

The U.S. Department of Energy SunShot Initiative is a collaborative national effort to make solar energy technologies cost-competitive with traditional forms of energy by the end of the decade. Reducing the total installed cost for utility-scale solar electricity to roughly 6 cents per kilowatt hour without subsidies will result in rapid, large-scale adoption of solar electricity across the United States. Reaching this goal will re-establish American technological leadership, improve the nation's energy security, and strengthen U.S. economic competitiveness in the global clean energy race.



Rooftop arrays like this one are common in Hawaii. The Systems Integration subprogram is working to allow even higher penetrations of solar by incorporating solar generation forecasts into energy management systems. Photo Courtesy: Department of Energy

## Systems Integration

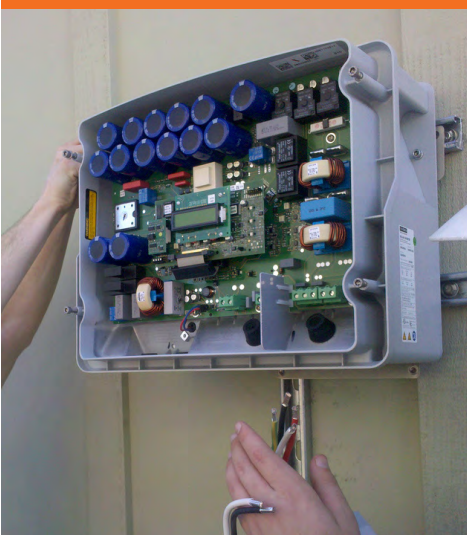
The SunShot Initiative's Systems Integration (SI) program enables the widespread deployment of safe, reliable, and cost-effective solar energy technologies by addressing the associated technical and non-technical challenges. These include timely and cost-effective interconnection procedures, optimal system planning, accurate prediction of solar resources, monitoring and control of solar power, maintaining grid reliability and stability, and many more. To address the challenges associated with interconnecting and integrating hundreds of gigawatts of solar power onto the electricity grid, the SI program funds research, development, and demonstration projects in four broad, interrelated focus areas: grid performance and reliability, dispatchability, power electronics, and communications.

### Grid Performance and Reliability

As solar electricity becomes an integral part of the electricity grid, it is imperative to maintain and enhance grid performance and reliability as hundreds of gigawatts of solar generation are deployed. The projects in this focus area are designed to study the feasibility of high-penetration PV scenarios under a wide range of system conditions through computer simulation and laboratory testing; to advance interconnection and performance codes and standards; to develop state-of-the-art grid modeling, simulation, and analysis tools for system planning and operation; and to integrate and validate hardware and software solutions in field demonstrations.

### Dispatchability

Solar power is only available while the sun is shining, thus creating intermittency, daily and seasonal variability, and uncertainty challenges. For sustainable integration of solar power onto the grid, it is imperative that solar power is available on-demand, in desired amounts, and in a manner that is comparable to or better than conventional power plants. Dispatchability projects aim to ensure that solar power plants based on PV and CSP technologies at both utility and distributed scales are capable of being controlled



SunShot is working to develop more efficient and reliable solar inverters that convert the variable direct current electricity from solar panels into alternating current electricity that can be used in your home. Photo Courtesy: Lauren Wellicome

and dispatched in such a manner. SunShot funds research to enhance the dispatchability of solar generation through integration with energy storage, load management, and accurate resource forecasting.

## Power Electronics

Power electronic devices are used to convert electricity from one form to another and deliver it from generation to end use. SunShot SI projects in this area develop solutions that build on transformative power electronic technologies to reduce conversion device cost, improve efficiency and reliability, and enhance power flow control. SunShot funds projects that reduce balance-of-system hardware costs, process costs, and installation time; improve efficiencies through innovative circuit design, advanced components, and optimal control; develop and demonstrate smart inverter functionalities through hardware-in-the-loop testing; develop accelerated life testing methods and physics of failure models to predict faults and improve reliability; and advance related codes and standards.

## Communications

In order to effectively and securely manage grid operations with high-penetrations of solar, advances in information, communications, and sensor technologies are needed to adequately monitor and control solar generators. Existing technologies will be leveraged and new tools are being developed for the collection, storage, visualization, and analysis of the growing amounts of data. Projects in the Communications area support the development of open and interoperable communication and control architectures; the advancement of communication network technologies that are fast response, scalable, highly available, and secure; the implementation



The Systems Integration subprogram works to ensure that higher penetrations of solar energy are capable of being handled by our nation's electric grid, so cleaner energy can reach your home.  
Photo Courtesy: Department of Energy

of standard communication protocols in hardware devices; and the development of enterprise integration platforms and standards. SunShot also supports the field demonstration and validation of end-to-end system integration, interoperability, and cybersecurity.

## Current Funding Programs

The SI program manages several funding programs, each of which addresses several of the aforementioned focus areas. Current active funding programs include:

- *Sustainable and Holistic Integration of Energy Storage and Solar PV (SHINES)* – this program develops and demonstrates integrated PV and energy storage solutions that are scalable, secure, reliable, and cost-effective. Projects work to dramatically increase solar-generated electricity that can be dispatched day or night to meet consumer electricity needs while ensuring the reliability of the nation's electricity grid.
- *Solar Utility Networks: Replicable Innovations in Solar Energy (SUNRISE)* – this program helps utilities develop adaptable and

replicable best practices, long-term strategic plans, and technical solutions to sustain reliable operations with large proportions of solar power on the grid.

- *SunShot National Laboratory Multiyear Partnership (SuNLaMP)* – this program supports SunShot's partnership with the national laboratories to conduct research and development that will enable hundreds of gigawatts of solar energy to be integrated onto the electricity grid.

## Funding Opportunities

For more information on open funding opportunities, visit the SunShot Initiative's financial opportunities webpage: [energy.gov/eere/sunshot/financial-opportunities](http://energy.gov/eere/sunshot/financial-opportunities).

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