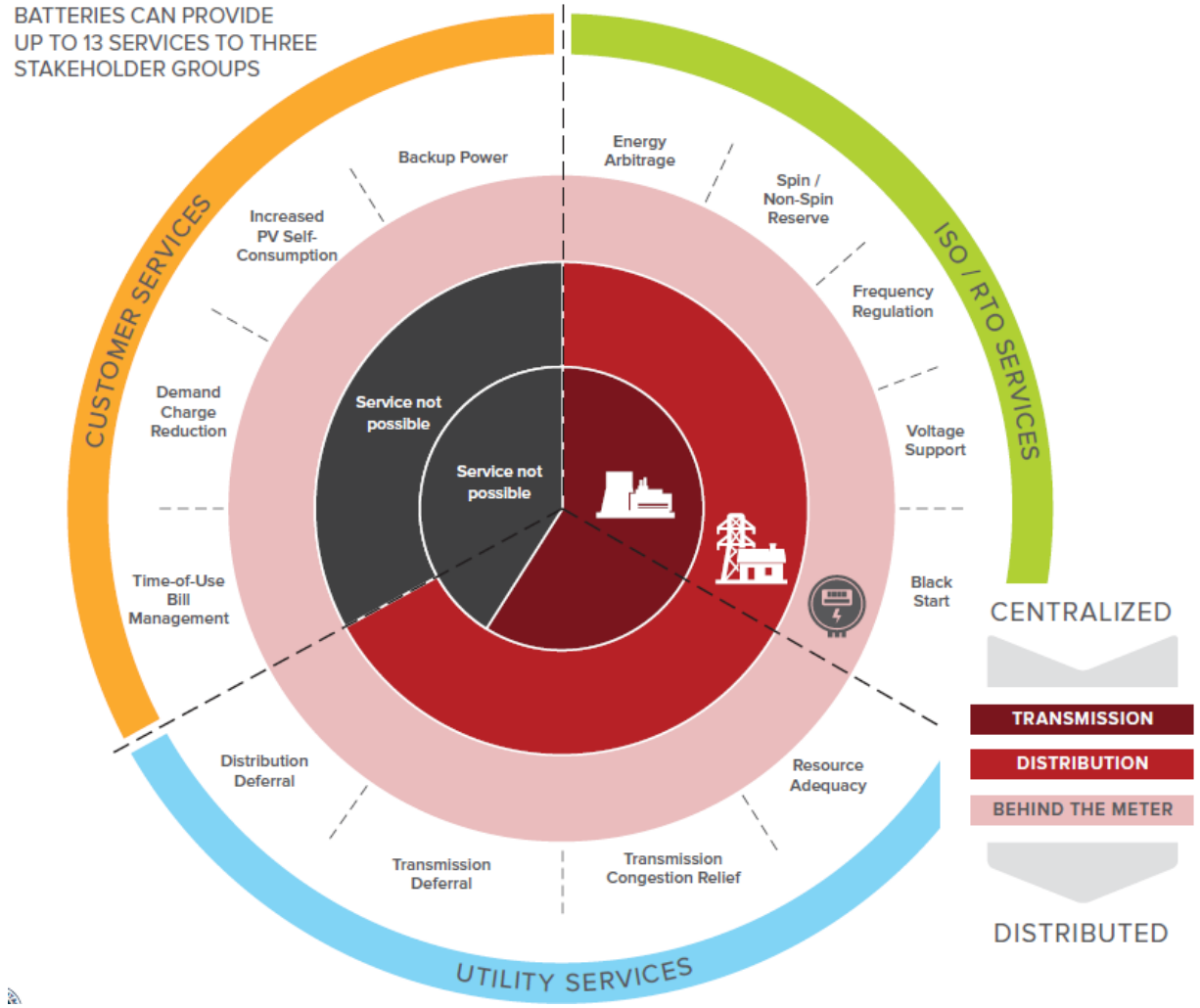
Time of Use Bill Management
Demand Charge Reduction
Back-up Power
Increased solar self-consumption



Energy
Regulation
Contingency Reserve
Resource Adequacy
Flexible Capacity
Flexible Ramping

Distribution Infrastructure deferral
Reactive Supply
Voltage Control
Frequency Response
Increased hosting capacity

Behind-the-meter resources can provide the most types of values.

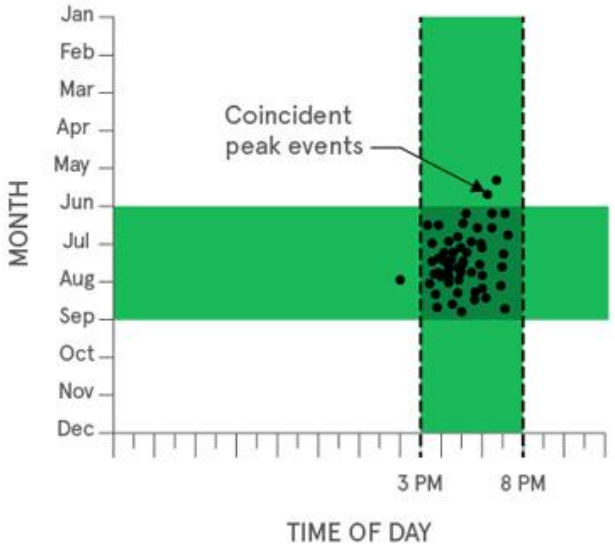


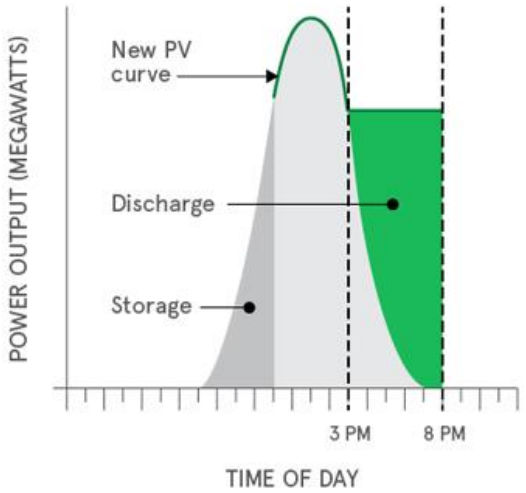
Source: “The Economics of Battery Storage”, Rocky Mountain Institute (RMI), October 2015

Current business model – Utility-scale Solar+Storage

- **Solar+Storage delivers power at times of peak demand.**

- **Example projects:**
  - Kaua‘i Island Utility Cooperative, Hawai‘i:
    - 17 MW solar
    - 13 MW / 52 MWh storage
  - Connecticut Municipal Electric Energy Cooperative:
    - 13 MW solar
    - 1.5 MW / 6 MWh storage



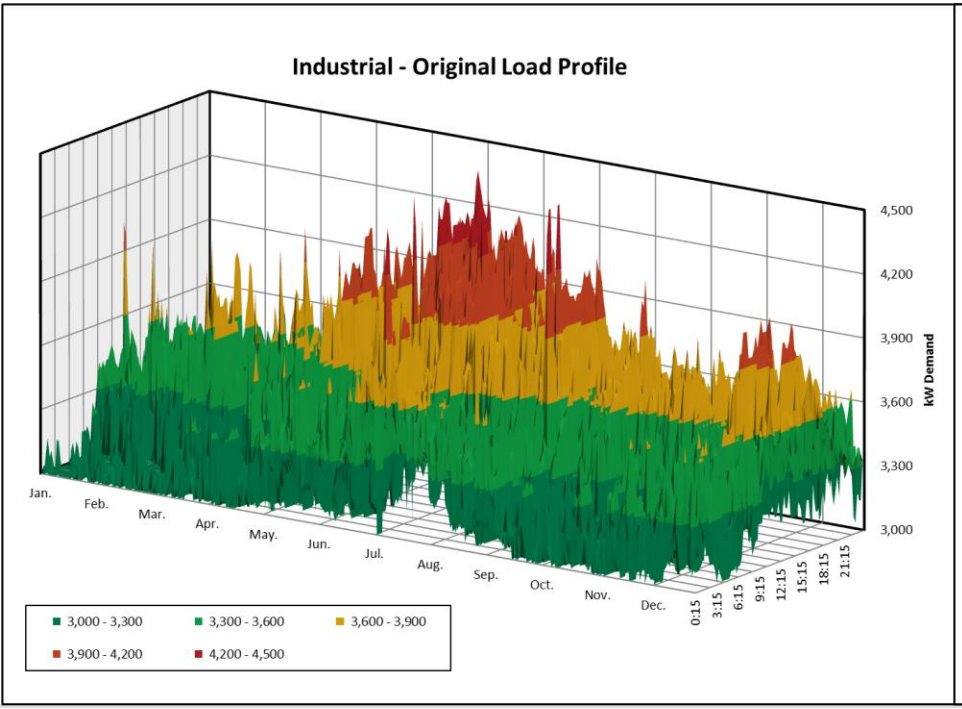


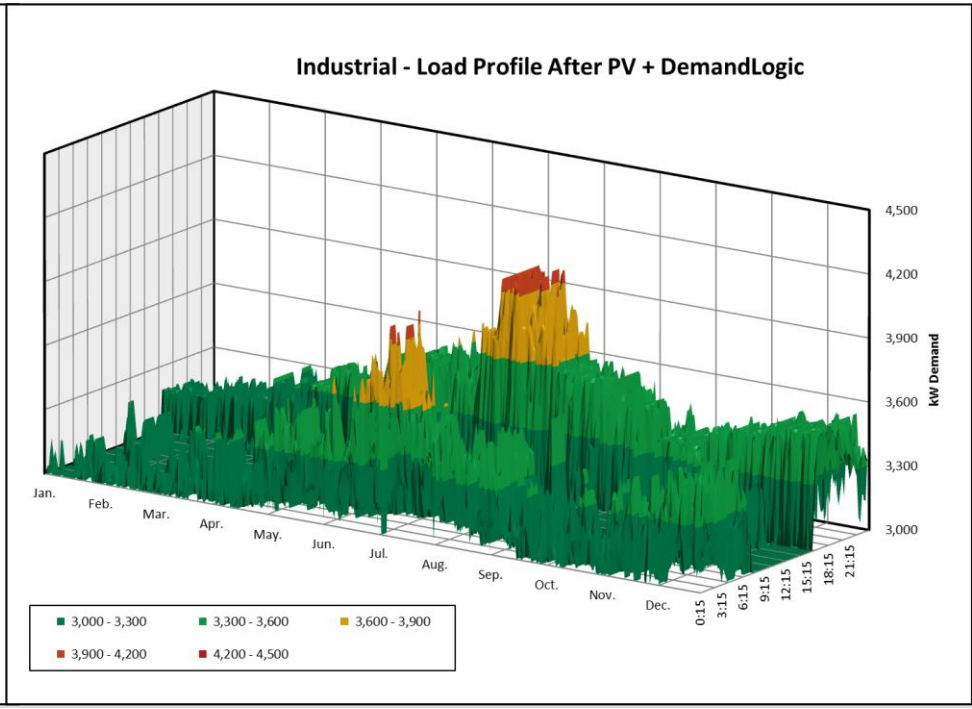
Current business model – Commercial Solar+Storage

DemandLogic systems reduce energy and demand charges.

Example project:

- Solar system size 4.7 MW
- Storage size 1MW/2MWh





Current business model – Residential Solar+Storage

Smart Energy Homes and Buildings: Commercially deployed in Hawaii for solar self-consumption

SOLAR PANELS

Solar panels capture energy from the sun and convert it to electricity to power your home.

HOME GATEWAY

The gateway allocates energy to maximize self-supply.

NEST LEARNING THERMOSTAT

The thermostat learns what temperature you like and builds a schedule around yours.

BATTERY

The battery stores your excess solar energy production for later use.

MYSOLARCITY APP

See how much energy you're importing from the grid compared to how much is being self supplied.

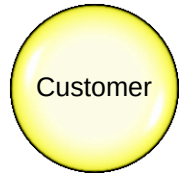
SMART WATER HEATER

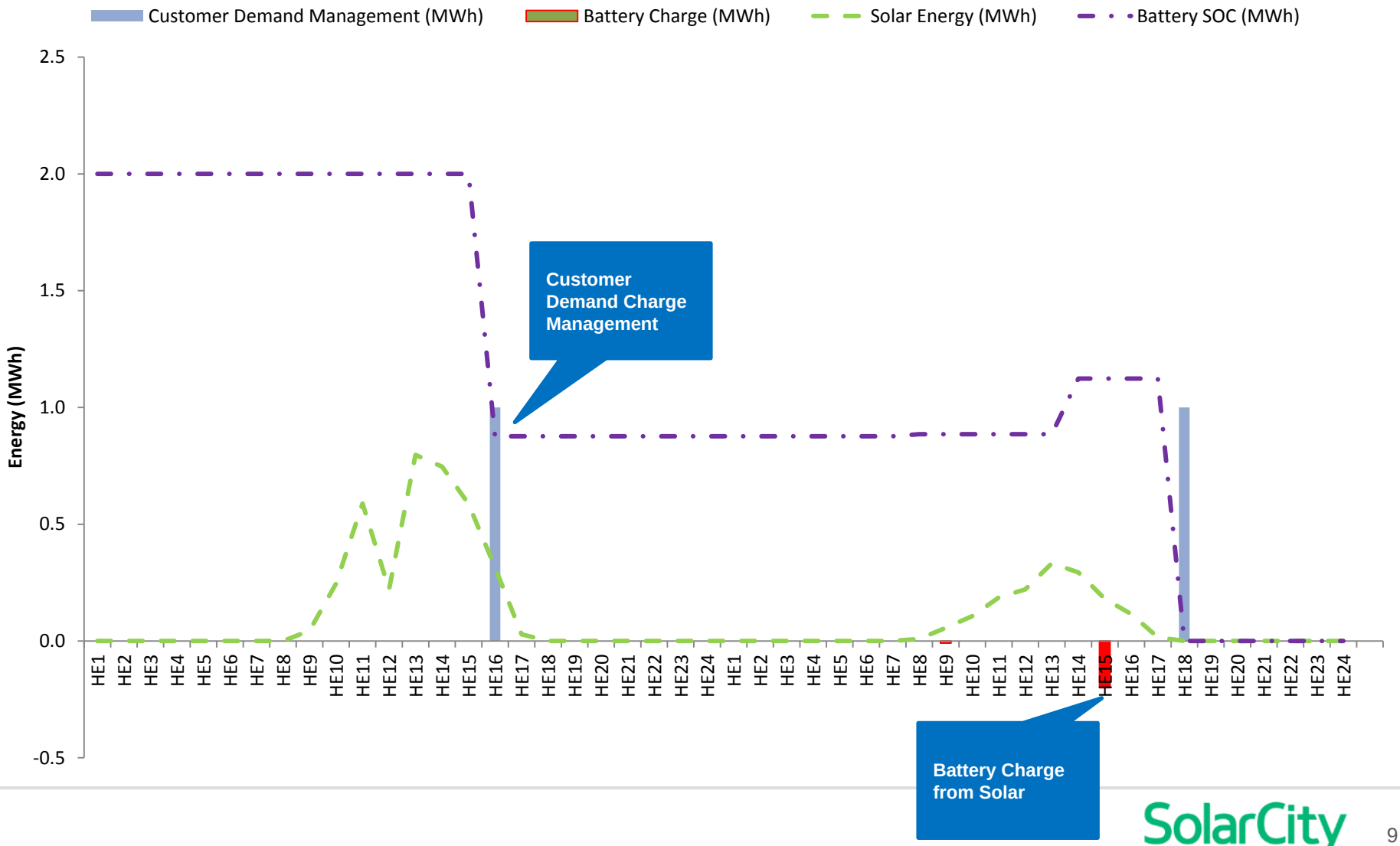
This uses excess solar production to heat hot water for your home.

Behind-the-meter Solar+Storage business models

- Current:
  - Reduce customer energy and demand charges
  - Solar self-consumption
  - Customer backup power
- Soon:
  - + Participate in NYISO markets (capacity, ancillary services)
  - + Reduce distribution peaks (non-wires alternative contracts and distribution-level demand response)
- Next:
  - + Smart energy rates
  - + Support increased hosting capacity (load shifting, smart inverters)
  - + Additional distribution services (VVO/CVR)

Multi-Use Applications Project Simulation 1
Current Capability: Customer Demand Optimization

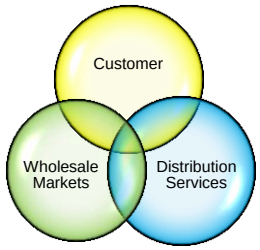


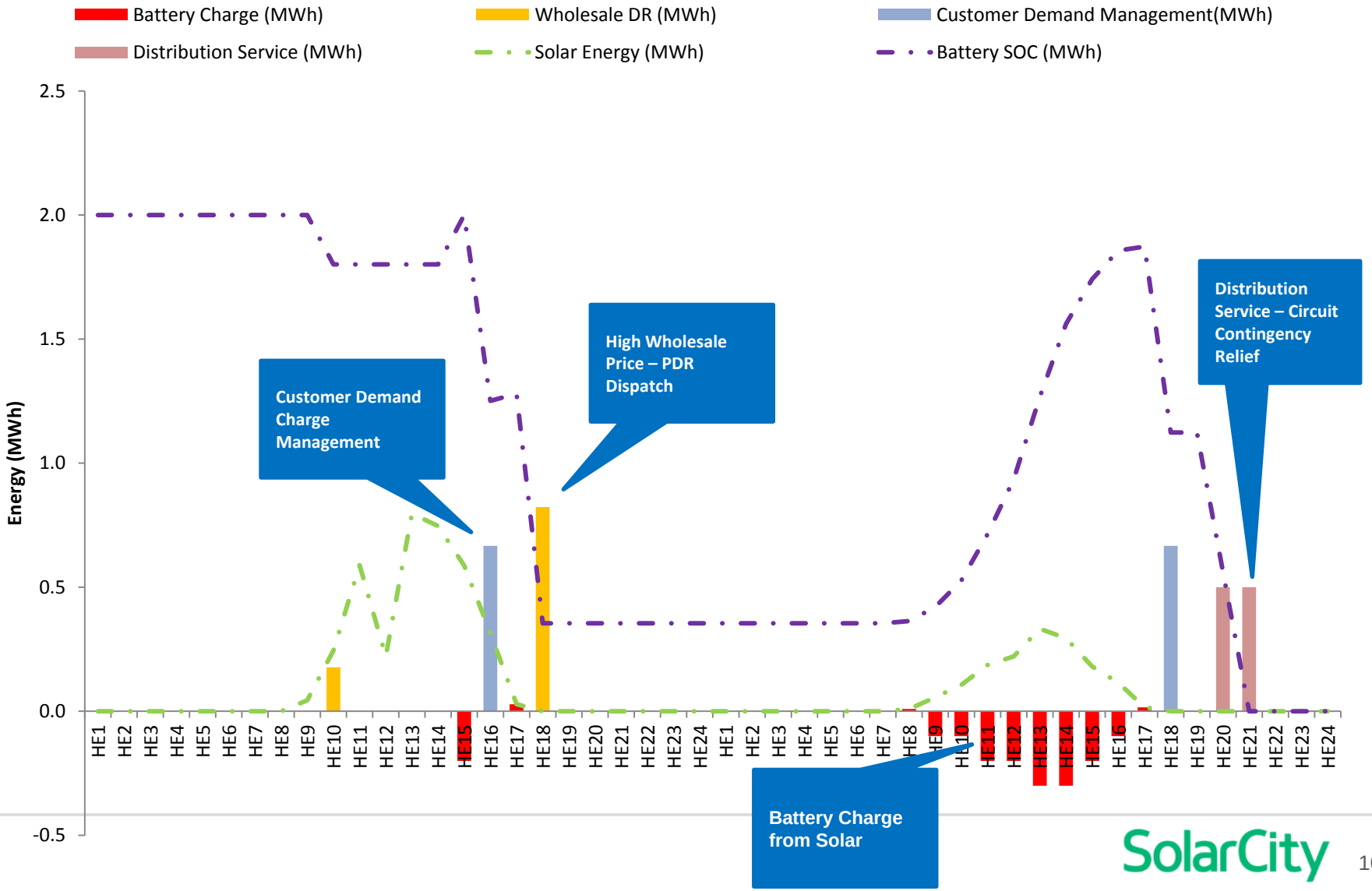


Multi-Use Applications Project Simulation 2

Near-term Plan:

Customer + Wholesale DR + Distribution Service





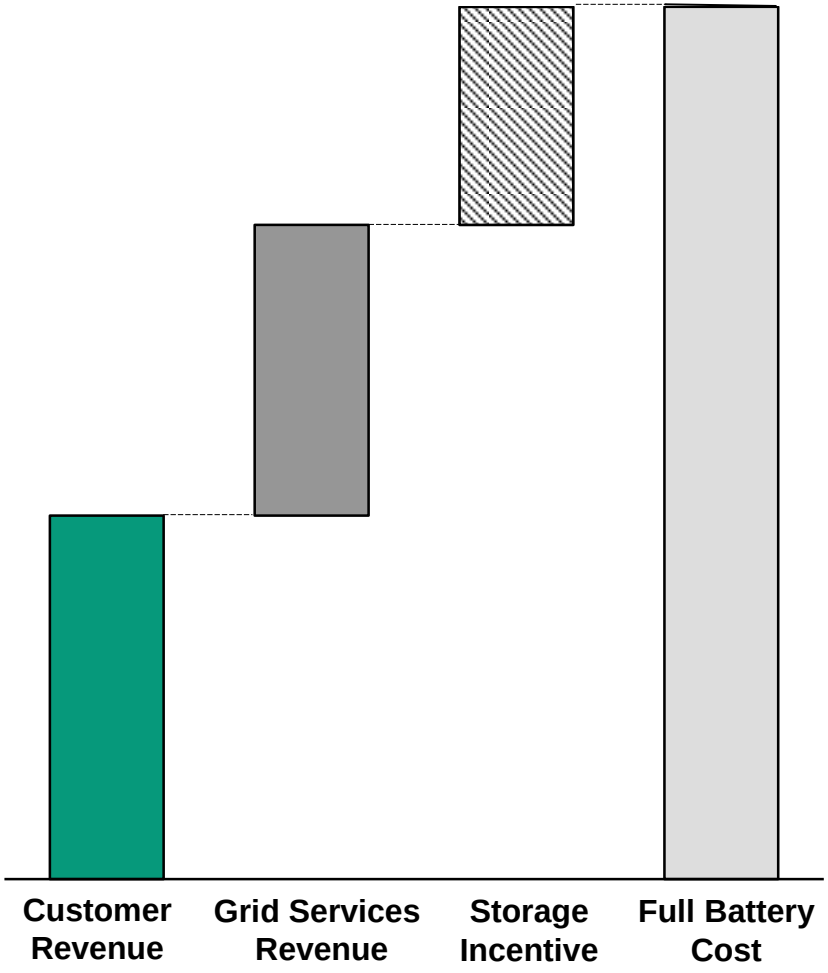
SolarCity

Barriers to full realization of multi-use applications for solar+storage must be overcome

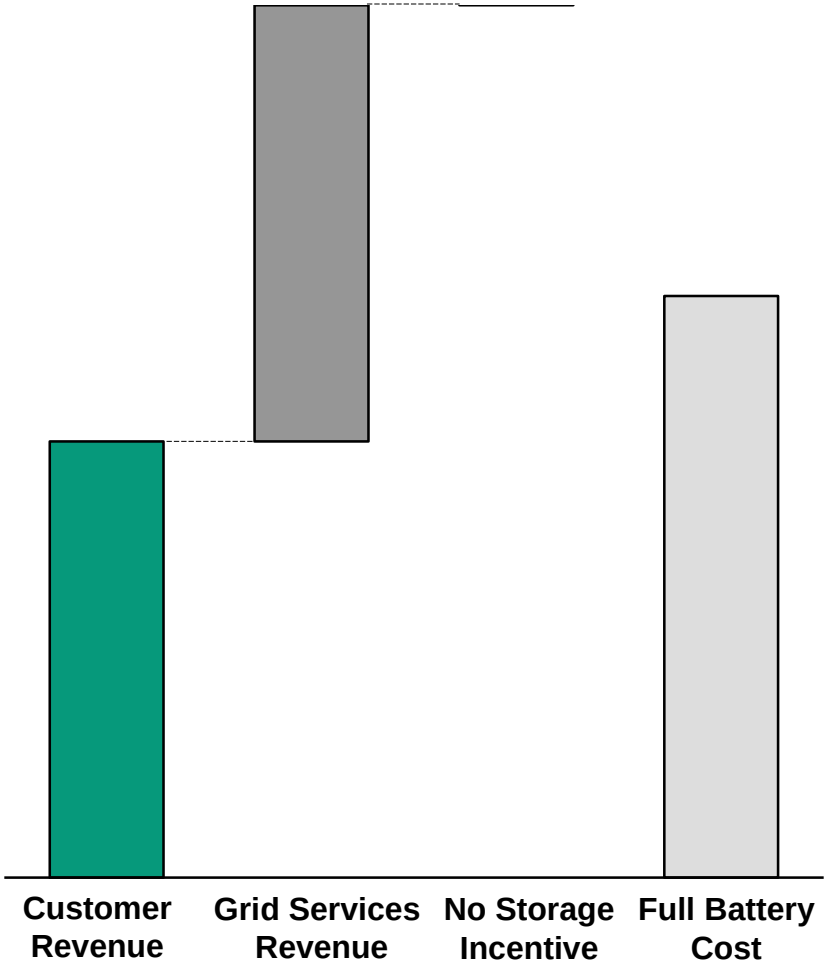
- **Rate Design**
  - Customer demand charge not aligned with system peaks
  - TOU rates may not allow inter-period netting
- **Market Eligibility and Scheduling**
  - Restrictions on NEM + other markets
  - Timing of markets may limit multi-use applications
- **Measurement & Verification**
  - Metering requirements
  - Customer baseline vs. measured inverter output vs. hybrids
- **Interconnection**
  - Unclear rules for some storage applications
- **Permitting**
- **Markets for some values do not exist yet**

Illustrative Economics

Today – Incentive Required



Future – Incentive Not Required



Recommendation:
Storage incentive to animate market

- Deployment of and experience with storage is crucial to support the CES and REV, but currently viable market opportunities are limited.
- A storage incentive can bridge the gap, while storage costs come down, and multi-use applications are further developed.

- Example model:
  - Declining block incentives proposed by CPUC for SGIP revamp:

Proposed Incentives for Energy Storage

	Step 1	Step 2	Step 3	Step 4	Step 5
Large Scale Energy Storage (>10 kW)	$0.50/Wh	$0.45/Wh	$0.40/Wh	$0.35/Wh	$0.30/Wh
Small Scale Energy Storage (<=10 kW)	$0.60/Wh	$0.55/Wh	$0.50/Wh	$0.45/Wh	$0.40/Wh

Source: CPUC Proposed Decision, Decision Revising the Self-Generation Incentive Program; Rulemaking 12-11-005; May 16, 2016

Recap

1. Behind-the-meter solar+storage can support "*Multi-Use Applications"*, providing value to the bulk system, distribution system, and customers, and supporting CES and REV goals.

2. Only a subset of *Multi-Use Applications* are commercially viable at this time, due to various barriers.

3. A storage incentive could help animate the market in the near-term, while these barriers are overcome and storage costs come down.

SolarCity

Thank you