Modeling Hybrid Power Systems in SAM

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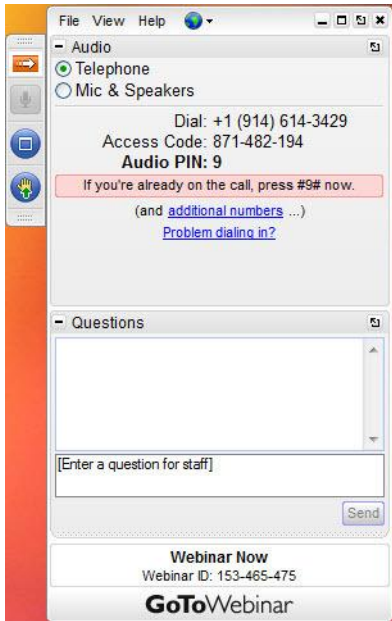August 27, 2024

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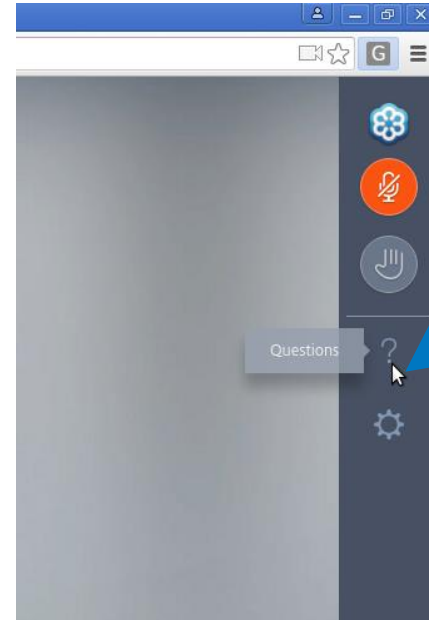
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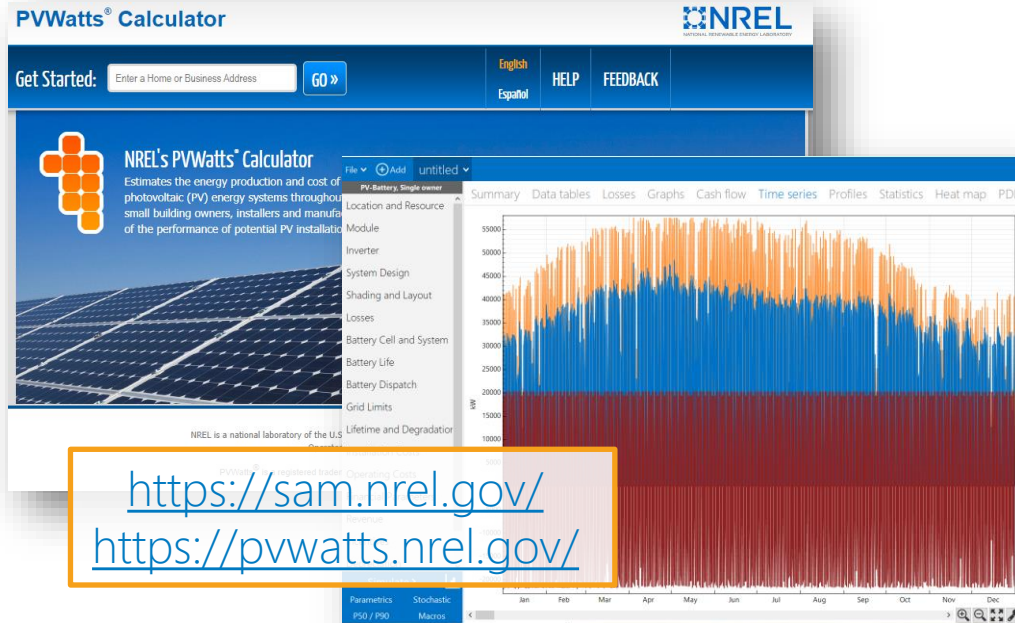
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Desktop application

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) & PVWatts

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

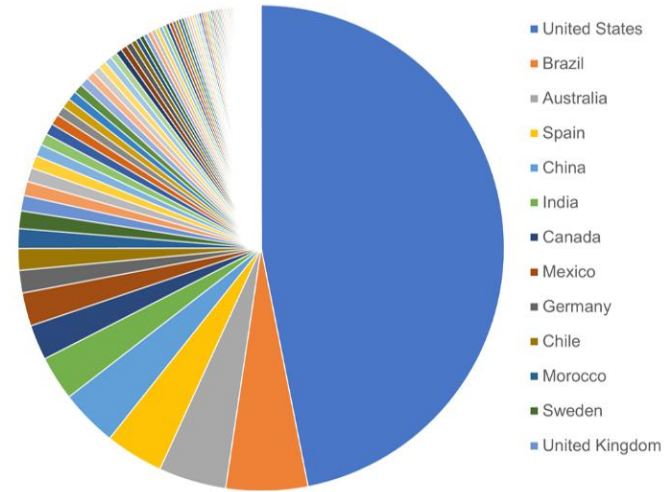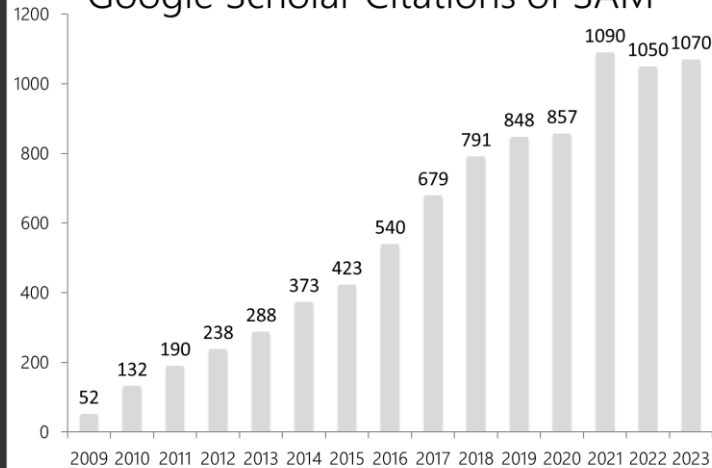https://sam.nrel.gov/
https://pvwatts.nrel.gov/

- ✓ Desktop application
- ✓ PVWatts web tool & API
- ✓ Software development kit
- ✓ PySAM Python package
- ✓ Open source code
- ✓ Extensive documentation
- ✓ User support

SAM Users

SAM is started **once every 1.4 minutes**

PVWatts receives over **17.5 million hits per month**

Over **150,000** users in 190+ countries

120+ webinars with **over 280,000 views**

Users include Sunrun, Enphase, AEP, Southern Company, EPRI, & more

Google Scholar Citations of SAM

Legend: United States, Brazil, Australia, Spain, China, India, Canada, Mexico, Germany, Chile, Morocco, Sweden, United Kingdom

What are hybrids in SAM?

More than one type of power generating technology in a single grid-connected plant, optionally coupled with storage

Why Add Hybrids?

- Previously possible to add cases together or to script adding different technologies

- Disadvantages of the previous method:
  - Clunky
  - Not easy to use parametrics

- As hybrids become more common, there are advantages to a better user interface:
  - Analyze the financials of a hybrid system as a whole
  - Easily vary subsystem sizes or technologies
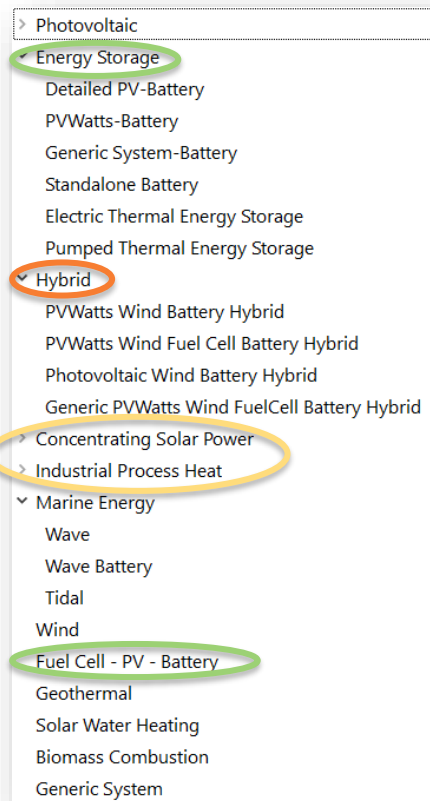 - Seamlessly use parametrics

Current Technology Combinations

- ➢ PVWatts, Wind Power, Battery Storage
- ➢ PVWatts, Wind Power, Fuel Cell, Battery Storage
- ➢ Detailed PV, Wind Power, Battery Storage
- ➢ Generic System, PVWatts, Wind Power, Fuel Cell, Battery Storage

Can I model just PV + Battery? Or X + battery?
Yes! In SAM, a single power generating technology paired with storage are either categorized under "Energy Storage" or paired with the power generating technology (especially true for thermal storage). The generic system – battery configuration can be used for technologies that aren't explicitly coupled.

Note that we refer to an individual technology (e.g. just the wind part of the system) as a "subsystem"

> Photovoltaic
> Energy Storage
>   Detailed PV-Battery
>   PVWatts-Battery
>   Generic System-Battery
>   Standalone Battery
>   Electric Thermal Energy Storage
>   Pumped Thermal Energy Storage
> Hybrid
>   PVWatts Wind Battery Hybrid
>   PVWatts Wind Fuel Cell Battery Hybrid
>   Photovoltaic Wind Battery Hybrid
>   Generic PVWatts Wind FuelCell Battery Hybrid
> Concentrating Solar Power
> Industrial Process Heat
> Marine Energy
>   Wave
>   Wave Battery
>   Tidal
>   Wind
>   Fuel Cell - PV - Battery
>   Geothermal
>   Solar Water Heating
>   Biomass Combustion
>   Generic System

What kinds of questions can you answer?

- What kind of hybrid system can I design for 24/7 carbon-free energy for an industrial electricity client?

- How can I add PV to my existing wind plant to maximize my interconnection agreement?

- How can I take advantage of complementary wind and solar resource profiles at my location?

- How can I use wind and solar to complement my *(fill in the blank)* generation (using the generic system model)?

    ...and more!

Availability

- Available as of **SAM Version 2023.12.17**

- Jointly funded by Southern Company and the DOE Solar Energy Technologies Office (SETO)

- Available with Single Owner financial model (front-of-meter) or Third Party Host/Developer (behind-the-meter)

- Also available in the NREL-PySAM python package
  https://sam.nrel.gov/software-development-kit-sdk/pysam.html

Assumptions

Differentiated per subsystem:

- Resource location*
- Subsystem specifications
- Subsystem installation costs
- Subsystem O&M costs

Applied to the entire system:

- Hybrid system installation and O&M costs
- Interconnection limit and curtailment
- Financial parameters
- Revenue
- Incentives and depreciation
- Electricity rates and load

These assumptions best represent a physically co-located system, if one sets resource location to be the same for all subsystems

Installation and O&M Costs

New user interface page represents installation or O&M costs that are shared by the entire hybrid system:

Users should evaluate which costs are applicable to the entire system and which are subsystem-specific, and adjust cost inputs accordingly

Live Demo

Photo from iStock-627281636

Feedback, Help, and Feature Requests

We love to hear from users!

Learn about SAM on YouTube (where we post our webinars!)
https://www.youtube.com/channel/UC_Z7m8z5tOclfNgaTfGDdPQ

Get help, report bugs, request new features, or discuss how you're using SAM! Visit our user support forum:
https://sam.nrel.gov/forum.html

If you're comfortable with Github, we also track bugs, feature requests, and development progress on our repositories:

https://github.com/NREL/SAM/wiki

And there's a lot more great content on our website!
https://sam.nrel.gov/

Thank you! Questions?

https://sam.nrel.gov/
SAM support email:
sam.support@nrel.gov