

# GMLC Overview for Electricity Advisory Committee

## February 2020

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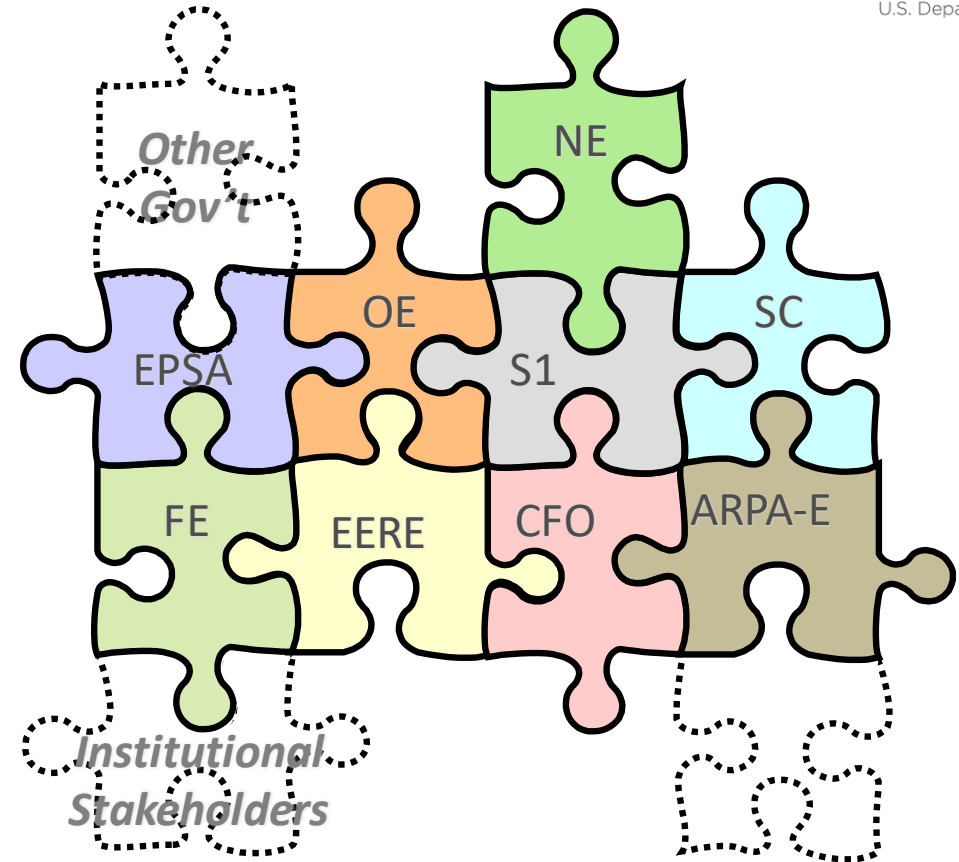
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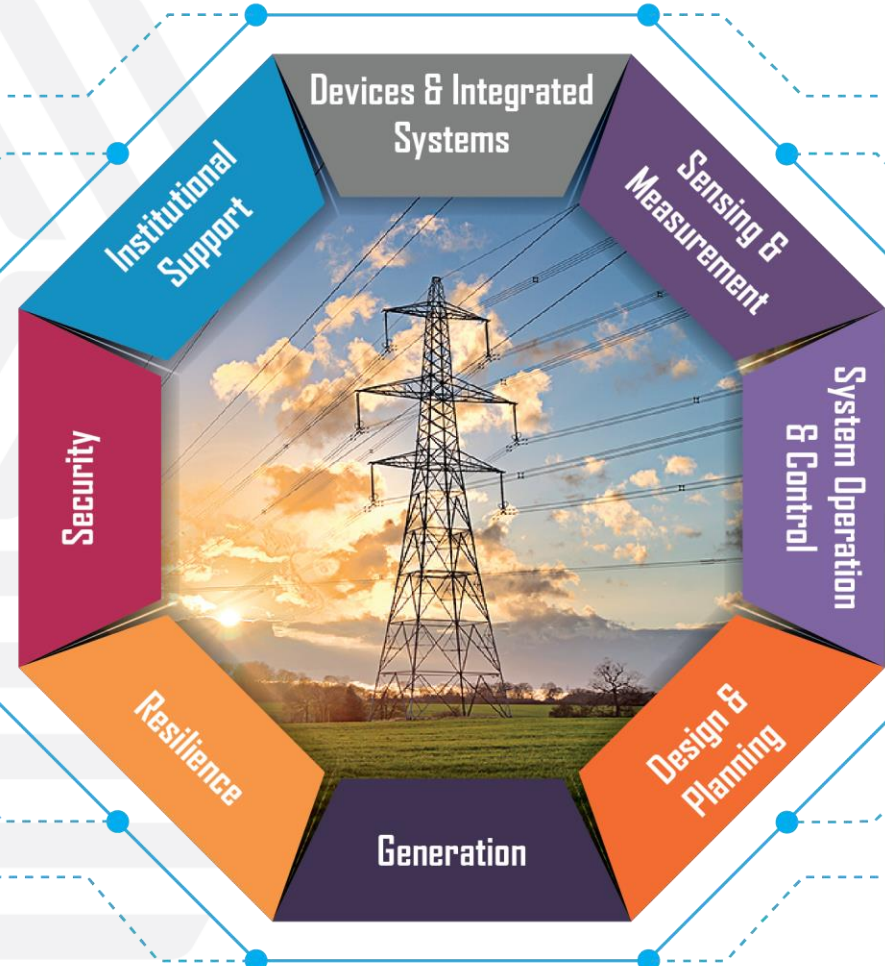
# DOE Grid Modernization Initiative

An aggressive five-year grid modernization strategy that includes

- ▶ Alignment of the existing base activities among DOE 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



# DOE's Grid Modernization Laboratory Consortium – 14 National Labs – 200+ Partners



# DOE Grid Modernization Investments

- GMLC Lab Calls
- Competitive Funding Opportunities



2016

## Grid Modernization Initiative

Department of Energy's Grid Modernization Lab Call (2019)

May 29, 2019

Gil Bindewald (OE), Kevin Lynn (EERE), Alicia Dalton-Tingler (FE), Trevor Cook (NE), Carol Hawk (CESER)



2017

## Resilient Distribution Systems

An FY17 Project Call for the Grid Modernization Laboratory Consortium

### A. Description/Background

#### Overview

The U.S. Department of Energy (DOE) has developed this Grid Modernization Laboratory Consortium (GMLC) Project Call as part of the Grid Modernization Initiative (GMI). This Project Call aims to advance research of resilient distribution systems through rigorous field validations. In particular, the Call focuses on the integration of clean distributed energy resources (DERs) and emerging grid technologies at regional scale.<sup>1</sup> The project results are expected to deliver credible information on technical and economic viability of the solutions as well as demonstrate viability to key stakeholders who are ultimately responsible for approving and investing in grid modernization activities. This FY17 GMLC Project Call builds on the momentum from the ongoing GMLC Foundational Activities of the FY16 GMLC Lab Call and continues research in the six technical areas laid out in the Grid Modernization Multi-Year Program Plan (MYPF). This FY17 GMLC Project Call is jointly developed and funded by the Office of Energy Efficiency and Renewable Energy (EERE) and the Office of Electricity Delivery and Energy Reliability (OE).

#### Objectives

This GMLC Project Call seeks to develop and validate innovative approaches to enhance the resilience of distribution systems (including microgrids) with high penetration of clean DERs. Technological advancements include control/coordination strategies, real-time system monitoring, robust communications infrastructure, grid planning and analytical platforms, and integration of multiple DER technologies.<sup>2</sup>

Grid modernization presents a complex bundle of technological, institutional and regulatory challenges. Thus, projects must include field validations that incorporate regionally appropriate solutions that verify the viability of distribution system design, validate architectural relationships and interoperability, quantify costs and benefits (i.e. characterize value proposition), ensure protection of system networks and data against cyber threats, and inform

<sup>1</sup>For the purpose of applications submitted under this Project Call, DER is defined as any controllable energy resource connected at the distribution level. This can include generation, load, and/or energy storage. "Clean" characterizes the technology's role in reducing or eliminating pollution, with emphasis on energy efficiency and renewable energy technologies such as solar, wind, energy storage, building efficiency technologies, and electric vehicles.

<sup>2</sup>These technologies are further defined in the Grid Modernization Multi-Year Program Plan (MYPF) as six key technical areas: a) Devices and Integrated Systems, b) Sensing and Measurement, c) System Operations, Power Flow, and Control, d) Design and Planning Tools, e) Security and Resilience and f) Institutional Support.

2019

## DEPARTMENT OF ENERGY GRID MODERNIZATION LABORATORY CALL

An Integrated and Coordinated Approach

This laboratory call is a coordinated funding call for the Grid Modernization Cross-cut Initiative for FY2019. Offices contributing to the lab call include the Office of Electricity and Energy Reliability, the Office of Energy Efficiency and Renewable Energy, and the Office of Energy Policy and Systems Analysis.

Since only DOE National Laboratories are eligible to apply as primary recipients under this Lab Call, the ensuing awards will be issued through the Work Authorization System based on a Field Work Proposal (FWP), an Inter-Entity Work Order (IEWO), an Annual Operating Plan (AOP) or other allowable instrument deemed appropriate by the Government.

DOE GMLC Lab Calls 2016 - 2019



# Over 200 GMLC Partners



- ▶ 41 utilities
- ▶ 12 bulk system operators
- ▶ 67 vendors
- ▶ 33 Industry organizations
- ▶ 30 universities
- ▶ 29 federal, state and local entities



# Devices and Integrated System Testing

## 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**

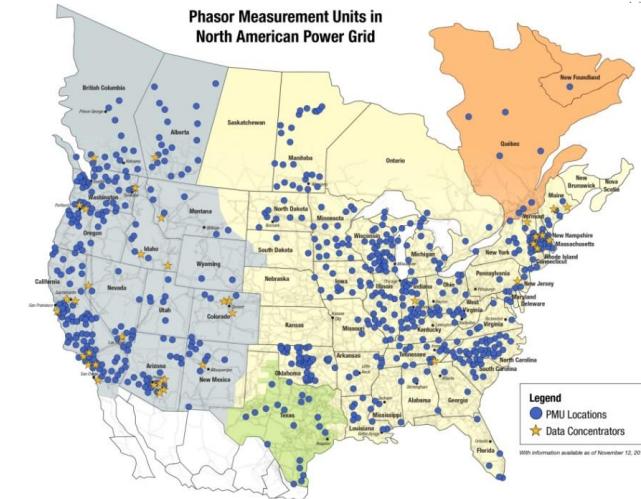


## Expected Outcomes

- ▶ 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

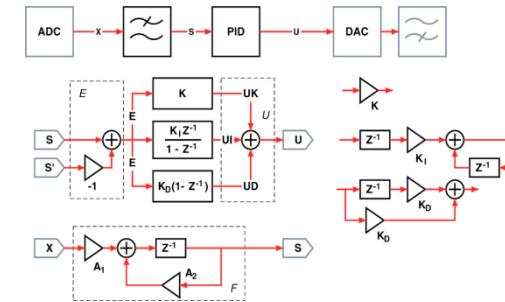
## Expected Outcomes

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

## 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





## 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

## 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

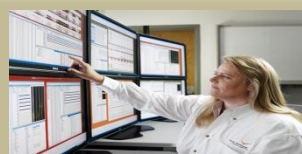
- ▶ Enable secure utility situational awareness leveraging national lab analytics capacity and national security capabilities



Data  
Collection



Large Scale  
Data Store



Common  
Operating  
Picture



Informed Decision  
Making

## Expected Outcomes

- ▶ Improve match of thermal generation to emerging grid characteristics
- ▶ Advance next generation modular thermal generation
- ▶ Validate options for hybrid thermal /variable generation concepts
- ▶ Identify role of energy storage in hybrid thermal generation

## Federal Role

- ▶ Characterize system level architecture trends
- ▶ Conduct modeling on challenges of the future system requirements for flexibility and resilience to support planning for alternate generation and fuels concepts

# EEI Wildfire Task Force Engagements (Aug – present)



## EEI WILDFIRE TARGET TOPICS

### ► Electric Grid Technologies

- Better / faster “downed line” technology
- Better / more accurate (incipient fault) detection
- Near real-time auto shutdown
- Faster / more intelligent reclosers

### ► Big Data Sources and Methods

- Satellite remote sensing data to determine “heat spots”, vegetation on slopes, forest health, etc.
- Drones and related technology to support electric infrastructure inspections and / or forest health conditions

### ► Big Data Analytics

- Improvements / more accurate modeling / predictive capabilities for weather, fuel sources, fire spread, etc.
- Near real-time identification of fire starts (e.g. machine learning for high resolution camera feeds)
- Improvements in / near real-time Lidar data processing speeds and analysis results

## DOE GRID MOD POTENTIAL LINKS

1. Emerging project on arc detection in substations [OE Sensor Program]
2. Satellite imaging for biomass characterization [BETO/EERE]
3. Satellite imaging for hurricane damage assessment and flooding [ISER/CESER]
4. HPC contingency analysis [AGM / OE]
5. ML analytic platforms for anomaly detection [GMLC]
6. NASPI work on downed conductor (SDG&E) [AGM / OE] to assess consequence analysis
7. Wildfire-energy Resiliency Enhancement with Physics informed A.I. Models for Critical Infrastructures [GMLC proposed]
8. Sensing roadmap [GMLC]
9. Optical sensors for incipient fault detection [GMLC]
10. Integrated transmission and distribution planning tools [GMLC]
11. Co-simulation platform to link grid consequence models to FEMA / USDA tools [GMLC]
12. Interdependency studies gas & electric for resilience [NAERM]



# Typical Industry Engagements



- ▶ Annual IEEE PES meeting sessions
- ▶ Annual IEEE ISGT meeting
- ▶ GMLC Peer Reviews
- ▶ DistribuTech sessions and booth (starting 2020)
- ▶ Updates by invitation
  - EPRI R&D meetings
  - NARUC and regional meetings
  - Educational Congressional hearings and caucus sessions
- ▶ XLab Grid Modernization Summit
- ▶ Membership entity outreach
  - NRECA
  - EEI
  - LPPC
  - EPRI
  - NERC and regional reliability councils

# Engagement Message to Industry at DistribuTECH



1. Join in upcoming funding opportunities
2. Participate in project advisory groups
3. Attend annual peer reviews
4. Follow progress on the website
  - [gmlc@doe.gov](mailto:gmlc@doe.gov)
5. Participate in industry outreach for MYPP updates

## Contact GMLC Chairs

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