NREL
NATIONAL RENEWABLE ENERGY LABORATORY

NREL's System Advisor Model Simplifies Complex Energy Analysis

The energy market is diversifying. In addition to fossil fuel-based power, decision makers can choose among solar, wind, and geothermal technologies as well. Each of these technologies has complex performance characteristics and economics that vary with location and other project specifics. That complex analysis about technology viability is easier now, thanks to the National Renewable Energy Laboratory (NREL).

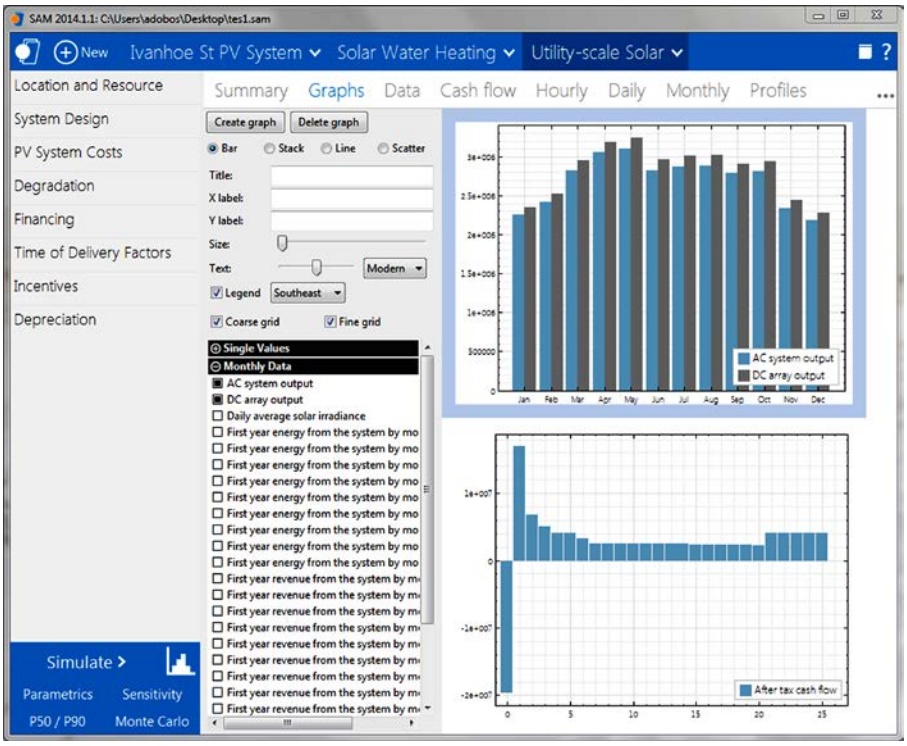
NREL has developed a tool—the System Advisor Model (SAM)—that can help decision makers analyze cost, performance, and financing of any size grid-connected solar, wind, or geothermal power project. Manufacturers, engineering and consulting firms, research and development firms, utilities, developers, venture capital firms, and international organizations use SAM for end-to-end analysis that helps determine whether and how to make investments in renewable energy projects.

SAM grew from a collaborative, five-year effort led by NREL in partnership with the U.S. Department of Energy; Sandia National Laboratories; the University of Wisconsin, Madison; and others. To build the model, the SAM team refined existing performance and financial models and combined them with new ones to create the powerful yet user-friendly modeling platform. Several key capabilities in SAM had not been available before.

Initially launched as the Solar Advisor Model, the unbiased analysis provided by SAM proved so popular that the tool was expanded to address additional renewable energy technologies.

SAM can now model the gamut of solar electric technologies, including both photovoltaic solar modules and concentrating solar power technologies, which include parabolic troughs, solar power towers, linear Fresnel concentrators, and dish-Stirling systems. SAM even calculates the value of saved energy from a domestic solar water heating system. In addition, SAM can model grid-connected small wind and geothermal projects.

Due to these extensive capabilities, SAM has been downloaded more than 45,000 times worldwide since its debut in 2006.



SAM's user-friendly interface is designed to help guide decision makers through the steps of analyzing the energy outputs and economics of a solar, wind, or geothermal project.

How SAM Works

SAM is a free, user-friendly, thorough, and extremely fast software tool that allows decisions about renewable energy projects to be made more quickly and more soundly. It starts with information about weather at the project site and calculates the hourly, monthly, and annual electrical output of a proposed energy system. Built-in financial models then calculate a project's cash flow over a multi-year analysis period. SAM even incorporates the effects of state and federal incentives—one of the only energy modeling tools to do so.

SAM has several advanced analysis capabilities that allow users to quickly see how variations in technology parameters, finance options, and

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performance affect project outcomes across residential, building, and utility-scale markets. Uncertainty and sensitivity analysis options along with advanced scripting capabilities further enhance the usefulness of the tool.

A Powerful Tool for All Types of Users

For people new to renewable energy technologies or to computer modeling, SAM offers technology- and market-appropriate default values for every entry box, which makes it easier to get started using the software. For more experienced modelers, SAM allows detailed inputs and advanced capabilities to explore the intricacies of system design or project financing.

Running SAM generates standard or user-customized summary graphs that can demonstrate the economics of the project. In addition, the software provides direct access to hundreds of calculated outputs for each technology that can provide insight into how a system is actually operating.

By combining renewable energy technology parameters with financial analyses, SAM helps installers, financiers, and developers predict the economic feasibility of proposed projects. More importantly, SAM makes it possible for these groups to work with the same data.

In addition to the Windows and Mac OS X desktop software, the SAM project provides a software development kit (SDK) that gives anyone direct access to the underlying engineering and economic calculations. Large solar companies have successfully integrated the SAM engine into their custom workflows, thereby reducing development time and cost. More importantly, users of the SAM SDK take advantage of NREL's wide-ranging expertise in renewables modeling and can trust the results.

Looking Ahead

The potential for renewable energy development is strong. Utilities are expanding their renewable energy portfolios. To meet these demands, the market for solar, wind, and geothermal energy is expected to grow more than 10% per year for the next two decades. With SAM's help, the energy community can continue to analyze the potential of renewable technology and make educated technology and investment decisions.

For more information on SAM, to download the desktop software or SDK, or get help using the software, access the SAM website at *https://sam.nrel.gov*.

Some Typical Uses of SAM

- Installers use SAM to determine the effects of orientation and tilt on rooftop solar arrays in their city.
- Developers use SAM's hour-by-hour weather files to determine if a concentrating solar power project makes financial sense for a specific location and electricity rate structure.
- Developers use SAM analyses to show bankers that their project is comparable to projects that have proven to be sound investments.
- Manufacturers show SAM-generated graphs to potential lenders to demonstrate their understanding of the main cost drivers of their renewable energy technology.
- R&D companies use SAM to analyze the performance benefits versus the financial costs of improving various system components.
- Project managers at the U.S. Department of Energy use SAM to evaluate the effect of their wind energy research investments on the cost of the technologies. They also use it to analyze applications for loan guarantees and to carry out feasibility studies.
- Utilities and federal energy managers use SAM for feasibility studies.
- Software developers use SAM's software development kit (SDK) to integrate parts of SAM with their own models.
- Engineering due-diligence firms and utilities use SAM to check assumptions having to do with solar field conditions, as well as the projected hourly and annual energy generation of a proposed project.
- Construction contractors and plant owners use SAM as a tool for "acceptance testing" of concentrating solar power plants.

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