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Motivation

Battery Energy Storage Systems (BESS) are increasing in popularity as more PV is connected to the grid and PV penetration levels increase. Rather than being constrained by irradiance, operators of PV + Storage (“PVS”) systems can dispatch energy at times when it is most economically favorable. First Solar has identified substantial cost and operational synergies from combining these assets and has pioneered a procurement framework for PVS to support utilities with publishing RFPs. Several utilities have adopted this framework and First Solar has successfully transacted around it. The PlantPredict PVS modeling capability shown here corresponds to that framework, allowing bidders to use PlantPredict to prepare their offer based on the energy off-taker’s inputs.

The screenshot shows the 'Energy Storage System' configuration page. It includes sections for 'Energy Capacity' (Nameplate, Factor, Usable), 'Dispatch Algorithm' (Interconnect Excess, Energy Available, Custom 8760), and a 'Target Period Table' for selecting discharge hours. The table shows months from January to December and hours from 0 to 23, with blue cells indicating selected discharge hours.

Users have the flexibility to decide how to charge and discharge the BESS. Charging schedules include the: (1) “Interconnect Excess” algorithm where the system sends any PV power that would have been clipped at the interconnect into the BESS and (2) “Energy Available” algorithm which sends any available PV energy to the BESS when the battery is not filled to capacity. The Target Period Table allows users to define when energy is most valuable and should be discharged. A “custom” importable .csv is also planned to allow users to define more advanced charging and discharging schedules.

This screenshot shows the detailed configuration for the Energy Storage System. It includes settings for Energy Capacity (Nameplate, Factor, Usable), DC Roundtrip Efficiency (Initial, Calendar, Cycling), Inverter (Real Power, Efficiency), MV Transformer (Power Rating, No Load Loss, Full Load Loss), and HVAC Losses (No Load Loss, Full Load Loss). A system diagram on the right shows the connection between PV Blocks & Arrays, Energy Storage, and the System.

Users start by defining their physical system, including energy capacity (which dictates how much energy the batteries can hold) and inverter capacity (which dictates how much power the system can charge or discharge at once), among other inputs.

PlantPredict Integration

PlantPredict, the most sophisticated and easy-to-use software for modeling utility-scale PV energy production, was a natural selection for incorporating AC-coupled storage modeling. With the release of this powerful new feature, users will be able to:

- Specify DC batteries, alongside inverter and MV transformers to build their PVS system
- Select from two charging algorithms: LGIA Excess and Energy Available
- Define discharge hours where energy is of highest value from a 12x24 selectable table
- Review energy output from the PV system, the Storage system and the combined PVS system in both time series and 12x24 format with target period hours highlighted
- Export detailed nodal data to support engineering and/or more complex analyses

Development for this feature is underway with release **scheduled June 2018!**

Months	Hours	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
January		0	0	0	0	0	0	0	0	4.67	4.67	4.67	4.67	4.67	4.67	4.67	4.67	4.67	0	0	0	0	0	0	0
February		0	0	0	0	0	0	0	0.24	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	0.24	0.04	0	0	0	0	0
March		0	0	0	0	0	0	0	1.48	4.81	4.81	4.81	4.81	4.81	4.81	4.81	4.81	4.81	1.48	1.48	0	0	0	0	0
April		0	0	0	0	0	0	0	1.61	4.85	4.85	4.85	4.85	4.85	4.85	4.85	4.85	1.61	1.61	0	0	0	0	0	0
May		0	0	0	0	0	0	0.03	1.58	4.61	4.61	4.61	4.61	4.61	4.61	4.61	4.61	1.58	1.58	0.03	0	0	0	0	0
June		0	0	0	0	0	0	0.03	0.86	3.93	3.93	3.93	3.93	3.93	3.93	3.93	3.93	0.86	0.86	0.03	0	0	0	0	0
July		0	0	0	0	0	0	0.01	0.78	2.95	2.95	2.95	2.95	2.95	2.95	2.95	2.95	0.78	0.78	0.01	0	0	0	0	0
August		0	0	0	0	0	0	0	1.04	2.98	2.98	2.98	2.98	2.98	2.98	2.98	2.98	1.04	1.04	0	0	0	0	0	0
September		0	0	0	0	0	0	0	2.13	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	2.13	2.13	0	0	0	0	0	0
October		0	0	0	0	0	0	0	2.64	2.36	2.36	2.36	2.36	2.36	2.36	2.36	2.36	2.64	2.64	0	0	0	0	0	0
November		0	0	0	0	0	0	0	1.66	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	1.66	1.66	0	0	0	0	0	0
December		0	0	0	0	0	0	0	0.02	2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01	0.02	0.02	0	0	0	0	0	0

A 12x24 summary of energy production is available for review along with a full time-series graph to help users understand how integrating storage with their PV system affects energy production.

Open Access to PlantPredict’s Storage Modeling

PlantPredict licenses are currently offered on a complimentary basis. To request a free license, e-mail support@plantpredict.com or fill out the Contact Us form at www.plantpredict.com.

For more information about PlantPredict, please review some of our other resources:

- www.plantpredict.com (for models & algorithms, user guide, upcoming events and release notes)
- <https://www.linkedin.com/showcase/plantpredict/>
- <https://vimeo.com/plantpredict>

