

# 10 <http://energy.gov/eere/sunshot/crystalline-silicon-photovoltaics-research>





## Overview

---

What is PV system design & energy yield research?

PV system design and energy yield research aims to understand how solar installations can be configured and operated to maximize energy generation. PV cell and module technology research aims to improve efficiency and reliability, lower manufacturing costs, and lower the cost of solar electricity.

Are solar cell efficiency records based on DOE research?

Approximately half the world's solar cell efficiency records, which are tracked by the National Renewable Energy Laboratory, were supported by the DOE, mostly by SETO PV research.

How much energy does a solar PV system return on investment?

The resulting energy returns on investment—expressed in terms of primary energy—range from 22 (at low irradiation) to 52 (at high irradiation) for sc-Si PV systems and from 21 to 47 for mc-Si PV systems. Furthermore, we examine the effects of cleaner electricity grids and grid efficiency improvements on these environmental and energy indicators.

How efficient are monocrystalline solar cells?

Monocrystalline solar cells reached efficiencies of 20% in the laboratory in 1985 (ref.238) and of 26.2% under 100× concentration in 1988 (ref.239). In this period, the efficiency of industrial solar cells slowly grew from 12% to 14.5%.

Can reshoring solar panel manufacturing reduce reliance on foreign PV panels?

Here, we study and report the results of climate change implications of reshoring solar panel manufacturing as a robust and resilient strategy to reduce reliance on foreign PV panel supplies.



Should c-Si solar panels be produced domestically?

Manufacturing c-Si PV panels is attractive to pursue domestically as reshored production demonstrates many more benefits. The domestic production of solar products also aids in building broader coalitions and offers possible spillover benefits for climate policy.



# 10 http energy gov eere sunshot crystalline-silicon-photovoltaics-re

**LPR Series 19'  
Rack Mounted**

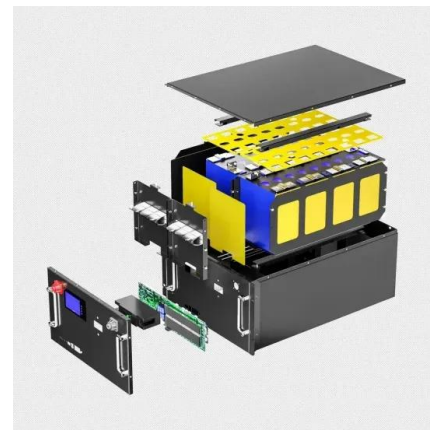


## [Photovoltaics \(Fact Sheet\), SunShot Initiative](#)

global PV manufacturing. The SunShot Initiative is bringing together the country's top talent to reduce the installed cost of solar energy systems, including photovoltaic systems, to achieve ...

### **PROJECT PROFILE: High-Efficiency, Low-Cost, One**

Funding Opportunity: SuNLaMP SunShot Subprogram: Photovoltaics Location: National Renewable Energy Laboratory, Golden, CO Amount Awarded: \$4,000,000 Low-cost III-V photovoltaics have the potential to lower the levelized cost of energy (LCOE) because III-V cells outperform silicon in terms of efficiency and annual energy harvesting efficiency.



### **PROJECT PROFILE: Colorado School of Mines (PVRD)**

Project Name: New Approaches to Low-Cost Scalable Doping for Interdigitated Back Contact Crystalline Silicon Solar Cells Funding Opportunity: PVRD SunShot Subprogram: Photovoltaics Location: Golden, CO SunShot Award Amount: \$615,000 Awardee Cost Share: \$68,333 Project Investigator: Sumit Agarwal This project lowers the cost and reduces the complexity of ...

### **SunShot Initiative Workshop on Silicon Photovoltaics**



On July 29, 2015, the SunShot Initiative held a workshop on silicon photovoltaics research directions beyond 2020 in conjunction with the NREL workshop on crystalline silicon solar cells ...



### Photovoltaics Fact Sheet

solar photovoltaics (PV), which is the direct conversion of sunlight into electricity by a semiconductor, in support of the goals of the SunShot Initiative. SunShot supports research and development to aggressively advance PV technology by improving efficiency and reliability and lowering manufacturing costs. SunShot's PV portfolio

### Photovoltaics (Fact Sheet), SunShot Initiative, U.S.

installed cost of solar energy systems, including photovoltaic systems, to achieve grid cost parity. If successful, SunShot will enable PV to meet 15-18% of America's electricity needs by 2030, making the U.S. a leader in the 21st century global clean energy race. To learn more about solar at DOE, check out [energy.gov/sunshot](http://energy.gov/sunshot). [energy.gov](http://energy.gov)



### Research Cell Efficiency Records , Department of Energy

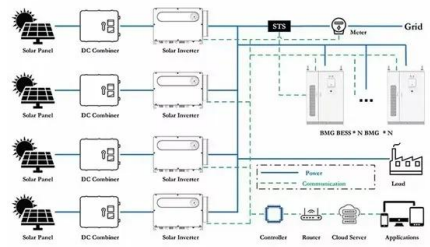
The National Renewable Energy Laboratory maintains a plot of compiled values of highest confirmed conversion efficiencies for research cells, from 1976 to the present, for a range of photovoltaic technologies. This chart highlights cell efficiency res



- ✓ 50KW/100KWH
- ✓ HIGHER POWER OUTPUT IN OFF-GRID MODE
- ✓ CONVENIENT OPERATION & MAINTENANCE
- ✓ PRE-WIRED

### Glitter-Sized Solar Photovoltaics , Department of Energy

Featured in this photograph are tiny glitter-sized photovoltaic cells, developed by Sandia National Laboratories scientists, that could revolutionize the way solar energy is collected and used. Representative thin crystalline-silicon photovoltaic cells - these are from 14 to 20 micrometers thick and 0.25 to 1 millimeter across.



### Next Generation Photovoltaics Round 2 , Department of Energy

Project Summary: Through this project, the university research team is addressing the efficiency limit and high fabrication cost of current light-trapping methods by developing novel low-symmetry gratings (LSG) for next-generation thin crystalline silicon (c-Si) and copper indium gallium selenide (Cu(InGa)Se 2 or CIGS) photovoltaic solar cells.

### [Multijunction III-V Photovoltaics Research](#)

Therefore, active research efforts are directed at lowering the cost of electricity generated by these solar cells through approaches such as developing new substrate materials, absorber materials, and fabrication techniques; increasing efficiency; and extending the multijunction concept to other PV technologies.



### Funding Notice: Fiscal Year 2024 Photovoltaics

Office: Solar Energy Technologies Office FOA Number: DE-FOA-0003337 Link to Apply: Apply on EERE Exchange FOA Amount: \$20 million On May 1, 2024, the U.S. Department of Energy (DOE) Solar Energy Technologies Office (SETO) announced the 2024 Photovoltaics Research and Development (PVRD) funding opportunity, which will award up to \$20 million for ...



### Status and perspectives of crystalline silicon photovoltaics in

Crystalline silicon (c-Si) photovoltaics has long been considered energy intensive and costly. Over the past decades, spectacular improvements along the manufacturing chain have made c-Si a low



### SOLAR ENERGY TECHNOLOGIES OFFICE

Solar Energy Technologies Office 2 List of Acronyms BAPVC Bay Area Photovoltaic Consortium c-Si crystalline silicon CdTe cadmium telluride CIGS copper indium gallium selenide CO2 carbon dioxide CSP concentrating solar-thermal power DC direct current DER distributed energy resource DG distributed generation DOE U.S. Department of Energy DOT U.S. Department of ...





### Photovoltaics Research and Development

The PV portfolio includes research directed toward reaching a levelized cost of energy of \$0.03 per kilowatt-hour. Reaching 2030 Goals With the levelized cost of energy (LCOE) of photovoltaics having decreased by roughly 90% since 2011, the PV team focuses on opportunities for even greater cost reductions to reach a LCOE of \$0.03/kWh.



LFP 48V 100Ah



### **Solar Research and Development Funding Programs**

The U.S. Department of Energy (DOE) Solar Energy Technologies Office (SETO) funds solar energy research and development projects through competitive solicitations known as funding opportunities, as well as prizes. View all current funding opportunities.

### **SunShot Awards**

SunShot Incubator PLANT PV Livermore CA \$749,853 Project will develop a new class of PV material, crystalline nanoporous frameworks, which will allow detailed control of Newark DE \$3,300,000 Project will research high-efficiency, silicon-based PV cells using thin-silicon wafers produced via high-speed laser



### **Considerations for Solar Energy Technologies to Grid Price ...**

50-MW PV system (including 25-year system life, 10% IRR target, 10.9% nominal discount rate, 50% debt fraction at 7% interest for 20 years, 30% federal ITC, and 5-year federal and state MACRS depreciation).





### Crystalline Silicon Photovoltaics Research

Silicon is the second most abundant element in Earth's crust (after oxygen). Learn more about SETO's PV research and how PV technologies work. DOE supports crystalline silicon photovoltaic (PV) research and development efforts that lead ...



### Photovoltaics Research and Development 2

Project Name: Fault Tolerant, Shade Tolerant High Voltage PV Modules Location: Tempe, AZ SETO Award Amount: \$180,000 Awardee Cost Share: \$20,000 Principal Investigator: Stuart Bowden Project Summary: This project is developing a solar cell architecture called the M-CELL, which enables higher voltage and lower current than conventional photovoltaic modules. . The ...

### **Photovoltaic Energy**

o Net energy ratio compares the life cycle energy output of a PV system to its life cycle primary energy input. One study showed that amorphous silicon PVs generate 3 to 6 times more energy than are required to produce them.<sup>26</sup> o Reusing multi-crystalline cells can reduce manufacturing energy by over 50%.<sup>27</sup>



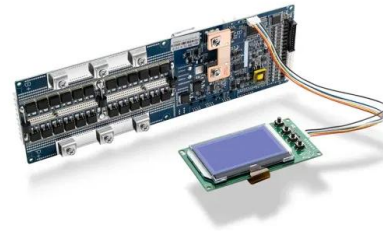
### Photovoltaics (Fact Sheet), SunShot Initiative

installed cost of solar energy systems, including photovoltaic systems, to achieve grid cost parity. If successful, SunShot will enable PV to meet 15-18% of America's electricity needs by 2030, making the U.S. a leader in the 21st century global clean energy race. To learn more about solar at DOE, check out [energy.gov/sunshot](http://energy.gov/sunshot). [energy.gov](http://energy.gov)



## Progress in Photovoltaics: Research and Applications

Progress in Photovoltaics: Research and Applications. Volume 24, Issue 9 p. 1272-1283. Different technological pathways are illustrated that may achieve the Department of Energy's SunShot goal of PV electricity that is at grid price parity with conventional electricity sources. In addition, the impacts on the 2015 baseline LCOE due to



## SunShot Vision Study

These facilities produce crystalline-silicon, CPV, and thin-film technologies such as a-Si, CdTe, CIGS, and organic photovoltaics (OPV), as well as polysilicon and wafers for use in crystalline ...

## SunShot Vision Study

SunShot Vision Study - February 2012 69 4. Photovoltaics: Technologies, Cost, and Performance 4.1 | INTRODUCTION Photovoltaic (PV) technologies currently supply only a small fraction of U.S. energy needs, largely because PV-generated electricity historically has cost more than electricity from conventional sources.



## Updated sustainability status of crystalline silicon-based ...

This paper provides a comprehensive assessment of the current life-cycle sustainability status of crystalline-based photovoltaic (PV) systems. Specifically, single ...



### Photovoltaics (Fact Sheet), SunShot, Solar Energy ...

the installed cost of solar energy systems, including photovoltaic systems. If successful, SunShot will enable PV to meet 15-18% of America's electricity needs by 2030. To learn more about DOE's solar activities, visit [solar.energy.gov](http://solar.energy.gov) and [energy.gov/sunshot](http://energy.gov/sunshot) DOE/GO-102011-3333 o June 2011



### Status and perspectives of crystalline silicon photovoltaics in

Crystalline silicon solar cells are today's main photovoltaic technology, enabling the production of electricity with minimal carbon emissions and at an unprecedented low cost.

### SunShot: Making Solar Energy Cost Competitive Throughout ...

If successful, SunShot will drive down the cost of solar electricity to about 6 cents per kilowatt hour and enable solar photovoltaics (PV) to account for 15-18% of America's electricity generation ...



### SunShot Vision Study

These facilities produce crystalline-silicon, CPV, and thin-film technologies such as a-Si, CdTe, CIGS, and organic photovoltaics (OPV), as well as polysilicon and wafers for use in crystalline-silicon PV. In 2010, U.S. cell production was about 1,100 MW or 5% of global production, and module production was about 1,200



## **Making Our Solar Future with American Manufacturing**

Every second that ticks by, six solar cells come off U.S. manufacturing lines that contain crystalline silicon. In 10 years, the Energy Department's SunShot Initiative expects nearly three-times that amount to be racing across the lines, helping to m



## **Contact Us**

---

For catalog requests, pricing, or partnerships, please visit:  
<https://www.vdbconstruction.co.za>