Grid Modernization Initiative (GMI)

GIL BINDEWALD AND KEVIN LYNN

October 17, 2018

Agenda

- Overview and Current Status of the GMI and the Grid Modernization Laboratory Consortium (GMLC);
- 2018 GMI Peer Review;
- Grid Modernization Multi-Year Program Plan

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Overview

FY19 Appropriations Senate Report
Grid Modernization

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- The Department is directed to continue the ongoing work between the national laboratories, industry, and universities to improve grid reliability and resiliency through the strategic goals of the Grid Modernization Initiative and encourages the Department to ***include all applied energy programs*** to ensure broad energy system resilience and modernization.
- Further, the Committee ***supports the Grid Modernization Laboratory Consortium*** and supports ***continued implementation of the Grid Multi-Year Program Plan***.
- Directs the Department to emphasize
  - national grid resilience modeling
  - improved grid cyber resilience
  - advanced sensors
  - energy storage
  - Advanced control paradigms
  - Field validation of it's most successful research outcomes

Grid Modernization Initiative

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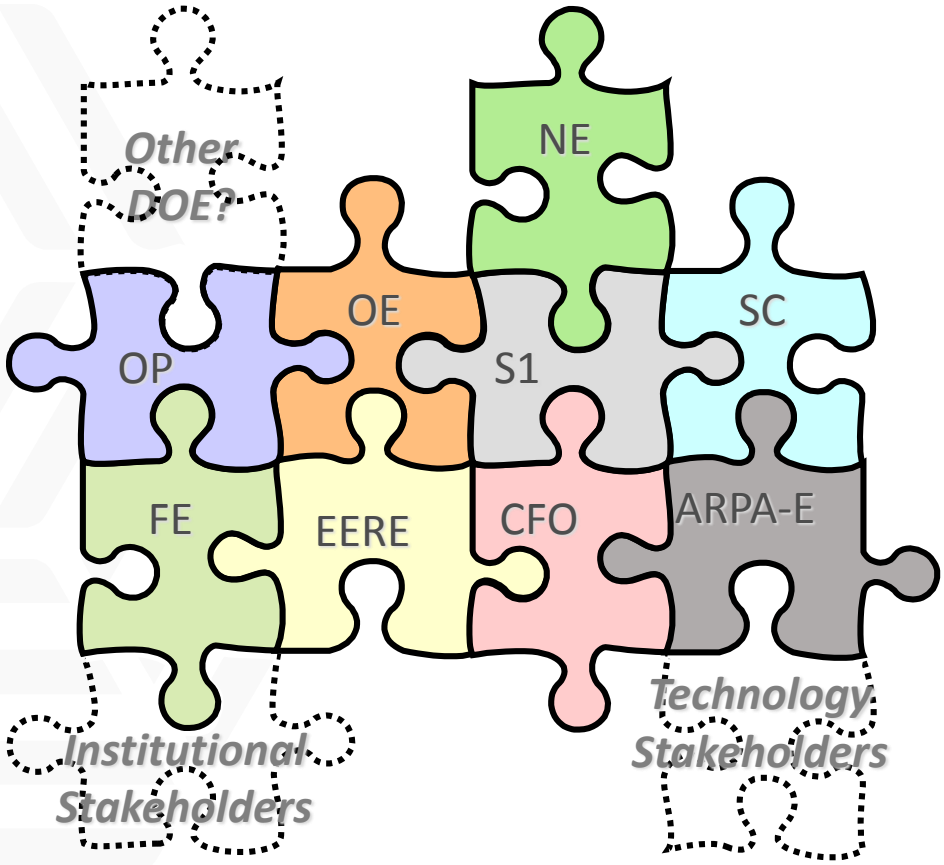
An aggressive and urgent five-year grid modernization strategy for the Department of Energy that includes

- **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

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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

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GMLC Structure Supporting the MYPP

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National Lab Lead Integrators
Co-Chairs: Carl Imhoff, PNNL and Juan Torres, NREL

Technical Team Lead: Design and Planning Tools	Technical Team Lead: System Control and Power Flow	Technical Team Lead: Sensing and Measurements	Technical Team Lead: Devices and Integrated Testing	Technical Team Lead: Security and Emergency Response	Technical Team Lead: Institutional Support
					
John Grosh, LLNL	Jeff Dagle, PNNL	Tom King, ORNL	Ben Kroposki, NREL		Chuck Goldman, LBNL
Design and Planning Tools Technical Team	System Control and Power Flow Technical Team	Sensing and Measurements Technical Team	Devices and Integrated Testing Technical Team	Security and Emergency Response Technical Team	Institutional Support Technical Team

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

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Devices and Integrated Systems

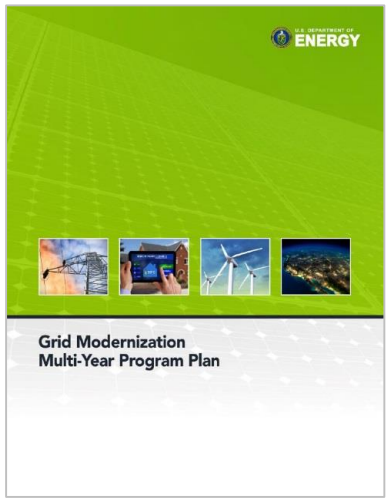
Sensing and Measurement

System Operations and Control

Design and Planning Tools

Security and Resilience

Institutional Support



Grid Modernization Lab Call 2016

Working across the country

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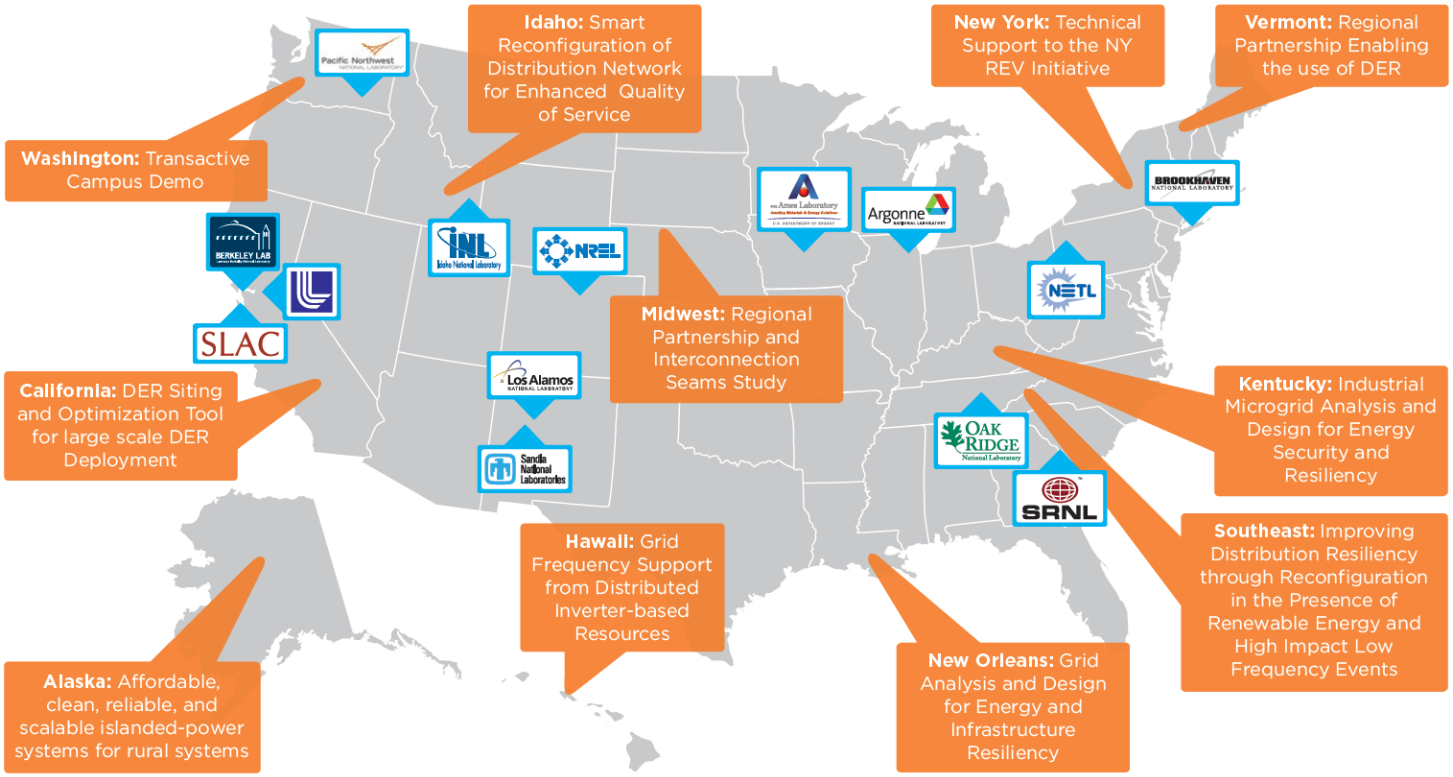

- Up to $220M
- 13 national laboratories
- 88 projects
- 150+ partners

A Sample of our Project Partners

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2018 Peer Review

2018 Grid Modernization Initiative Peer Review

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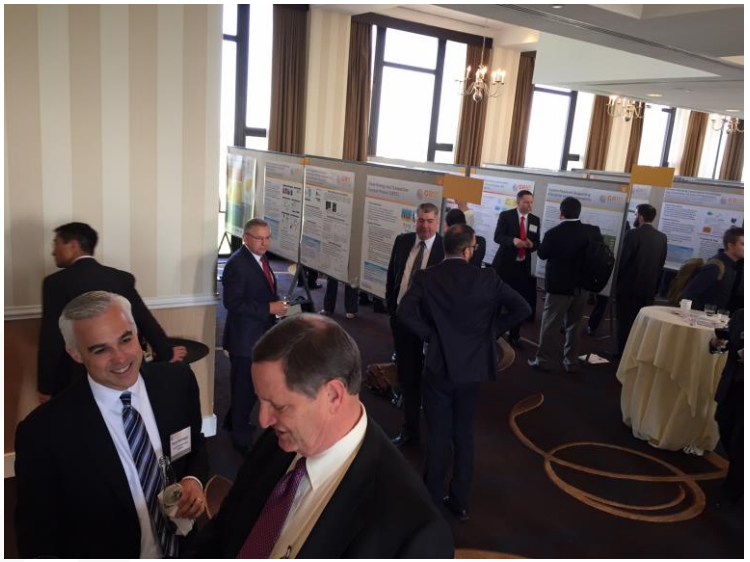
September 4–7, 2018

Sheraton Pentagon City Hotel

GMI Peer Review activities included:

- 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



High-Level

- **Communications**: Communicate results better across the board!
- **Tech Transfer**: Involve industry early and often to ensure maximum transfer of technology from the labs to industry
- **Convergence**: Encourage convergence in areas where it is absolutely necessary (e.g. interoperability, system controls)
- **Scaling Projects**: Take results from local projects and make them nationally accessible!
- **Success Stories**: Communicate success stories
- **Success metrics** should be identified and tied to the GMLC pillar goals and articulate the transformative story and specific project contributions more readily

GMI Peer Review

Findings from the Assistant Secretaries from the Applied Offices

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- Importance of Resilience and the need to identify and address challenges to the power system in real-time through situational awareness
- Understanding the Role and Importance of Baseload Generation
- Importance of Affordability, Reliability, and Sustainability as Attributes of the Power System
- Understanding the role of small, modular generation sources in the grid of the future
- Fully integrated vision of the electricity system from generation to load
- Importance of interdependencies between the power system and other infrastructures including communications, gas, etc.

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Grid Modernization Multi-Year Program Plan

Devices and Integrated System Testing

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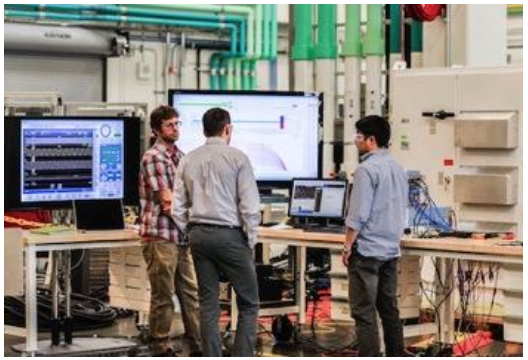
Expected Outcomes

- Develop standards and test procedures
- Build capabilities and conduct device testing and validation
- Conduct multi-scale systems integration and testing

Federal Role

- Common approach across labs and industry testbeds for effective validation of emerging technologies
- Develop common interoperability and interconnection standards and test procedures for industry / vendor community

Framework for federated testing of systems at multiple test facilities



Sensing and Measurement

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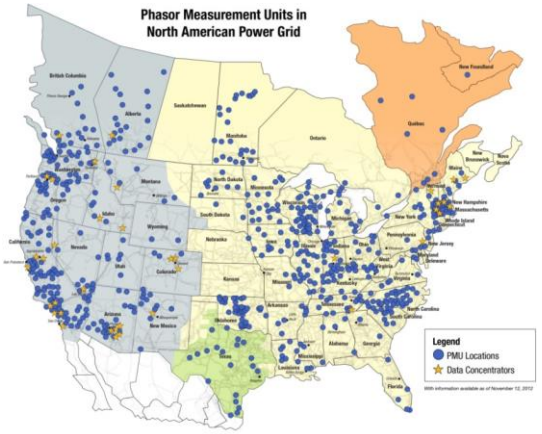
Expected Outcomes

- Improve sensing for buildings and end-users
- Enhance sensing for distribution system
- Enhance sensing for the transmission system
- Develop data analytic and visualization techniques

Federal Role

- Transfer national lab scientific & national security data analytics to transform grid systems
- Leverage lab cyber expertise to design resilient SCADA and communication systems for emerging grid



Interoperability testing of advanced phasor measurement units from multiple vendors

System Operations, Control, and Power Flow

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Expected Outcomes

- Develop architecture and control theory
- Develop coordinated system controls
- Improve analytics and computation for grid operations and control

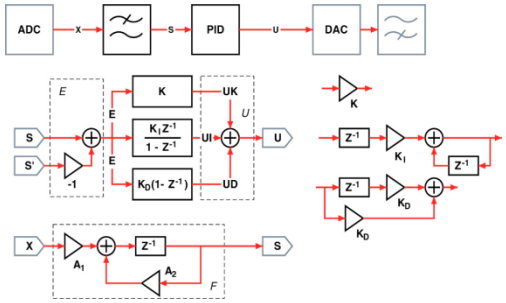
Federal Role

► Utilize DOE's convening authority to provide leadership in providing a public/private vision of advanced grid architecture

► Advance fundamental knowledge for new control paradigms for emerging grid to support industry transformation

► Utilizing expertise developed at the national laboratories, deliver computational science, materials science & mathematics to transform integrated faster-than-real-time software platforms.

***Conventional** controls*



***Distributed** controls*

Design and Planning Tools

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Expected Outcomes

- Deliver open software platform for adding advanced computation approaches to grid planning & design tools (50x speedup)
- Add capacity to model uncertainty in grid planning
- Incorporate system dynamics into planning tools to enhance resilience in face of increased system variability

Federal Role

- Leverage Lab system computational expertise to develop open platform for vendor engagement
- Leverage Lab system fundamental mathematics assets to incorporate uncertainty and system dynamics into grid tool sets

Grid Security and Resilience

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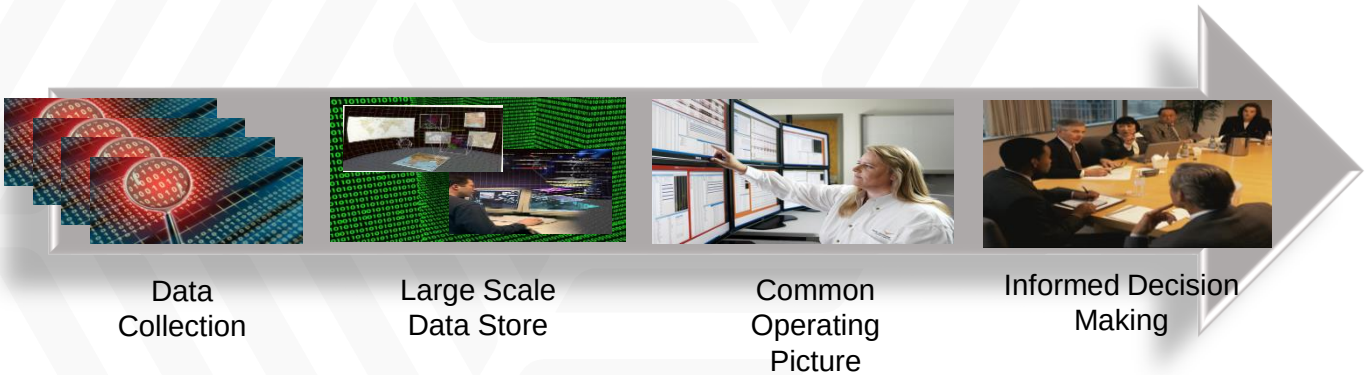
Expected Outcomes

- ►Improve ability to identify threats and hazards
- ►Increase ability to protect against threats and hazards
- ►Increase ability to detect potential threats and hazards
- ►Improve ability to respond to incidents
- ►Improve recovery capacity time

Federal Role

- ► Enable secure utility situational awareness leveraging national lab analytics capacity and national security capabilities



Emerging Themes

- Generation (including Fuel Interdependencies)
- North American Resilience Modeling
- Physical Security and Cybersecurity
- Advanced Sensors
- Energy Storage
- Institutional Support and Analysis (including Metrics and Valuation)