

Grid Modernization Initiative (GMI)

Briefing to the State Energy Advisory Board (STEAB)

KEVIN LYNN

- ▶ Overview of the Grid Modernization Initiative
- ▶ Overview of the Grid Modernization Lab Call (2016)
- ▶ Results from the Grid Modernization Peer Review
- ▶ Lab Call: Resilient Distribution Systems (2017)
- ▶ Investigating Cybersecurity in EERE
- ▶ Beyond Levelized Cost of Energy (BLCOE)

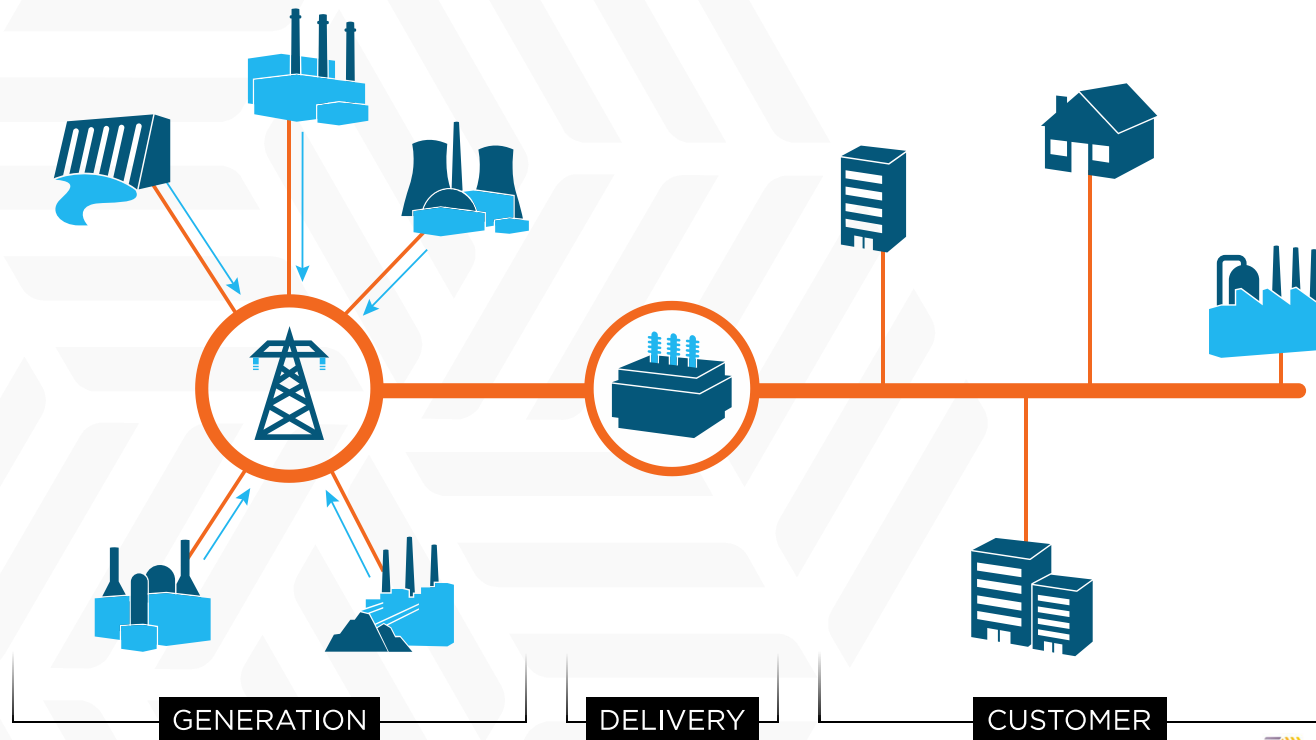
Questions for STEAB



- ▶ 1) What are the most important grid modernization challenges you are facing today?
- ▶ 2) How can DOE help address those challenges?

The 20th Century Grid

The grid is one of the greatest engineering achievements of the last century



Drivers of Change

Why do we need grid modernization?



New Market Opportunities



Security Threats



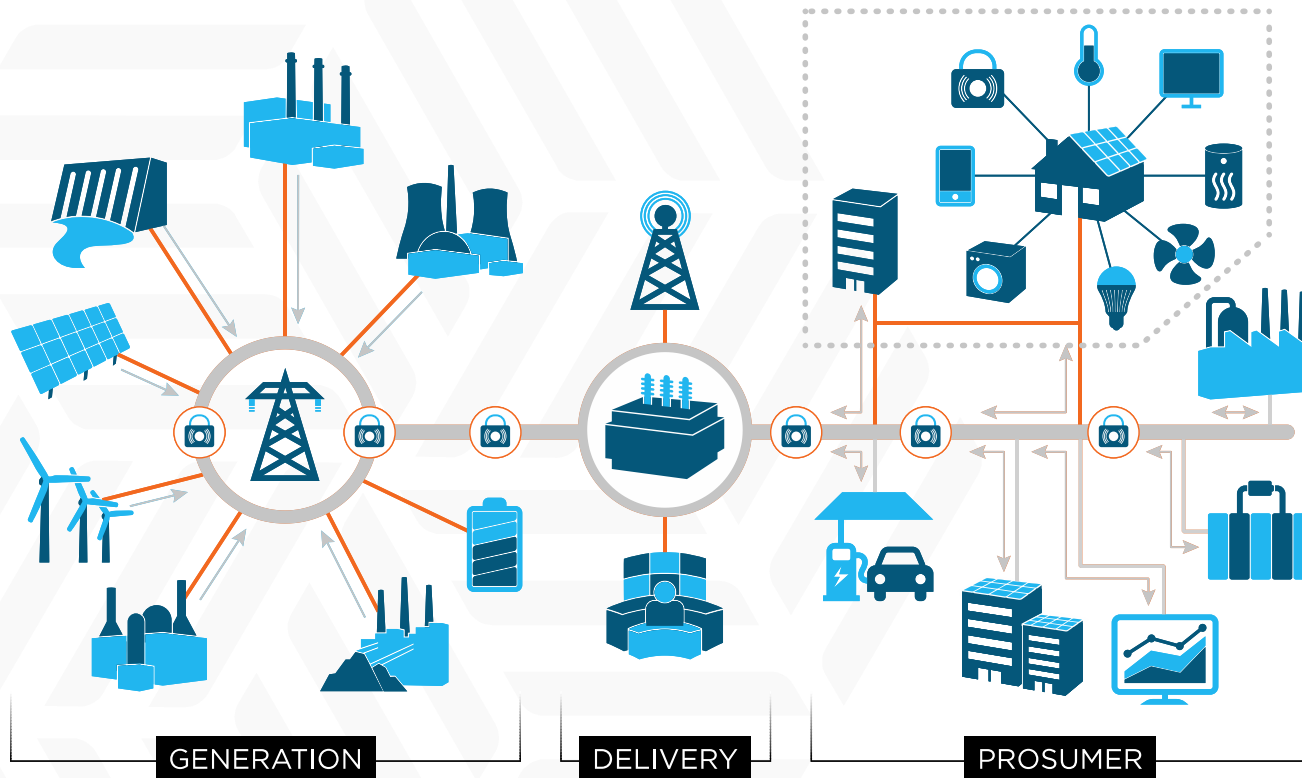
Extreme Events



Changing Supply Mix

Creating a 21st Century Grid

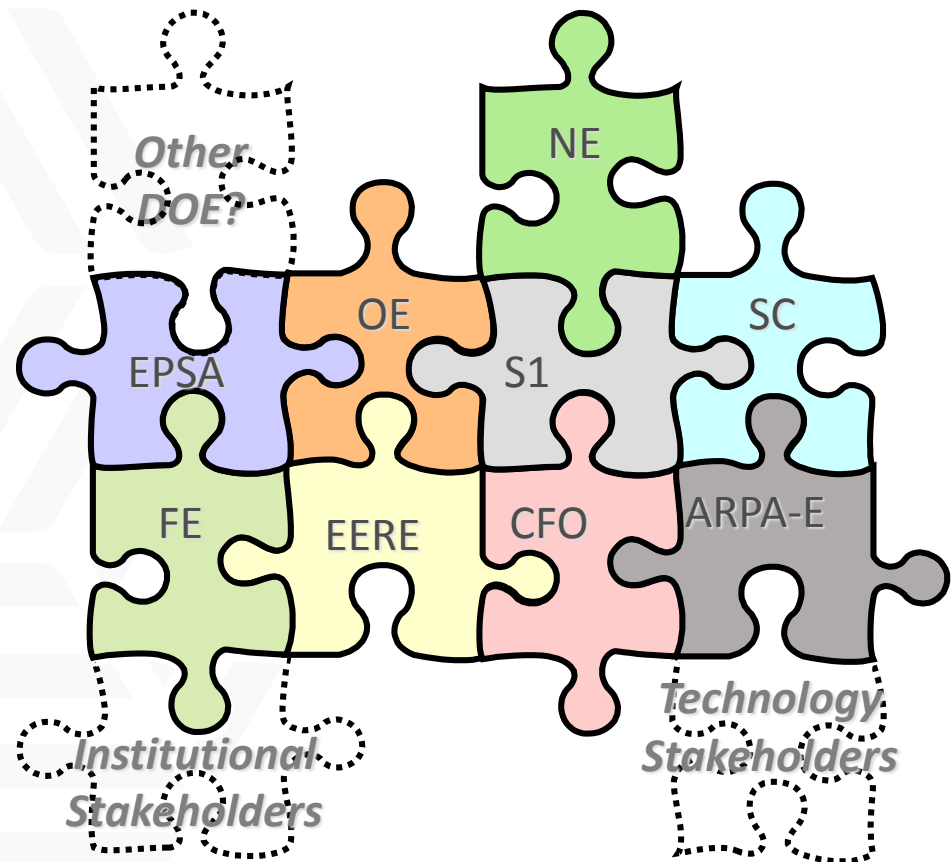
Responding to the drivers of change



Grid Modernization Initiative

An aggressive and urgent five-year grid modernization strategy for the Department of Energy that includes

- Alignment of the existing base activities among the Offices
- An integrated Multi-Year Program Plan (MYPP)
- New activities to fill major gaps in existing base
- Development of a laboratory consortium with core scientific abilities and regional outreach



Grid Modernization Laboratory Consortium



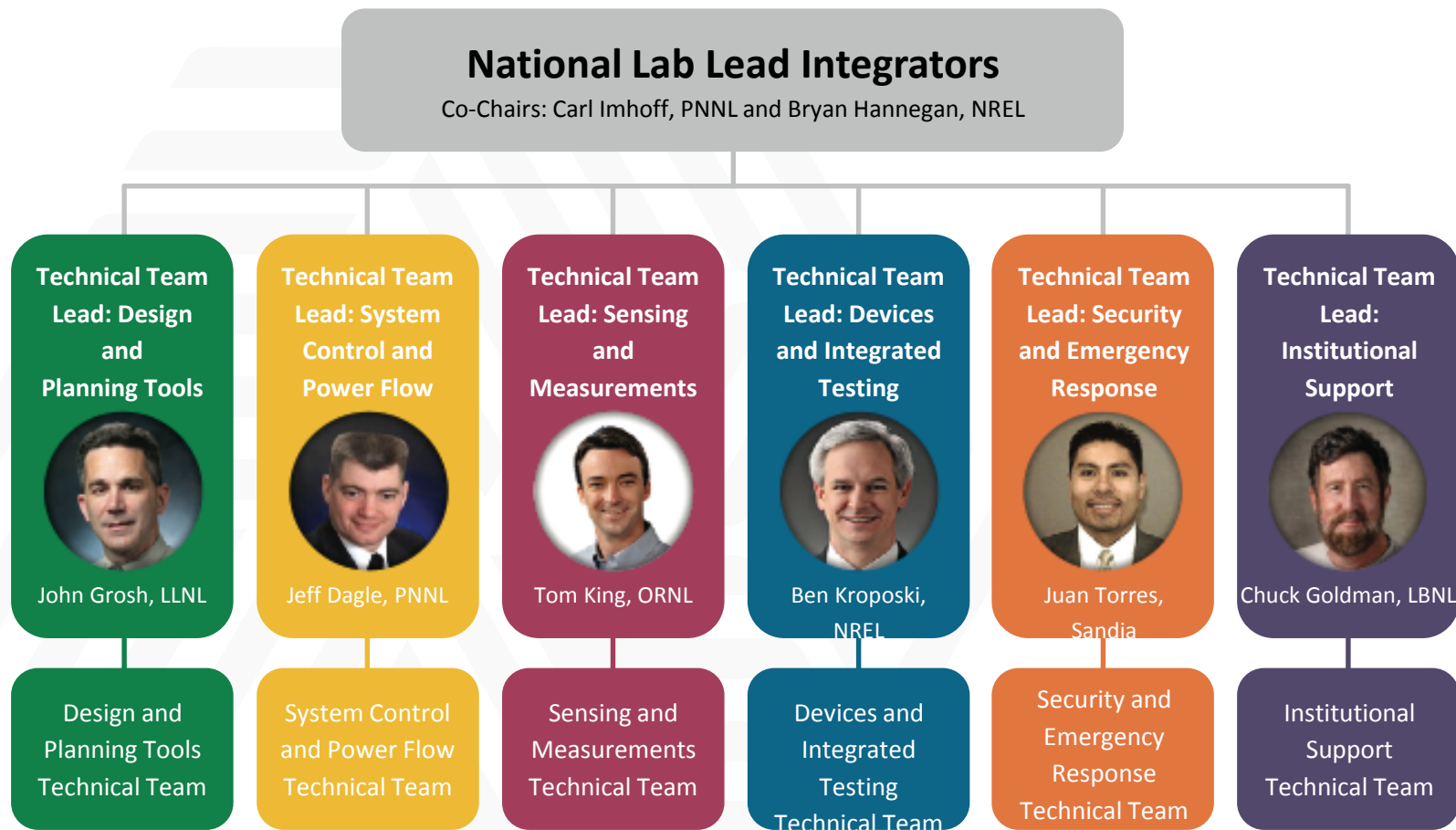
Move from a collection of DOE and lab projects to a DOE-Lab Consortium Model that integrates and coordinates laboratory expertise and facilities to best advance DOE Grid Modernization goals.

Efficiency, Synergy, Collaboration, Acceleration



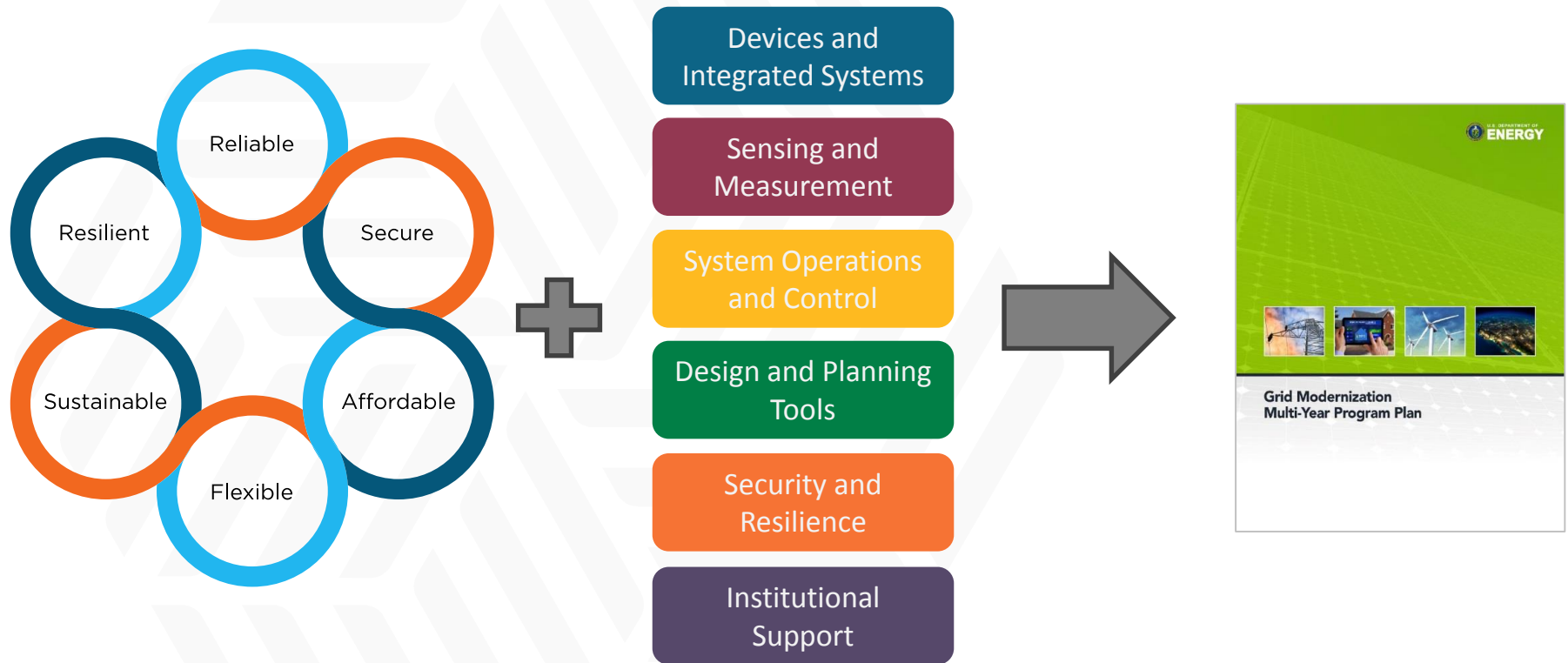
GRID
MODERNIZATION
LABORATORY
CONSORTIUM
U.S. Department of Energy

GMLC Structure Supporting the MYPP



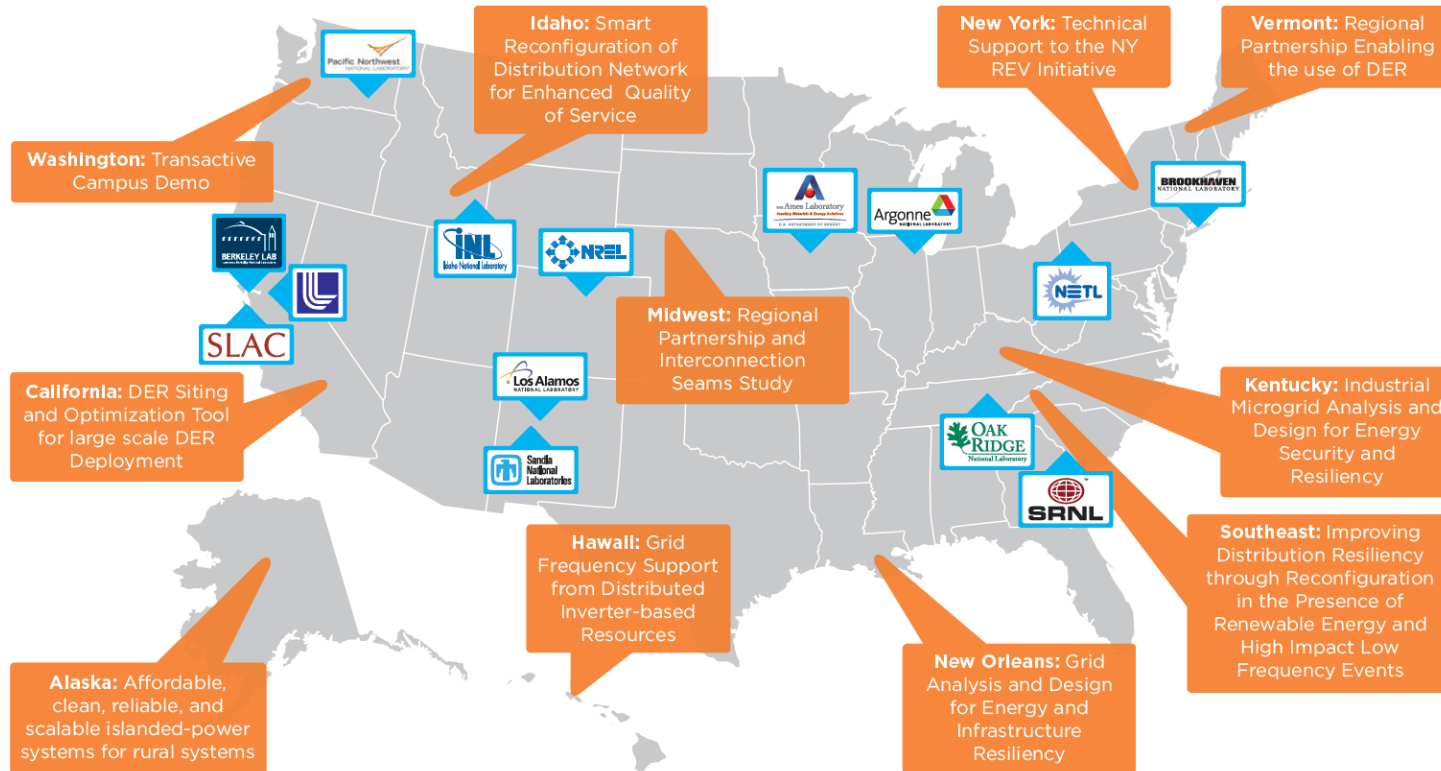
Lab leads coordinate teams and projects across the GMLC to ensure DOE and the national laboratories are meeting the goals in the multiyear plan.

Grid Modernization Multi-Year Program Plan



Grid Modernization Lab Call 2016

Working across the country



- Up to \$220M
- 88 projects
- 13 national laboratories
- 150+ partners

A Sample of our Project Partners



MYPP Integrated Technical Thrusts



Technology Innovation

Design and Planning Tools

- Create grid planning tools that integrate transmission and distribution and system dynamics over a variety of time and spatial scales

System Operations, Power Flow, and Control

- Design and implement a new grid architecture that coordinates and controls millions of devices and integrates with energy management systems

Sensing and Measurements

- Incorporates information and communications technologies and advances low-cost sensors, analytics, and visualizations that enable 100% observability

Devices and Integrated Systems

- Develop new devices to increase grid services and utilization and validate high levels of DER at multiple scales

Security and Resilience

- Develop resilient and advanced security (cyber and physical) solutions and real-time incident response capabilities for emerging technologies and systems

Institutional Support

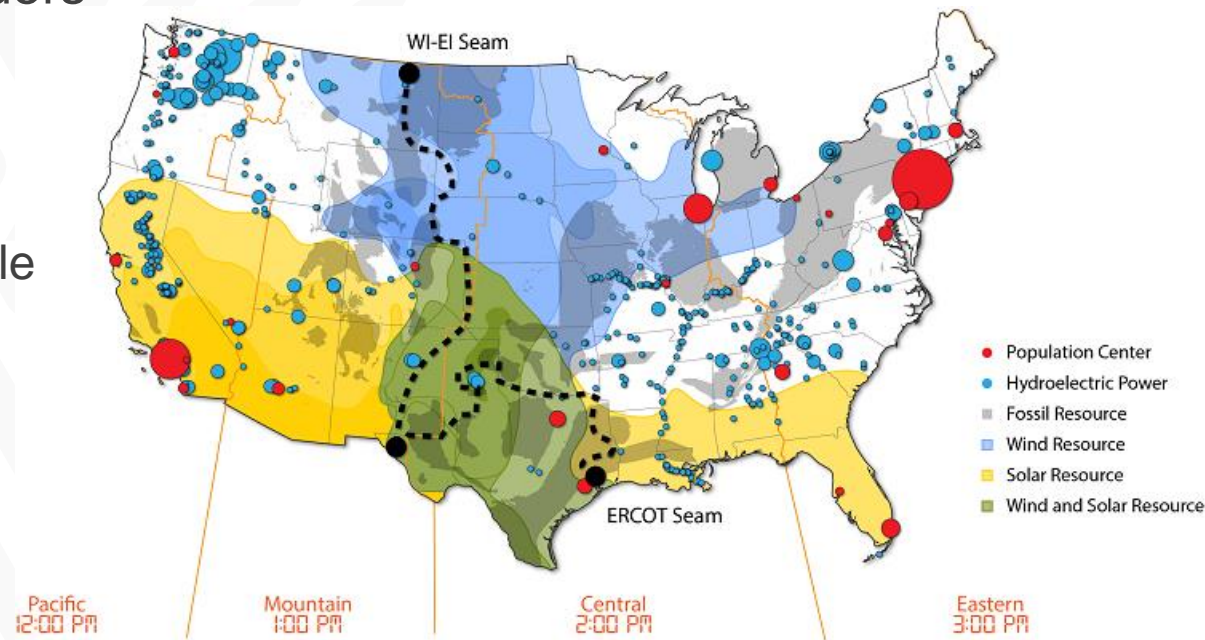
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INTERCONNECTION SEAMS STUDY

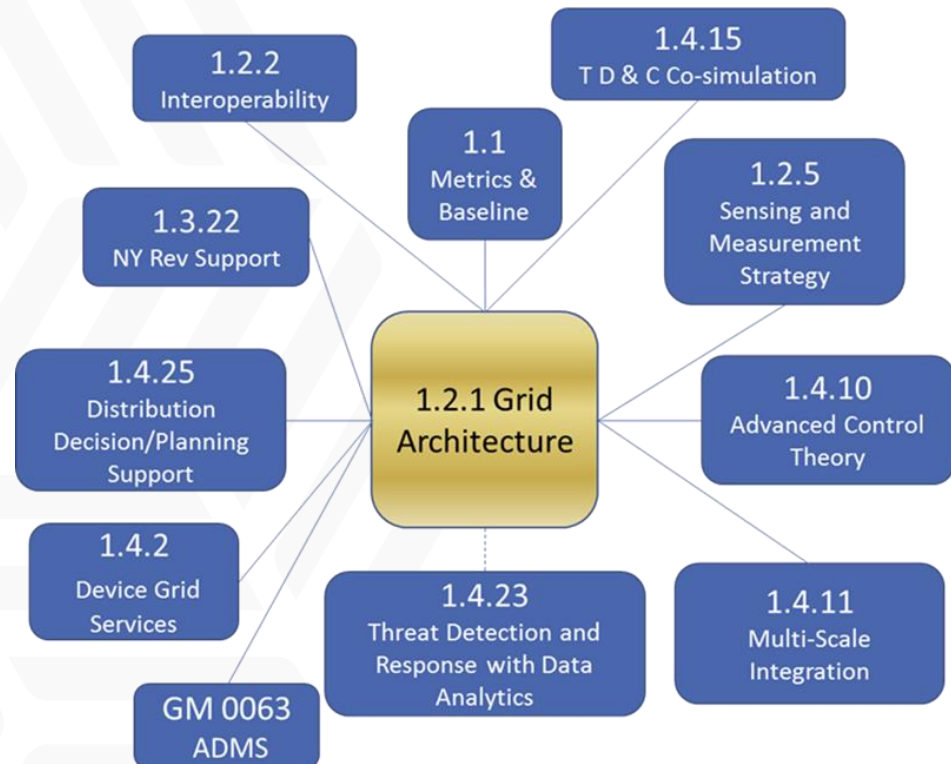
Design and Planning Tools



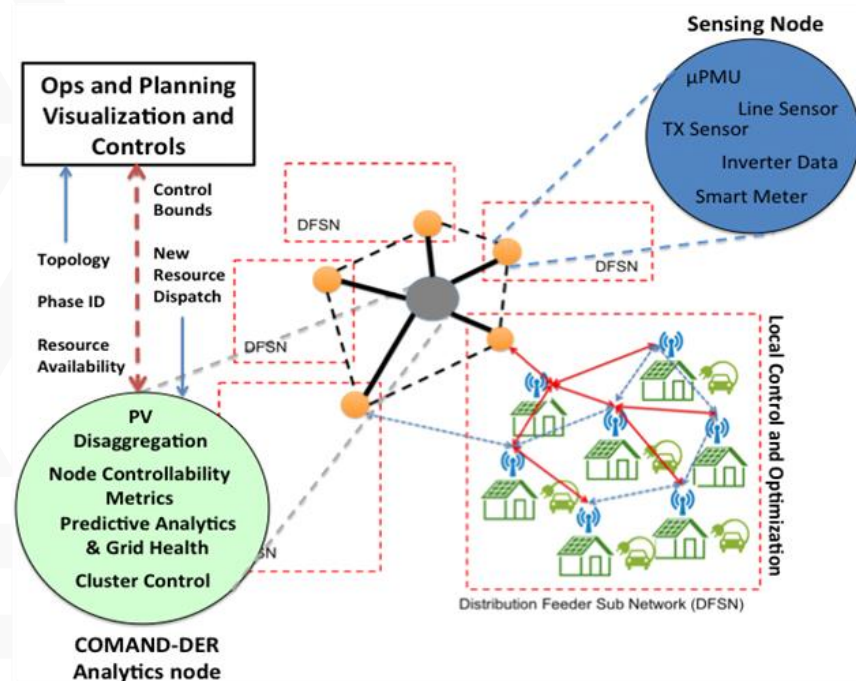
- ▶ Wide-area study of the reliability and efficiency of 4 transmission futures.
- ▶ Leverages state-of-the-art data, HPC, and stakeholders across the country.
- ▶ Great synergy to other projects:
 - North American Renewable Integration Study
 - Production Cost Modeling
- ▶ Partnerships with MISO, SPP, WAPA. SPP and MISO interested in doing further work.



- ▶ Working on the application of system architecture, network theory, and related disciplines to the entire grid.
- ▶ Principles and guidelines to grid architecture with scenarios, prioritization, and reference models
- ▶ Stakeholder driven: common shared terms with EPRI, SGIP, and others



- ▶ Develop and demonstrate distributed analytics solutions to building-grid challenges, leveraging multi-scale data sets, from both sides of the meter.
- ▶ Evaluate and demonstrate the application of machine learning to create actionable information for grid and building operators.
- ▶ Enable the transition from data to actionable information at the building to grid interface.



Virtual Battery Storage

Research focus: Existing residential and commercial building infrastructure, such as water heaters, refrigerated warehouses, and air conditioning units, are possible energy management resources, with potential flexibility in the timing of their power consumption. This project will investigate a software-based solution for existing infrastructure to serve as a lower-cost, smaller-scale virtual storage resource

Key Activities

- Understand the capacity of virtual storage systems
- Provide characterization of methods and decision-support tools for building owners and utilities.
- Develop algorithms to control the resources
- Integrated in the VOLTRRON platform, which coordinates energy use between the grid and a building's system.

Expected Outcomes

- Preliminary capacity analysis found a potential of 81 GW of flexible energy storage – 10 percent of national generation capacity.
- The findings also show roughly three times the savings to the customer or building owner.



Buildings and infrastructure, such as HVAC units, can serve as energy storage systems.

Partners

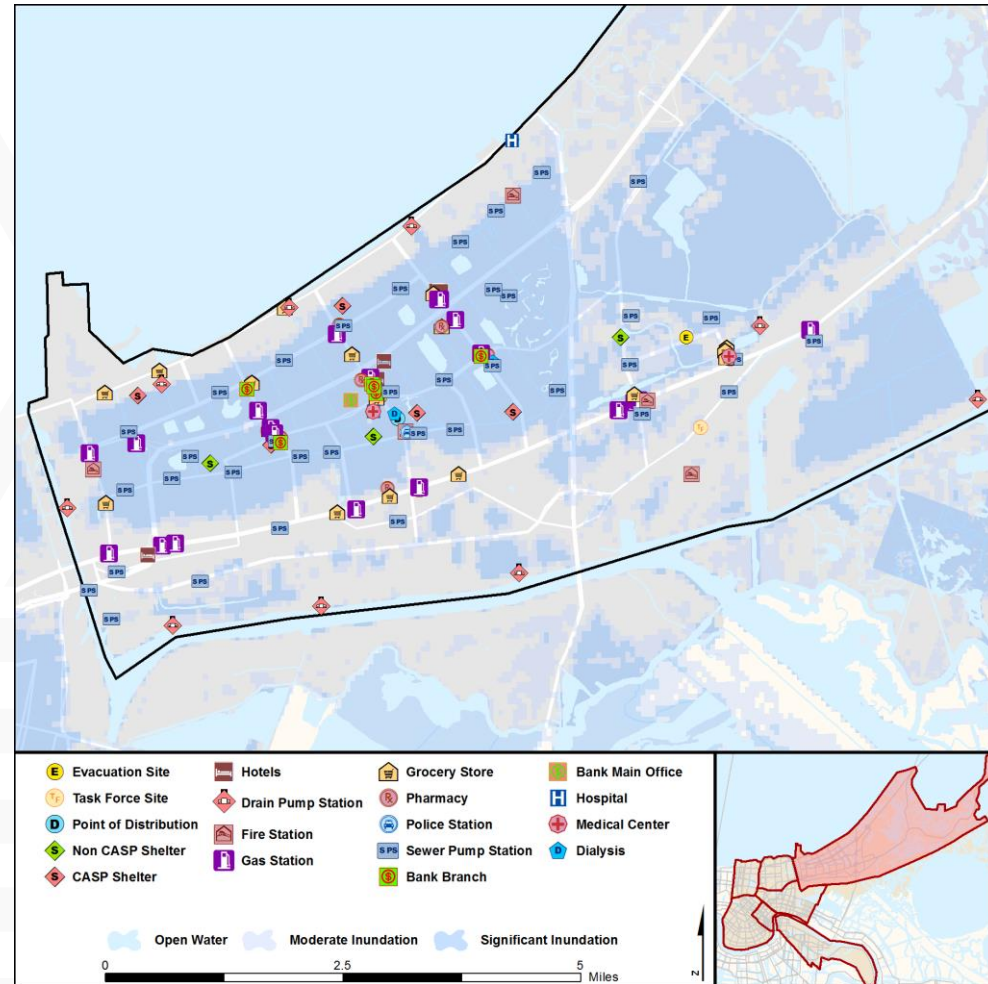
- University of Florida
- United Technologies Research Center
- Tennessee Valley Authority

INFRASTRUCTURE RESILIENCE IN NOLA

Security and Resilience



- Focused on enhancing grid resilience in order to improve overall community resilience. Reduction of cost and effort for system integration; improved performance, efficiency, and security.
- Project show how investments in the grid, namely *microgrids*, improve community resilience, and how these investments can be prioritized.

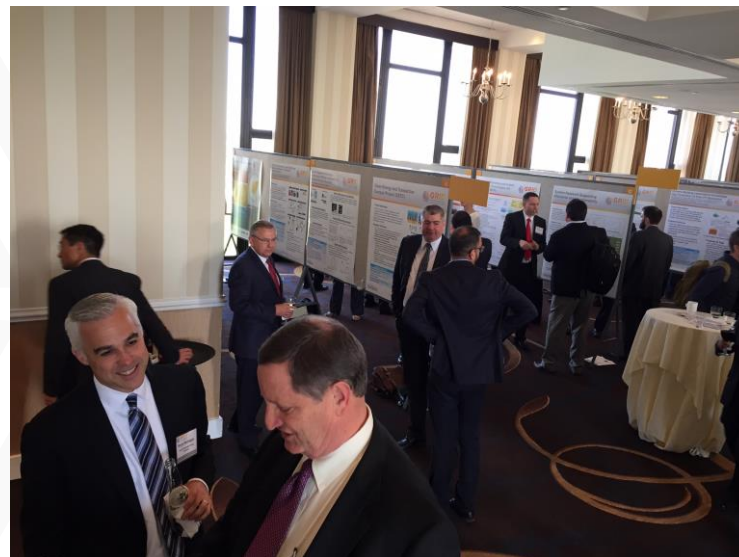


- ▶ Provide technical assistance and analysis for public utility commissions (PUCs) and a series of reports with multiple perspectives on evolving utility regulation and ratemaking, utility business models and electricity markets:
 - Adapting to new technologies and services
 - Assessing potential financial impacts on utility shareholders and customers
 - Engaging consumers
 - Addressing utility incentives to achieve grid modernization goals

- ▶ Reports:
 - *The Future of Centrally-Organized Wholesale Electricity Markets* (March 2017)
 - *Regulatory Incentives for Utilities to Invest in Grid Modernization* (under peer review)
 - *Value-Added Electricity Services: New Roles for Utilities and Third Parties* (underway)

Grid Modernization Peer Review

April 18th – 21st (Washington, D.C.)



Resilient Distribution Systems



- ▶ **Title:** Resilient Distribution Systems
- ▶ **Primary Recipients:** The Grid Modernization Laboratory Consortium (minimum two labs for each application with one lead lab)
- ▶ **Total Amount to be Awarded:** \$25M - \$30M
- ▶ **DOE Office Contributors:** OE, SETO, BTO, WPTO
- ▶ **Average Award Amount:** \$5M - \$7M (4-5 awards)
- ▶ **Period of Performance:** 36 months
- ▶ **Cost Share Requirement:** At least 20%
 - ☐ Labs provide 5% of the cost share by providing relevant LDRD work
- ▶ **Partners:**
 - ☐ Must have an active utility partner for field validation
 - ☐ Must have an institutional partner (state, city, other)
 - ☐ Strongly encourage partnerships an institution of higher education, regional transmission organization or ISO, and technology provider.
 - ☐ At least **25% of funding MUST go to non-lab partners** (10% (or less) management fee cap for subcontract)

Lab Call Awardees

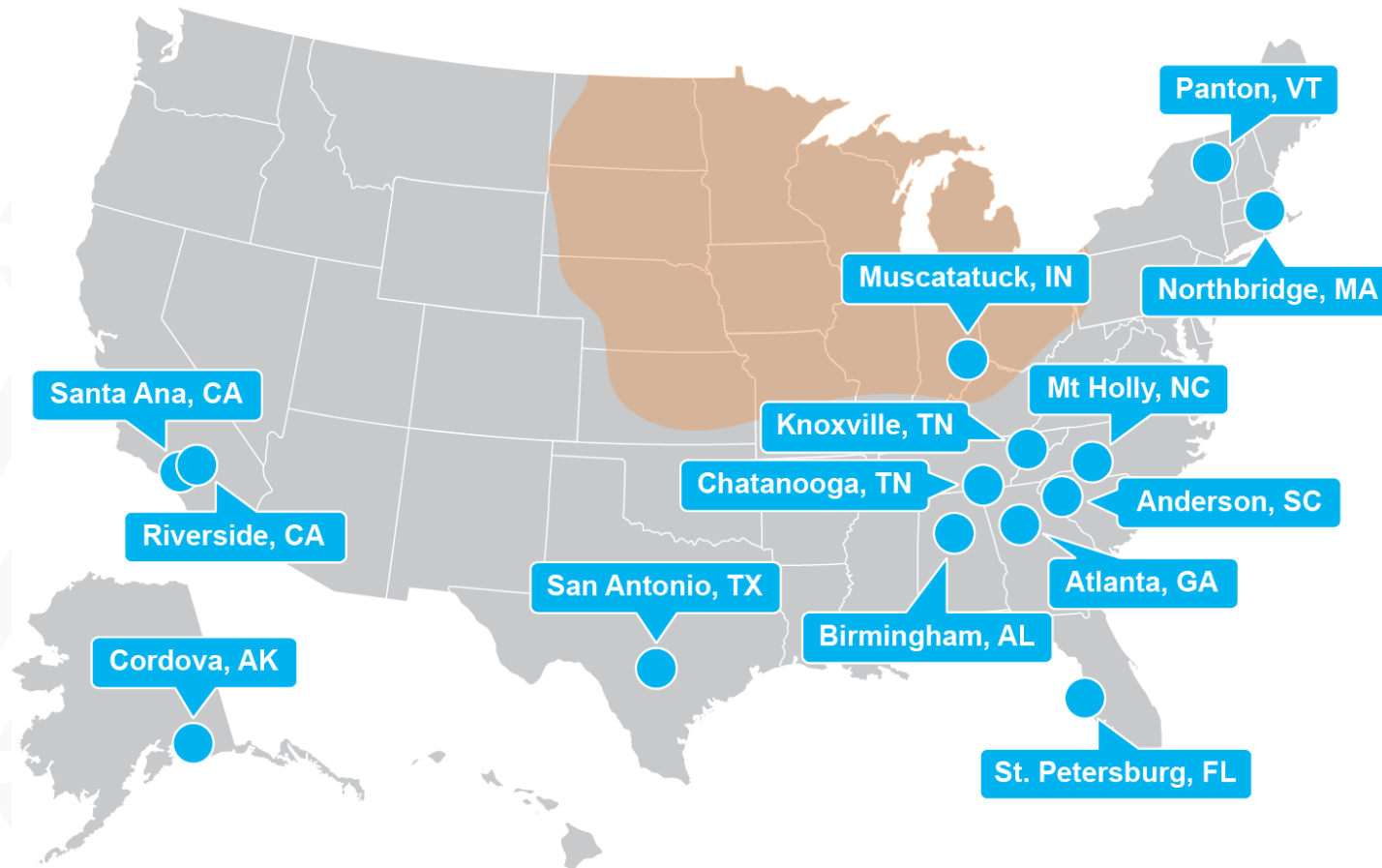


Title	Lead Lab	DOE Funds (\$k)*	Supporting Labs
Resilient Alaskan Distribution system Improvements using Automation, Network analysis, Control, and Energy storage (RADIANCE)	INL	6,200	SNL, PNNL
Decentralized FLISR with High Penetrations of DERs using an OpenFMB-Based Reference Architecture	PNNL	6,000	ORNL, NREL
Integration of Responsive Residential Loads into Distribution Management Systems	ORNL	5,000	PNNL, SLAC
GRIP- Grid Resilience and Intelligence Platform	SLAC	6,000	LBNL
CleanStart-DERMS	LLNL	5,000	PNNL, LANL
Resiliency and Energy Storage**	SNL	1,500	PNNL, ORNL, NREL, BNL
Laboratory Valuation Analysis Team	PNNL	1,500	PNNL, ANL and others TBD
Total		31,200	

* Most funding are from FY17, however some are dependent on FY18.

** Undergoing major scope change. Title may change.

Project Locations



The Historical Role of EERE and New Challenges including Cybersecurity



- ▶ **Driving Down Costs:** EERE's primary focus *has been* on driving down the costs of individual clean energy technologies.
- ▶ **Increasing Deployment:** These technologies are becoming cost competitive, resulting in growing numbers of these technologies being integrated into the electrical power system.
- ▶ **Integration Challenges:** This integration introduces new challenges, and provides new opportunities to ensure the electrical power system continues to operate in a safe, reliable, and cost-effective manner.
- ▶ **Cybersecurity and Resilience:** EERE technologies
 - ❑ May provide critical reliability services going forward
 - ❑ Will soon include standards that require DER to provide communication-based grid services
 - ❑ May not be owned by the utility
 - ❑ May be connected to the grid via public internet channels

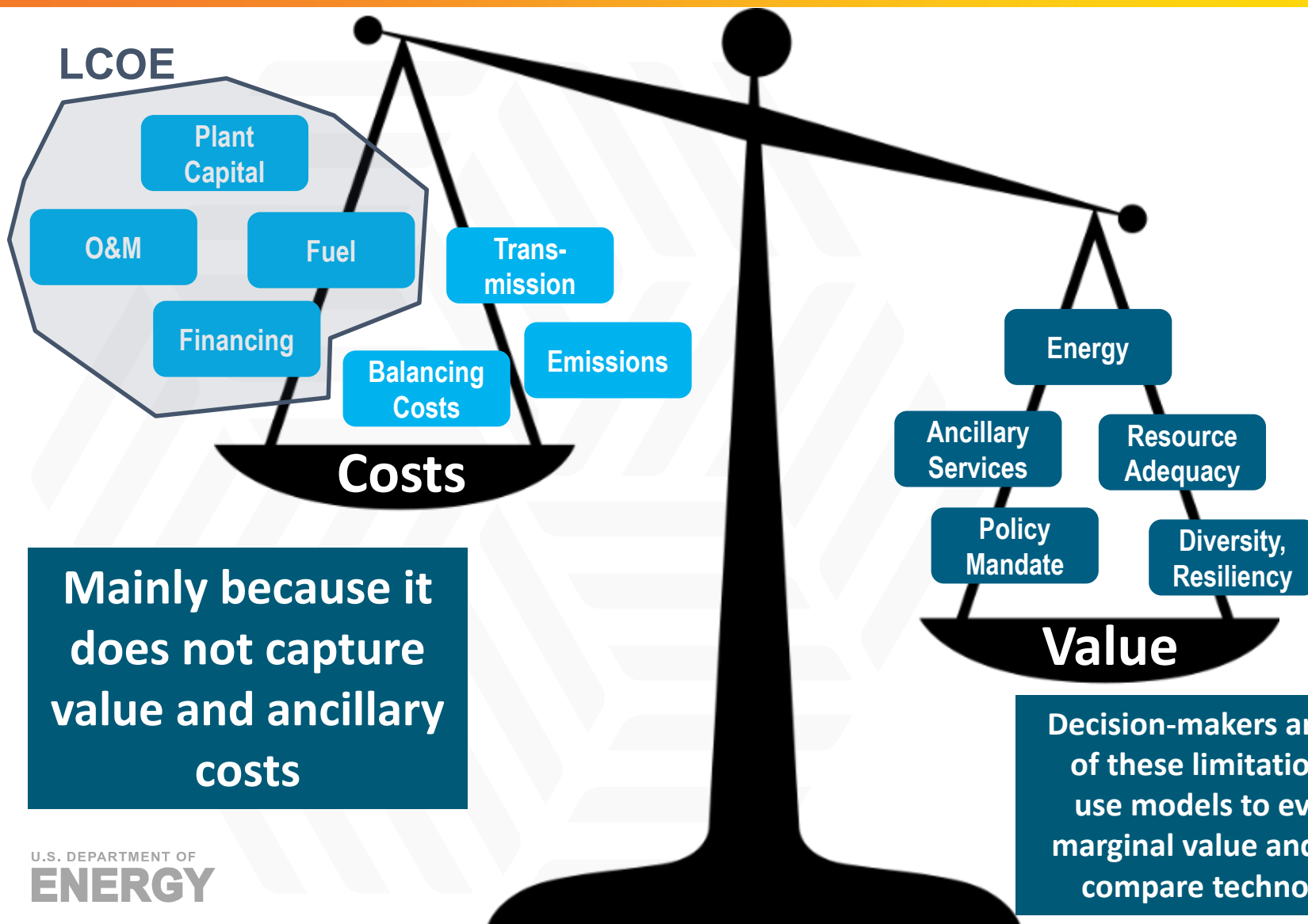
High Level Results from Workshop for Cybersecurity in EERE



- ▶ Develop a vision and timeline of actions that guide DOE EERE cybersecurity efforts
- ▶ Develop a risk landscape review that could drive priorities.
- ▶ Develop template language that can be used in FOA, Lab Calls and other contracting efforts to incorporate cyber security and resilience in project initiation.
- ▶ Initiate periodic seminars lead by laboratory experts on research highlights to enhance knowledge growth across EERE and labs.
- ▶ Compile an on-call “Red Team” including industry and lab experts that can provide review of program efforts for strategy and relevance.
- ▶ Initiate a way to engage with sector technology leaders and stakeholders to share insights on risks and better understand application challenges.

Beyond LCOE

LCOE is not a bad metric...but an incomplete one



SAVE THE DATE!

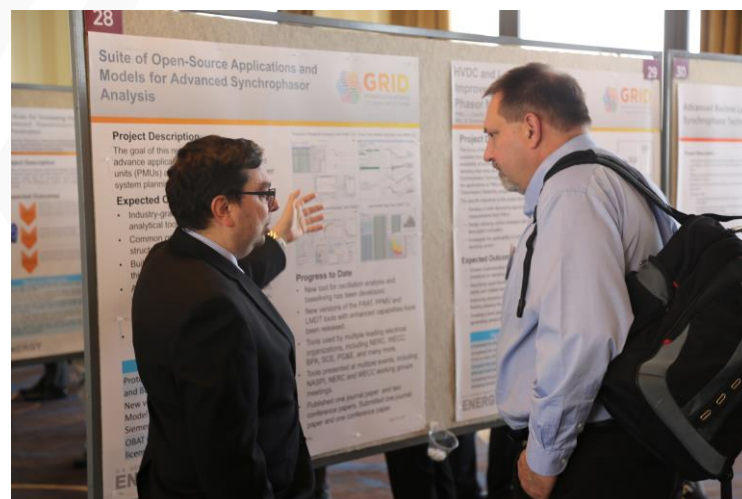
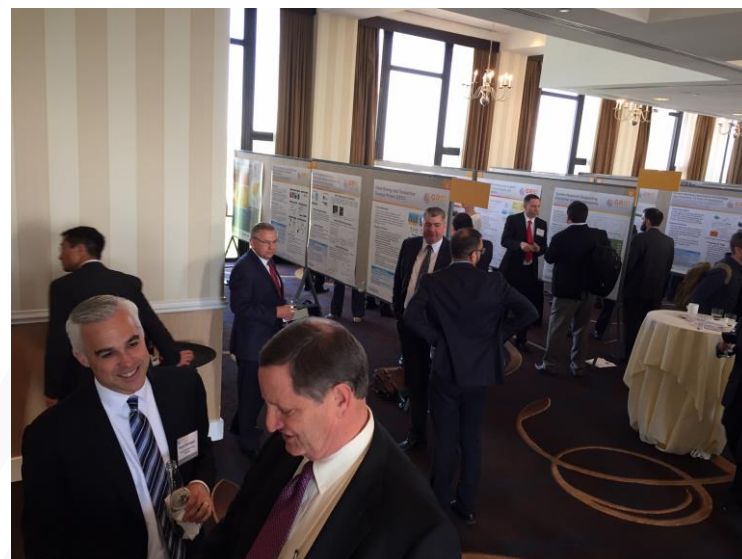
2018 Grid Modernization Initiative Peer Review



September 4–7, 2018
Sheraton Pentagon City Hotel

GMI Peer Review activities include:

- ❑ Reviewing DOE's grid modernization portfolio
 - ❑ Listening to industry leaders discuss the future grid during a panel discussion
 - ❑ Hearing from leadership at the national laboratories discuss future grid activities
 - ❑ Reflecting on the updated Grid Modernization Multi-Year Program Plan
 - ❑ Engaging with other GMI projects in the portfolio during the poster session
- Look out for an email with more information and registration details.
- Not on our distribution list? Contact us at gmi@hq.doe.gov



Thank You



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