NREL
Transforming ENERGY

Batteries in SAM 2020.2.29: Behind-the-Meter Systems

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September 2, 2020

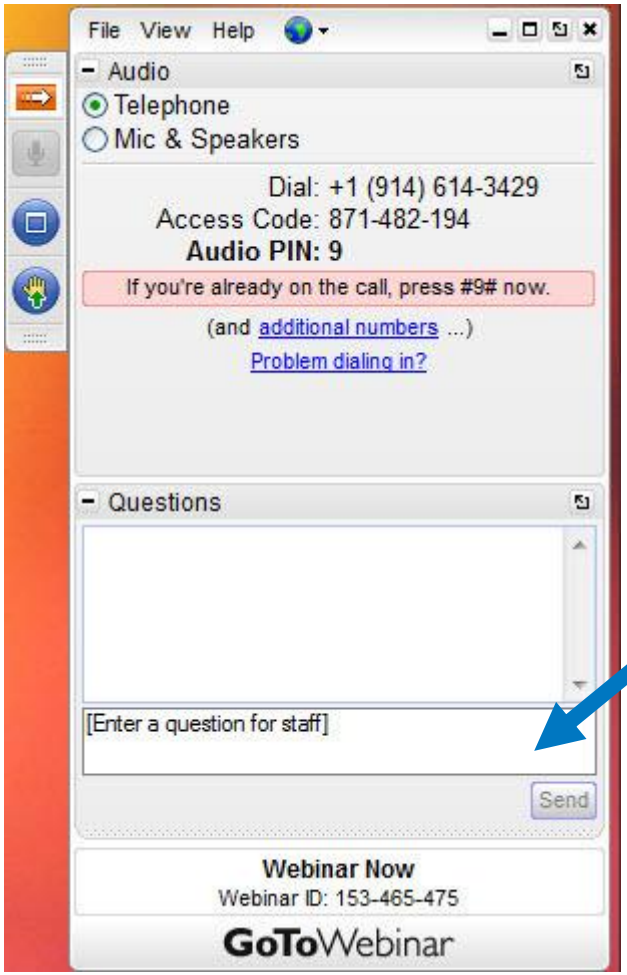
SAM 2020 Webinar Series

- Introduction to SAM Workshop — July 22
- PV Systems in SAM 2020.2.29 — Aug 5
- Batteries in SAM 2020.2.29:
  - Focus on Battery Technology — Aug 19
  - **Behind-the-Meter Systems** — **Sep 2**
  - Front-of-Meter Systems — Sep 16

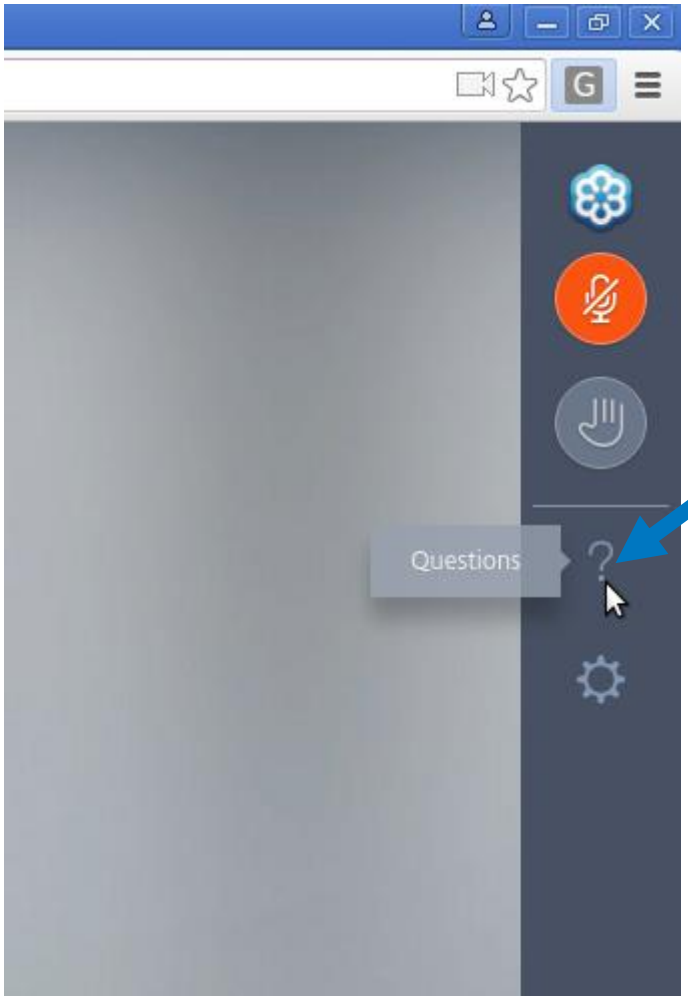
Register for free at: https://sam.nrel.gov/events.html

This webinar will be recorded and posted on the SAM website at https://sam.nrel.gov/events.html

Use the GoToWebinar control panel to ask questions



Desktop application

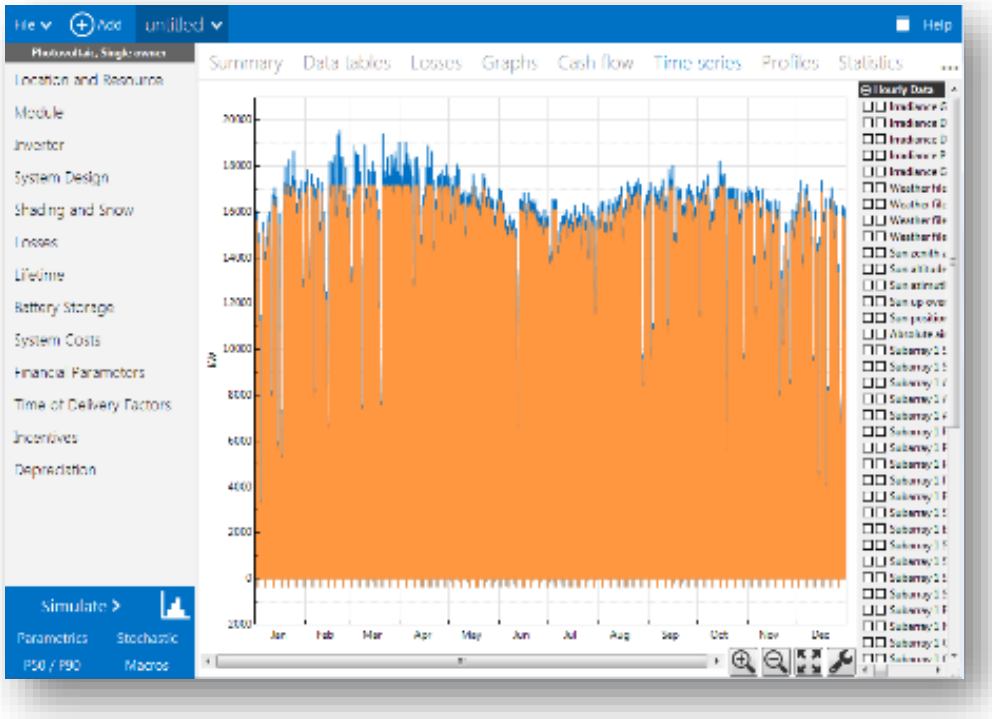


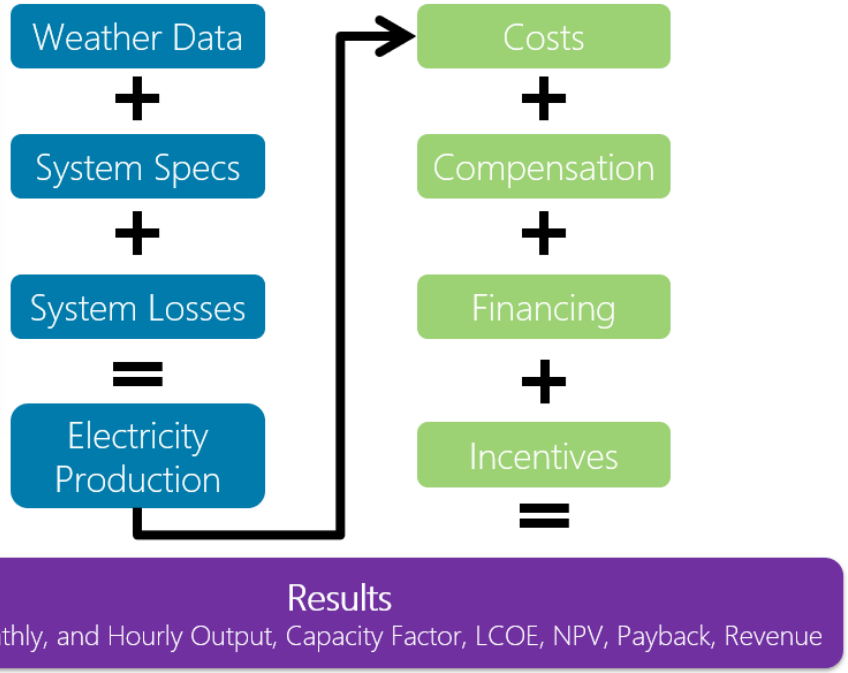
Instant Join Viewer

We will either type an answer to your question or answer it at the end of the presentation.

System Advisor Model (SAM)

Free software that enable detailed performance and financial analysis for renewable energy systems





http://sam.nrel.gov/download

Technologies

- Photovoltaics
  - Detailed & PVWatts
- Battery Storage
- Concentrating solar power
- Fuel cell-PV-battery
- Wind
- Marine Energy
- Geothermal
- Solar water heating
- Biomass
- Generic

Financial

- Behind-the-meter
  - residential
  - commercial
  - third-party owned
- Power purchase agreements
  - single owner
  - equity flips
  - sale-leaseback
- Host/developer
- Merchant plant
- Simple LCOE calculator

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Webinar Outline

1. Changes Since SAM 2018.11.11
2. Dispatch Mode Overview
3. Residential System Demo
4. Commercial System Demo
5. Generic System Demo

Changes Since SAM 2018.11.11

Batteries in SAM 2018.11.11

SAM 2018.11.11

Choose a performance model, and then choose from the available financial models.

- Photovoltaic (detailed)
- Photovoltaic (PVWatts)
- High concentration PV
- Wind
- Biomass combustion
- Geothermal
- Solar water heating
- Generic system
- CSP parabolic trough (physical)
- CSP parabolic trough (empirical)
- CSP power tower molten salt
- CSP power tower direct steam
- CSP linear Fresnel molten salt
- CSP linear Fresnel direct steam
- CSP dish Stirling
- CSP generic model
- CSP integrated solar combined cycle
- Process heat parabolic trough
- Process heat linear direct steam

Photovoltaic, Commercial

- Location and Resource
- Module
- Inverter
- System Design
- Shading and Layout
- Losses
- Lifetime
- Battery Storage
- System Costs
- Financial Parameters
- Incentives
- Electricity Rates
- Electric Load

No Battery

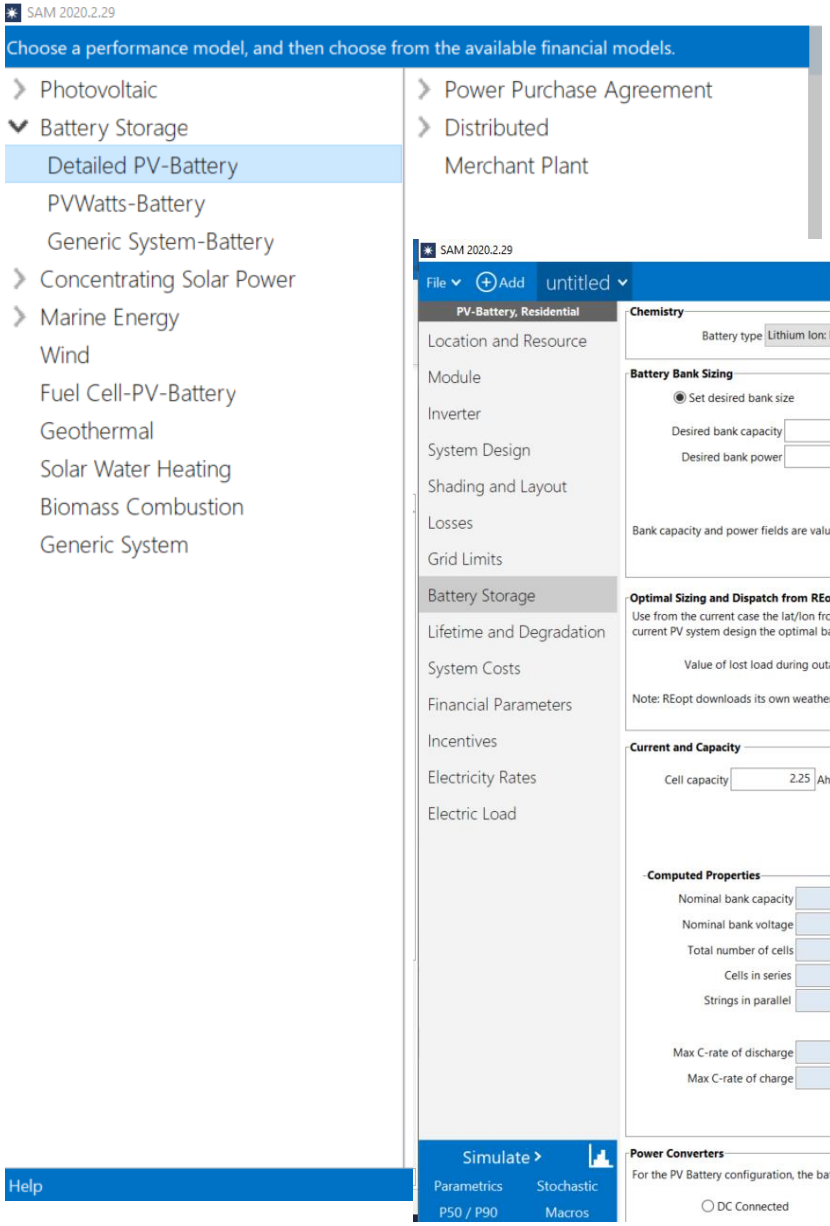
Battery Energy Storage

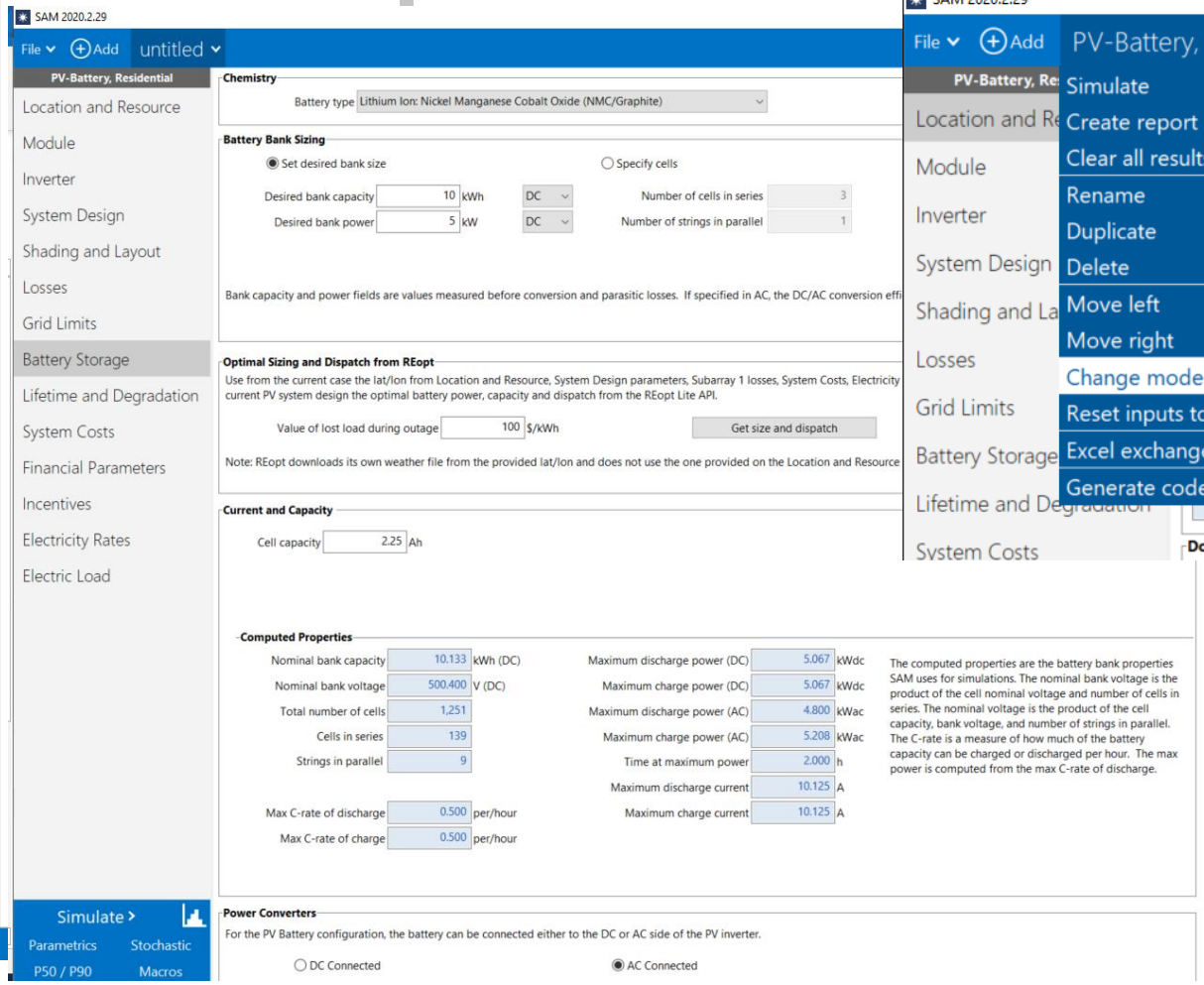
By default, the battery model is not enabled. To enable, select "Enable Battery" in the above drop down.

The battery model provides comprehensive modeling of lead-acid and lithium ion batteries for integration with PV systems, including monitoring of battery capacity, terminal voltage variation with current and charge state, thermal effects, and lifetime degradation. A manual dispatch controller provides the ability to dispatch the battery to meet specific energy and power needs based on time-of-day and time-of-year.

Batteries in SAM 2020.2.29

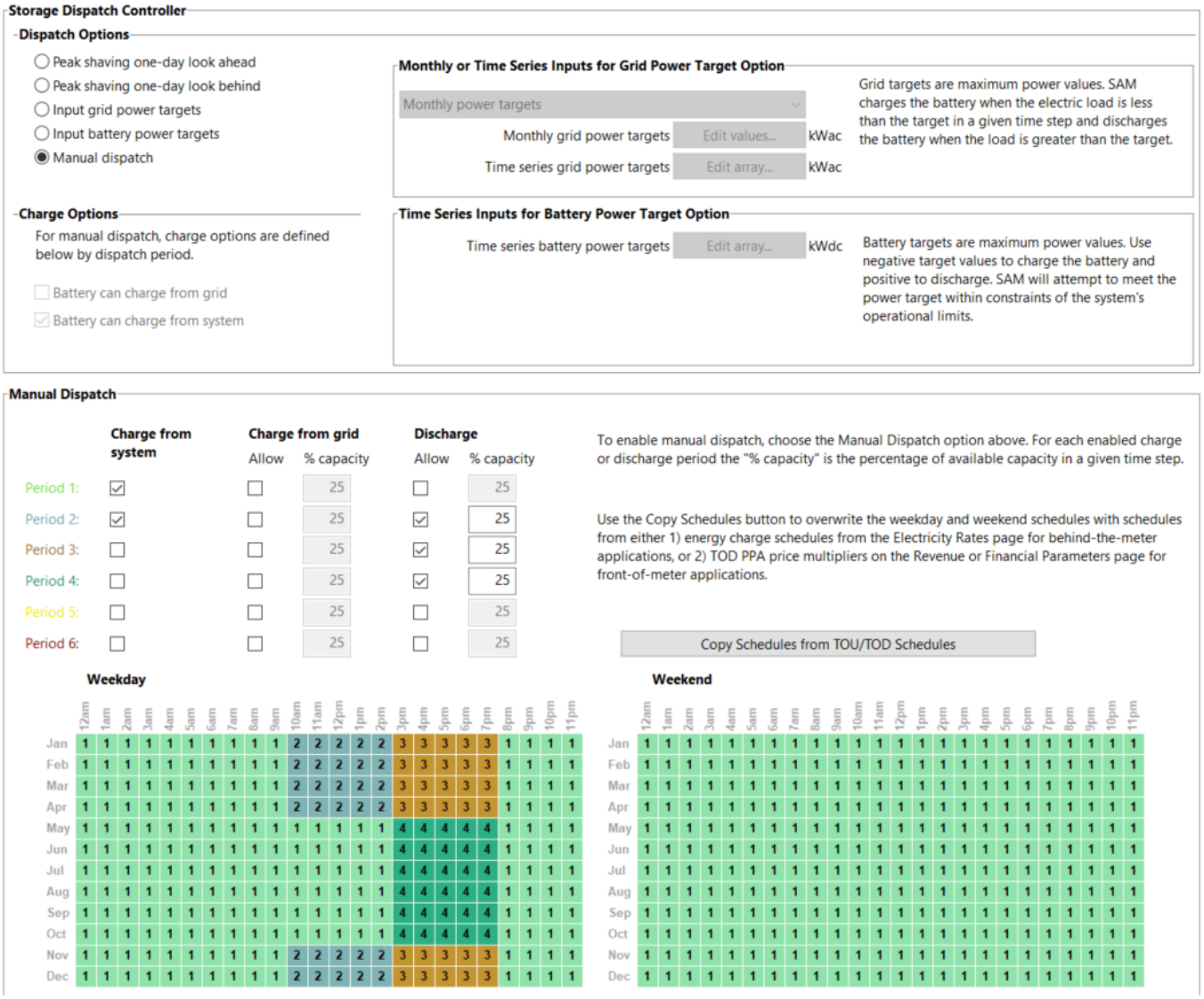
The technology selection menu has been modified to specifically select battery-enabled and hybrid systems





Dispatch Mode Overview

Behind The Meter Dispatch Modes



Behind The Meter Dispatch Modes

System Advisor Model

Dispatch Mode	Inputs	Use Case
Peak Shaving (look ahead)	Upcoming PV and Load forecast	Peak Demand Charges
Peak Shaving (look behind)	Yesterday's actual PV and Load	Peak Demand Charges (worst case)
Input Grid Power Targets	Monthly or time series targets	Specify more detailed peak power
Custom Dispatch	Time series	PySAM / outside optimization
Manual Dispatch	Schedule by hour and month	Energy Arbitrage

Bold: defaults
Italics: Available in PVWatts-Battery model

Residential System Demo

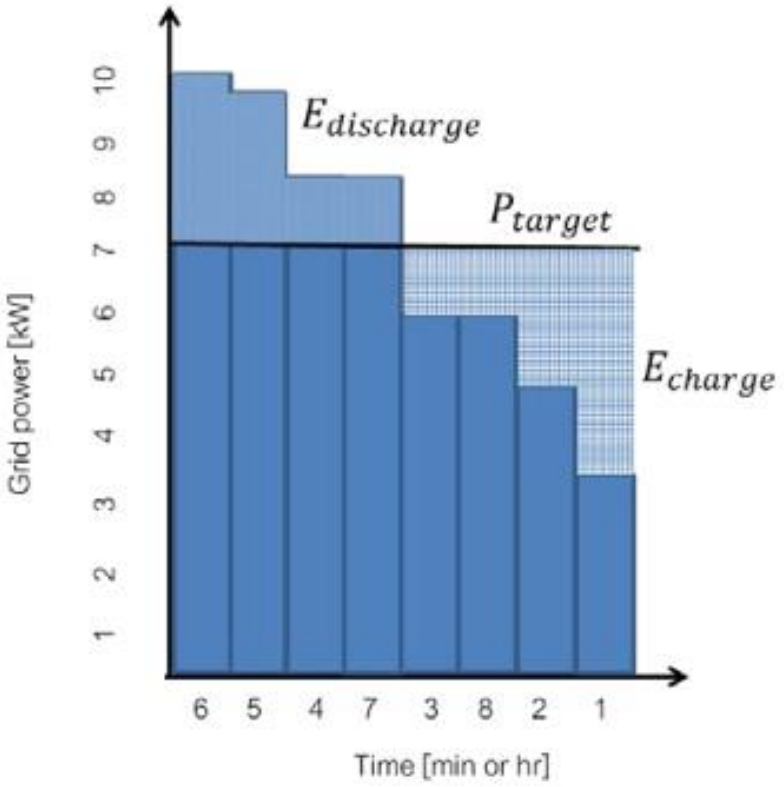
Goal: Demonstrate dispatch options suited to time of use rates for behind the meter storage connected to a PV system

Commercial System Demo

Goal: Demonstrate automated dispatch options for peak shaving and their relationship with peak demand charges

What is a grid power target?

- Computed every 24 hours based on:
  - Battery capacity (full depth of discharge each day)
  - System energy forecast
  - Load forecast
- Sort and dispatch during the top n hours of grid use (load minus system generation)
- If grid use is greater than the target, dispatch
- If less than the target, charge
- Battery will not cycle if insufficient energy is available
- Use monthly maximum



From DiOrio 2017

Generic System Demo

Goal: Demonstrate a wind generation profile and a stand-alone battery

Referenced Webinars

- **PV Design:**

https://sam.nrel.gov/photovoltaic/pv-videos.html

- **Battery Model Chemistry and Sizing:**

https://sam.nrel.gov/battery-storage/battery-videos.html

- **Load and Utility Rates:**

https://sam.nrel.gov/financial-models/residential-and-commercial.html

- **Open EI Utility Rate Database:**

https://openei.org/apps/USURDB/

Thank you! Questions?

Janine Freeman – project lead, photovoltaic and wind models
Nate Blair – emeritus lead, financials, costs, systems
Darice Guittet – software development, battery models
Brian Mirletz – software development, battery models
Matt Prilliman – photovoltaic and marine energy models
Steve Janzou – programming, utility rate structures (subcontractor)
Paul Gilman – user support and documentation (subcontractor)
Ty Neises – concentrating solar power models
Matt Boyd – concentrating solar power models

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