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Transforming ENERGY

Batteries in SAM 2020.2.29: Behind-the-Meter Systems

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SAM 2020 Webinar
September 2, 2020

SAM 2020 Webinar Series

System Advisor Model

- 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

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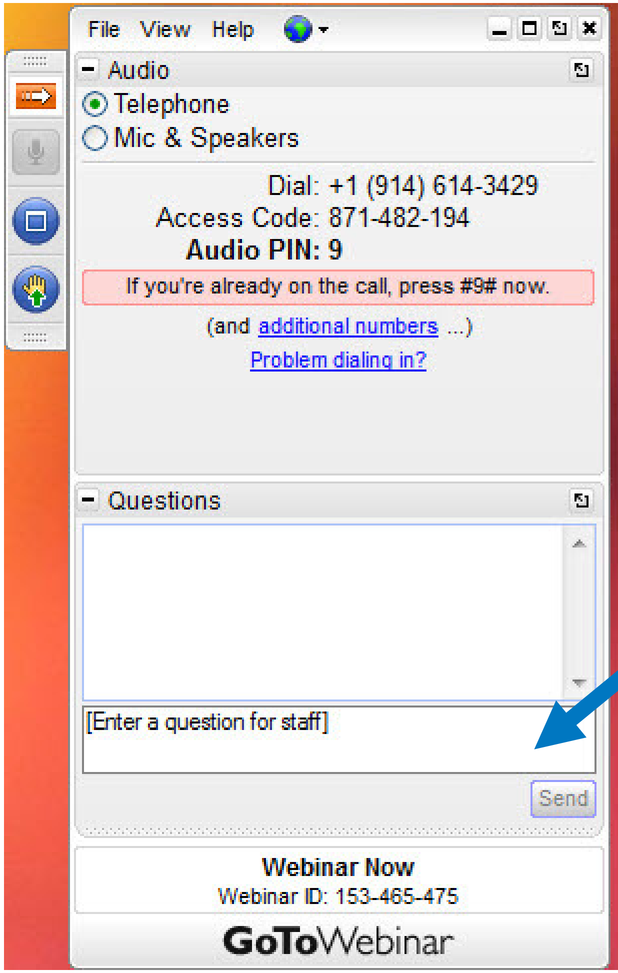
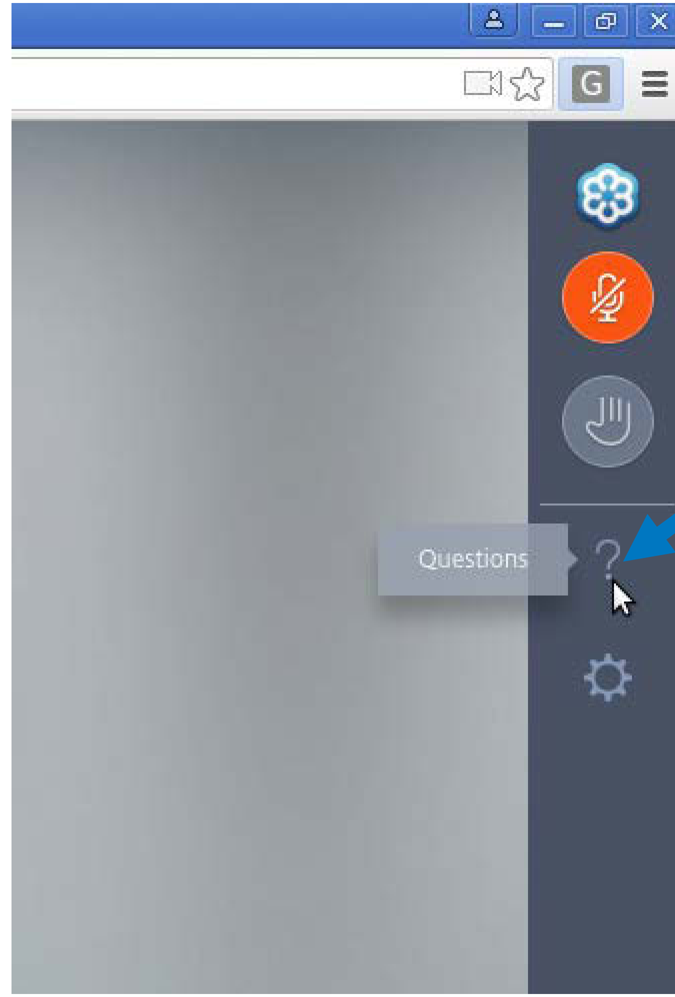


Desktop application



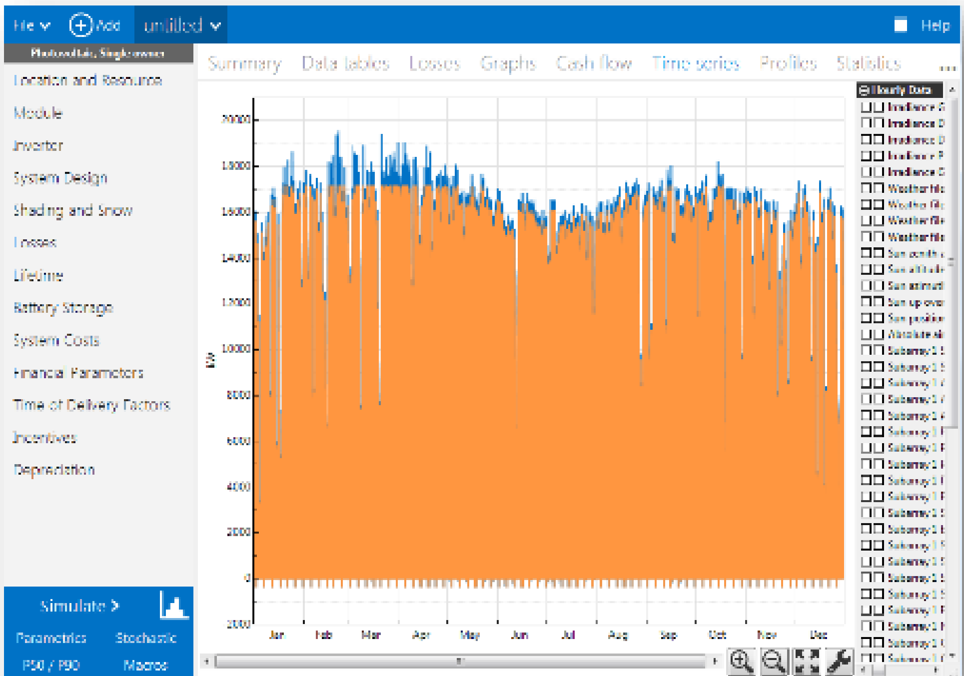
Instant Join Viewer

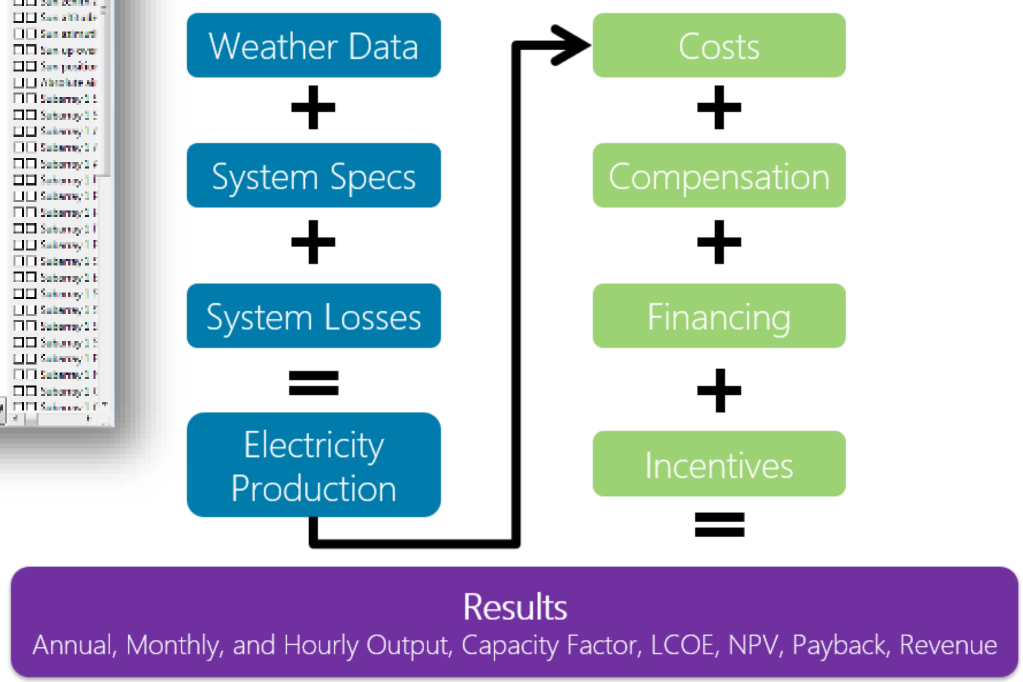
We will either type an answer to your question or answer it at the end of the presentation.

System Advisor Model (SAM)

System Advisor Model

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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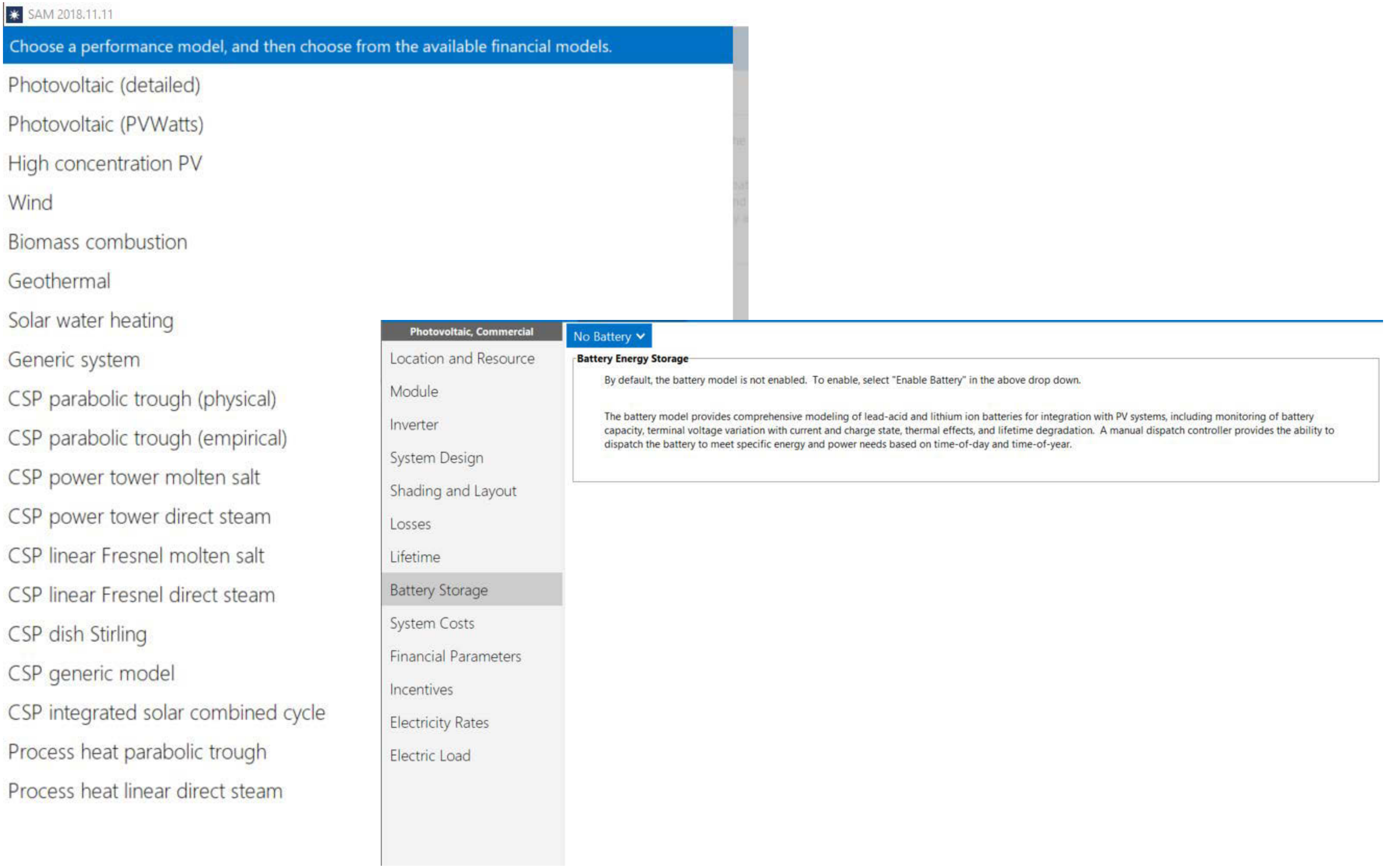
Webinar Outline

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

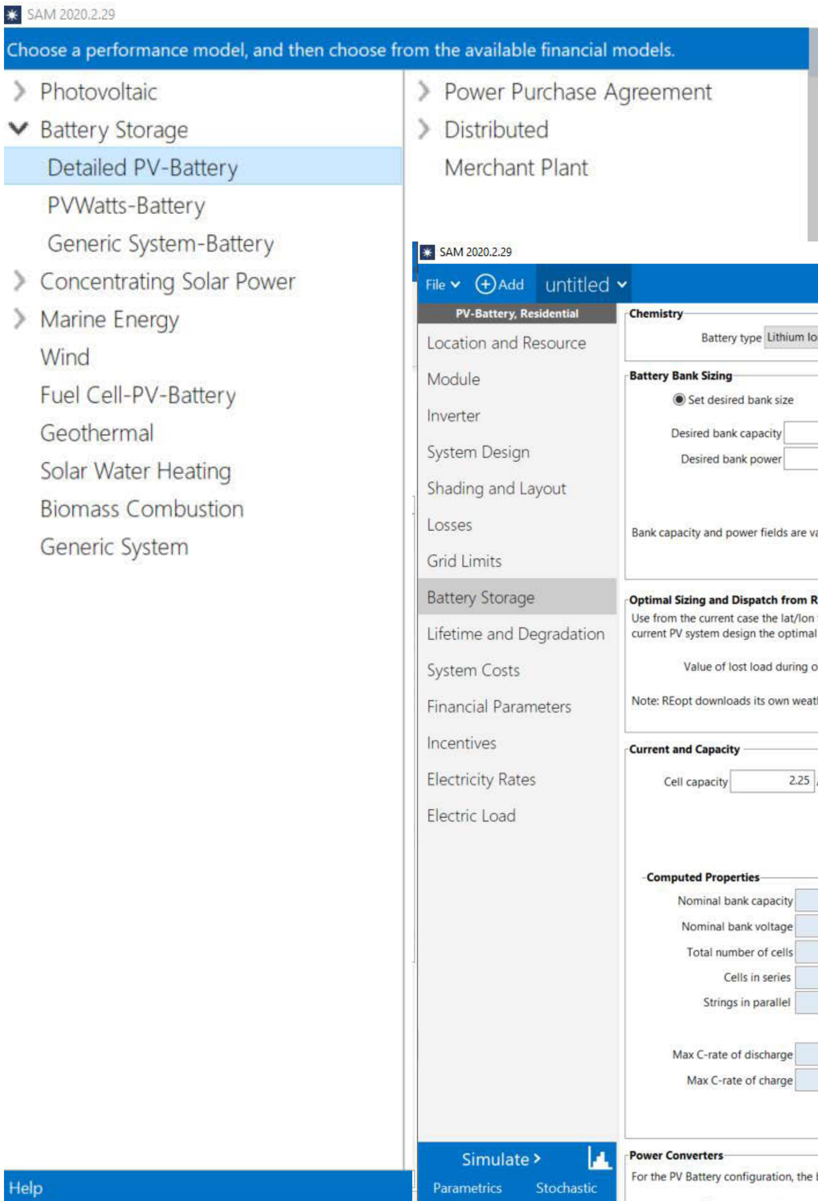
Batteries in SAM 2018.11.11

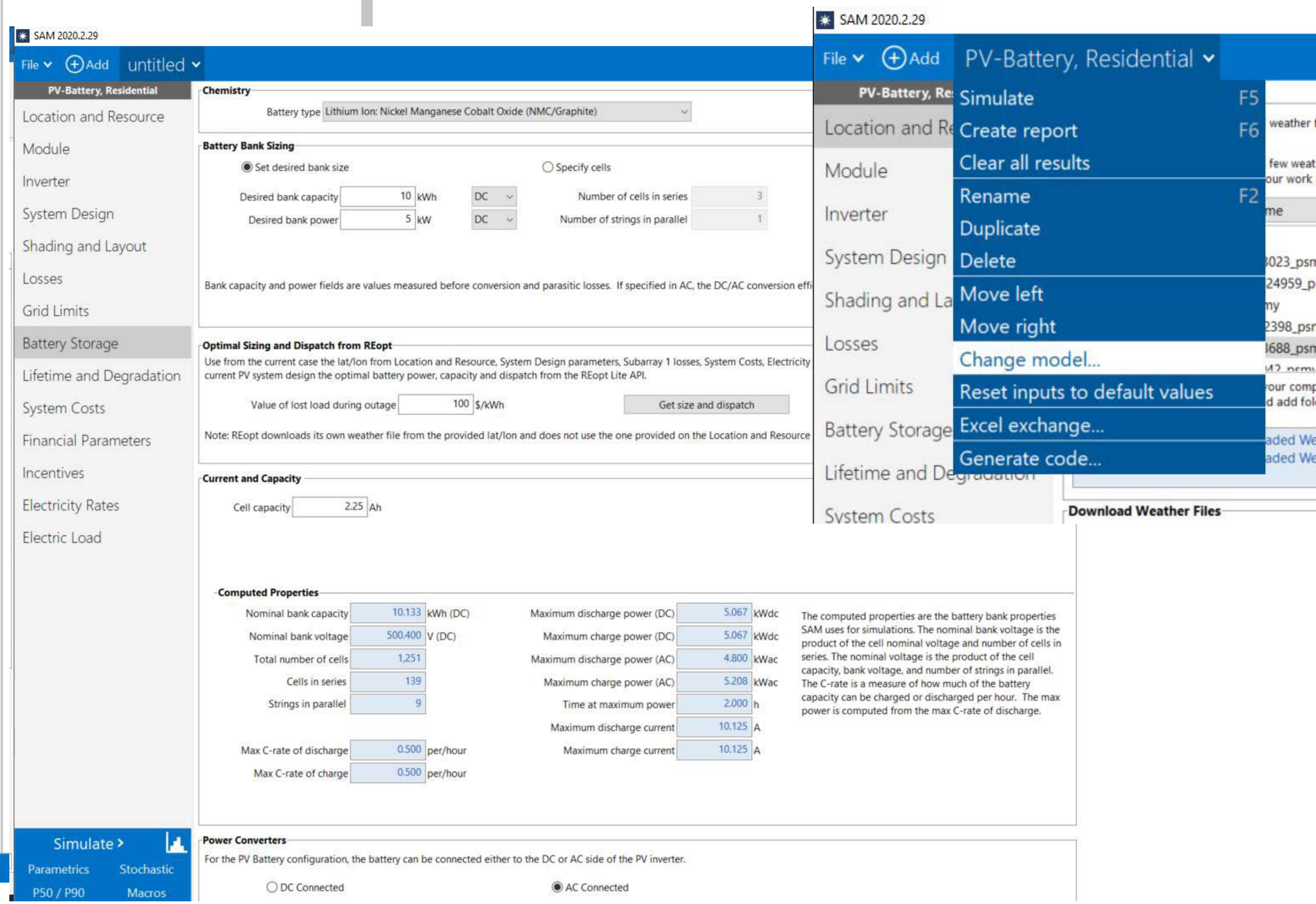
System Advisor Model



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

System Advisor Model

Storage Dispatch Controller

Dispatch Options

- ◯ Peak shaving one-day look ahead
- ◯ Peak shaving one-day look behind
- ◯ Input grid power targets
- ◯ Input battery power targets
- ◉ Manual dispatch

Monthly or Time Series Inputs for Grid Power Target Option

Monthly power targets

Monthly grid power targets [Edit values...] kWac

Time series grid power targets [Edit array...] kWac

Grid targets are maximum power values. SAM charges the battery when the electric load is less than the target in a given time step and discharges the battery when the load is greater than the target.

Charge Options

For manual dispatch, charge options are defined below by dispatch period.

- ☐ Battery can charge from grid
- ☑ Battery can charge from system

Time Series Inputs for Battery Power Target Option

Time series battery power targets [Edit array...] kWdc

Battery targets are maximum power values. Use negative target values to charge the battery and positive to discharge. SAM will attempt to meet the power target within constraints of the system's operational limits.

Manual Dispatch

	Charge from system	Charge from grid: Allow	Charge from grid: % capacity	Discharge: Allow	Discharge: % capacity
Period 1:	☑	☐	25	☐	25
Period 2:	☑	☐	25	☑	25
Period 3:	☐	☐	25	☑	25
Period 4:	☐	☐	25	☑	25
Period 5:	☐	☐	25	☐	25
Period 6:	☐	☐	25	☐	25

To enable manual dispatch, choose the Manual Dispatch option above. For each enabled charge or discharge period the "% capacity" is the percentage of available capacity in a given time step.

Use the Copy Schedules button to overwrite the weekday and weekend schedules with schedules from either 1) energy charge schedules from the Electricity Rates page for behind-the-meter applications, or 2) TOD PPA price multipliers on the Revenue or Financial Parameters page for front-of-meter applications.

[Copy Schedules from TOU/TOD Schedules]

Weekday

	12am	1am	2am	3am	4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm	9pm	10pm	11pm
Jan	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	1	1	1	1
Feb	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	1	1	1	1
Mar	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	1	1	1	1
Apr	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	1	1	1	1
May	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	4	4	4	4	4	1	1	1	1
Jun	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	4	4	4	4	4	1	1	1	1
Jul	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	4	4	4	4	4	1	1	1	1
Aug	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	4	4	4	4	4	1	1	1	1
Sep	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	4	4	4	4	4	1	1	1	1
Oct	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	4	4	4	4	4	1	1	1	1
Nov	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	1	1	1	1
Dec	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	1	1	1	1

Weekend

	12am	1am	2am	3am	4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm	9pm	10pm	11pm
Jan	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
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Jun	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
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Dec	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Behind The Meter Dispatch Modes

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

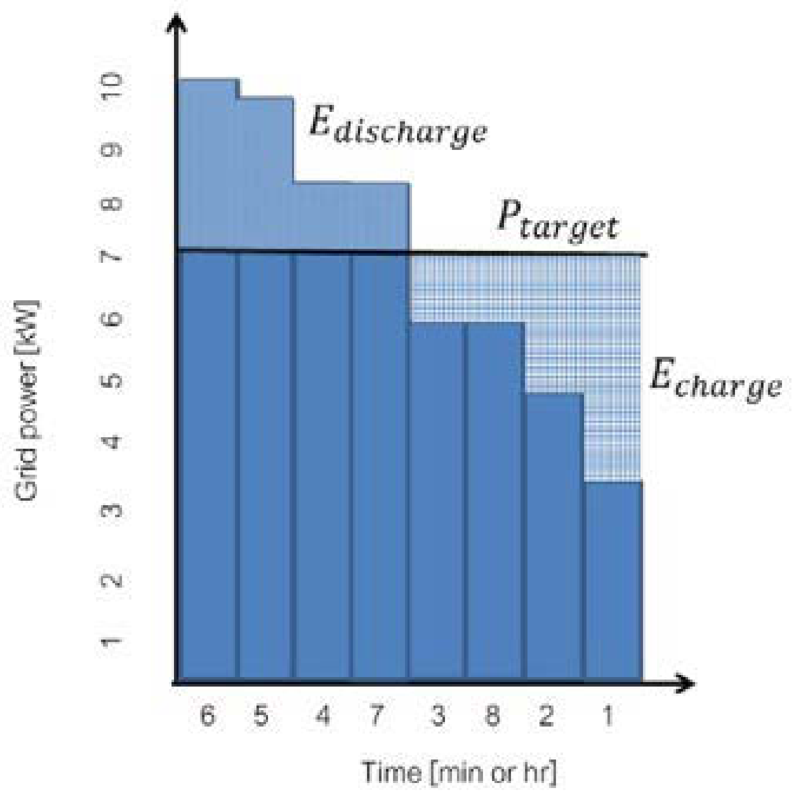
Goal: Demonstrate dispatch options suited to time of use rates for behind the meter storage connected to a PV system

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

NREL/PR-6A20-78282

This work was authored by the National Renewable Energy Laboratory, operated by Alliance for Sustainable Energy, LLC, for the U.S. Department of Energy (DOE) under Contract No. DE-AC36-08GO28308. Funding provided by the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy Solar Energy Technologies Office. The views expressed in the article do not necessarily represent the views of the DOE or the U.S. Government. The U.S. Government retains and the publisher, by accepting the article for publication, acknowledges that the U.S. Government retains a nonexclusive, paid-up, irrevocable, worldwide license to publish or reproduce the published form of this work, or allow others to do so, for U.S. Government purposes.

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