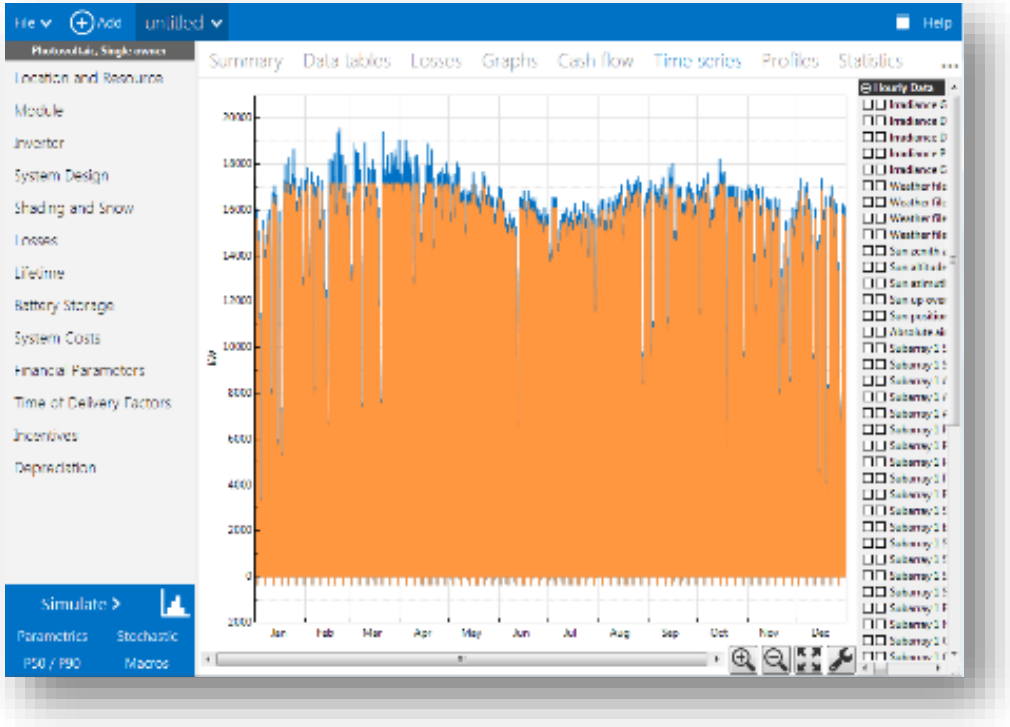
Heuristic Dispatch Based on Price Signals for Behind-the-Meter PV-Battery Systems in the System Advisor Model

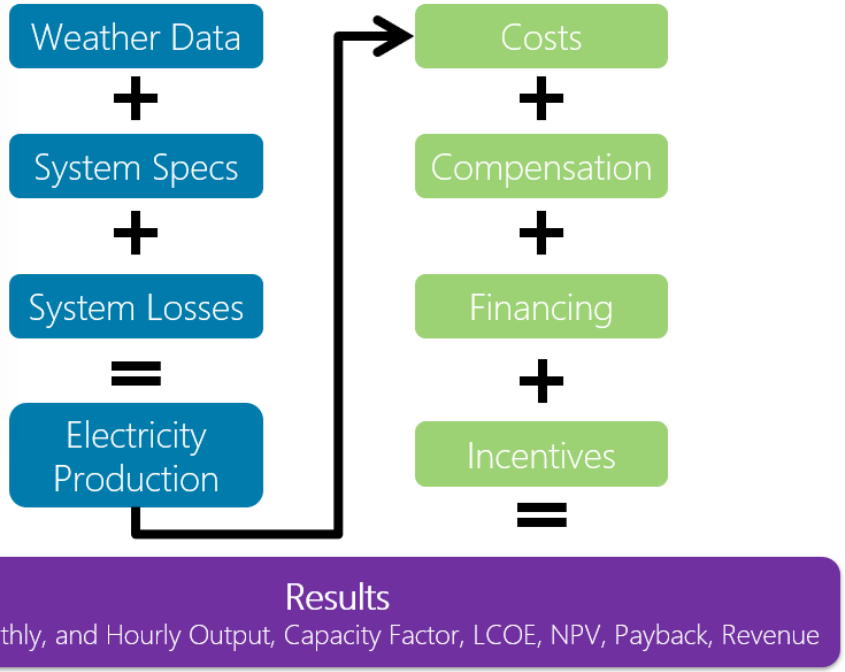
Brian Mirletz and Darice Guittet
June 23, 2021

IEEE Photovoltaic Specialists Conference 48
Miami-Fort Lauderdale, FL
6/20/2021 – 6/25/2021
NREL/PR-7A40-80293

System Advisor Model (SAM)

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





http://sam.nrel.gov/download

https://github.com/NREL/SAM

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
Price Signals Dispatch	Upcoming PV and Load forecast, utility rates	Mix of TOU charges and demand charges, battery degradation

Bold: defaults

Italics: Available in PVWatts-Battery model

Price Signals Dispatch Algorithm

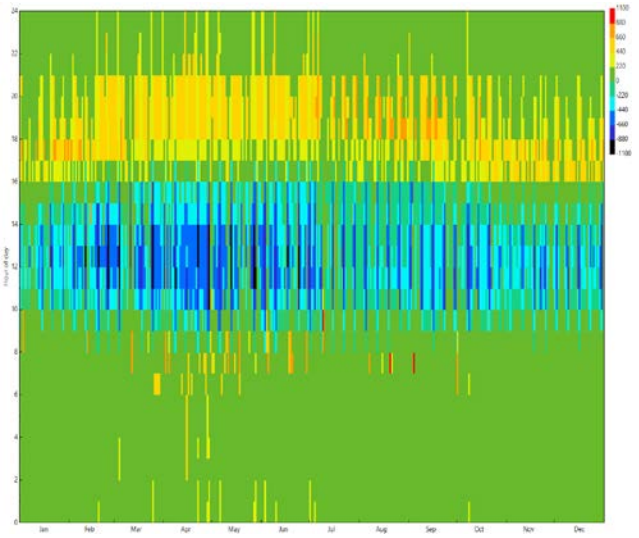
1. Forecast cost of utility bill without dispatch
2. Schedule discharge to the load for the highest cost periods according to: $P_{discharge,t} = \frac{E_{remaining,t} * C_t}{(\sum_{i=t}^{p} C_i) * dt}$
3. Schedule charging for the lowest marginal cost periods
4. Reduce discharging or charging based on expected SOC
5. Repeat 2-4 to generate plans with 0 to 12 hours of dispatch
6. Select lowest cost plan according to:

$$C_{total} = C_{utility\_bill} + C_{cycle} * n_{cycles} - E_{remaining} * C_{marginal}$$

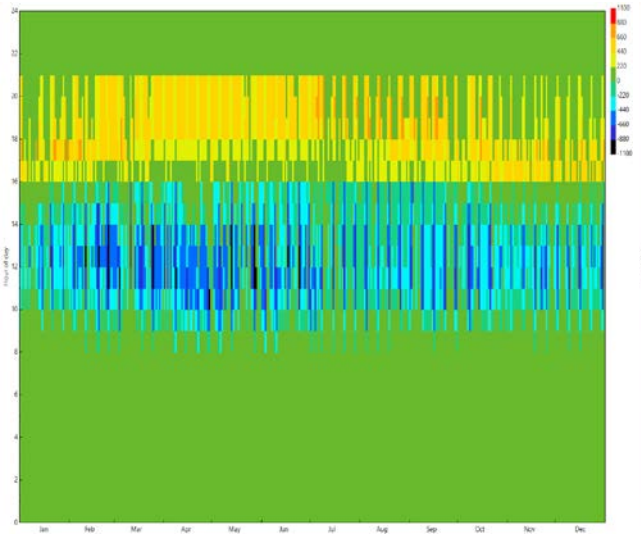
Case Study

- San Diego Hospital
- Utility rate includes TOU energy periods and demand charges
  - High cost energy is 4 pm to 9 pm
- PV + Battery System sized using REopt Lite
- Price signals dispatch achieved highest net present value, despite allowing higher demand charges

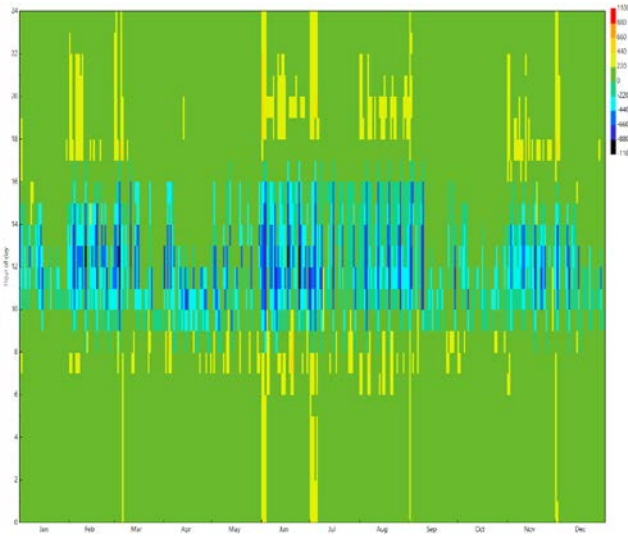
Price Signals Dispatch



Manual Dispatch



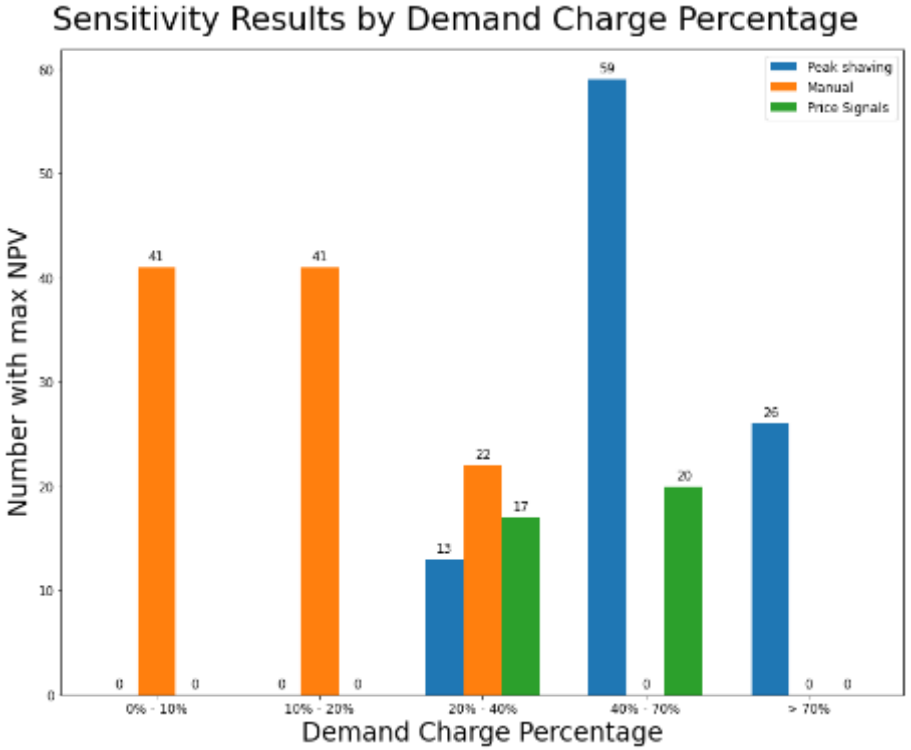
Peak Shaving Dispatch

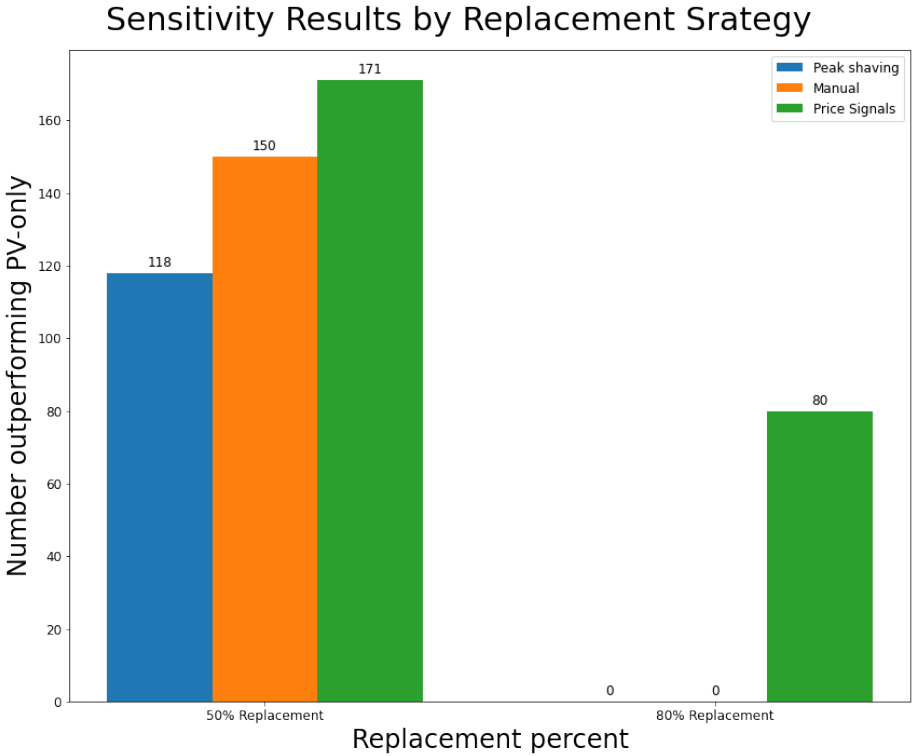


Sensitivity Analysis

Parameter	Min Value	Max Value
Max Energy Charge	$0.10/kWh	$0.50/kWh
Ratio of TOU Periods	1	10
Fixed Demand Charge	$0/kW	$59.05/kW
TOU Demand Charge	$0/kW	$13.45/kW

Sensitivity Analysis Results





Thank you!

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.

www.nrel.gov
http://sam.nrel.gov