U.S. DEPARTMENT OF ENERGY | Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

SOLAR ENERGY TECHNOLOGIES OFFICE

The Right Combination: Solar, Storage, and Demand Response

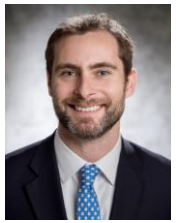
Solar Energy Technologies Office/ System Integration (SI)

February 25 & 26, 2021

energy.gov/solar-office

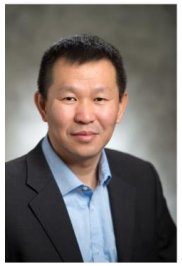
Moderator: Kemal Celik on Behalf of SI

DOE Participants



- Alejandro Moreno is the Deputy Assistant Secretary for Renewable Power (Acting).

- Dr. Becca Jones-Albertus is the Solar Energy Technologies Office Director within the Office of Energy Efficiency and Renewable Energy.



- Dr. Guohui Yuan is the program manager for the Systems Integration subprogram.

- Jeremiah Miller is a technology manager with the Systems Integration subprogram.

- Dr. M. Kemal Çelik is a technology manager in the Systems Integration subprogram.

Invited Project PI Speakers – Day 1

Day 1:

- Matt Kromer is a Director, Grid Integration, Fraunhofer USA.
- John Powers is the Founder/CEO at Extensible Energy.

Day 2:

- Jeremiah Miller is a technology manager for the Systems Integration team.
- Dr. Aminul Huque is a Principal Project Manager at Electric Power Research Institute.
- Shari Ishikawa is the Smart Grid Program Manager at Hawaiian Electric Company.

The Right Combination: Solar, Storage, and Demand Response

- Agenda
  - Feb. 25, 2021:
    - EERE/SETO leadership opening remarks
    - SI PM will present an overview of SETO systems integration challenges, programs and vision
    - SI TM will introduce the Solar + X challenges and projects
    - Fraunhofer will discuss their centralized scheduling solution to optimize utility-scale PV generation, storage, DR around commercial and industrial flexible loads, and granular load forecasting
    - Extensible Energy will present their building energy management solution around optimized on-site solar, storage and flexible loads
  - Feb. 26, 2021:
    - SI Technology Manager for Austin Energy's SHINES project will discuss their distributed energy resource management platform that can adapt to any region and market structure
    - EPRI team will present their work with five utilities to create technology that integrates storage and load management with PV generation on the grid
    - Hawaiian Electric team will present their demonstration of the system-level benefits of greater utility visibility and control of the distribution system
  - There will be a 30 min. Q&A session on both days

Solar Energy Technologies Office

WHAT WE DO

The Solar Energy Technologies Office (SETO) funds early-stage research and development in three technology areas: photovoltaics (PV), concentrating solar-thermal power (CSP), and systems integration with the goal of improving the **affordability**, **performance**, and **value** of solar technologies on the grid.

HOW WE DO IT

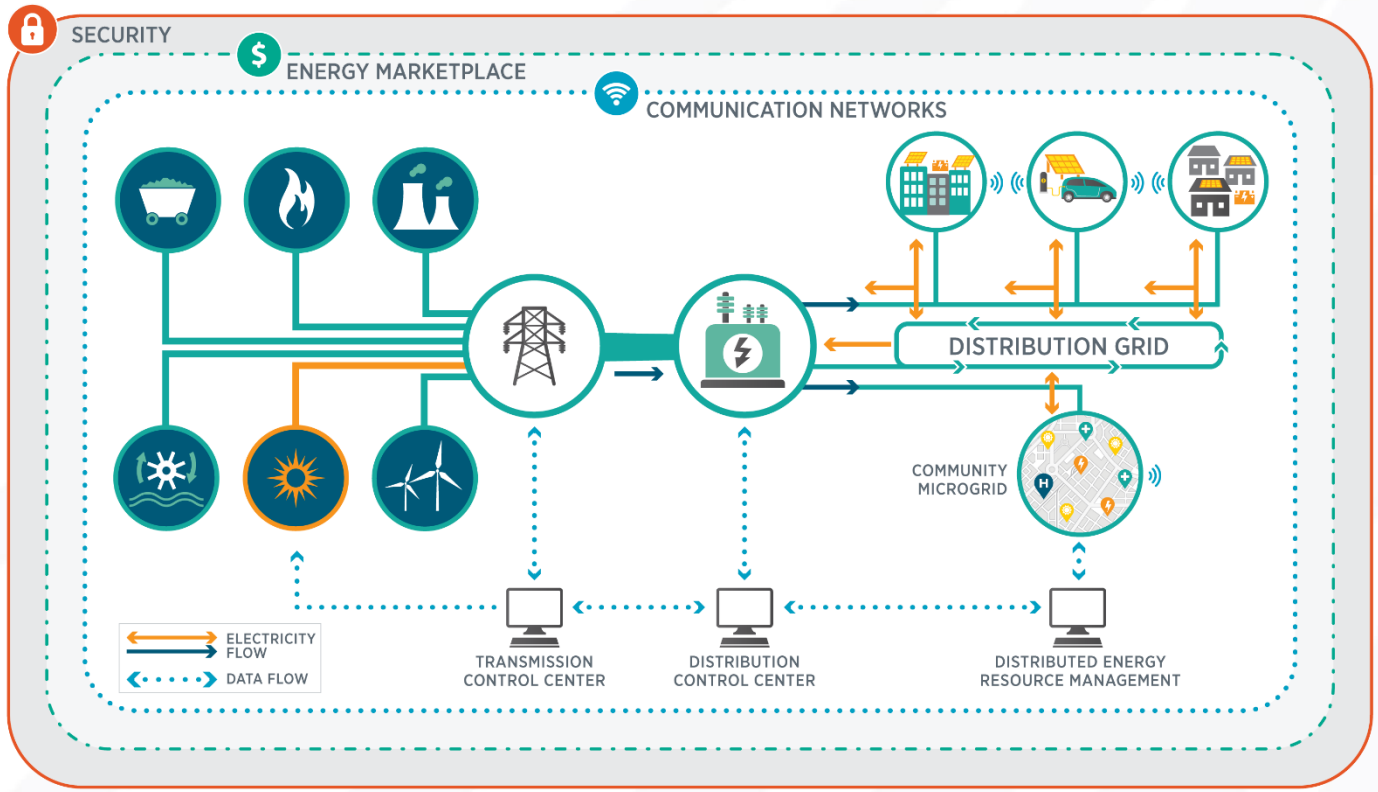
Advance solar technology to drive U.S. leadership in innovation and reductions in solar electricity costs.

Enable solar to **support grid reliability** and pair with storage to provide new options for **community resilience.**

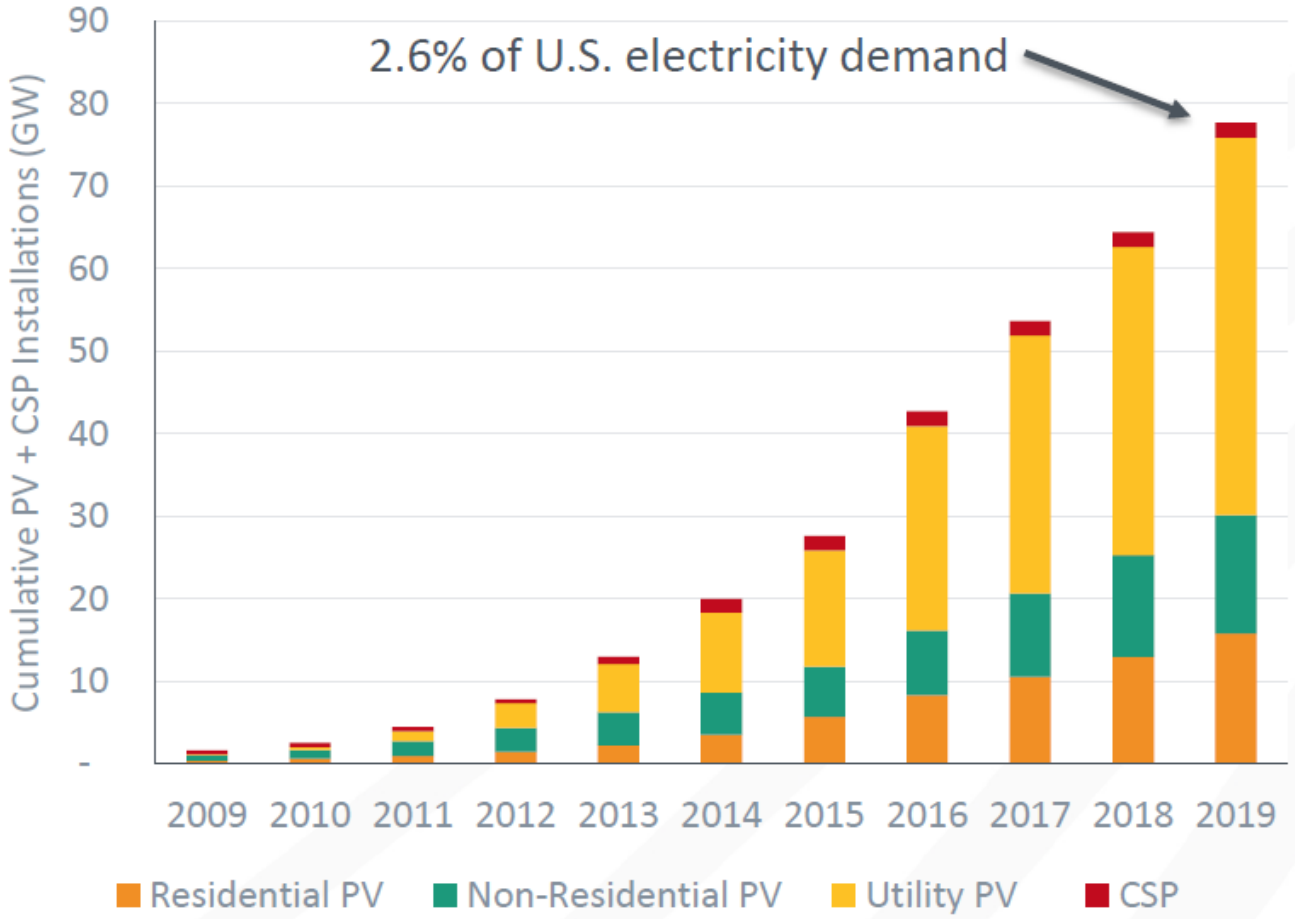
Provide **relevant and objective technical information** on solar technologies to stakeholders and decision-makers.

SETO Systems Integration (SI) Program

The Systems Integration (SI) subprogram supports early-stage research, development, and demonstration (RD&D) of technologies and solutions – focusing on technical pillars **data, analytics, control, and hardware -** that advance the **reliable, resilient, secure and affordable** integration of solar energy onto the U.S. electric grid.



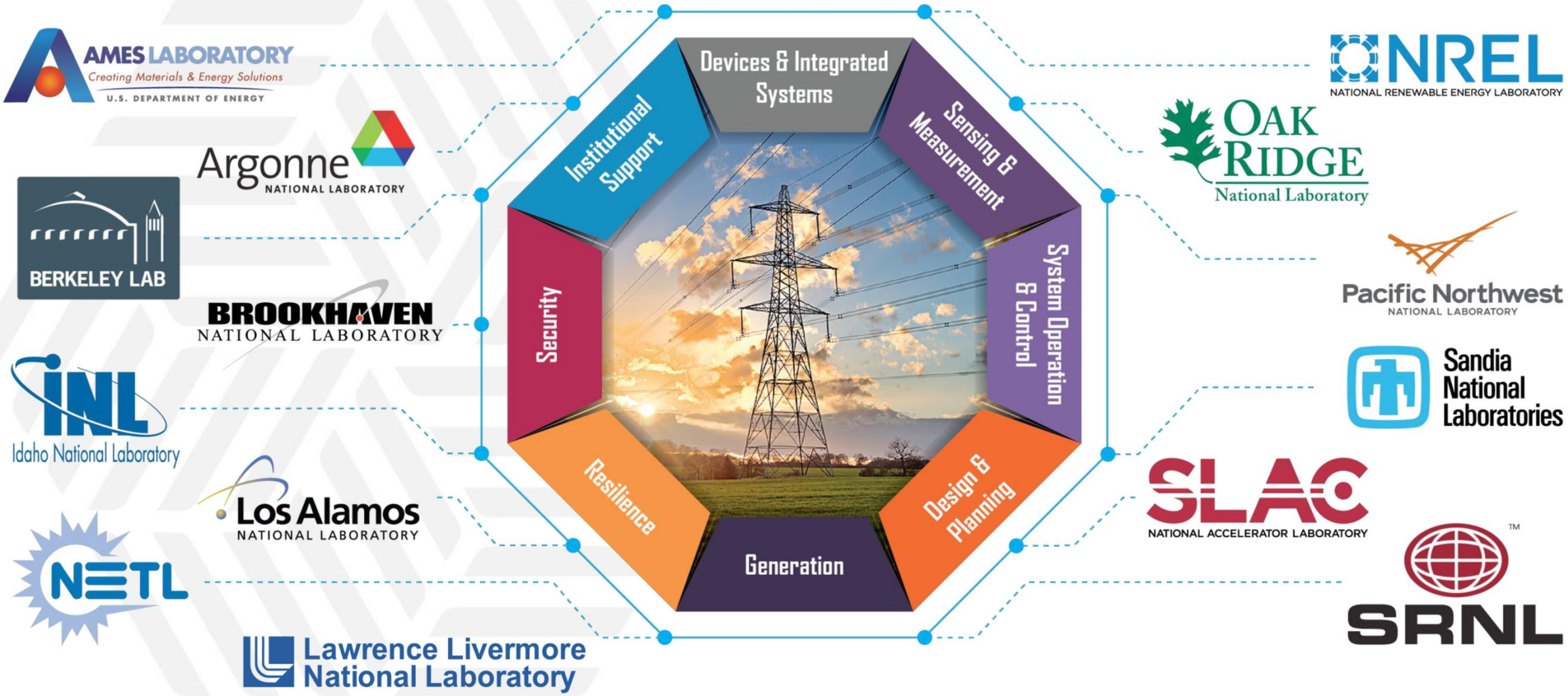
The Big Picture: Many Challenges for Solar Grid Integration



Sources: Wood Mackenzie

- Weak grid and Low inertia
- Fast dynamics of IBR
- Variability and uncertainty
- Protection
- Situation awareness
- BTW DER control
- T&D interdependence
- Cybersecurity
- Resilience
- Cost/benefit
- Institutional challenges
- And others …

SETO SI: Part of DOE's Grid Modernization Efforts



The shifting grid paradigm

- **Lower Inertia:** Power electronics-connected generation and consumption reduce the mechanical inertia in the system.
- **More Uncertain:** Uncertainties increase due to variable generation, smart loads, electric vehicles, generation and network contingencies, weather and cyber events, and hidden failures.
- **More Distributed:** The grid trends to having many small active resources such as rooftop PVs, smart appliances, and electric vehicles.

- **Responsive:** The high-speed control capabilities of power electronics present new opportunities for achieving a more ***responsive*** power grid.
- **Adaptive:** The solutions can and should make the grid more ***adaptive*** – ramping requirements, network reconfiguration, AC/DC hybrid operation and islanding at various granularities.
- **Scalable:** Small resources are more ***scalable*** through various combinations as needed, e.g. against cyber or physical disturbances and during outage recovery.

The Right Combination: Solar, Storage, and Demand Response

- Integration of Solar PV with synergistic technologies to support dispatchability and provide grid services [with focus on smaller scale (BTM) solar]
  - Storage
  - Demand Response
  - Buildings Controls
  - Electric Vehicles
- Leverage innovative compensation mechanisms and flexible interconnection approaches
- Grid services by BTM solar co-located with other DER through innovative approaches for smart control and optimization technologies

The Right Combination: Solar, Storage, and Demand Response

- 2014 SETO/SI SHINES Program
  - Consist of the solar PV plant and energy storage
  - utilize smart inverters
  - Be capable of operating in conjunction with smart loads (such as optimized operation of HVAC systems and other appliances),
  - Enable demand response
  - Incorporate solar and load forecasting into decisions
  - Be interoperable internally and externally using standard protocols that satisfy communication and control capabilities
- Small Business Innovation Research (SBIR)
  - highly competitive programs that encourage domestic small businesses to engage in Federal Research/Research and Development with the potential for commercialization

Summary

- Grid is facing challenges in lower inertia, more uncertainties, and more distributed participation, shifting to a new paradigm – responsive, adaptive, and scalable
- Grid integration of emerging resources is a system challenge and needs a system approach. All resources (solar, wind, buildings, etc.) can help, forming an energy ecosystem
- Control (in a broad sense) is at the core for grid integration, but also needs advancements in data, analytics, and hardware
- Solar+X has lots to offer to grid flexibility, reliability, and resilience (though how to manage and control the large number of devices is a challenge)