



National Laboratory
of the Rockies

System Advisor Model: Open-Source Benefits and Opportunities

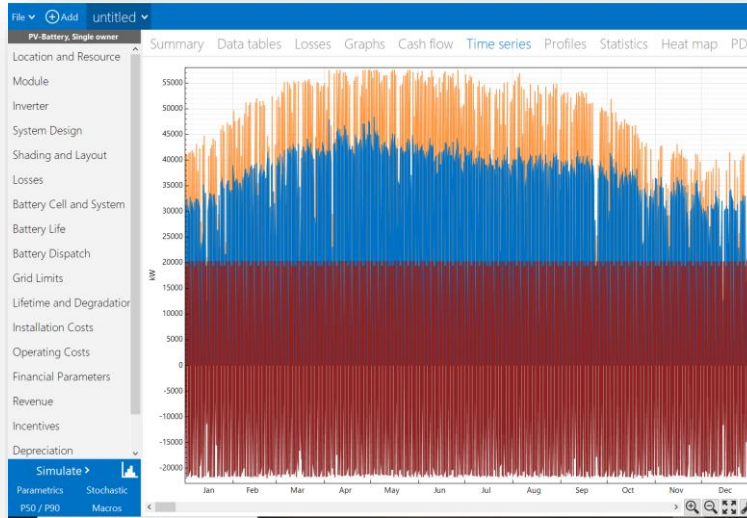
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National Laboratory of the Rockies
8/2/2026



System
Advisor
Model

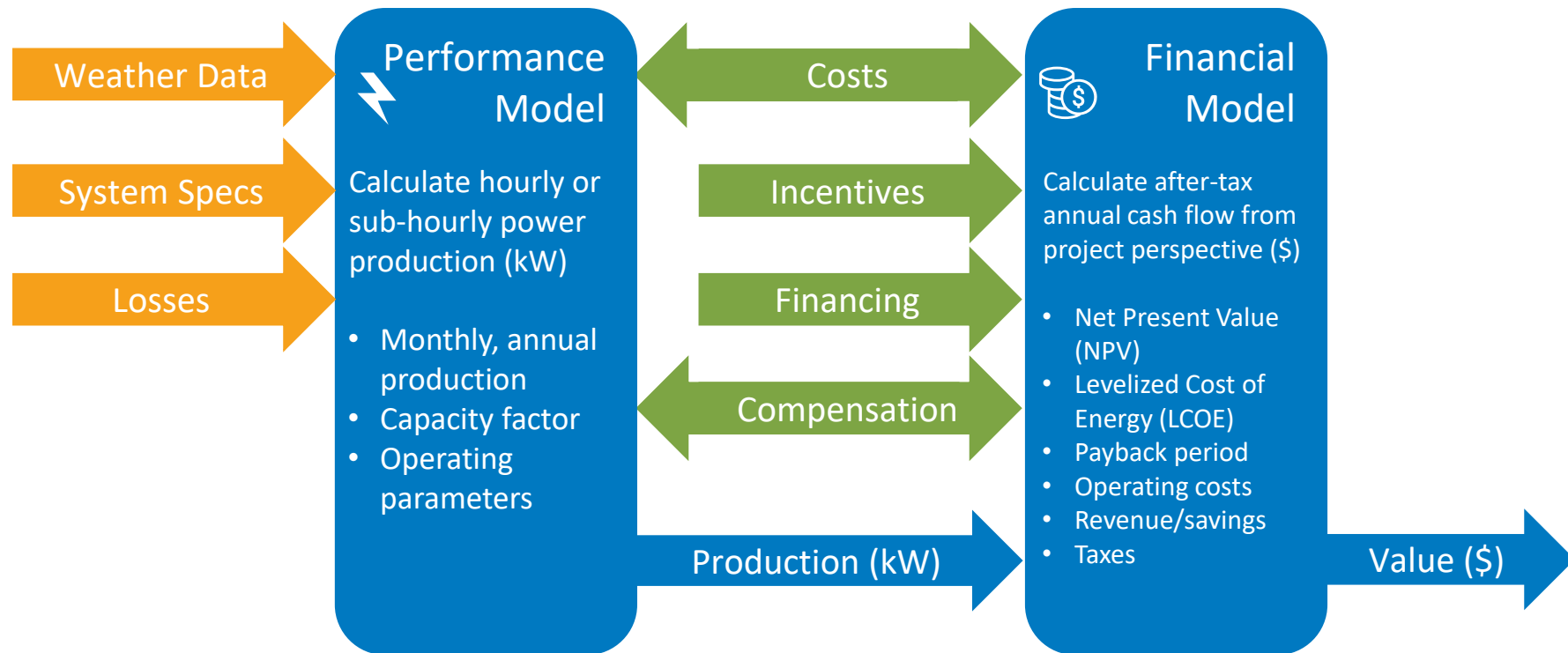
System Advisor Model™ (SAM)

Free software that enables detailed performance and financial analysis for a variety of energy system types and markets



- ✓ Desktop tool for Windows, Mac, and Linux
- ✓ Software development kit
- ✓ PySAM Python package
- ✓ Open-source code
- ✓ Extensive documentation
- ✓ User support
- ✓ Updated annually with new capabilities
- ✓ Access [SAM](#) today

Model Structure



History

Development began in 2004 by...

- U.S. Department of Energy (DOE)
- National Laboratory of the Rockies
- Sandia National Laboratories.

With the vision of...

- Allowing DOE to identify the strongest R&D opportunities based on analysis of the entire system, including costs
- Modeling different types of renewable energy projects in a single third-party, validated, and impartial platform
- Facilitating technology comparison by handling performance, costs, and financing consistently across technologies.



System
Advisor
Model



U.S. DEPARTMENT
of **ENERGY**



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Sandia
National
Laboratories



Image by NLR, 065134

Technologies

- Energy storage
 - Electric battery
 - Electric thermal storage
 - Pumped thermal
- Concentrating solar power
- Photovoltaic
- Industrial process heat
- Marine energy
- Wind power
- Fuel cell
- Geothermal power
- Solar water heating
- Biomass combustion
- Generic system

PLUS: HYBRID SYSTEMS that combine multiple generation and storage types

Financial Models

- Power purchase agreements
 - Single owner
 - Partnership flips
 - Sale leaseback
- Residential
- Commercial
- Third-party ownership
- Merchant plant
- Community solar
- Simple LCOE calculator

SAM Users

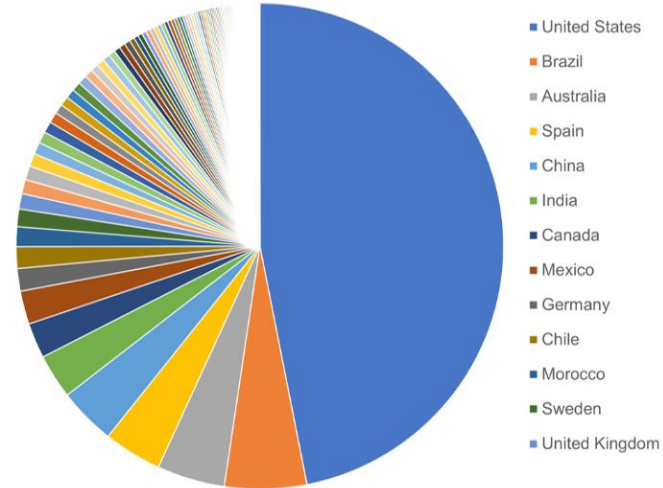
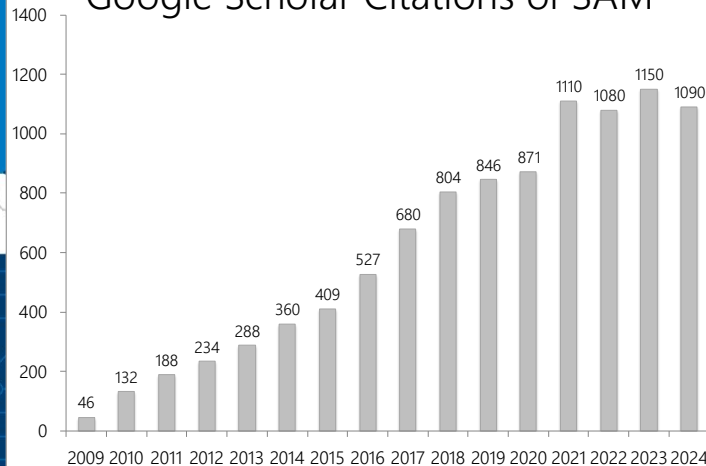


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SAM is started **once every 1.4 minutes**
PVWatts receives over **20 million hits per month**
Over **280,000** users in 190+ countries
140+ webinars and videos with **over 600,000 views**

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

Google Scholar Citations of SAM

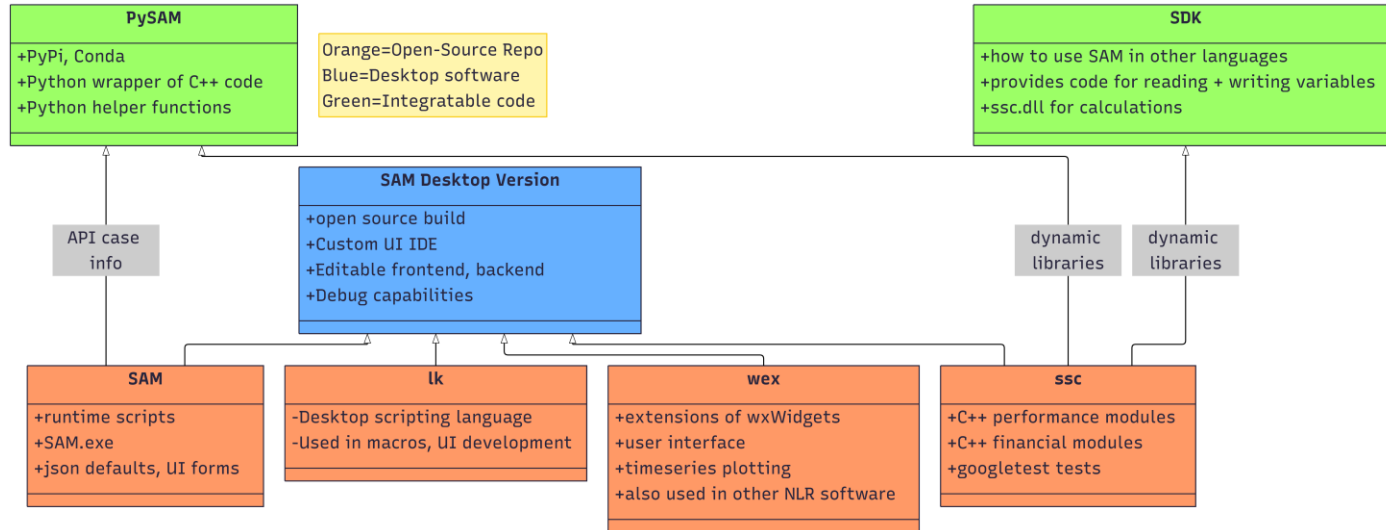


Who Uses SAM? Why?

- **Lawmakers and Utilities**
 - ... to study how a policy would affect the economics of a typical system
 - ... to analyze different types of utility rate structures for renewables
- **Developers and Engineers**
 - ... to compare technologies, sites, or configurations
 - ... to estimate the Levelized Cost of Energy for a system
- **Researchers**
 - ... to examine how an innovative concept might be able to lower the Levelized Cost of Energy
 - ... to estimate the technical potential of a technology in a region
- **Students**
 - ... to learn about renewable energy
 - ... to explore financing structures for renewable energy

Open Source Code

- The full SAM build consists of 4 open-source GitHub repositories, plus an additional repo for the PySAM Python wrapper. This maximizes code reusability, allowing core algorithms to be used externally (Python, SDK) without the GUI



<https://sam.nlr.gov/sam-open-source.html>

Open-Source Users

- Open-source users:
 - ✓ Other NLR teams
 - ✓ Sandia National Laboratories
 - ✓ Cypress Creek Renewables
 - ✓ Envision Digital
 - ✓ OpenInvest
 - ✓ Passivenous Consulting
 - ✓ Southern Company
 - ✓ Solesca
- Success stories for open-source:
 - ✓ Mermoud/Lejeune module model
 - ✓ Slope-aware backtracking algorithm
 - ✓ Chemistry specific battery degradation algorithms
 - ✓ Updates to utility rates interface to account for more detailed rules of local jurisdiction

Challenges and Opportunities

Challenges

- C++ offers speed, but smaller pool of developers
- Graphical User Interface brings in more no-code users, but adds layer of complexity to OS contributions; core team has often added user interface layer to other contributions

Opportunities

- Help documentation system has recently been open-sourced; users can now contribute by editing simple RST files *without needing to build the entire software package*
- CEC Module and Inverter Library generation: Python scripts are used to generate list from raw CEC data, these lists are frequently referenced by SAM, pvlib, etc.

Contribution Pathways

No Code

- File issue request on GitHub
- Request features on GitHub for our wishlist
- Participate in discussion on our User Forum

Some code

- Contribute help documentation by editing RST files
- Contribute helper functions or example files written in Python for PySAM
- Write a small PV sub-model in C++ with assistance from the SAM team

Expert coding

- Contribute a large performance model addition or enhancement in C++
- Update the GUI for any corresponding ssc changes

Partnership Opportunities

- Work with the SAM team to directly fund SAM integrations, enhancements, or analyses in collaborative research agreements
- Deliverables are negotiated to fit business needs
- Drive innovation while benefitting the broader energy community

Thank you! Questions?

Janine Keith – project lead, photovoltaic and wind models

Brian Mirletz – project lead, software, battery models

Matt Prilliman – photovoltaic, geothermal, and marine energy models

Darice Guittet – software development, battery models

Steve Janzou – programming, utility rates, financials (subcontractor)

Paul Gilman – user support and documentation (subcontractor)

Ty Neises, William Hamilton, and Taylor Brown – concentrating solar power models



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This work was authored by the National Laboratory of the Rockies for the U.S. Department of Energy (DOE), operated under Contract No. DE-AC36-08GO28308. Funding provided by U.S. Department of Energy Office of Critical Minerals and Energy Innovation Integrated Energy Strategies 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.