Solar Energy Technologies Office Overview

MISSION

We accelerate the **advancement** and **deployment of solar technology** in support of an **equitable** transition to a **decarbonized energy system by 2050**, starting with a decarbonized power sector by 2035

WHAT WE DO

Drive innovation in technology and soft cost reduction to make solar **affordable** and **accessible** for all Americans

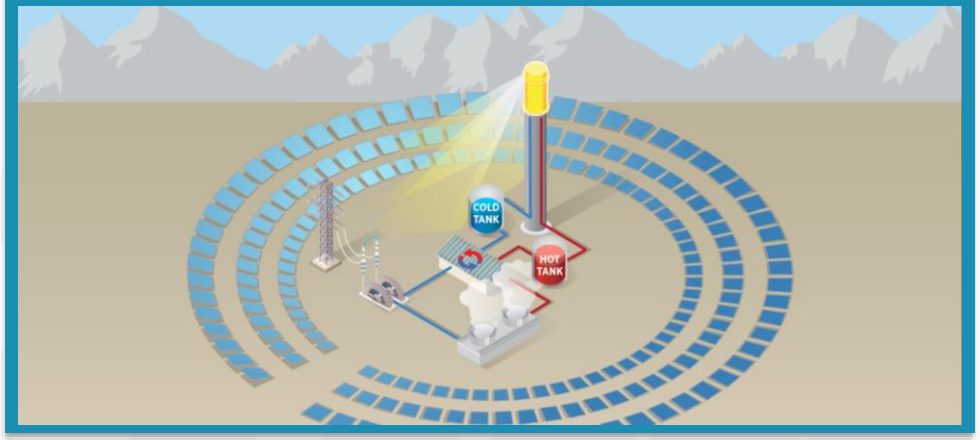
Enable solar to support the **reliability**, **resilience**, and **security** of the grid

Support **job growth**, **manufacturing**, and the **circular economy** in a wide range of applications

SETO Program Areas

PHOTOVOLTAICS

CONCENTRATING SOLAR-THERMAL POWER



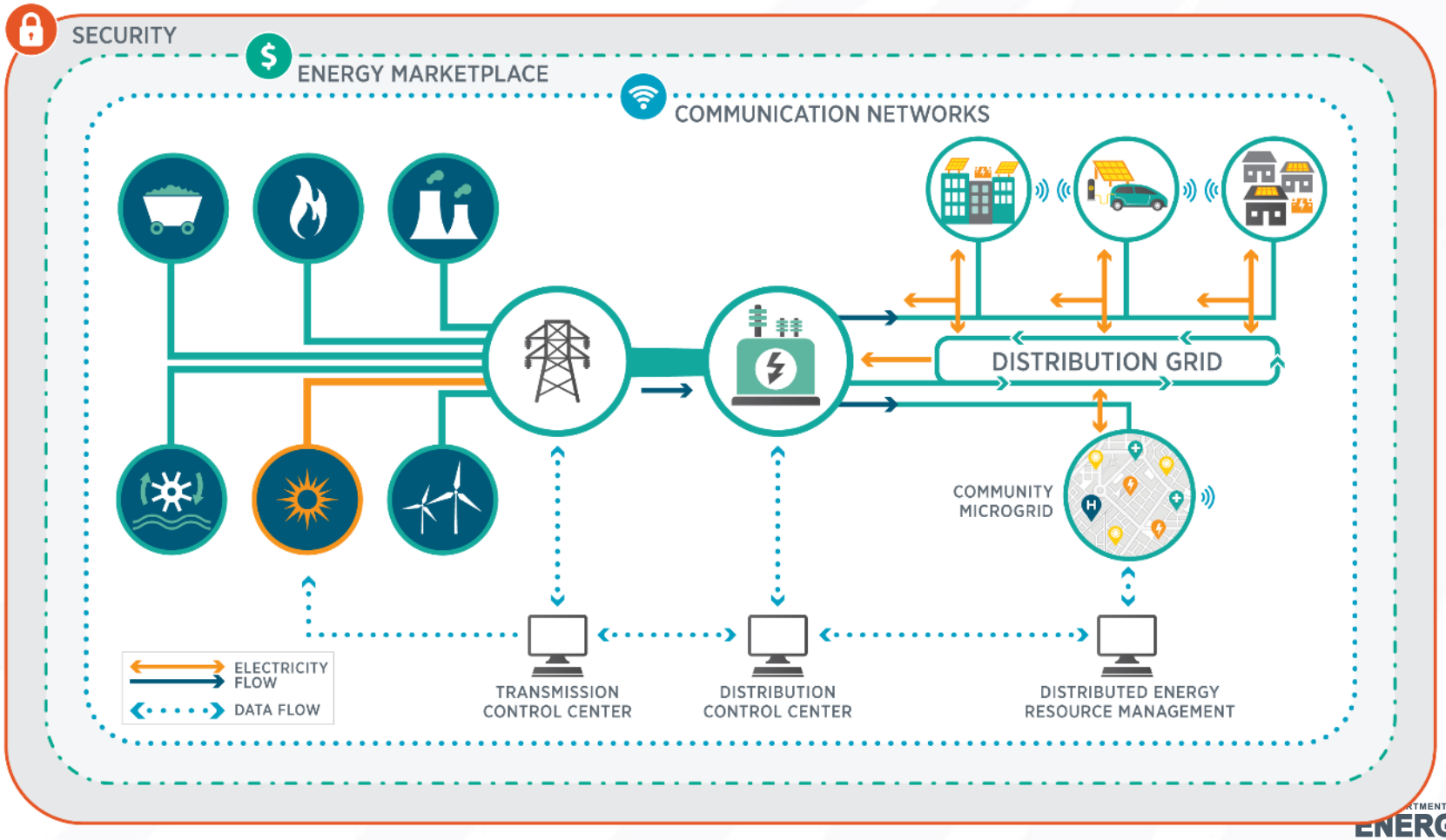
SOFT COST REDUCTION

SYSTEMS INTEGRATION

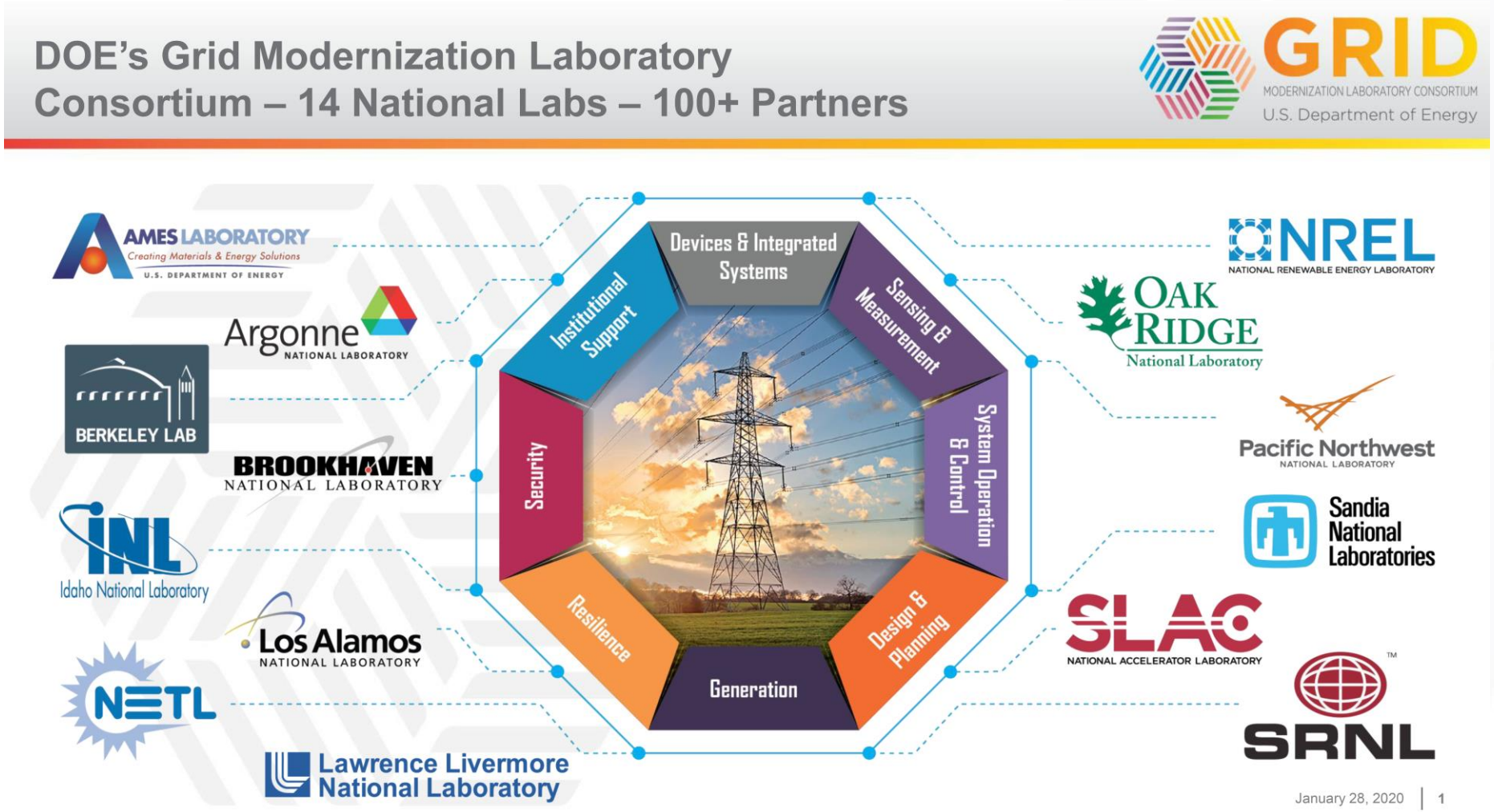
MANUFACTURING AND COMPETITIVENESS

SETO Systems Integration (SI) Program

The SI program supports research, development, and demonstration of data, analytics, controls, and hardware technologies that advance the **reliable, resilient, secure, and affordable** integration of solar energy onto the U.S. electric grid.



DOE-wide Collaboration on Grid Modernization



Solar Supporting Reliable Grid Operation

Today: PV only contributes energy to the grid; PV doesn't support all aspects of grid stability (e.g., frequency and voltage regulation)

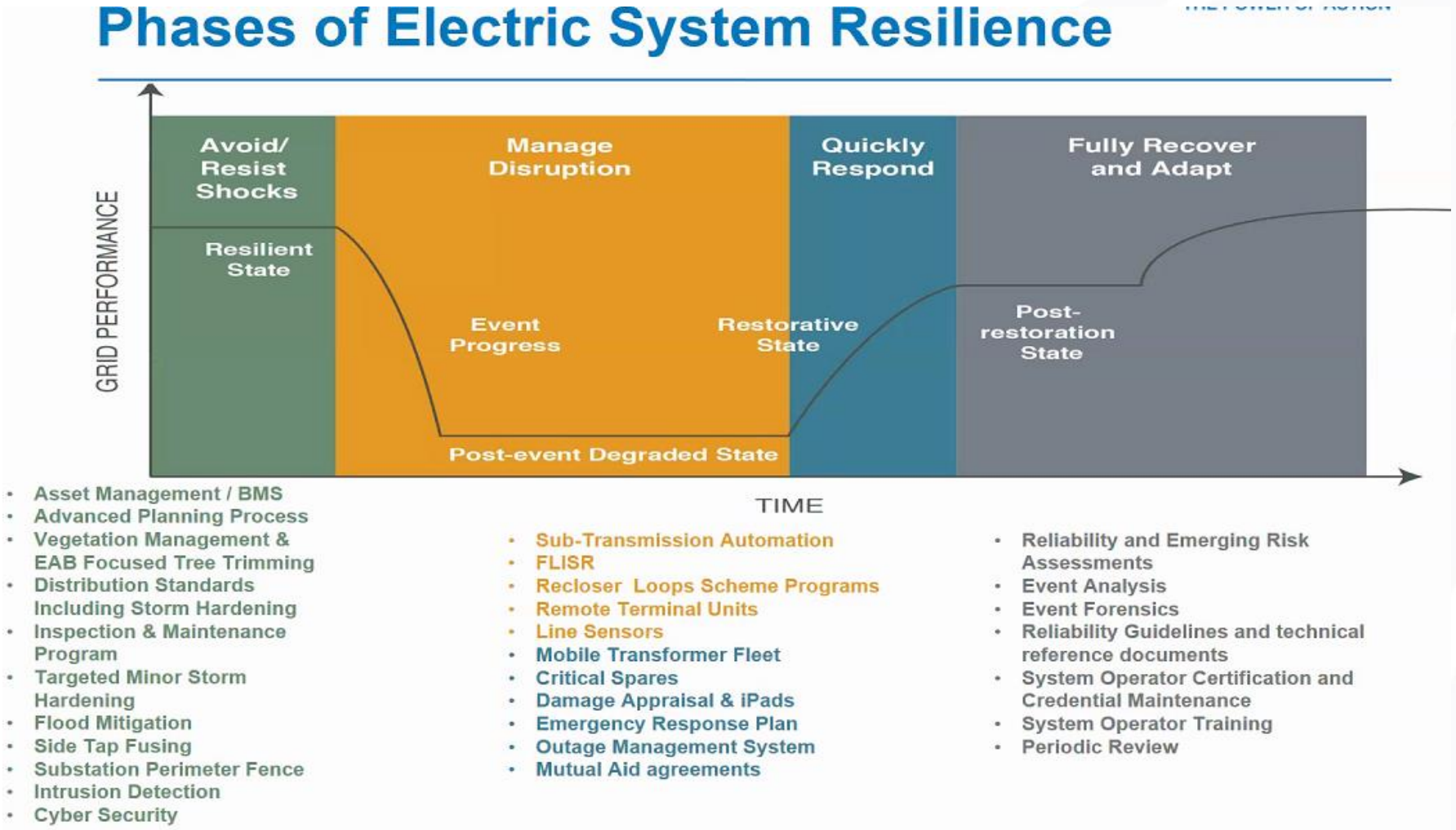
Next 5 Years: Smart PV inverters contribute essential grid reliability services like a conventional generator (e.g., frequency and voltage regulation)

Next 10 Years: Harness the fast-responding capabilities of power electronics-based generators to improve the efficiency and reliability of the grid in areas with high penetrations of wind and solar

Ongoing foundational research topics:

- PV cybersecurity
- Situational awareness
- Solar forecasting
- Integration with storage, controllable loads, and other distributed energy resources
- Distributed energy resource management systems

Designing for Resilient Systems



SNL (Jeffers, Broderick)

Solar + Storage Enhancing Grid Resilience

Today

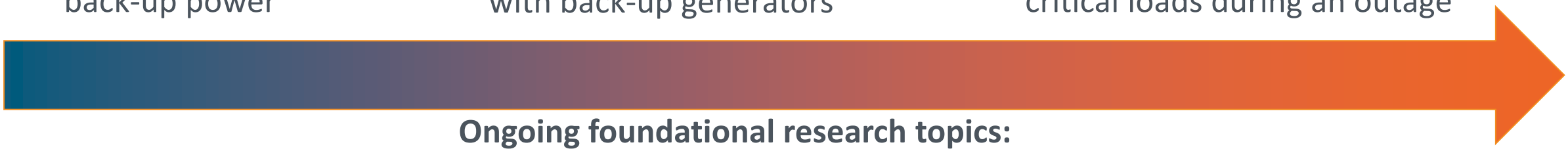
- PV + storage can power simple building loads in the event of an outage for a short period
- PV can reduce need for fuel storage for back-up power

Next 5 Years

- PV black-start capabilities validated in field trials
- PV + storage operating in microgrid mode for longer durations
- PV can provide significant fuel savings compared with back-up generators

Next 10-15 Years

- PV + storage black-start solutions adopted to start up microgrids in the event of an electricity outage
- New design and control capabilities enable grid reconfiguration to supply critical loads during an outage

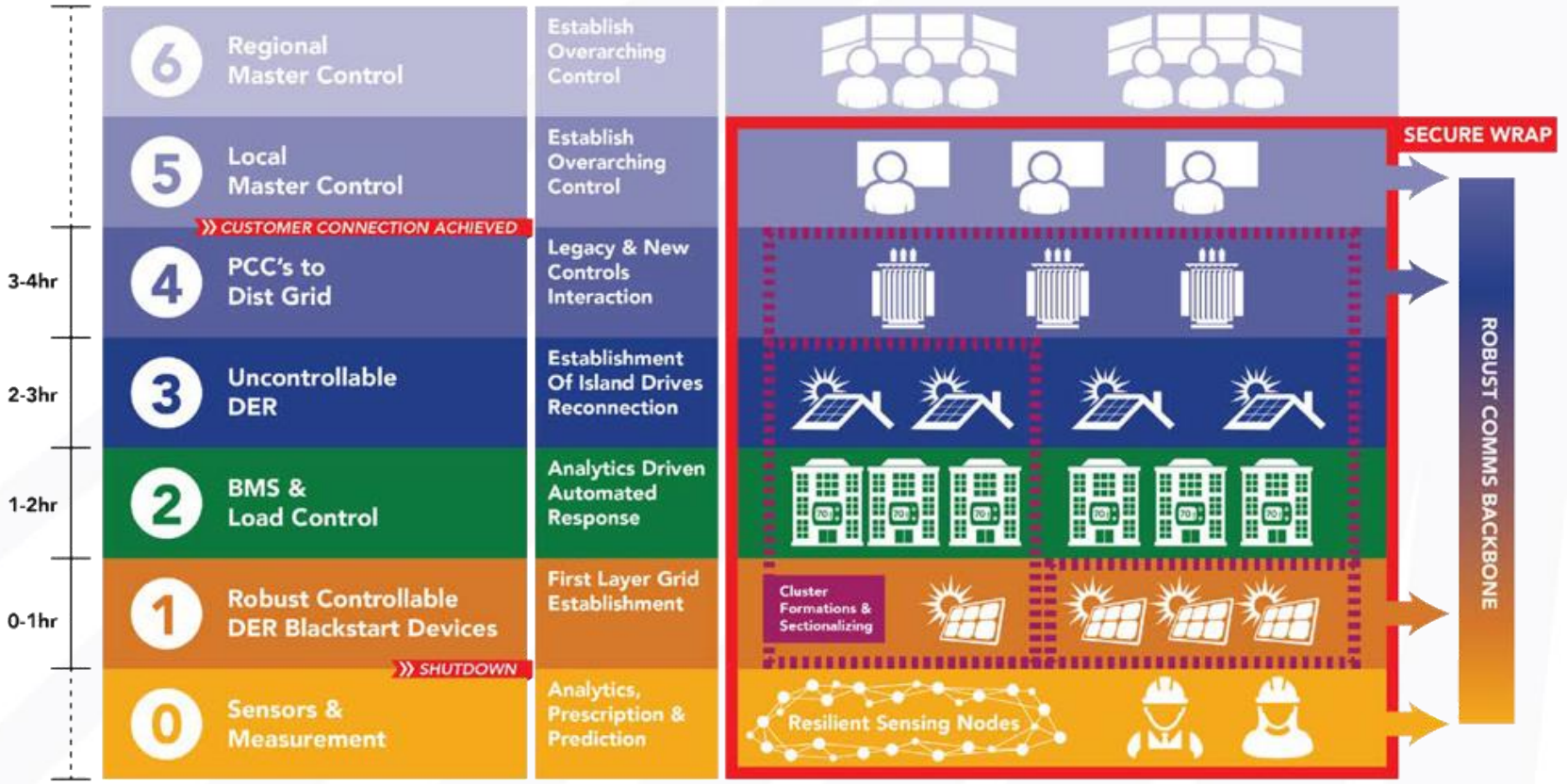


Ongoing foundational research topics:

- PV cybersecurity
- Solar forecasting
- Control optimization algorithms
- Integration with storage, controllable loads, and other distributed energy resources
- Distributed energy resource management systems

GMLC-RDS: CleanStart DERMS (LLNL)

- Approach: Achieve black start and restoration objectives through combination and application of advanced co-simulation and architecture design, measurement and analytics, controls and optimization, communications and cyber security
- TD&C co-simulation planning tools will be used to design, validate and evaluate CSDERMS controls and scale up results for metrics and impact



- Distinctive characteristics
  - Development of dynamic ad-hoc microgrids, which form around resilience objectives integrating both traditional and non traditional DER
  - Solves critical problems for partner utilities yet applicable throughout the nation at similar facilities

Building Resilient Power System in Puerto Rico

Objective: DOE Office of Electricity and SETO have tasked national laboratories to perform near-, medium-, and long-term modeling activities to support the rebuilding of a more resilient electric power grid system in Puerto Rico after the devastation of Hurricane Maria in late September 2017.

Phase 2 Approach:

1. Build on insight from research in Hawaii and elsewhere
2. Develop integrated portfolio
3. Rigorous modeling and analysis
4. Broad stakeholder engagement (federal, state, local community, and industry)

Fuels/Interdependencies
- LNG Infrastructure
- Telecom Infrastructure
- Solar Resource and Supply Curves

Bulk Power System
- Investment Support Tools
- Capacity Expansion Modeling (AURORA)
- Production Cost Modeling (FESTIV)
- System Stability Modeling (Epfast)
- Dynamic Modeling (MAFRIT)

Transmission
- Protection and R/T Info
- Risk-Based Contingency Analysis
- Grid Asset Benefit-Cost Evaluations

Distribution & Edge
- System Advisory Model & PVWatts
- DER Interconnection Standards
- DER Feeder Hosting Methodology
- Contingencies, Operations, and Storage Sizing for Islandable Sections
- GIS Resiliency Improvement Tool

Lead Lab Key:
- ANL
- NREL
- ORNL
- PNNL
- SNL

QUESTIONS?