The Solar Energy Technologies Office

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Becca Jones-Albertus
Deputy Director
Solar Technologies: Photovoltaics, Concentrating Solar Power

Photovoltaic (PV) technologies absorb energy from sunlight and convert it directly into electricity through a semiconductor material, such as silicon. Individual PV panels/modules are connected together to make large arrays.

Concentrating solar power (CSP) technologies use mirrors to reflect and concentrate sunlight onto a receiver where it is collected and converted into heat. This heat energy can be stored and used to produce electricity whenever it is needed.
U.S. Solar Capacity Grows >50x in 10 Years

Generating 2% of electricity today

Sources: WoodMac Research and EIA Electric Power Monthly
Top States in Solar Generation (2018)

% of Electricity from Solar

CA: 19.0%
NV: 12.7%
HI: 11.2%
VT: 11.0%
MA: 10.7%
AZ: 6.5%
UT: 6.4%
NC: 5.4%
NM: 4.7%
NJ: 4.2%
U.S.: 2.3%

Data Courtesy of David Feldman, NREL
Source: EIA Electric Power Monthly
Lower Costs and Policy Incentives Drive Deployment

29 States + DC have a Renewable Portfolio Standard, 3 states have a Clean Energy Standard (8 states have renewable portfolio goals, 2 states have clean energy goals)

- Extra credit for solar or customer-sited renewables
- Includes non-renewable alternative resources

**Renewable & Clean Energy Standards (DSIRE)**

www.dsireusa.org / June 2019
240,000+ U.S. Jobs in the Solar Industry


energy.gov/solar-office
Solar Energy Technologies Office Overview

EARLY-STAGE RESEARCH to improve the
AFFORDABILITY
FLEXIBILITY
PERFORMANCE of solar technologies
Modern Electric Grid: Two Way Energy and Data Flow

Goal: Centralized and distributed generation optimized with finely tuned, 2-way load balancing
SETO Funds 350+ Active Projects

Projects and partners in 47 states plus the District of Columbia

- 40% of projects at national labs
- 25% of projects with universities
- 35% of projects with businesses & non-profits*

Note: SETO has funded past projects in Kentucky, Louisiana, and Wyoming.
SETO Subprograms

**PHOTOVOLTAICS**
R&D of photovoltaic technologies to improve efficiency and reliability, lower manufacturing costs, and drive down the cost of solar electricity.

**CONCENTRATING SOLAR POWER**
R&D to develop low cost concentrating solar-thermal power technologies, which incorporate thermal energy storage to provide electricity when the sun is not shining.

**SYSTEMS INTEGRATION**
R&D to enable the reliable, resilient, secure, and affordable integration of solar energy onto the U.S. electric grid.

**SOFT COSTS**
Research and technical assistance to reduce the non-hardware costs of solar (e.g., siting, permitting, installation, interconnection, financing) by providing information and analyses, and developing new tools, best practices and workforce training.

**MANUFACTURING AND COMPETITIVENESS**
Supports activities that amplify the impact of R&D projects and enable the private sector to develop and sustain new solar products.
Progress and Goals: New 2030 Goal

The office invests in innovative research efforts that securely integrate more solar energy into the grid, enhance the use and storage of solar energy, and lower solar electricity costs toward the SunShot cost goals.

*Levelized cost of electricity (LCOE) progress and targets are calculated based on average U.S. climate and without the ITC or state/local incentives. The residential and commercial goals have been adjusted for inflation from 2010-17.
One Pathway To 3 Cents per kWh

Improve efficiency while decreasing cost

2016 Real LCOE (U.S. Cents/kWh)

- Seattle, WA (10¢)
- Kansas City, MO (1.2¢)
- Daggett, CA (1¢)
- Daggett, CA w/ITC (1.1¢)
- Seattle, WA (0.7¢)
- Kansas City, MO (3¢)
- Daggett, CA (100 MWDC) (1.860 kWh(AC)/kW(DC)) First-Year Performance. Includes 5 Year MACRS. Cost of capital is 7% and inflation is 2.5%.
One Pathway To 3 Cents per kWh

Speed up installation and interconnection processes, reduce balance of system hardware costs (and improve module efficiency)

100 MW_{DC} One-Axis Tracking Systems With 1,860 kWh_{(AC)/kW_{(DC)}} First-Year Performance. Includes 5 Year MACRS. Cost of capital is 7% and inflation is 2.5%.
One Pathway To 3 Cents per kWh

- Improve upon today’s best-in-class reliability in low-cost modules, better understand and predict degradation.

2016 Benchmark
- Lower Sustainable Module Price: $0.65 to $0.30/W
- Lower Balance of System Hardware and Soft Costs $0.85 to $0.55/W
- Improve Lifetime: 30 to 50 years and Lower Degradation Rate: 0.75% to 0.2% /year
- Lower O&M: $14 to $4/kW-yr

SunShot 2030 Goal
- 100 MW(DC) One-Axis Tracking Systems With 1,860 kWh(AC)/kW(DC) First-Year Performance. Includes 5 Year MACRS. Cost of capital is 7% and inflation is 2.5%.
One Pathway To 3 Cents per kWh

Employ automation and data analytics, improve characterization tools

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DOE R&D Drives Solar Cell Efficiency Records

More than 40% of all solar cell efficiency world records have been directly funded by DOE and 30% of all patents in the solar energy field are linked to intellectual property attributable to DOE.

CSP plants have receivers that use heat transfer fluids to collect and store solar thermal energy. Molten salts used in commercial receivers reach 500-600°C, but higher temperatures need to be attained to improve efficiency and lower costs.

Using novel ceramic particles, researchers at Sandia reached temperatures as high as 840°C, enabling the same amount of sunlight to produce more power for the grid at all hours of the day. Winner of 2016 R&D 100 Award.
Enabling Solar to Support Grid Reliability
Like a conventional electricity source

• **Power Ramping**
  ✓ Ramp its real-power output at a specified ramp-rate
  ✓ Provide regulation up/down service

• **Voltage Control**
  ✓ Control a specified voltage schedule
  ✓ Operate at a constant power factor
  ✓ Produce a constant level of MVAR
  ✓ Provide controllable reactive support
  ✓ Provide reactive support at night

• **Frequency**
  ✓ Provide frequency response for low frequency & high frequency events
  ✓ Control the speed of frequency response
  ✓ Provide fast frequency response

Tests successfully conducted with CAISO on 300 MW First Solar plant

Source: Mahesh Morjaria, First Solar
Enhancing Grid Resilience with Distributed Resources

- In the event of a **major disaster** like an earthquake, hurricane or flood, electricity might be lost for days, affecting communications, recovery efforts and lives.
- Currently, restarting the grid is performed manually using special generators. It's an extremely slow process that does not account for electricity that could be generated by distributed sources.

- Researchers at **Lawrence Livermore National Lab**, funded by the **Grid Modernization Lab Consortium**, are working to demonstrate that distributed solar PV and storage can help recover from an outage.
- Using “agile islanding”—forming microgrids around local solar customers—solar electricity can help to restart local power supplies and jumpstart critical grid functions.
Through its SHINES project, EPRI is working with several utilities to design, develop, and demonstrate technology for end-to-end grid integration of energy storage and load management with PV generation. The technology is a simple, two-level, optimized control architecture.
Solar Energy Technologies Office FY2019 Funding Opportunity

$130 Million for Advanced Solar Energy Research

The U.S. Department of Energy Solar Energy Technologies Office is looking to fund up to 80 projects that lower the cost of photovoltaic and concentrating solar-thermal power technologies, improve grid integration, develop manufacturing solutions, and lower soft costs by reducing regulatory burdens.

Funding Opportunity Topic Areas

- Photovoltaics Research and Development
- Concentrating Solar-Thermal Power Research and Development
- Balance of Systems Soft Costs Reduction
- Innovations in Manufacturing – Hardware Incubator
- Advanced Solar Systems Integration Technologies

Selection notifications anticipated in November 2019
American-Made Solar Prize

The American-Made Solar Prize is a $3 million prize competition designed to revitalize U.S. solar manufacturing by supporting entrepreneurs as they develop transformative technology ideas into concepts and then into early-stage prototypes ready for industry testing.

COMPETE
U.S.-based entrepreneurial individuals and teams compete in contests to solve difficult challenges in the solar industry and can win cash prizes and vouchers for in-kind support.

SUBMIT BY DECEMBER 10

CONNECT
Partners join the American-Made Network to support competitors as they rapidly develop solutions and can win recognition rewards.

ONGOING

Up For the Challenge?
Visit americanmadechallenges.org/solarprize to learn more
American-Made NETWORK

132 Network partners from 31 states plus 17 national laboratories
Fellowship Opportunities

• Play an integral role in establishing and implementing new projects and initiatives to make solar energy more affordable and reliable.
• Learn about the federal government and its role in advancing science and technology.

Design and implement national R&D strategies for:
• Photovoltaic Technology
• Concentrated Solar Power Technology
• Technology to Enable better Solar Integration with the Grid

Eligibility:
• The opportunity is available to highly talented scientists and engineers holding bachelor’s, master’s, or Ph.D. degrees of all quantitative backgrounds as well as applicants with relevant post-degree experience.

Benefits:
• One-year appointment, renewable for a second year
• Competitive stipend
• Mentorship from DOE officials
• Travel allowance
• Health insurance supplement
• Relocation expenses

Applications are accepted on a rolling basis with two annual review dates: January 15 | June 15

For additional information or to apply:
VISIT: https://www.zintellect.com/Posting/Details/3603
EMAIL: DOE-RPP@orau.org
Upcoming Stakeholder Webinar:
October 10, 2019 | 2:00 P.M. ET

Agenda:
• EERE Assistant Secretary Daniel R Simmons presenting EERE priorities and vision
• National Community Solar Partnership
• Systems Integration research overview

Sign up for the SETO Newsletter for registration info:
www.energy.gov/eere/solar/solar-newsletter

Thank You!

Becca Jones-Albertus, Ph.D
Becca.Jones-Albertus@ee.doe.gov