U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

SOLAR ENERGY TECHNOLOGIES OFFICE FY 2018 BUDGET AT-A-GLANCE

The Solar Energy Technologies Office (SETO) sponsors the SunShot Initiative, a collaborative public-private partnership conducting early-stage research and development (R&D) nationwide, designed to drive down industry costs and make solar energy more widely available to Americans.

Economic Highlights

The solar industry is contributing to U.S. economic growth and is a major source of new jobs.

- The solar industry employs 266,000 American workers, having added nearly 1,000 new jobs every week in 2016.
- The U.S. solar industry is growing 17 times faster than the U.S. economy. In 2016, one in every 50 new U.S. jobs was created by the solar industry—representing 2% of all new jobs.

SunShot R&D investments contribute to industry cost declines while strengthening U.S. energy security and resilience.

- The SunShot Initiative provides industry with a clear, long-term focus on cost reduction, while supporting creative technology innovations beyond the time horizon of private financial instruments.
- Since SunShot's inception, the average price per kilowatt hour (kWh) of a utility-scale photovoltaic (PV) project has dropped from about $0.21 to $0.07. The U.S. has more than 42 gigawatts (GW) of solar installed across all 50 states, enough to power 8.3 million average-sized American homes.
- In 2016, the U.S. solar industry, valued at $23 billion, installed 15 GW of solar power, twice the installations of 2015.

FY 2018 Priorities

FY 2018 Program Focus

R&D targets SunShot 2030 goals to–

- Achieve $0.03/kWh for electricity from utility-scale PV, and $0.05/kWh from concentrating solar power (CSP) with thermal energy storage.
- Address grid integration challenges and other identified barriers to scale.

FY 2018 funds will support activities that–

- Drive progress in efficiency, long-term reliability, and performance prediction,
- Enable the secure integration of solar power into the nation's electric grid system.
- Advance DOE's Grid Modernization Initiative (GMI) to optimize infrastructure utilization and consumer choices.

Activity Highlights

- High Performance PV Materials – Research and validation of advanced materials and devices to improve performance, reduce costs, establish refined modelling, and improve efficiency and durability.
- Grid Integration of Solar Power – Research on solar power system deployment, including two-way power flows, voltage and frequency controls, reliability and operations science, and cyber security to support SunShot's goal of seamless networking of diverse, distributed generation. Solar studies will link grid, loads, and storage with power system planning and operation, sensors and feedback control loops, communication integrity, and data analytics.
- Next Generation CSP Thermal Energy Storage Systems – Research innovative high-temperature components for next-generation systems to supply electricity at any time of day. Investigate advanced heat exchangers unique to U.S. manufacturing and new concepts for collecting and harvesting light cost efficiently.
- Techno-Economic Analysis – Create and validate modeling instruments to grow beyond levelized cost of energy reference cases to establish the value of solar forecasted generation, storage, and dispatchable load technologies.

FY 2018 Budget Request

Budget Authority (Dollars in Thousands)	FY 2018 Request
Concentrating Solar Power	8,000
Photovoltaic R&D	43,700
Systems Integration	18,000
Total, Solar Energy Technologies	**69,700**

With SunShot early-stage R&D support, the solar industry has dramatically cut costs, enabling greater technological advances and market growth, advancing U.S. leadership in energy innovation, and contributing to the security and resilience of America's energy grid.

Major Accomplishments and Goals

SunShot investments have an immediate and measurable impact on the solar industry of today.

- Benefiting from SETO R&D, the solar industry achieved 90% of the SunShot 2020 cost target of $0.06/kWh for utility-scale PV.
- Advanced inverter testing at the National Renewable Energy Laboratory's Energy Systems Integration Facility, enabling thousands of solar customers to connect to the grid.
- A toolkit for electric cooperatives enabled doubling of solar capacity in 2017, reaching 873 megawatts (MW).
- SunShot's "train-the-trainer" model qualified 1,000 solar instructors and prepared more than 30,000 students to enter the solar workforce.
- SunShot's $158 million investment in early-stage small businesses accelerated market access for new products and services, yielding $3.4 billion in private follow-on funding for businesses. That equates to $22 in private financing for every $1 of public support.
- Over the past 35 years, SETO awardees achieved more than half of all solar cell efficiency world records. A SunShot project at the NREL has mapped the path to set a new world record of 50% efficiency for conversion of sunlight to electricity.

SunShot investments have an even greater impact on the solar industry of the future.

- In 2016, SunShot set a new goal for cutting the cost of solar electricity by an additional 50% between 2020 and 2030. Achieving this goal would make utility-scale solar one of the least expensive new power generation sources.
- SETO supports early-stage R&D and innovation that aim to reduce the cost of solar power to $0.03/kWh at utility scale, $0.04/kWh at commercial scale, and $0.05/kWh at residential scale, without government incentives.
- SunShot projects will focus on contributing to seamless integration of solar energy into the electric grid in a safe, reliable, and cost-effective manner.

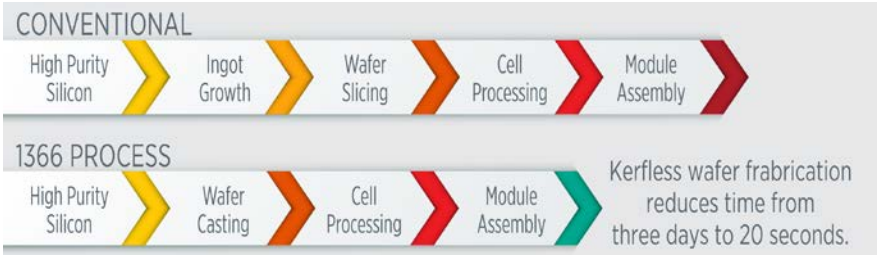
Success Stories

SunShot Awardee 1366 Technologies Turns Cutting-Edge Research into Manufacturing Success

The story of 1366 Technologies illustrates how effective the DOE SunShot Initiative has been in targeting early-stage R&D and accelerating the process of commercialization. In 2008, 1366 received an incubator award from SunShot for its early-stage research into developing molten materials for solar cells in the lab. In 2011, SunShot support enabled 1366 to improve supply chain efficiency and establish the first commercial-scale line in Lexington, Massachusetts.

Silicon, a major cost contributor in making a solar cell, is often wasted in the traditional sawing methods used to create wafers. 1366 developed a process that creates silicon wafers directly from molten silicon. The 1366 "kerfless wafering" process produces less waste and takes 20 seconds to form a single wafer. This is a vast improvement over conventional processes that take up to three days to make a solar wafer and expend 66% more energy.

Altogether, 1366's innovations can potentially drive down the manufacturing costs of a silicon wafer by 50%. As a result, 1366 has raised $96.5 million in private capital and announced plans to expand its manufacturing operations that will create 1,000 new jobs in upstate New York.



National Laboratory Scientists Discover the Science Behind Solar Cell Contacts

Through Sunshot's early-stage PV R&D at the Stanford Linear Accelerator Laboratory and the NREL, scientists gained a greater understanding of contact formation in a solar cell. Creating good metal contacts is critical in making solar cells and modules that will effectively collect electrons generated by sun shining on a solar panel. The most common way to make metal contact lines is to screen-print a specialized paste containing metal particles onto a silicon solar cell, and then heat it to form a durable electrical connection. Pastes have been empirically optimized over the years to ensure low electrical resistance, which maximizes the current from the solar cell. Despite common use, solar manufacturers and scientists have never fully understood the exact reactions taking place as pastes are sintered and a mechanically stable electrical contact is formed. SunShot R&D used X-rays to study the reaction of pastes containing metal particles and specialized powered glass with silicon solar cells at different stages of contact formation. As a result, solar researchers and manufacturers gained insights for developing metal contact pastes that contain less precious metal, which has the potential to lower the cost of solar panels. Researchers also now understand the role that glass plays in the paste composition and are equipped to identify even better materials and process options.