

Operation and Planning Tools for Inverter-Based Resource Management and Availability for Future Power Systems (OPTIMA)

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Solar Energy Technologies Office (SETO) Overview

MISSION

We accelerate the **advancement** and **deployment of solar technology** in support of an **equitable** transition to a **decarbonized economy no later than 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 Systems Integration Program

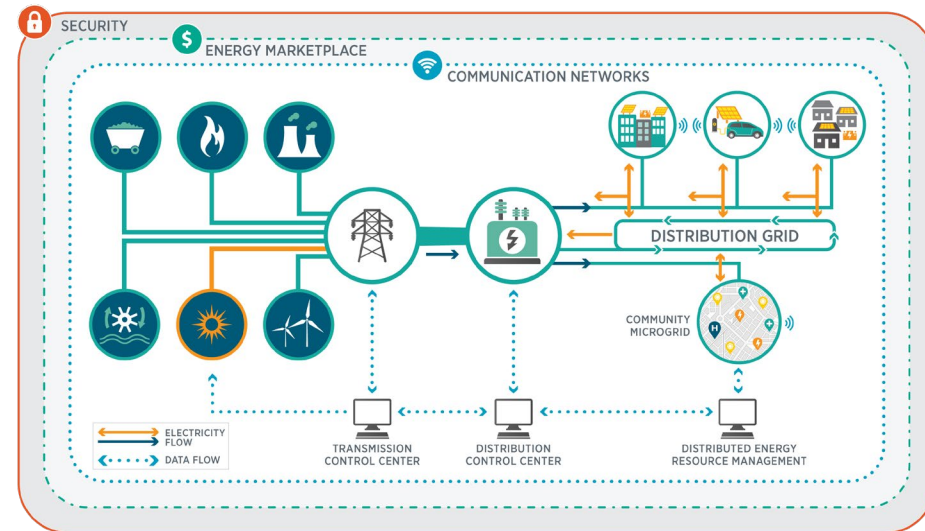
The Systems Integration (SI) subprogram supports early-stage research, development, and demonstration (RD&D) of technologies and solutions – focusing on technical pillars **data**, **analytics**, **control**, and **hardware** - that advance the **reliable, resilient, secure and affordable** integration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

System Planning

System Operations

System and Community Resilience

Solar and DER Cybersecurity



Achieving 100% Decarbonized Power System

Changing Energy Landscape

Regional operation nearing 100% IBR operation



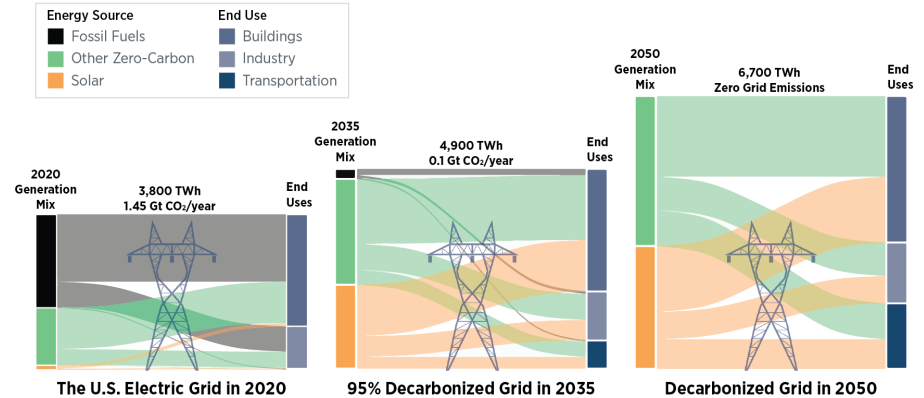
Diurnal changes in resource mix and varying source dynamics



Increased uncertainty in operations



Inadequate operator tools to handle increased need for flexibility

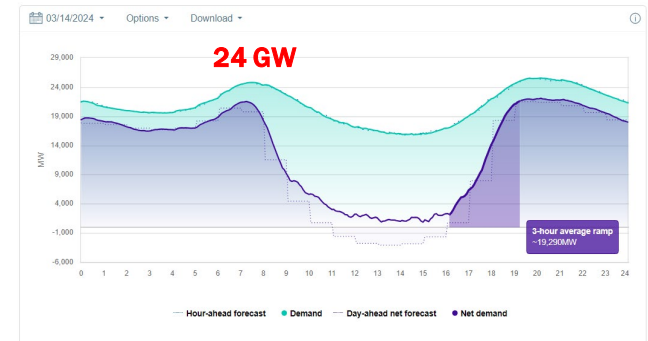


Wind + Solar
~100%

March 14, 2024
 Load 16.5 GW
 Solar 12.5 GW
 Wind 3.5 GW
Wind + Solar ~100%

Net demand trend

System demand minus wind and solar, in 5-minute increments, compared to total system and forecasted demand.



Opportunities to Address IBR Challenges

CHALLENGES

High variable renewable generation and low situational awareness

Operating near 100% IBR Sources

Varying Dynamics of Resource Mix

Faster Dynamics & Complexity from IBR

OPPORTUNITIES

Flexible controls for grid operators

- Probabilistic forecasts and dispatch
- Incorporating GETs
- Visualize/control DER at BPS & Distribution

Ensure Grid Strength and Reliability

- Stabilizing, grid-forming inverters
- Emerging sources grid services
- Adequate protection

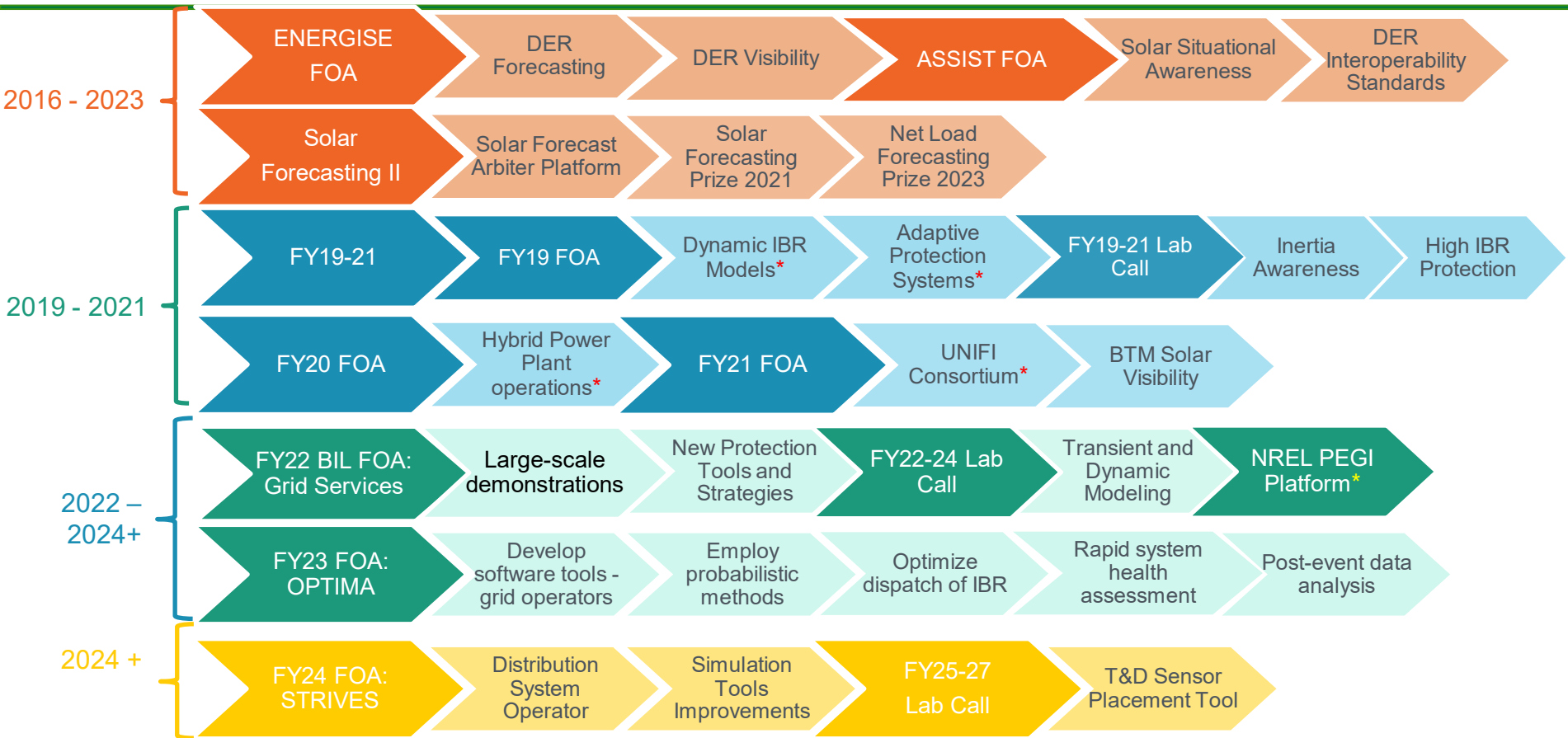
Ensure Grid Strength/Inertia

- Inertia estimation and support
- Adaptive protection systems

Improved software tools

- Real-time instability identification
- Large data aggregation and analysis
- Improved dynamic analysis tools

SETO: Grid Operations Efforts



Full applications due Oct 17th

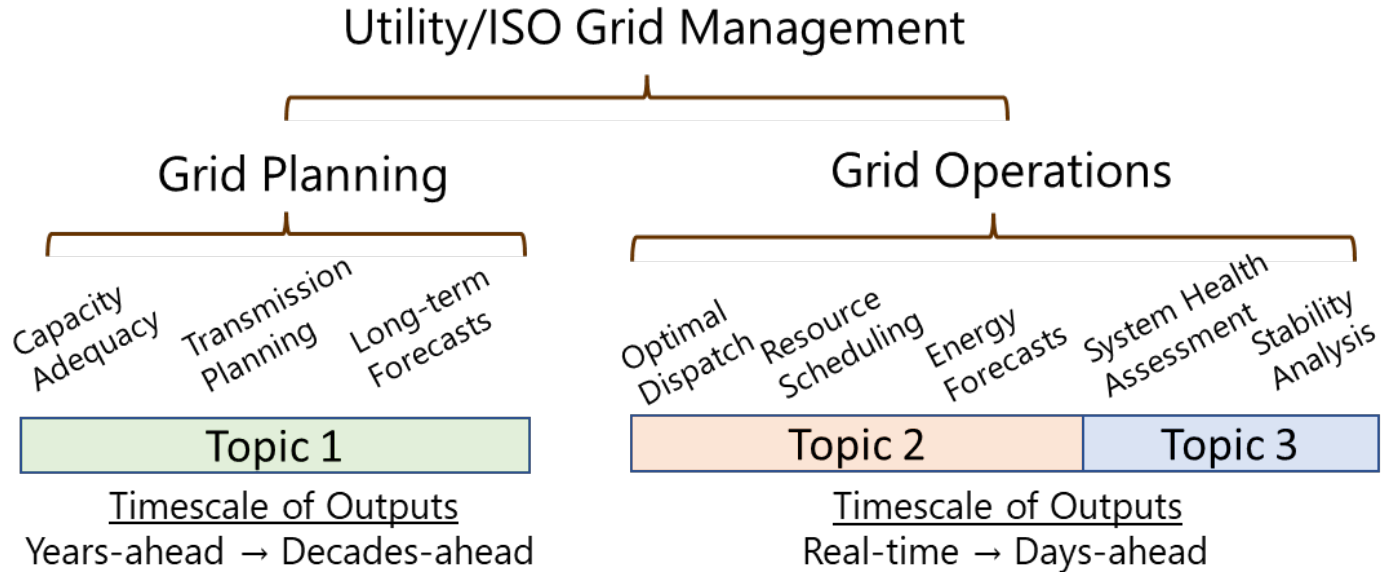


SOLAR Funding Program

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

Operation and
Planning Tools for
IBR Management and
Assurance in Future
Power (OPTIMA)

Grid Planning vs Operations



- Planning and operations studies will often use the same tools
- No need to silo expertise in one category

OPTIMA Research Areas

Topic 1. Planning Tools for Future Power Systems

- New tools and methods to incorporate VRE, IBRs, and DERs.
- Improve BPS long term planning
- Impacts of cascading disturbances.
- Accurate modeling and estimation of aggregated DERs in system net loads

Topic 2. Variability Management in Grid Operations

- New tools for grid operators to optimally utilize and control large-scale transmission connected VREs and large numbers of DERs
- BPS dispatch or resources and services.
- Solutions at the distribution or aggregator level to improve real time dispatchability and utilization of VREs.

Topic 3. Rapid System Health and Risk Assessment Tools for Grid Operators

- New tools for grid operators, data and communications systems that support them to identify and mitigate emerging system risks driven by faster dynamics and uncertain control interactions or IBRs.
- Data ingestion from multiple data sources.
- Labeled data sets for quick analysis improving situational awareness.
- Visualization tools to accurately estimate system state.

Awards

| Topic | Awardee | Project Title |
|-------|---|--|
| 1 | Florida International University | Advanced Methods for Integrating Renewables in Grid Planning (ADMIRE-GridPlan) |
| | Washington State University | Planning Tools for Managing Uncertainties in Future Power Grids |
| 2 | Georgia Institute of Technology | ENVELOPE: Energy Variability and Electricity Optimization Using Stochastic Operational Envelopes |
| | Iowa State University | Modernizing Operation and Decision-Making Tools Enabling Resource Management in Stochastic Environment (MODERNISE) |
| | Midcontinent Independent System Operator (MISO) | Operations Risk Platform for Risk Assessment and Control Room Operations |
| | National Renewable Energy Laboratory | Coordinated Operation for Renewable Energy Dominant Transmission Grids (CORRECT) |
| | National Renewable Energy Laboratory | Digital Twin Addressing Multi-Scale Operational Needs of IBR-rich Grids (DIAMOND) |
| 3 | Arizona State University | DASH-IBR: Dynamic Assessment of System Health for IBR-dominant Power Systems |
| | Oak Ridge National Laboratory | Enhanced Observability of Power Grids |
| | Pacific Northwest National Laboratory | Wave Apps: Distributed Waveform Analysis Platform for Grid Operation Applications |
| | Quanta Technology | Grid Operator Analytics and Assessment Tools for IBRs Dominated Grid (GOAT-IBR) |
| | University of South Florida | SPRING: Stability Predication for IBR-Penetrated Grids Enabled by Digital Twins |

Summary

- Research efforts are targeting challenges related to planning, operations and reliability of power systems with high penetration of inverter-based resources and distributed energy resources.
- New tools, techniques and long-term demonstrations are needed to fully utilize the potential of solar and solar + systems to support grid reliability.
- The clean energy transition is introducing new techniques and tools, in addition to new stakeholders who will play a role in grid operations and services ensuring systems reliability, resilience and security.

Thank you!

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