Technology Council Meeting Agenda

February Webinar Meeting - 2/24/2021 @ 3:00 PM EST

I.	Welcome	Steve Hauser, CEO Karen Wayland, Interim CEO
II.	Antitrust Guidelines	Richie O'Neill, Executive Director
III.	Discussion on Current Events	All
IV.	Presentation on National Lab and Department of Energy activities 1. Grid Modernization Lab Consortium (GMLC) a. Key Products to Leverage b. Tools for Extreme Weather Planning 2. Energy Storage Grand Challenge 3. North American Energy System Resiliency Model 4. Priorities for New Administration and Opportunities to Interact	Carl Imhoff, Manager, Electricity Market Sector, Pacific Northwest National Laboratory (PNNL)
V.	Next Meeting	R. O'Neill

GRIDWISE ALLIANCE

GridWise Alliance
Antitrust Compliance Program Guidelines

It is the policy of the GridWise Alliance to comply fully with the antitrust laws. The Sherman Act and other applicable antitrust laws are intended to promote vigorous and fair competition and to combat various restraints of trade.

Each person who participates in GridWise Alliance activities has a responsibility to his/her employers and to the GridWise Alliance to avoid any improper conduct from an antitrust standpoint. The following guidelines will assist in meeting this responsibility:

1. GridWise Alliance meetings and discussions generally cover topics related to the generation, transmission and distribution of electricity. Should related discussions ever have any potential for competitive impact, all due care shall be taken to avoid such discussion between competitors.

2. In view of antitrust considerations and to avoid any possible restraints on competition, the following legally sensitive subjects must be avoided during any discussion between competitors:

   (a) Future marketing plans of individual competitors should not be discussed between competitors;

   (b) Any complaints or business plans relating to specific customers, specific suppliers, specific geographic markets or specific products, should not be discussed between competitors;

   (c) Purchasing plans or bidding plans of companies in competition should not be discussed (except privately between two parties with a vertical commercial relationship such as supplier and customer); and

   (d) Current and future price information and pricing plans, bidding plans, refund or rebate plans, discount plans, credit plans, specific product costs, profit margin information and terms of sale should not be discussed between competitors. All of the above are elements of competition.

3. Any question regarding the legality of a discussion topic or business practice should be brought to the attention of the GridWise Alliance legal counsel or a company's individual legal counsel for advice.

Discussion on Current Events

- GridWise supporting members' grid resilience efforts
  - Collecting case studies
  - Coordinating meetings with Administration and members of Congress
  - Developing content

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DOE/National Lab Update on Grid Modernization

Feb. 24, 2021

Carl Imhoff
Manager, Electricity Infrastructure Sector

U.S. DEPARTMENT OF ENERGY BATTELLE

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Discussion Topics

- Frame top DOE initiatives shaping Grid Modernization
  - Grid Modernization Initiative
  - Energy Storage Grand Challenge
  - North American Energy Resilience Model
- Share key transition themes
- Sample GMI projects from PNNL related to GridWise agenda
- Conversation: opportunities for industry to shape and engage the DOE Grid Modernization journey
  - Shaping strategy
  - Partnering on research agenda
  - Preparing for regional responses related to potential stimulus legislation

DOE Grid Modernization Strategy (2017-2020)

GRID MODERNIZATION LABORATORY CONSORTIUM
U.S. Department of Energy

- Fully Integrated Vision:

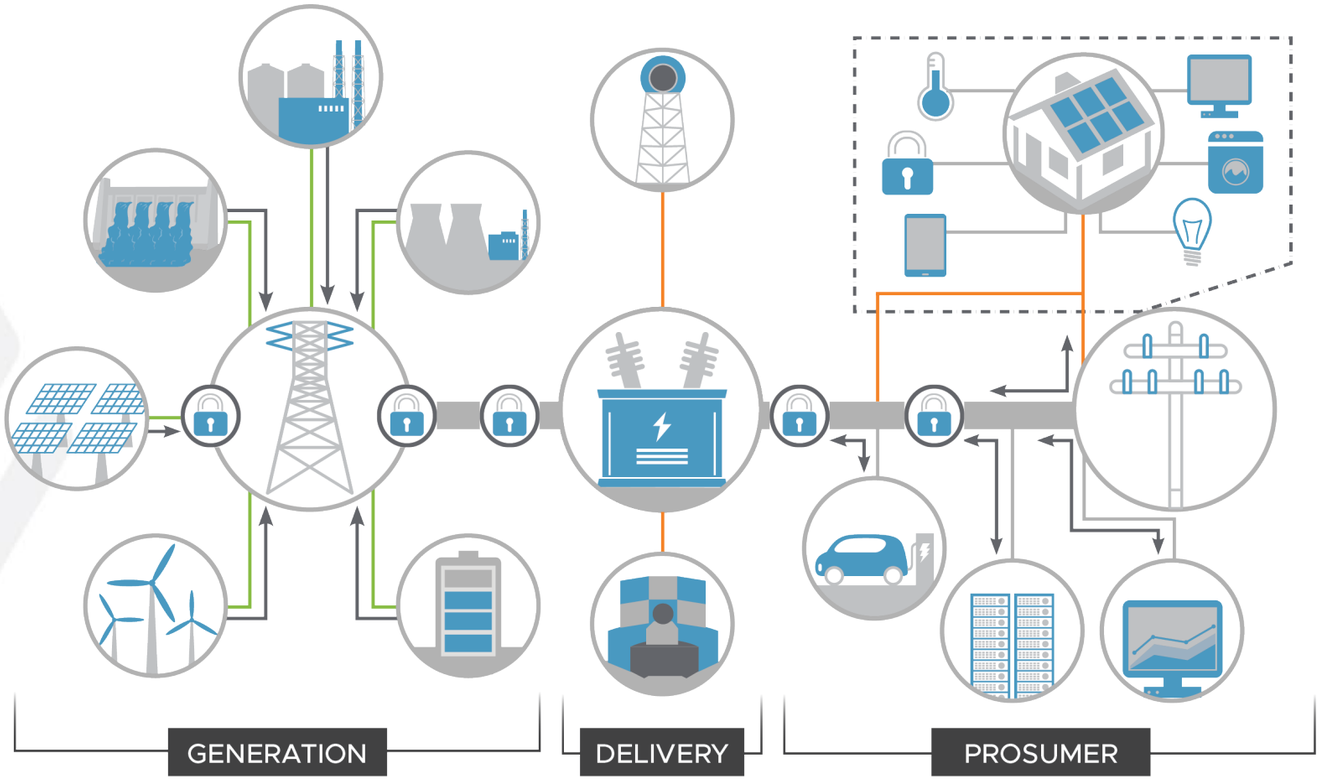
  Encompassing the energy system from fuel to generation to load, including interdependent infrastructures

- Reliability and Resilience:

  This effort will strengthen, transform, and improve the resilience of energy infrastructure to ensure access to reliable and secure sources of energy, secure all malicious threats, natural disasters, and other systemic risks such as human error or the grid's dependence on other critical systems

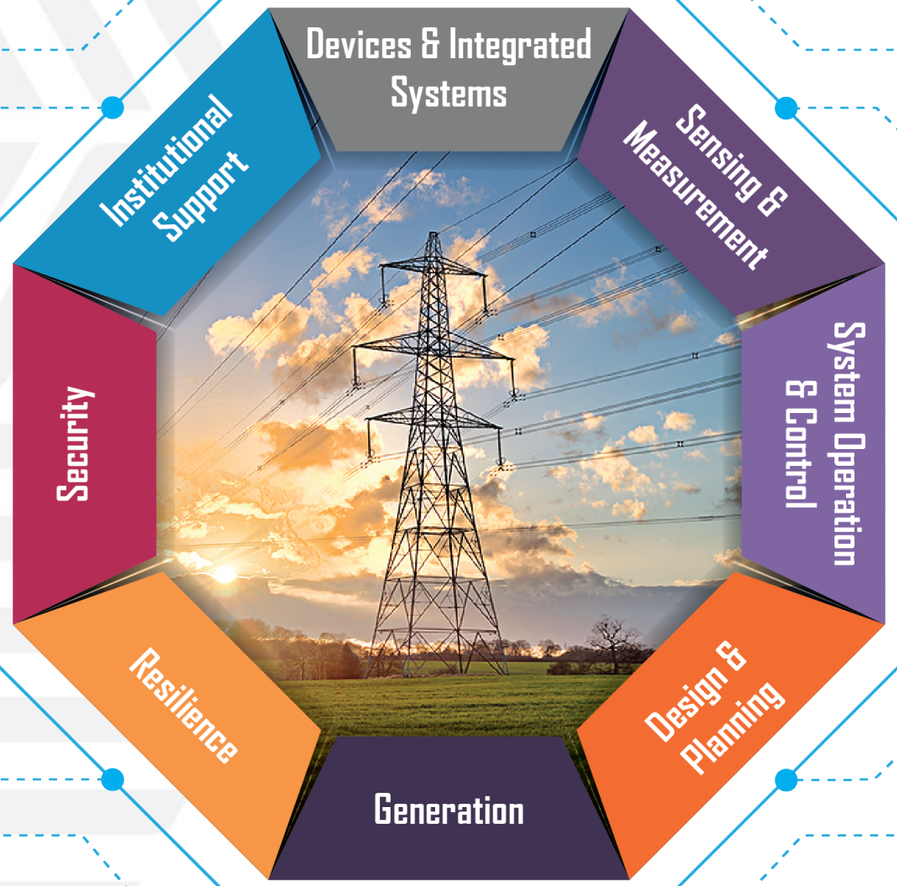
- Participation:

  A collaborative partnership of five DOE Offices to leverage the talent and expertise in the Office of Fossil Energy (FE), the Office of Nuclear Energy (NE), the Office of Electricity (OE), the Office of Energy Efficiency and Renewable Energy (EERE), and the Office of Cybersecurity, Energy Security, and Emergency Response (CESER)



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

GRID MODERNIZATION LABORATORY CONSORTIUM
U.S. Department of Energy



AMES LABORATORY
Creating Materials & Energy Solutions
U.S. DEPARTMENT OF ENERGY

Argonne NATIONAL LABORATORY

BERKELEY LAB

BROOKHAVEN NATIONAL LABORATORY

INL Idaho National Laboratory

Los Alamos NATIONAL LABORATORY

NETL

Lawrence Livermore National Laboratory

NREL NATIONAL RENEWABLE ENERGY LABORATORY

OAK RIDGE National Laboratory

Pacific Northwest NATIONAL LABORATORY

Sandia National Laboratories

SLAC NATIONAL ACCELERATOR LABORATORY

SRNL™

DOE Grid Modernization Investments

- GMLC Lab Calls
- Competitive Funding Opportunities

DOE GMLC Lab Calls 2016 - 2019

Over 200 GMLC Partners

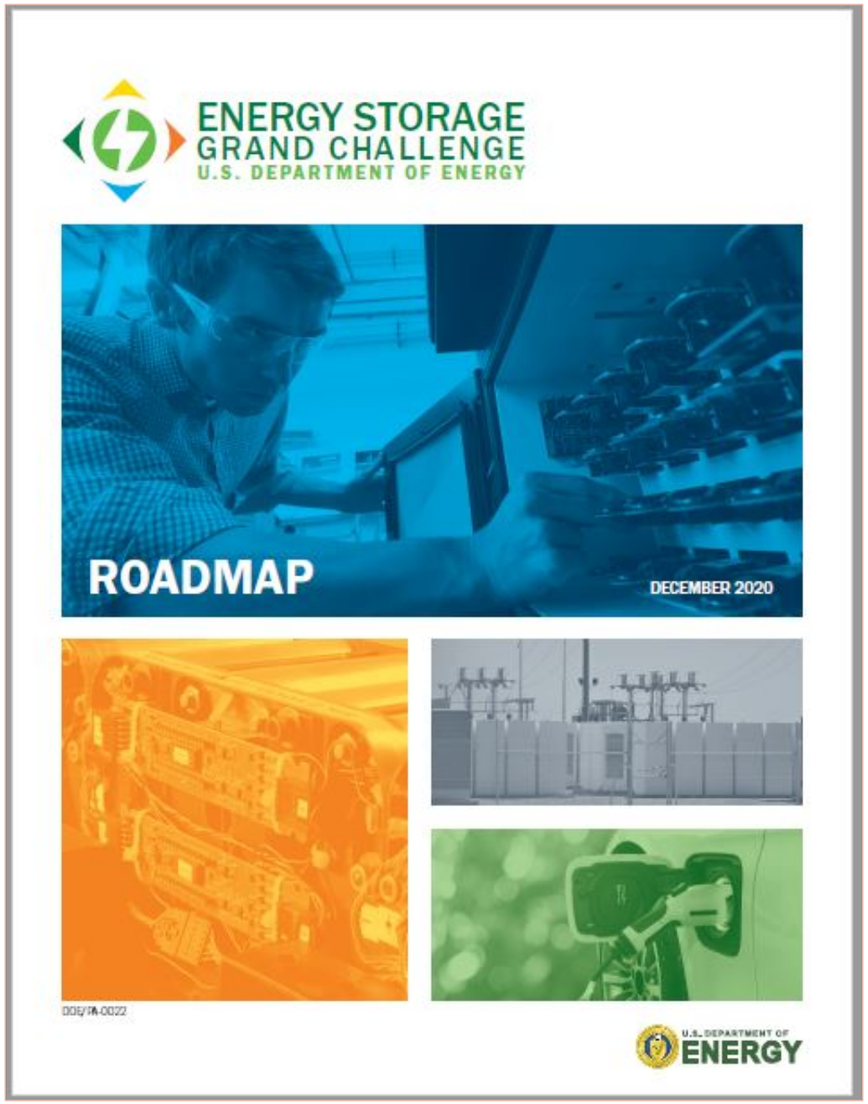
- 41 utilities
- 12 bulk system operators
- 67 vendors
- 33 Industry organizations
- 30 universities
- 29 federal, state and local entities

Strategy in Transition

- Revised 2020 to reflect generation and resilience emphasis of Trump Administration
- Expect a pivot to reflect Biden Administration climate agenda
- Transition messages to date:
  - Carbon neutral power system 2035 goal
  - Anticipate resilience a joint goal
  - Jobs and equity important in DOE programs
  - Congressional and transition team support for cross-cut initiatives
  - Increased emphasis on industry engagement and demos
- Increasing discussion on Infrastructure Bill

Energy Storage Grand Challenge

- New cross-cut started FY20; continued support in transition discussions
- Broad approach
  - Bi-directional batteries (grid and transportation)
  - Chemical & thermal
  - Flexible gen and load
- Vison as key to power system flexibility for clean and resilient power system
  - Innovate here
  - Build here
  - Deploy everywhere
- DOE stewarding Grid Storage Launchpad facility to open in 2023



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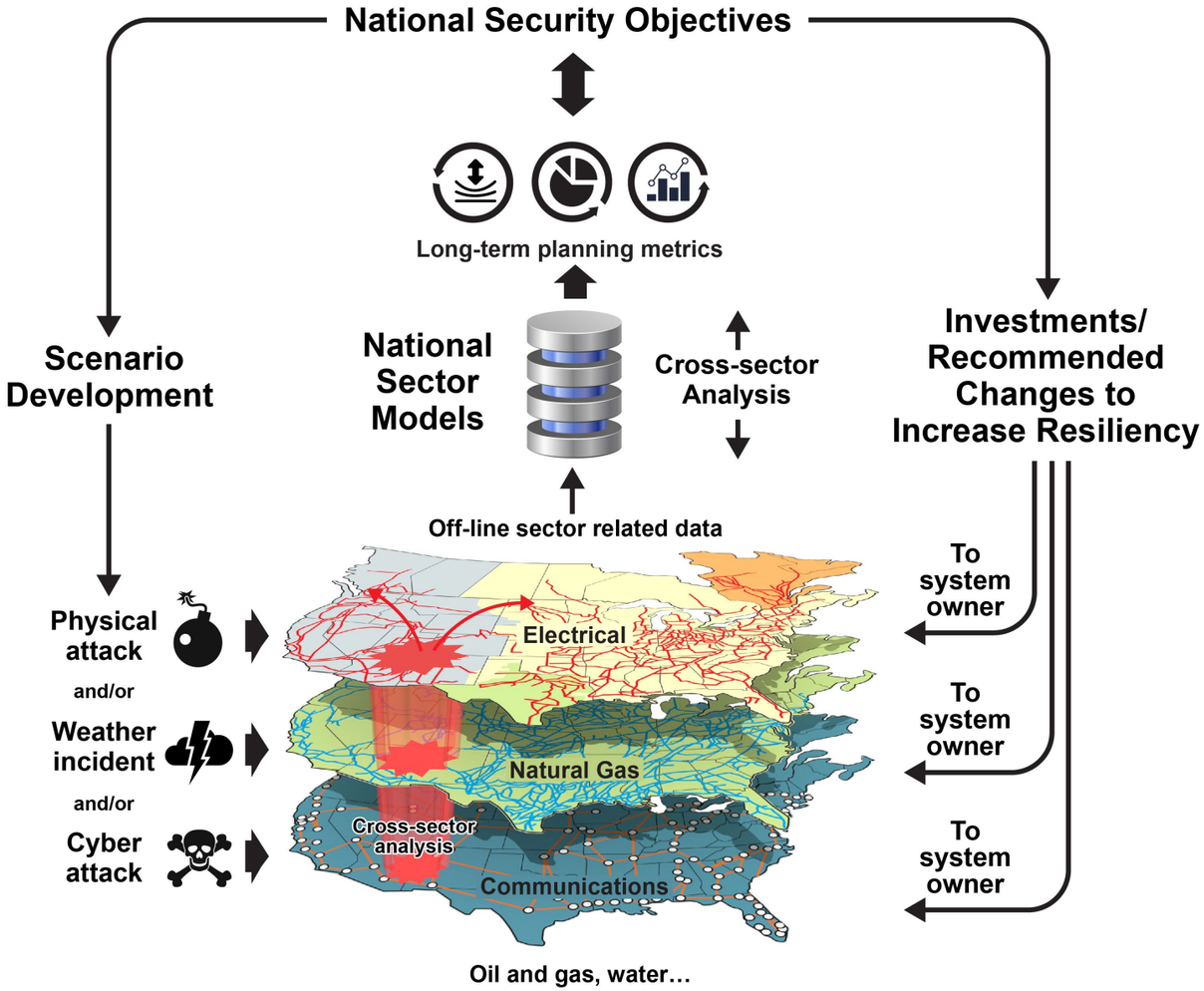
Planning for the **Grid Storage Launchpad**

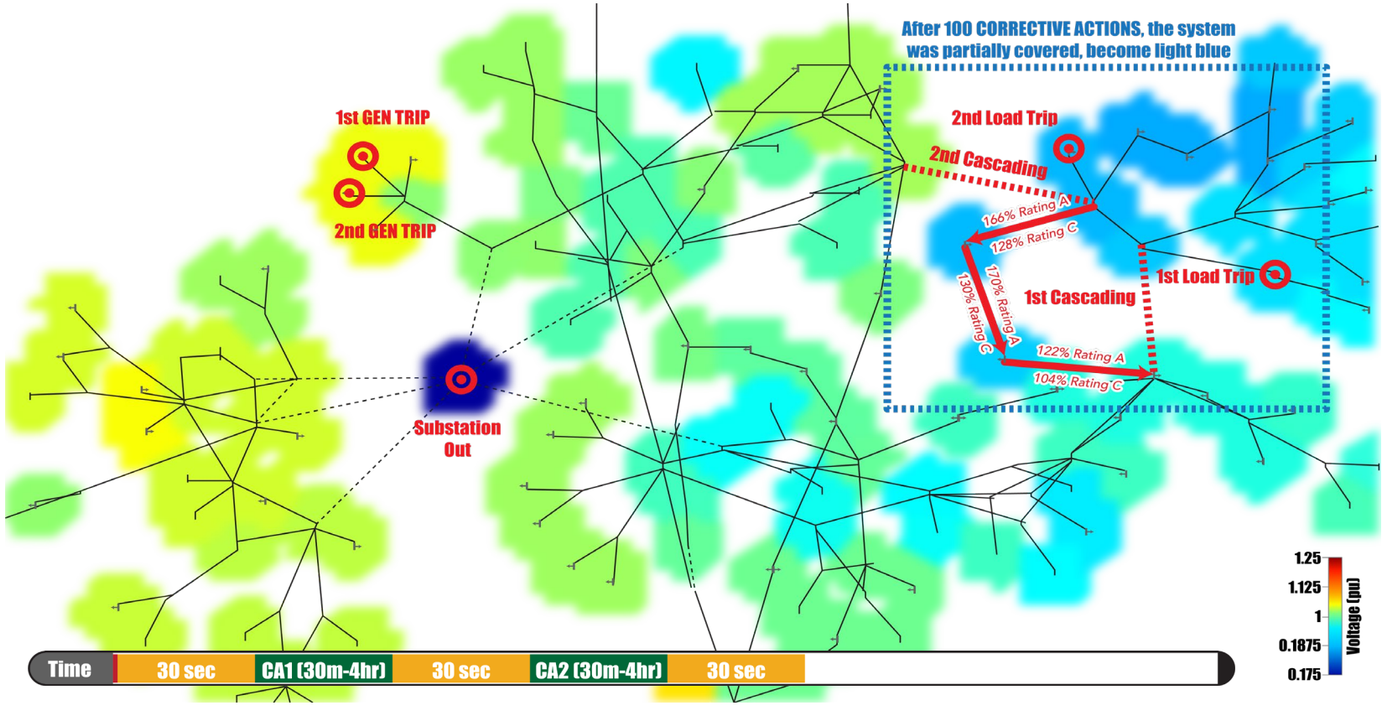
North America Energy Resilience Model (NAERM)

- Rapidly predict consequences and responses to known and emerging threats to national energy infrastructure
- DCAT: faster and better realistic situational awareness and decision support
- HELICS v2.0, scalable to 100,000 domain simulators, a core engine for NAERM to co-simulate grid, communication, and natural gas system



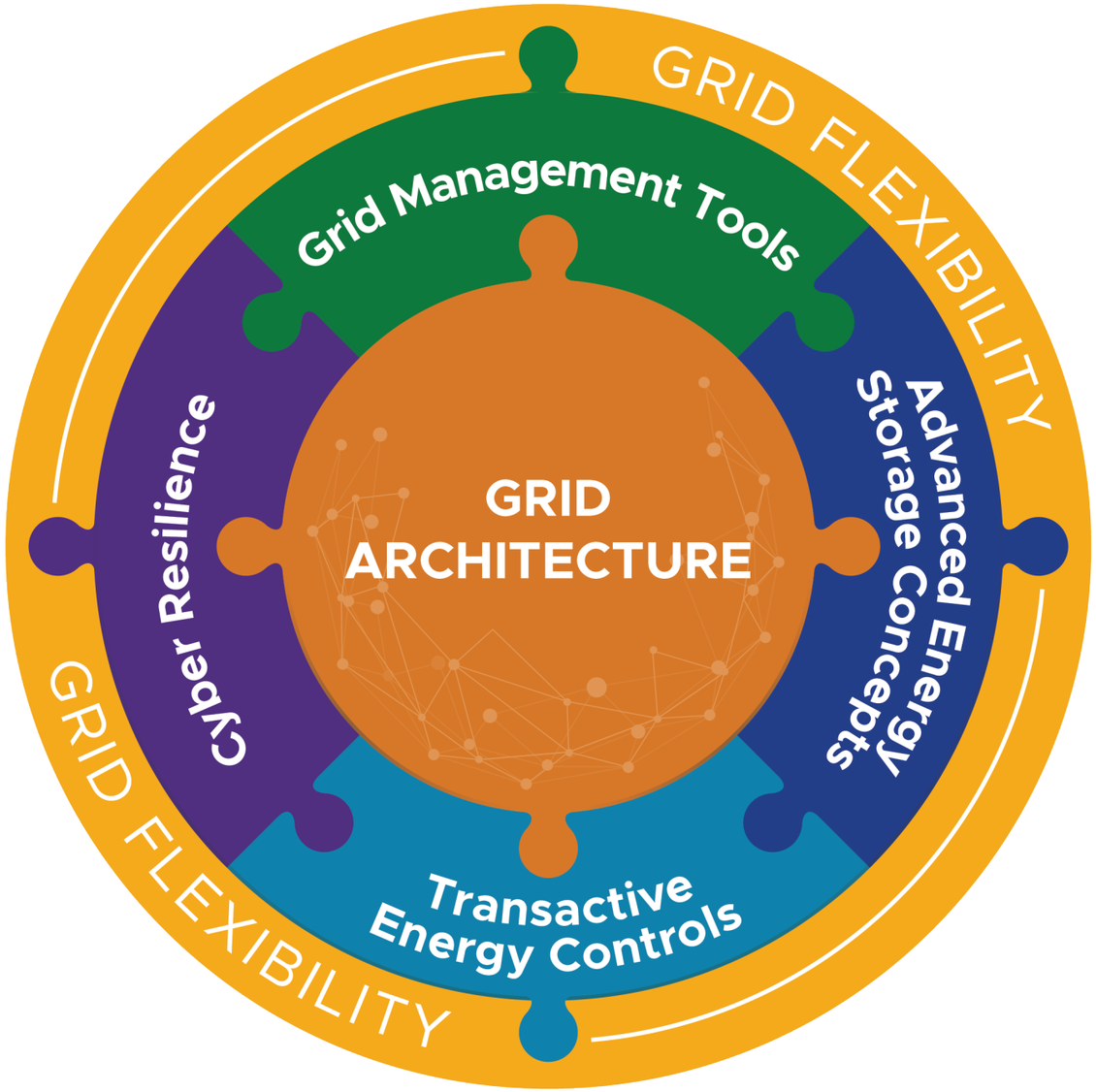
Dynamic Contingency Analysis Tool (DCAT)

- High-fidelity, high-performance methods and tool for N-1-1 contingency analysis
- A hybrid dynamic and steady-state approach to mimic cascading failure process, including both fast dynamic and slower events
- Integrated dynamic models with protection scheme models
  - special protection schemes and remedial action schemes
  - automatic and manual corrective actions
- DCAT is used in NAERM electricity analysis, as well as our transmission-level resilience assessment work in Puerto Rico



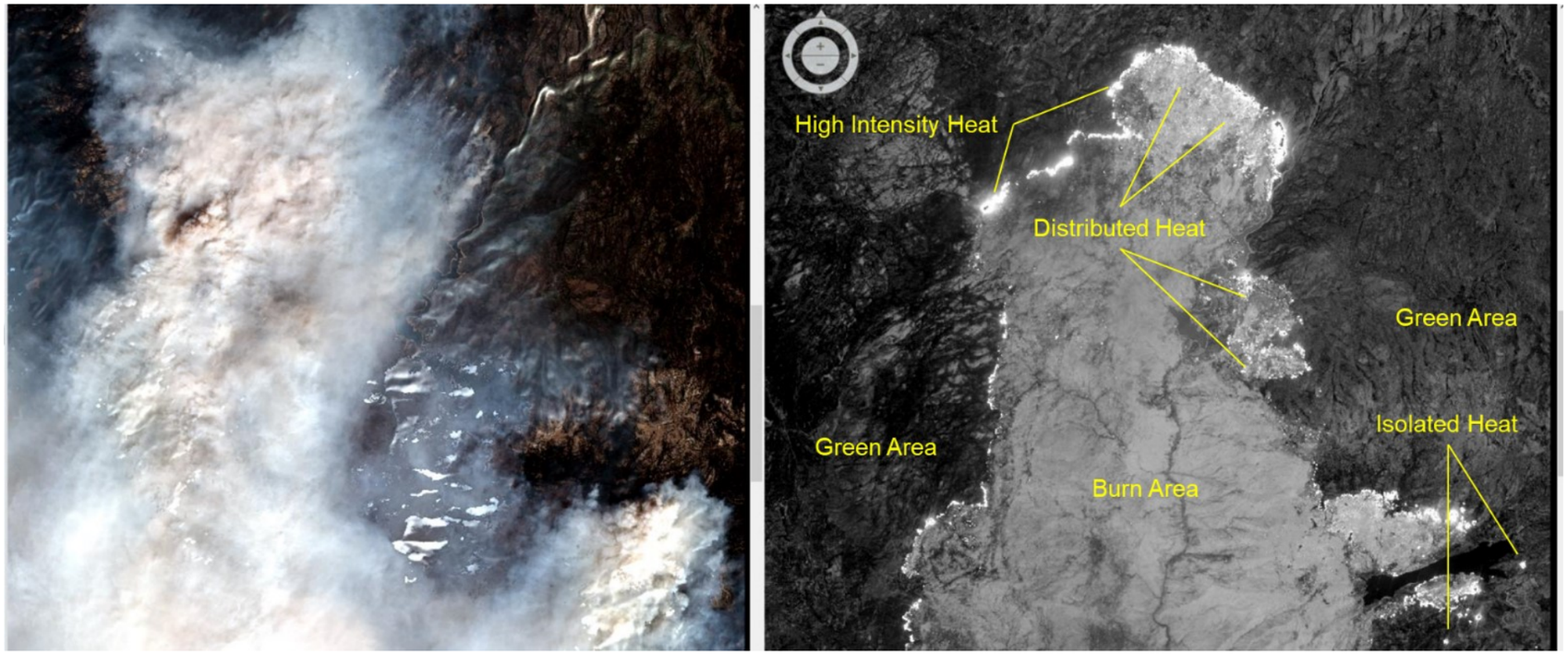
Grid Flexibility is Core to Deep Decarbonization & Resilience Agendas

- **Resilience**: able to *resist outage* AND upon outage, mitigate scope and speed recovery *National Academy July 2017*
- **Grid flexibility** increases both **resilience** and capacity for **clean generation**; delivered through responsive generation, and coordination with storage and responsive loads
- **Lab Objective Elements** deliver resilience and flexibility jointly



AI/ML-enabled Imagery Analysis for Energy Infrastructure Damage Assessment

- Expanded to include wildfire analysis
- Used in 40 U.S. disasters since 2016
- Detailed damage assessments delivered within a few hours of event (8X faster)



The Creek Wildfire in California's Sierra National Forest, as seen through the lens of a multi-spectral imaging satellite on Sept 8, 2020. The image on the left is true color; on the right are results from a new Rapid Analytics for Disaster Response (RADR) algorithm using infrared spectra.

TRAST: Transforming Remedial Action Schemes

- High-performance computing and machine learning to accelerate RAS implementation
- Collaboration with PacifiCorp, Idaho Power, WECC
- Part of PNNL's commercialization portfolio

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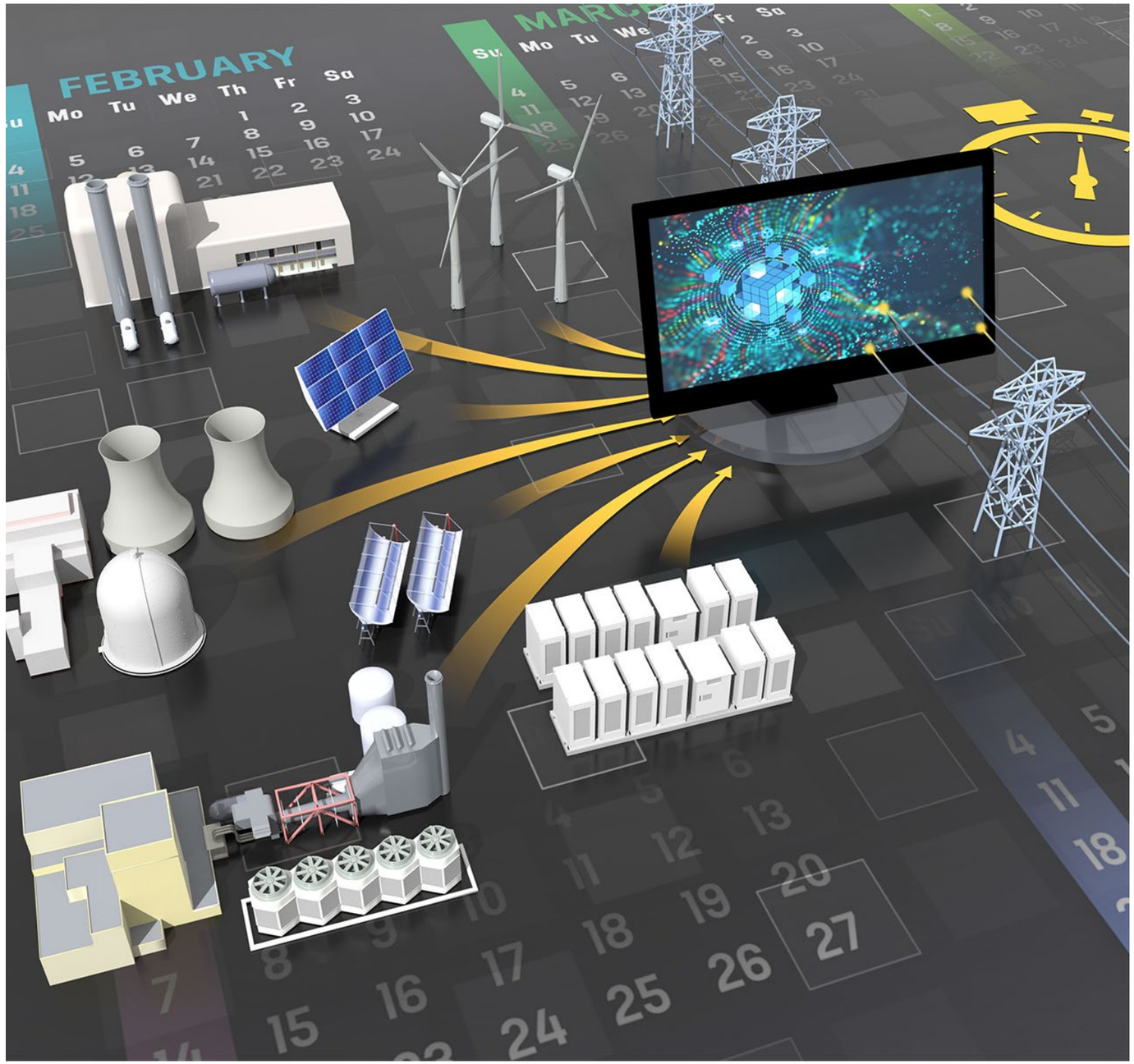
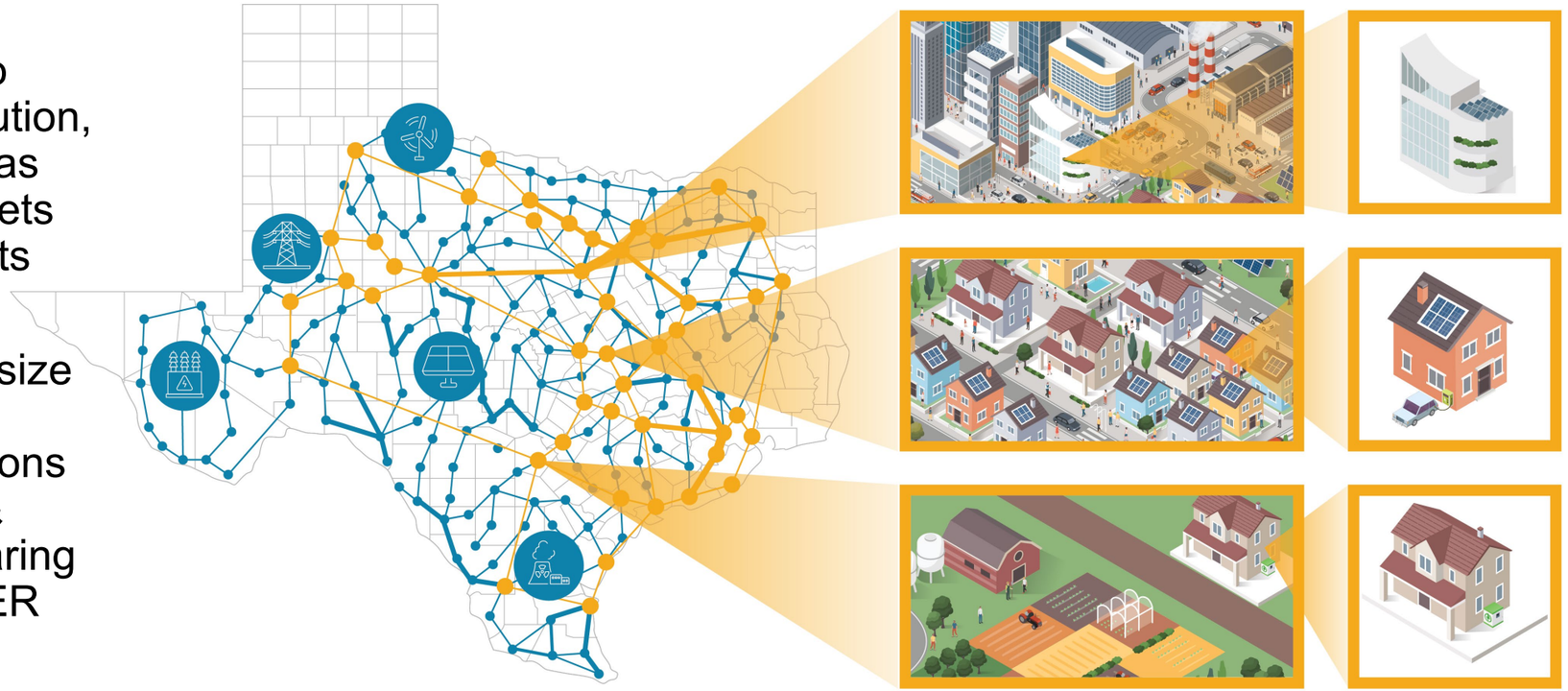
HIPPO: Optimizing a Diversifying Energy Resource Mix

- Security Constrained Unit Commitment (SCUC) a huge challenge with DERs
- High-Performance Power Grid Operation (HIPPO) computation engine utilizes advanced optimization theory, a high-performance computing cluster, and machine learning techniques
- Testing shows to 35X faster; cost within 0.1% of optimal
- Being deployed in MISO's cloud environment



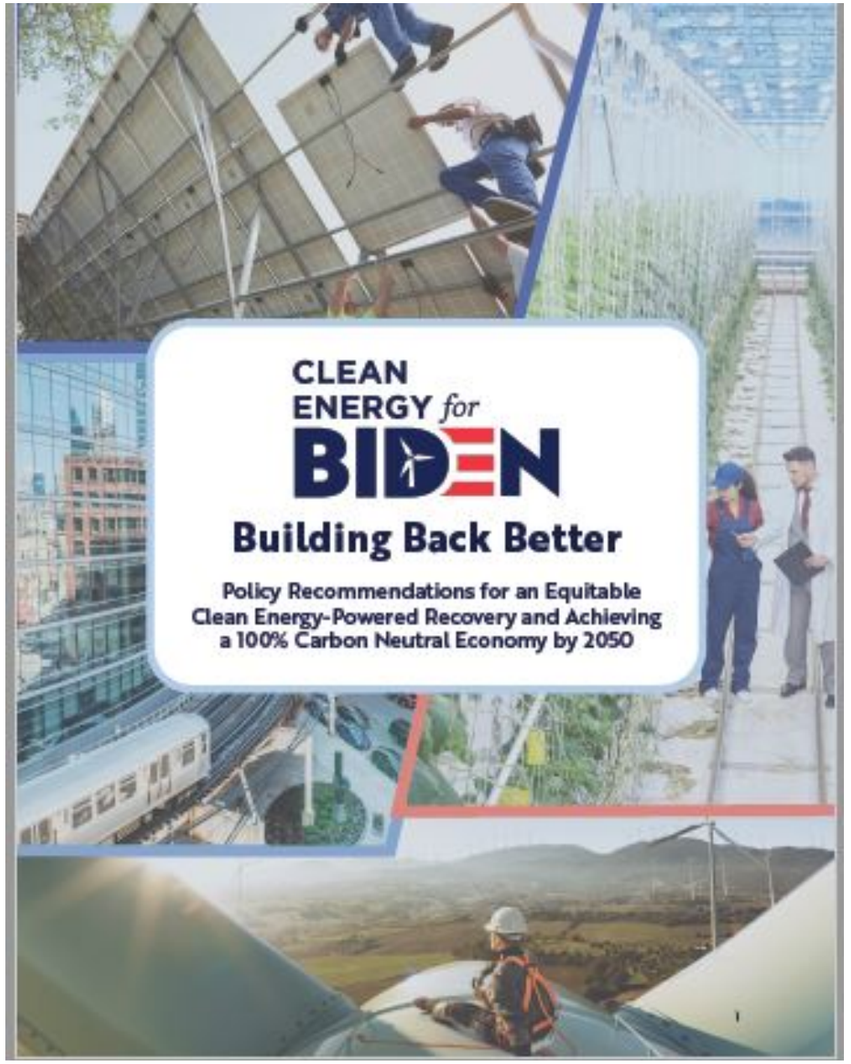
DSO+T: Modeling the Impacts of Transactive Energy Control at Scale

- **High-fidelity capability** to simulate customer, distribution, & bulk system operations as coordinated by retail markets linked to wholesale markets
- **Analysis** of the economic operation of a system the size of ERCOT subjected to moderate & high penetrations of renewable generation & electric vehicles by comparing business-as-usual with DER flexibility coordinated by Transactive Energy



Perspective on Transition, DOE Priorities, Opportunities for Engagement

- Industry input on Grid Modernization, Energy Storage Grand Challenge and Grid Decarbonization strategies
- Utility / vendor planning for regional infrastructure investments and demos
  - Address major obstacles to 2035 goals
  - Focus regionally …. Scale to national agenda
- Engage in DOE R&D portfolios
  - Peer reviews
  - Advisory groups
  - Partner in projects
- Advise on how to improve / accelerate progress and impact in public /private partnerships



How Industry Engages GMLC

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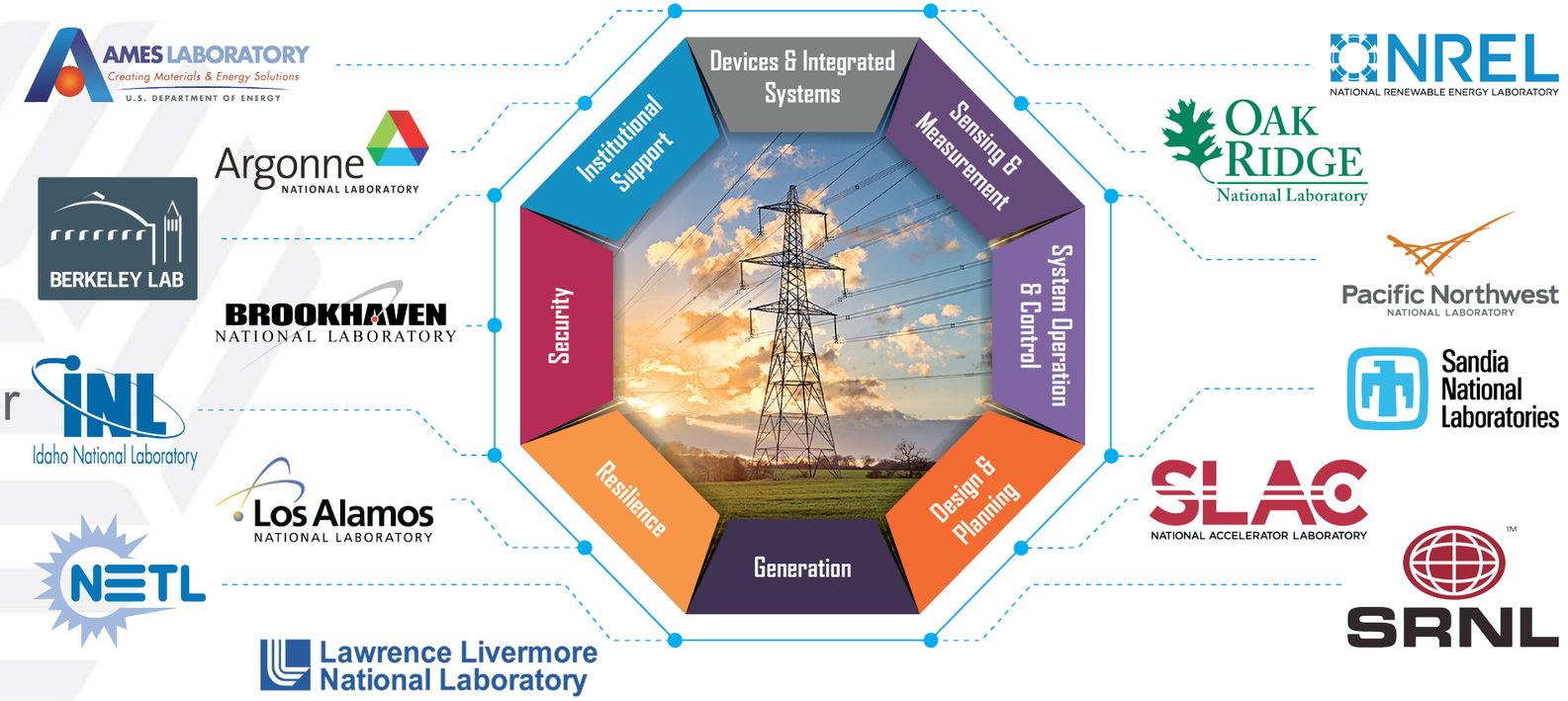
U.S. Department of Energy

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
5. Participate in industry outreach for MYPP updates



Contact GMLC Chairs

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- Juan.Torres@nrel.gov

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Thank you

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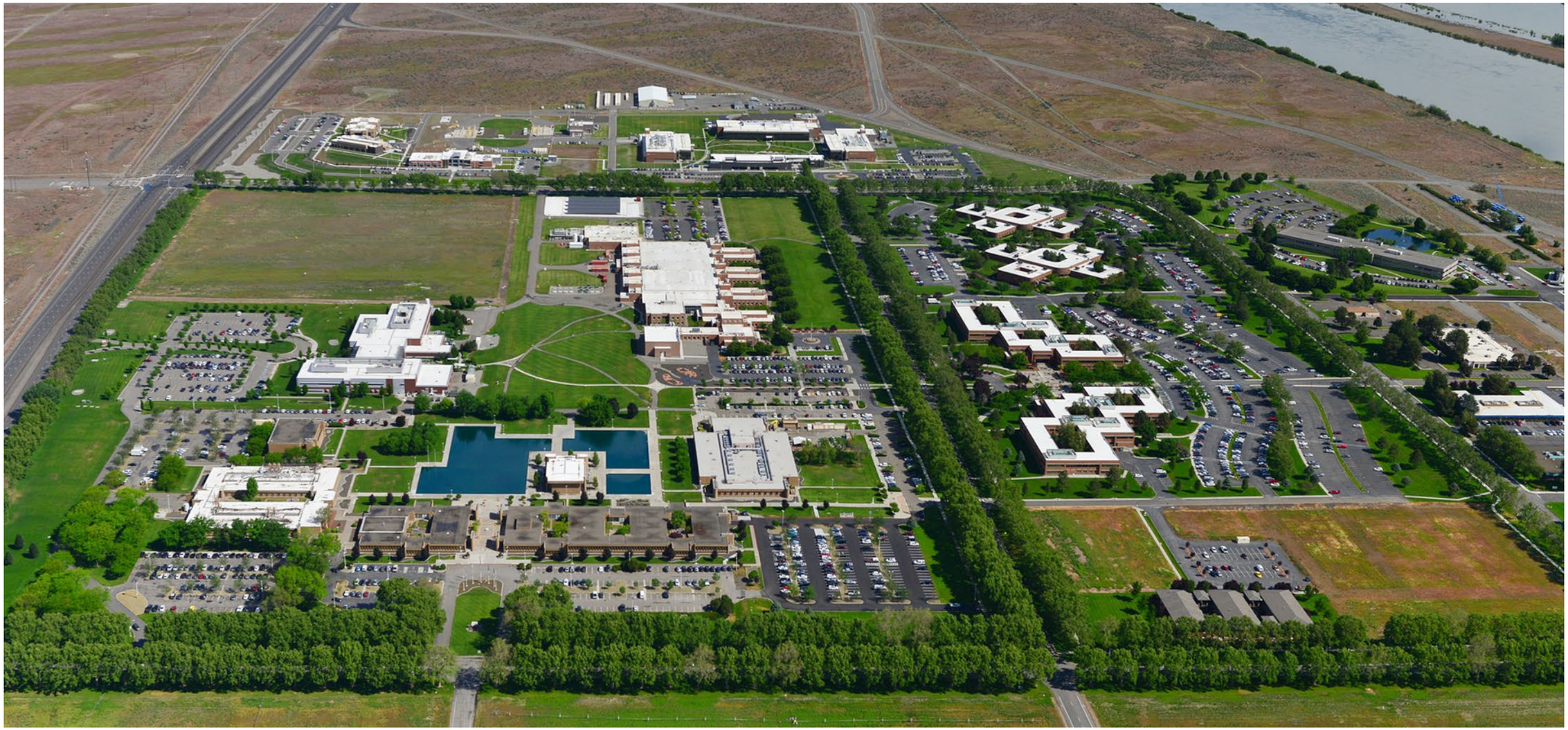
PNNL: A regional, national, and international scientific resource



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PNNL's distinguishing **strengths** enable mission **impact**