SOLAR ENERGY
TECHNOLOGIES OFFICE
U.S. Department Of Energy

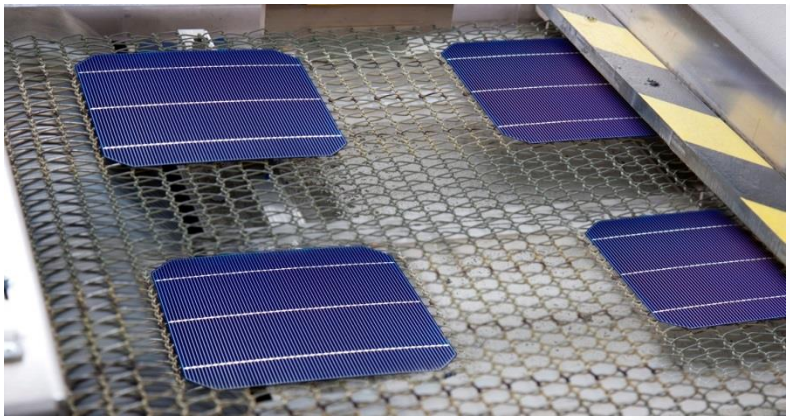
# The Solar Energy Technologies Office

2 October 2019

Becca Jones-Albertus
Deputy Director

# Solar Technologies: Photovoltaics, Concentrating Solar Power

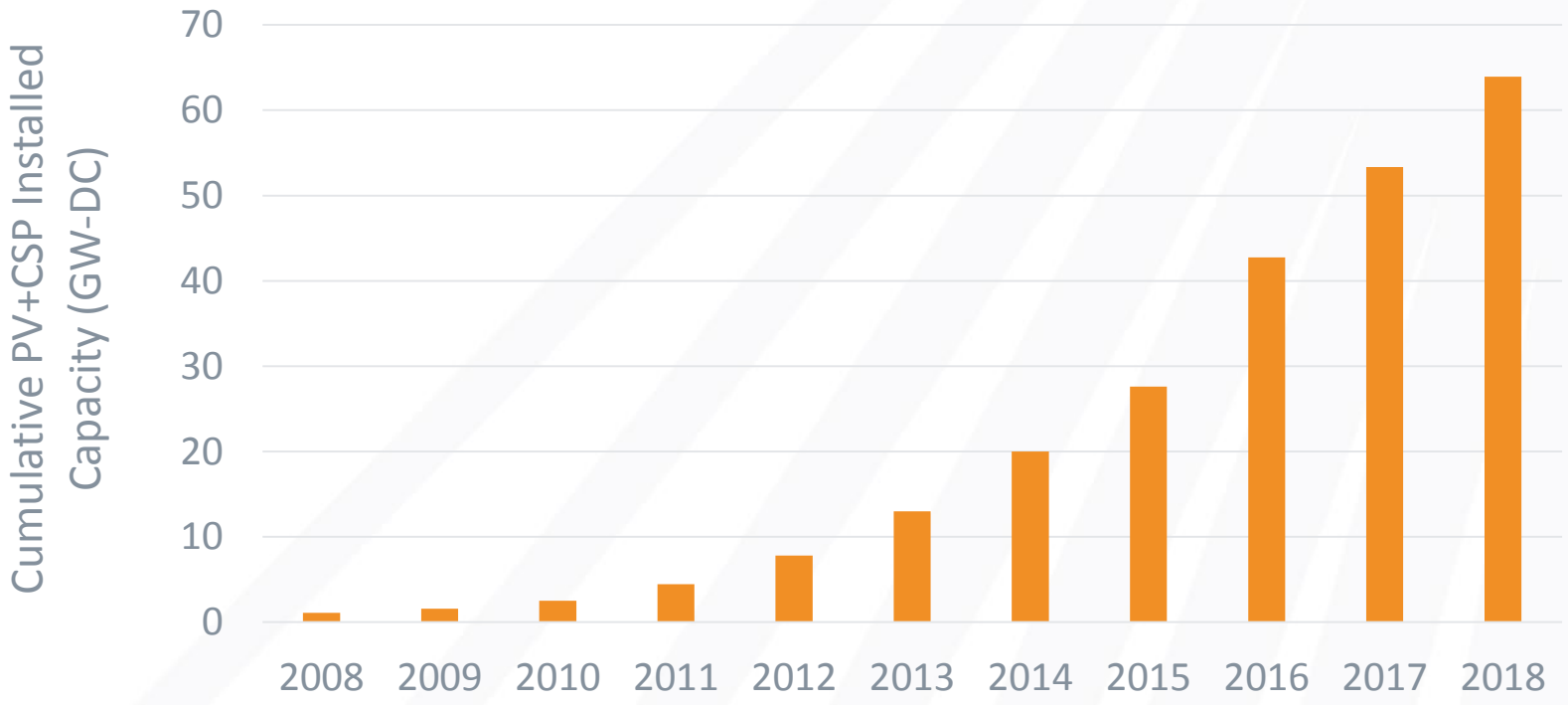
Photovoltaic (PV) technologies absorb energy from sunlight and convert it directly into electricity through a semiconductor material, such as silicon. Individual PV panels/modules are connected together to make large arrays.



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.

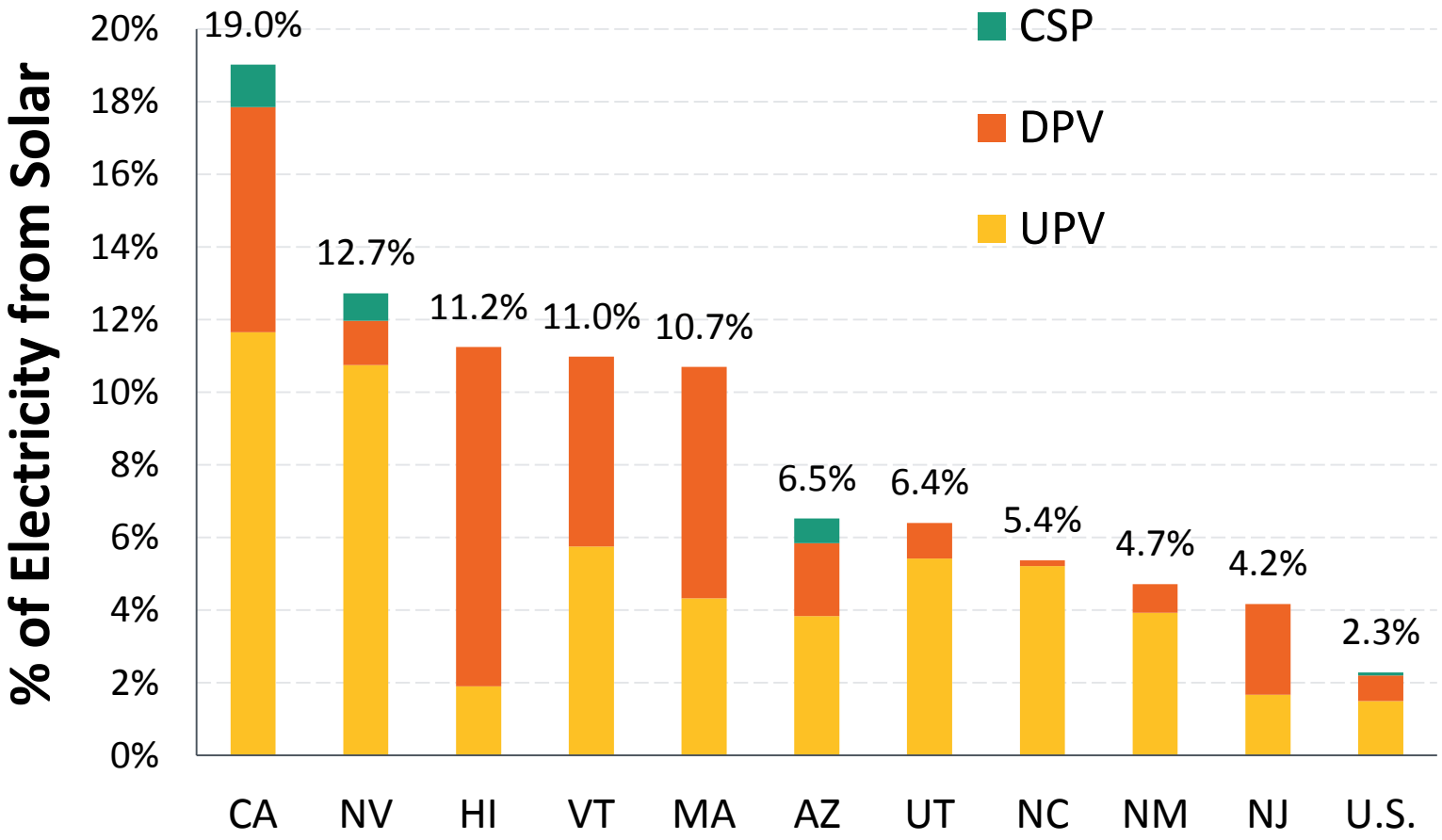
# U.S. Solar Capacity Grows >50x in 10 Years

## Generating 2% of electricity today



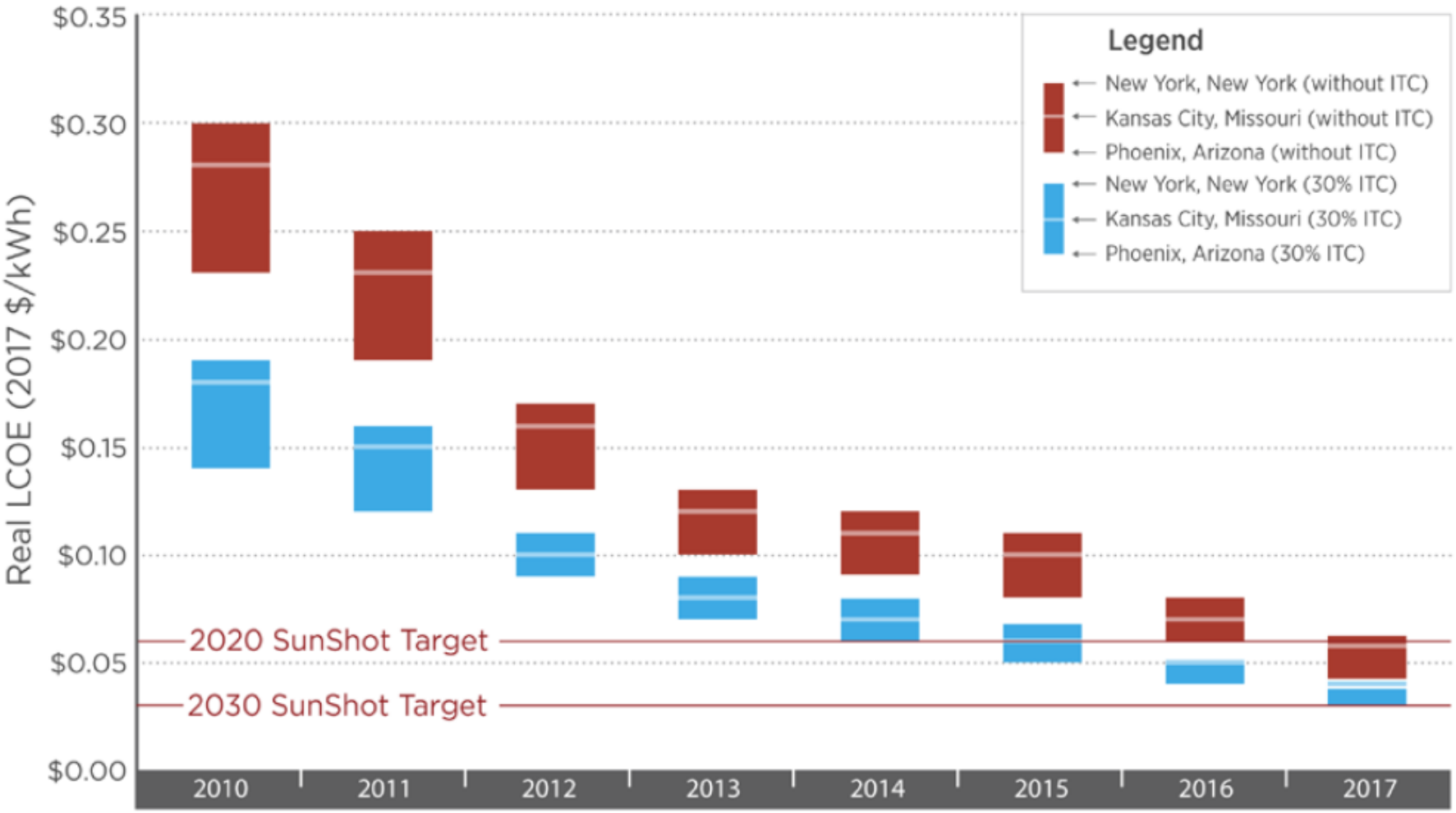

Sources: WoodMac Research and EIA Electric Power Monthly

# Top States in Solar Generation (2018)




Data Courtesy of David Feldman, NREL
Source: EIA Electric Power Monthly

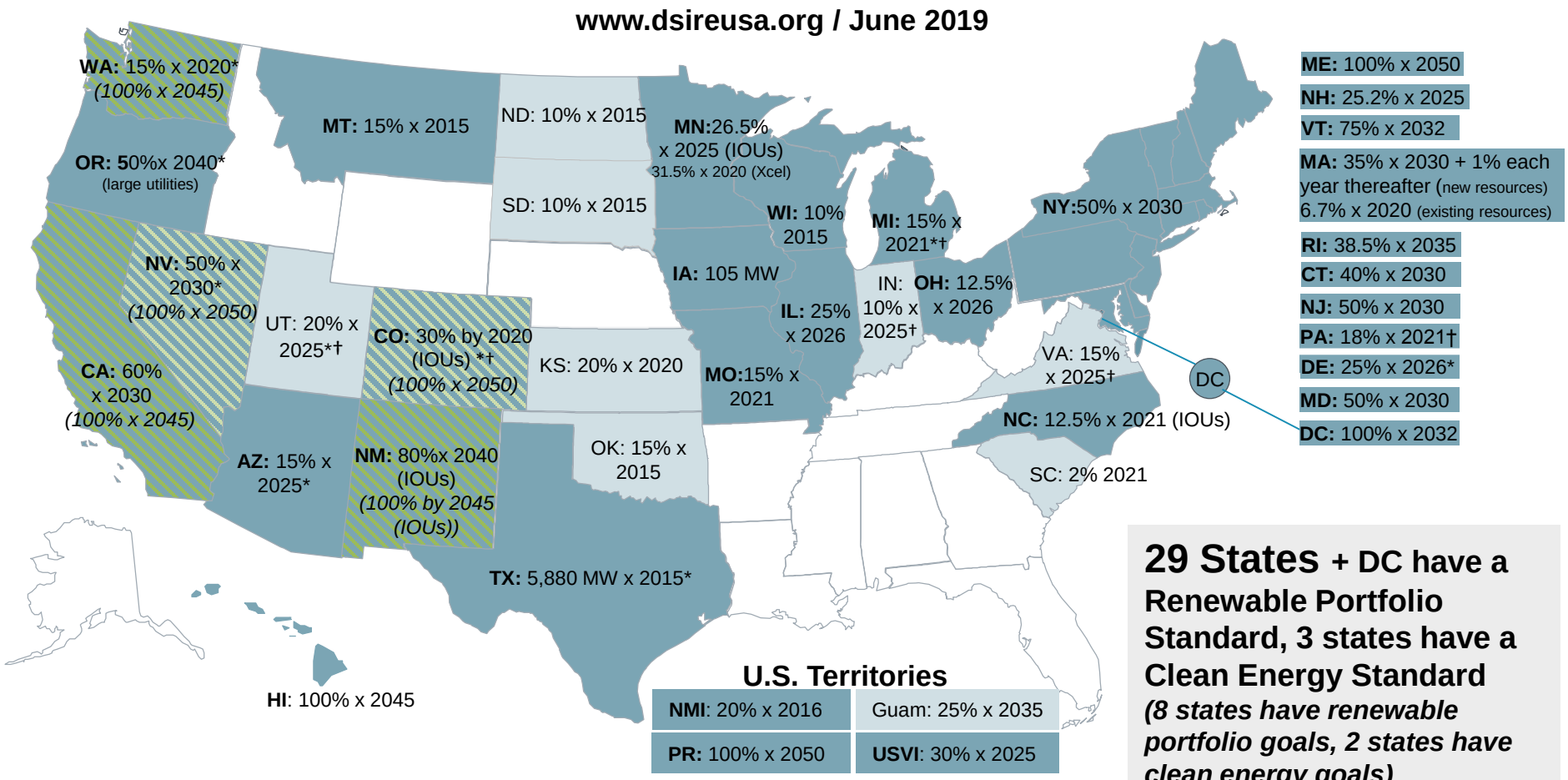
# Lower Costs and Policy Incentives Drive Deployment




Sources: National Renewable Energy Laboratory, "U.S. Solar Photovoltaic System Cost Benchmark: Q1 2017"

SOLAR ENERGY TECHNOLOGIES OFFICE
U.S. Department Of Energy

# Renewable & Clean Energy Standards (DSIRE)



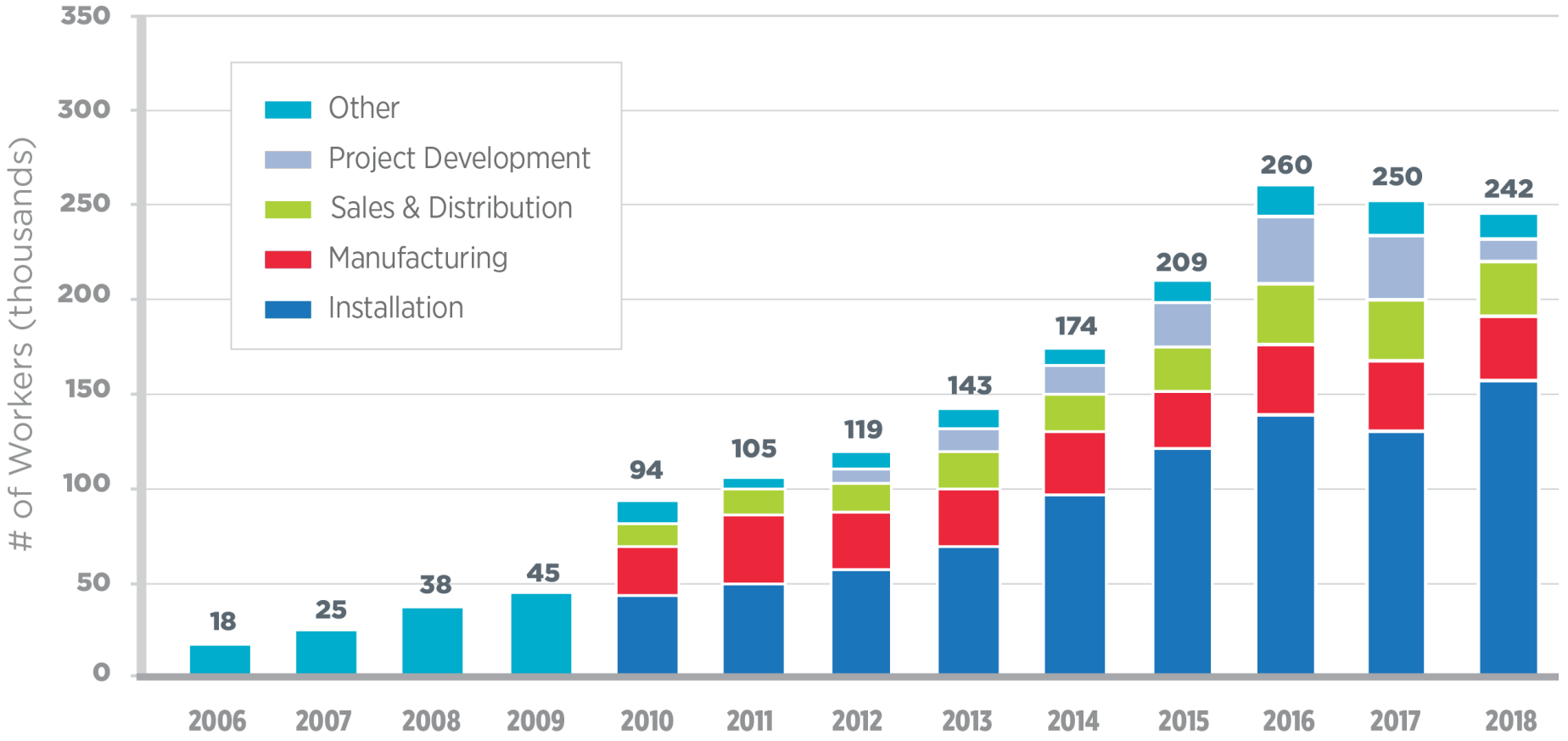

**29 States + DC have a Renewable Portfolio Standard, 3 states have a Clean Energy Standard**
***(8 states have renewable portfolio goals, 2 states have clean energy goals)***

Renewable portfolio standard
Renewable portfolio goal
*Clean energy standard*
*Clean energy goal*

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

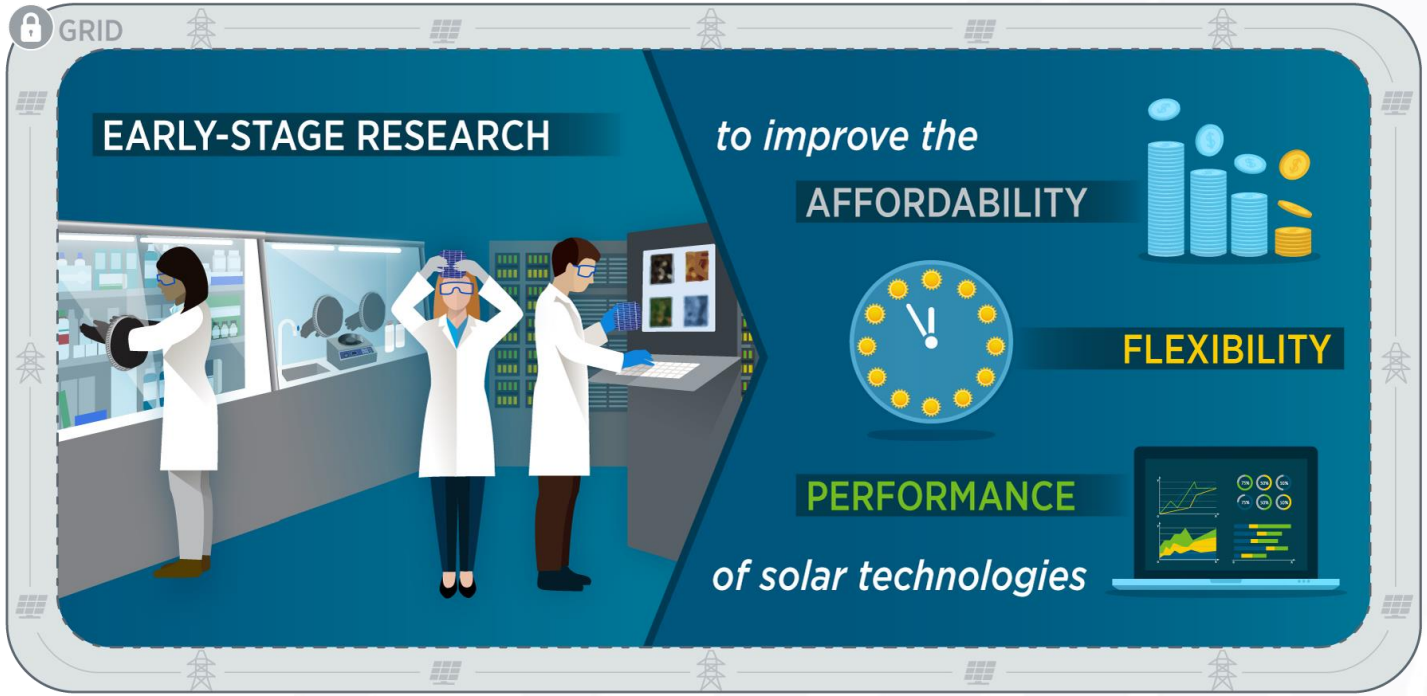
SOLAR ENERGY TECHNOLOGIES OFFICE
U.S. Department Of Energy

# 240,000+ U.S. Jobs in the Solar Industry

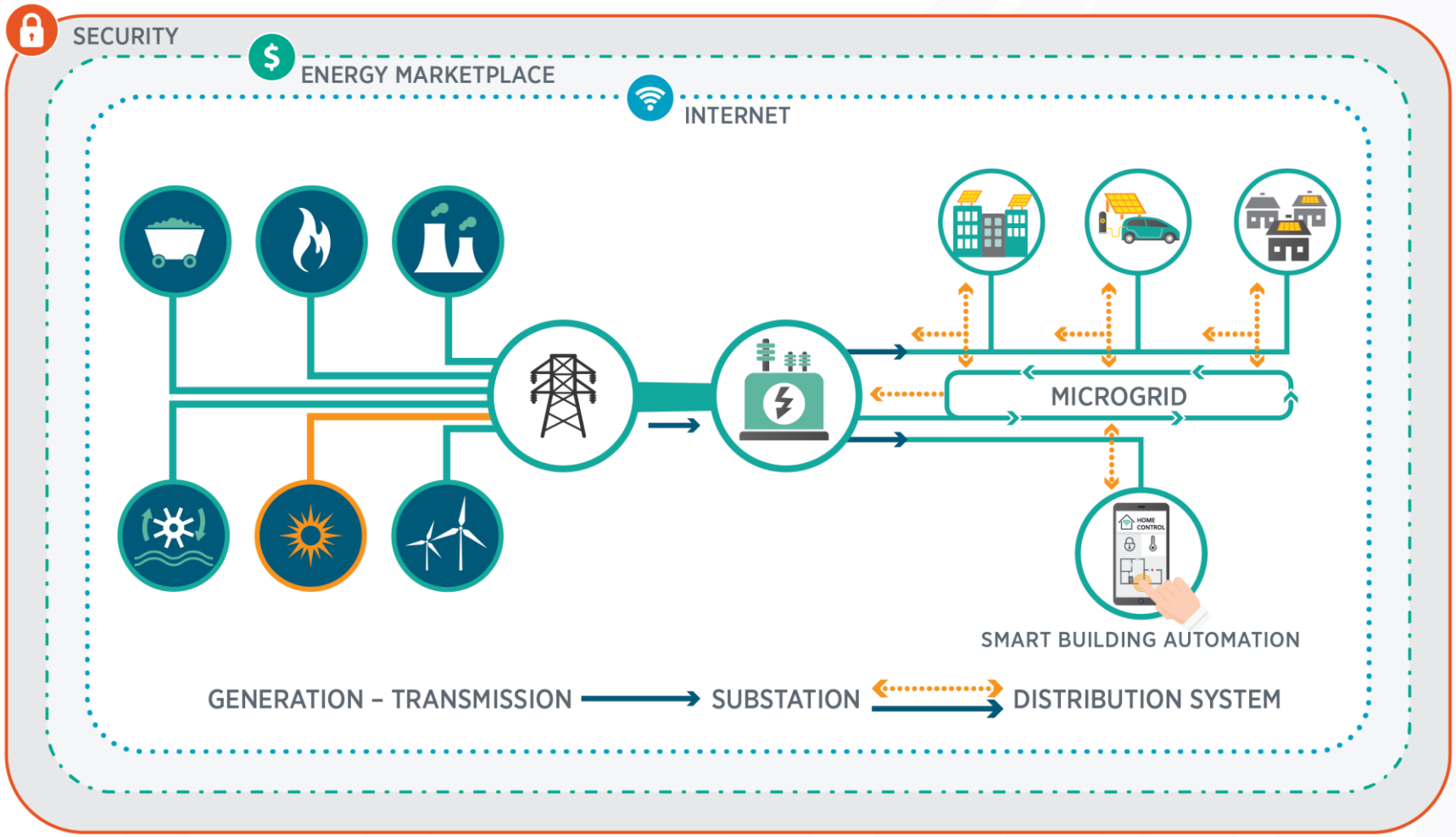



Source: The Solar Foundation, "2018 National Solar Jobs Census."
energy.gov/solar-office

# Solar Energy Technologies Office Overview




# Modern Electric Grid: Two Way Energy and Data Flow

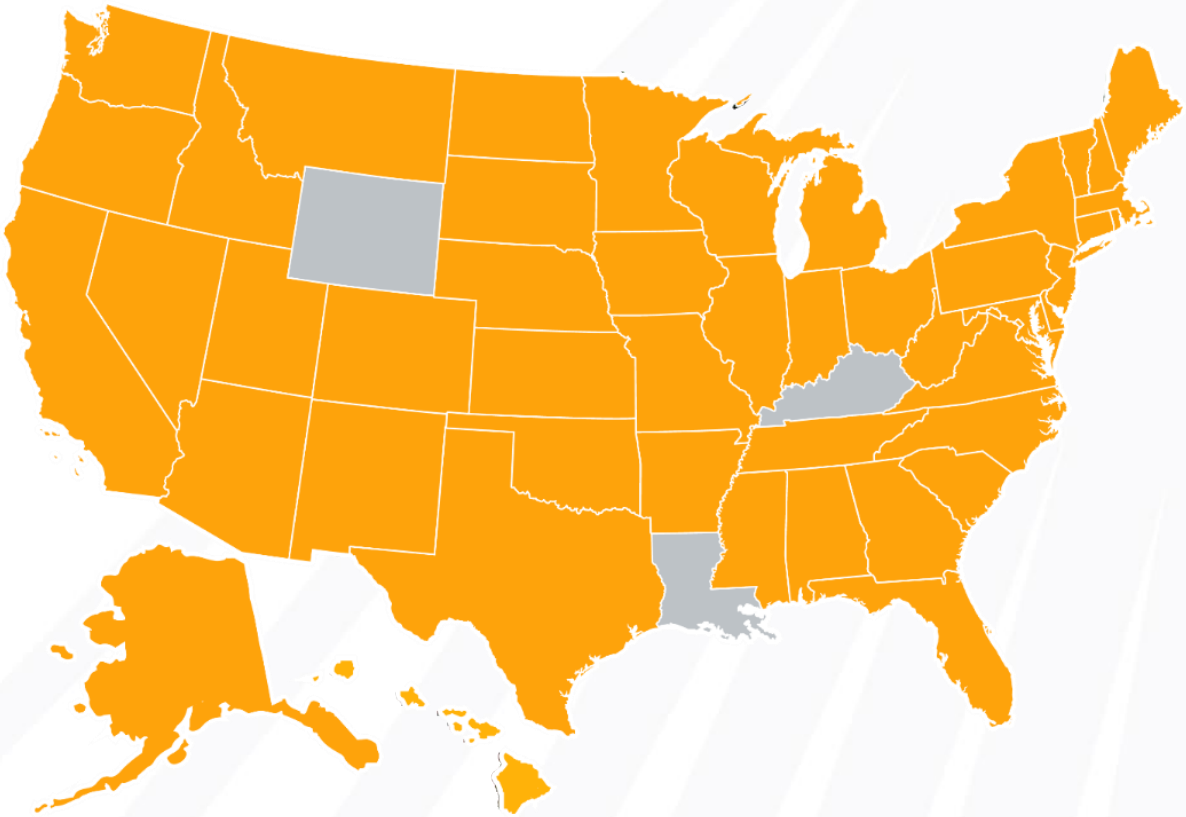



Goal: Centralized and distributed generation optimized with finely tuned, 2-way load balancing

# SETO Funds 350+ Active Projects

## 2019 Budget: $246M

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

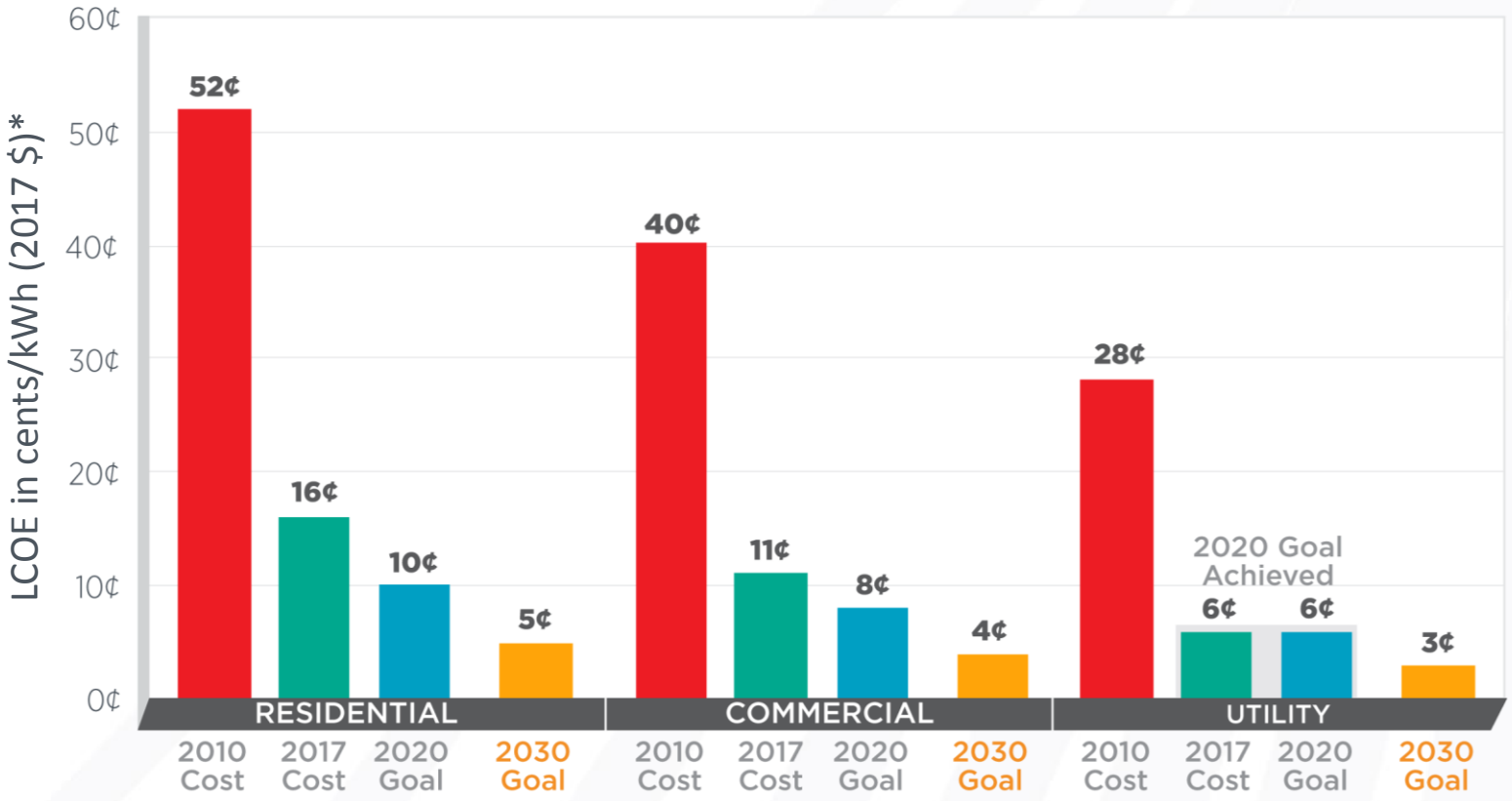
Research and technical assistance to reduce the non-hardware costs of solar (e.g., siting, permitting, installation, interconnection, financing) by providing information and analyses, and developing new tools, best practices and workforce training.

### 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.

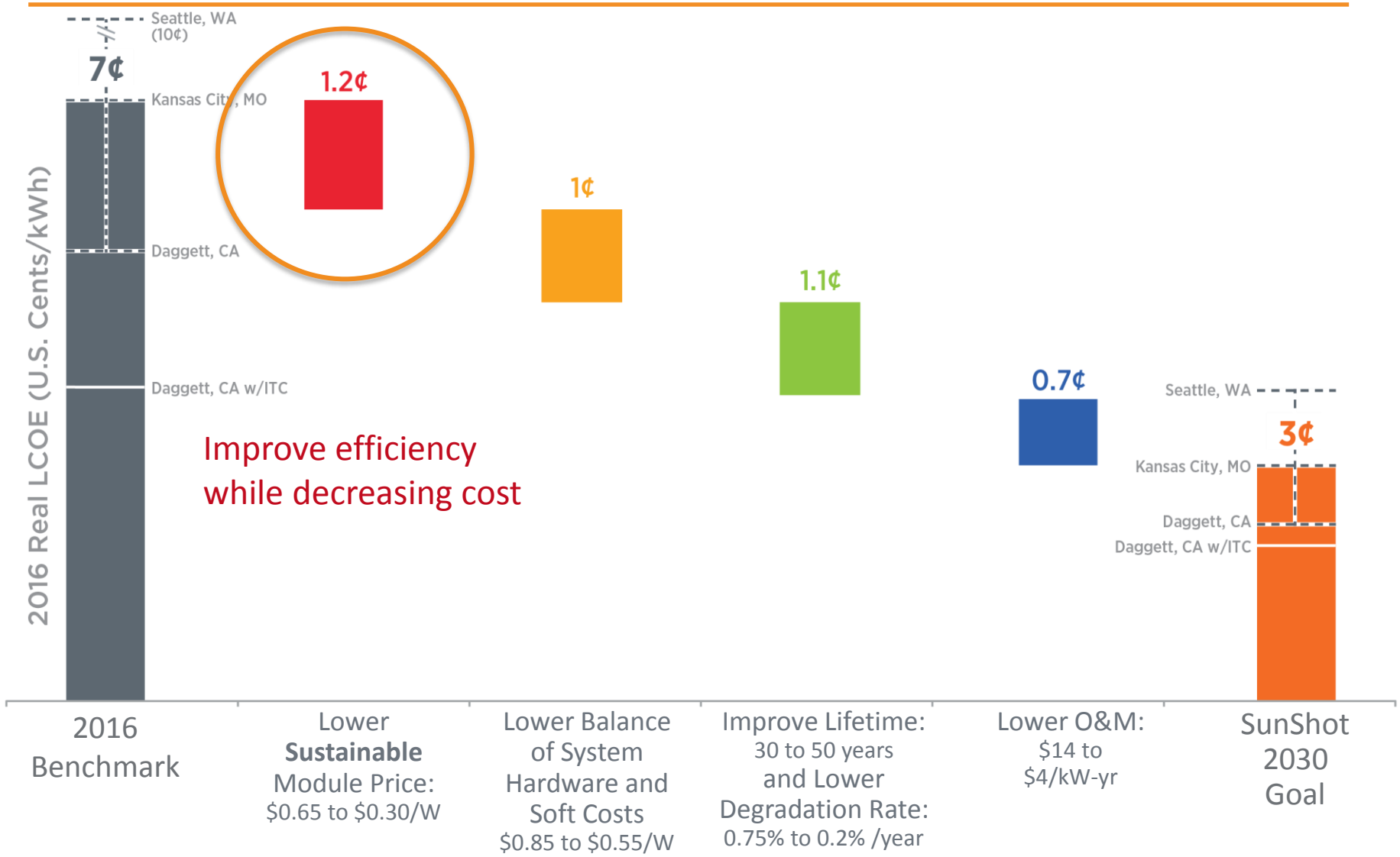
# Progress and Goals: New 2030 Goal

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.

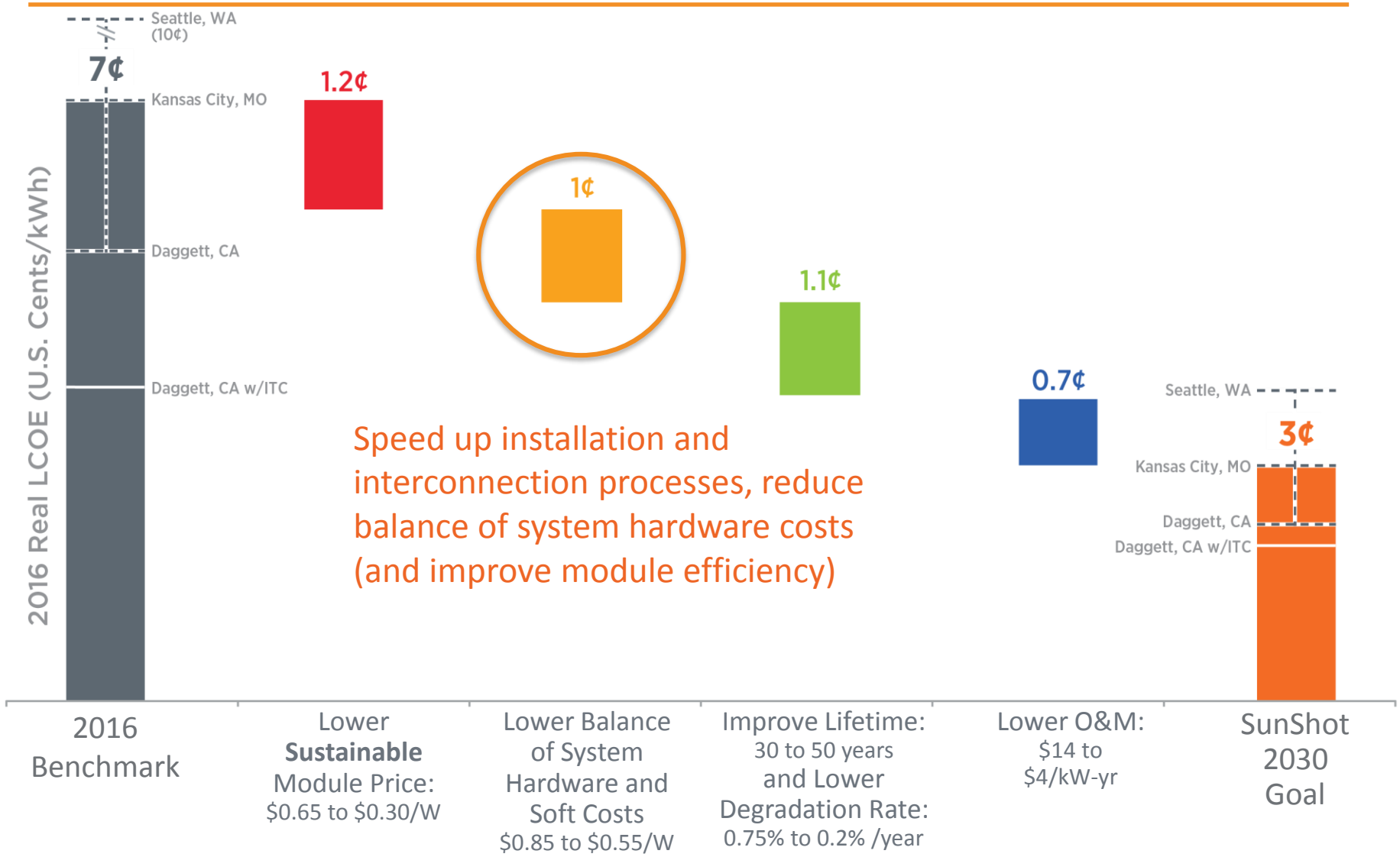
# One Pathway To 3 Cents per kWh




**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%.**

SunShot U.S. Department of Energy

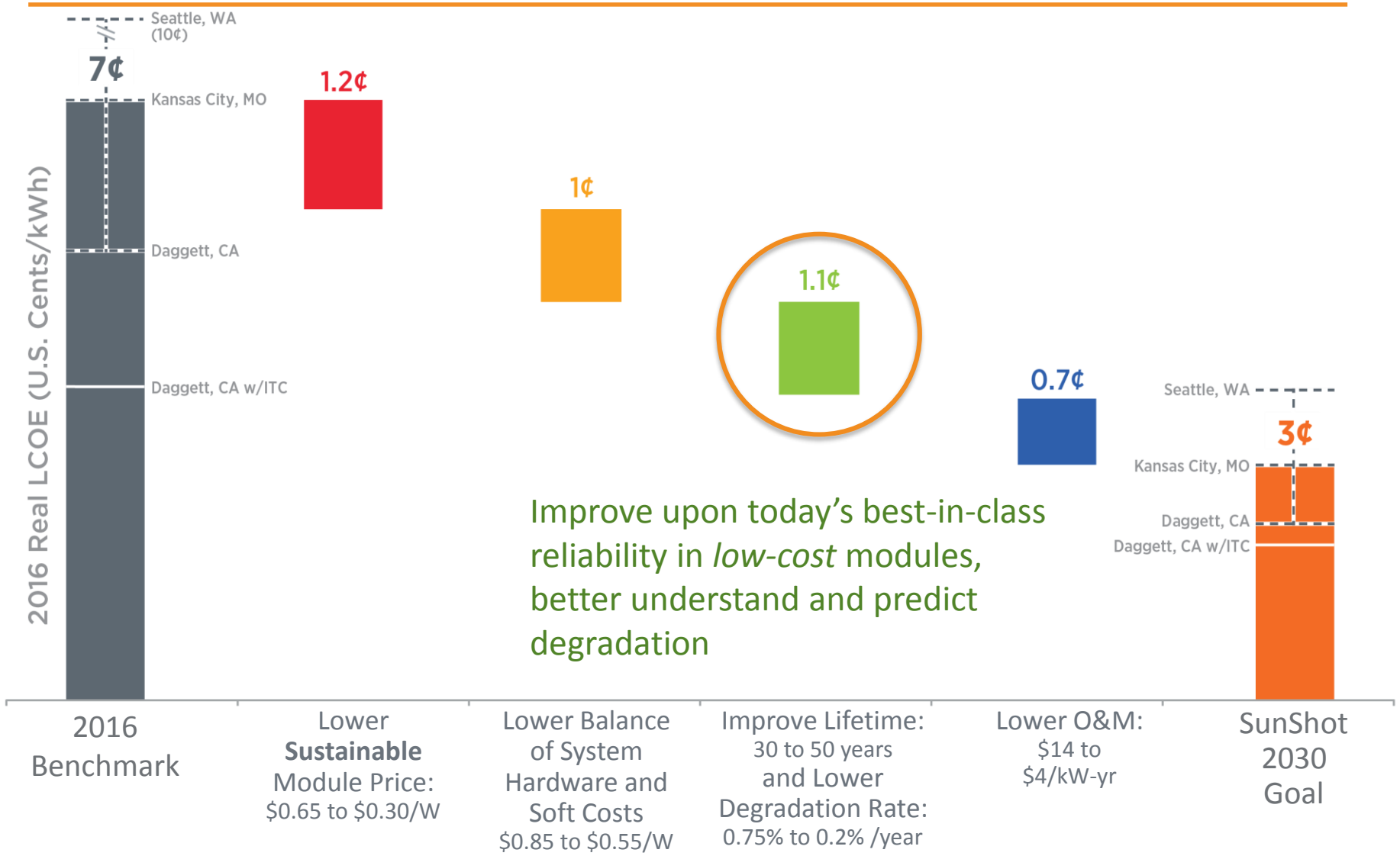
# One Pathway To 3 Cents per kWh




**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%.**

SunShot U.S. Department of Energy

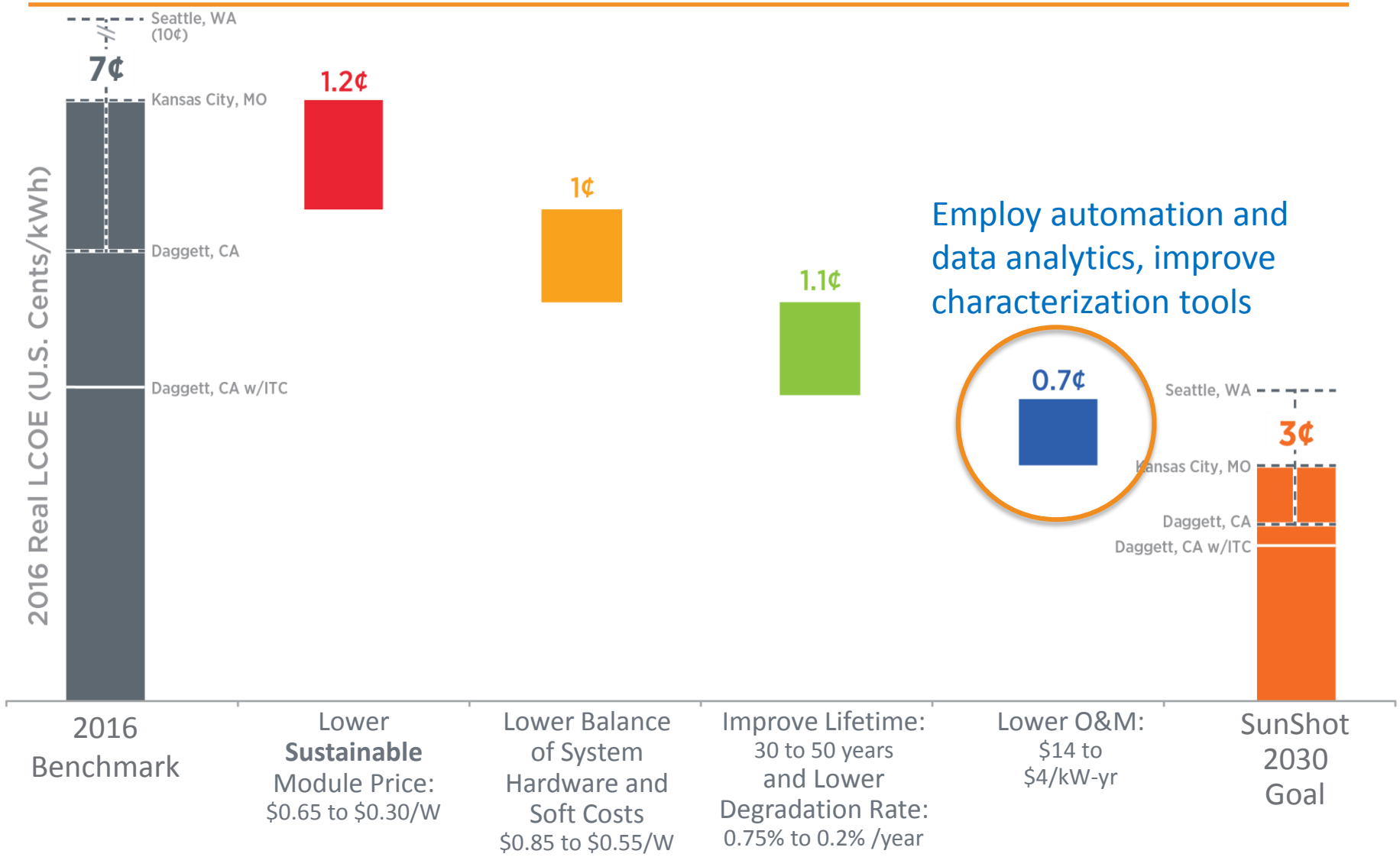
# One Pathway To 3 Cents per kWh




**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%.**

SunShot U.S. Department of Energy

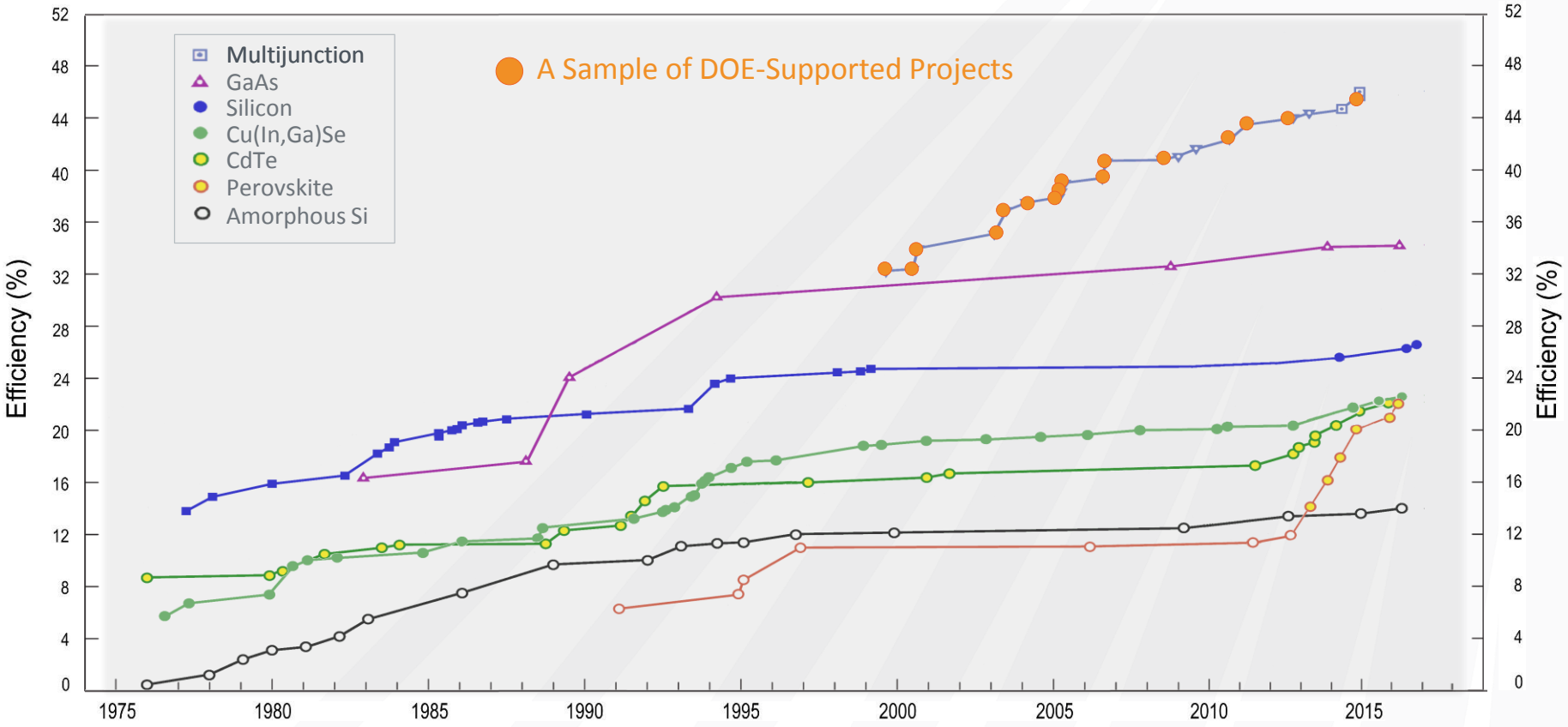
# One Pathway To 3 Cents per kWh




**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%.**

SunShot U.S. Department of Energy

# 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.

Sources: U.S. Department of Energy, "Retrospective Benefit Cost Evaluation of DOE Investment in Photovoltaic Energy Systems" (Patent data accurate as of 2010); National Center for Photovoltaics, "Research Cell Record Efficiency Chart"

# Reaching New Limits with Solar Storage

- 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.

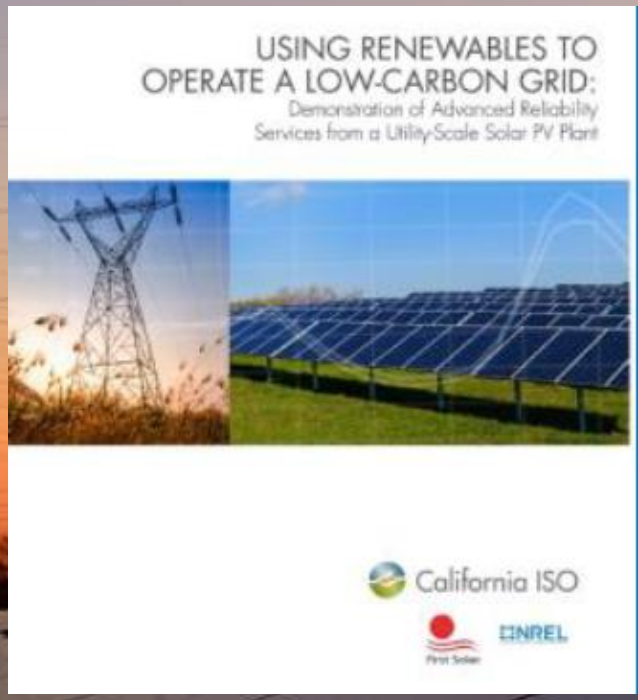
- Using novel ceramic particles, researchers at Sandia reached temperatures as high as **840°C**, enabling the same amount of sunlight to produce **more power for the grid at all hours of the day**.
- Winner of 2016 R&D 100 Award

# 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:
nrel.gov/docs/fy17osti/67799.pdf

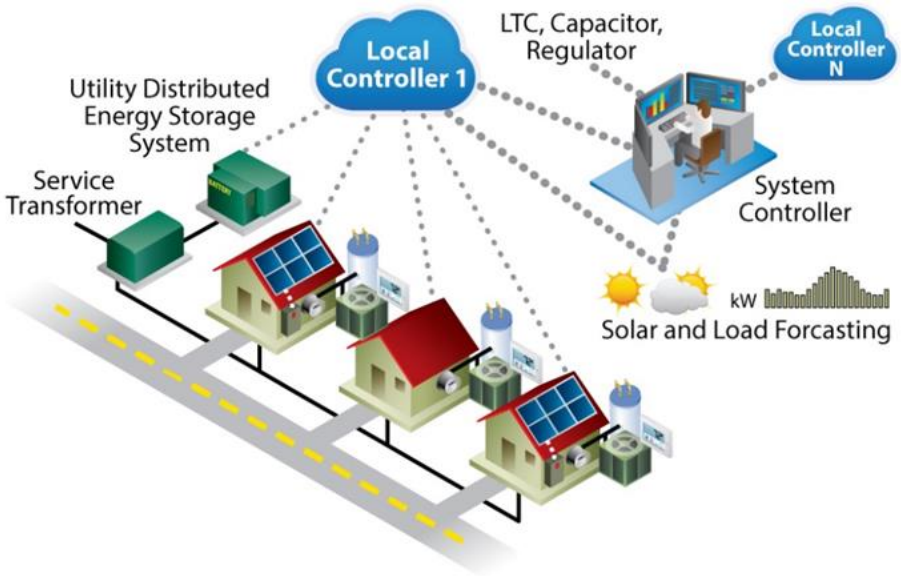
Source: Mahesh Morjaria, First Solar

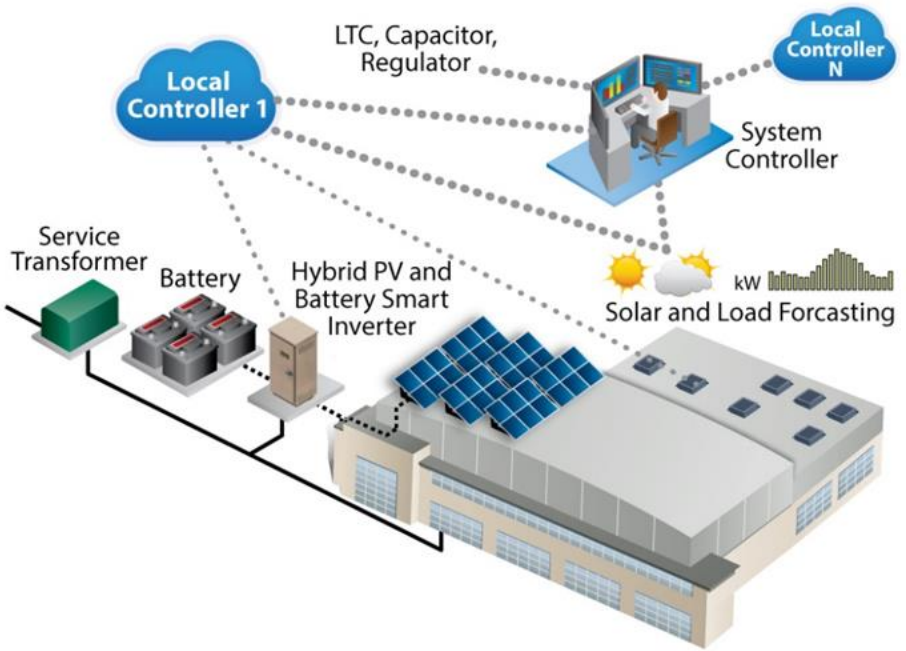
# Enhancing Grid Resilience with Distributed Resources

- 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.

# Integrating Solar with Storage and Flexible Load




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.

# What's next for SOLAR?

## 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


U.S. DEPARTMENT OF ENERGY

**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

SOLAR ENERGY TECHNOLOGIES OFFICE
U.S. Department Of Energy

# American-Made **NETWORK**

132 Network partners
from 31 states plus
17 national laboratories

Connectors

Power Connectors

# 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.


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:

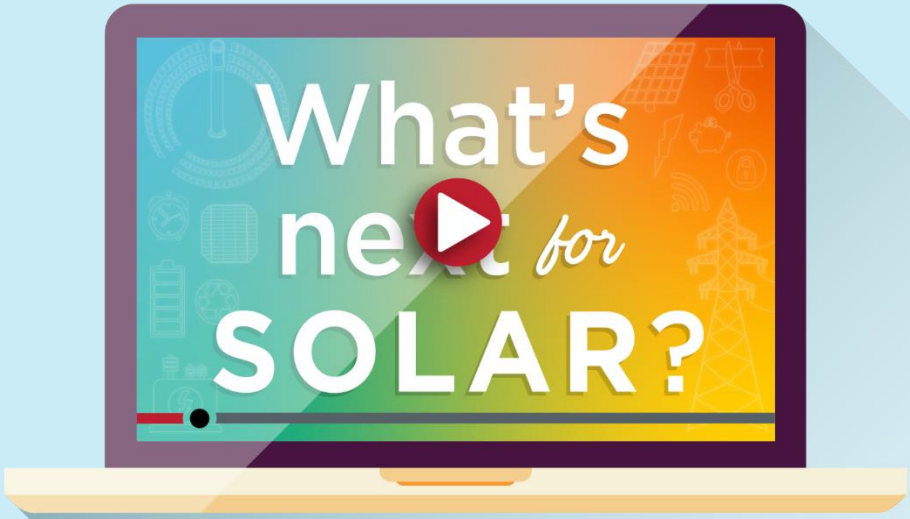
October 10, 2019 | 2:00 P.M. ET

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