



TRANSFORMING GRID OPERATION AND PLANNING

Future Power Grid Initiative

By integrating new grid sensor technologies with communication and computational technologies, researchers at the Pacific Northwest National Laboratory (PNNL) are working to advance science and develop technology for the future power grid. With its three distinct Focus Areas, the Future Power Grid Initiative, or FPGI, will meet the nation's expectations for a highly reliable and efficient electric grid, while reducing dependence on foreign oil and reducing carbon emissions.

THE CHALLENGE

- ▶ In order to manage and optimize grid operations, operators need to see grid performance in near real-time across a wide service area and under emerging contingency situations.
- ▶ Planners need to view the grid under potential alternative configurations, with the ability to evaluate those options against national goals and performance objectives.

IMPACT

- ▶ Bridging operation and planning to enable seamless grid management and control
 - Remove overhead involved in communication between operation and planning
 - Improve response when facing emergency situations
- ▶ Integrating transmission and distribution in end-to-end grid modeling and simulation capable of handling 10^9 devices with uncertainty
 - Understand the emerging behaviors in the power grid due to smarter loads, mobile consumption, and intermittent generation
- ▶ Managing interdependency between power grid and data network (a test lab for power grid data networking is being set up)
 - Enable "all-hazard" analysis
 - Prepare grid operators and planners with the knowledge of data network impact on the power grid

OUR APPROACH

Utilizing PNNL's distinctive capabilities in power systems, data-intensive high-performance computing and visual analytics to address the scale and real-time challenges in future grid operation and planning, our research will:

- ▶ Expand the limits of current power grid networking to support large scale and secure real-time data flow.
- ▶ Design innovative computational approaches to deliver a new class of real-time and high fidelity tools for grid modeling and simulation in a large-scale, dynamic, stochastic environment.
- ▶ Advance state-of-the-art visual analytics to convert very large volumes of multi-domain real-time data into actionable information.

FOCUS AREAS

Focus Area One addresses data networking and management issues, and enables the digital infrastructure for the future grid. This focus area will address the gaps in networking and real-time data management by developing advanced algorithms and software tools and techniques.

Focus Area Leads: Bora Akyol (bora@pnnl.gov) and Phil Craig (philip.craig@pnnl.gov).

Focus Area Two targets research in the areas of advanced mathematical models, next-generation simulation and analytics capabilities for the power grid. Projects in Focus Area Two will use high-throughput data streams produced by projects in Focus Area One and integrate them with sophisticated mathematical models to conduct large-scale power grid

simulation and analysis. Focus Area Two strives to advance the state-of-the-art in modeling and simulation in order to achieve much higher fidelity situational awareness and global comprehension for power grid stability, efficiency and flexibility. **Focus Area Leads:** Daniel Chavarria (daniel.chavarria@pnnl.gov), Tom Ferryman (tom.ferryman@pnnl.gov), and Ning Zhou (ning.zhou@pnnl.gov).

Focus Area Three aims to convert large amounts of model and sensor data into information and knowledge to support decisions in grid operation, planning, and policymaking. This area concentrates on the development of coordinated visualization interfaces and decision support capabilities in a modular, extensible software environment that can be used for both real-time grid operations as well as long-term planning. **Focus Area Leads:** Bill Pike (william.pike@pnnl.gov) and Paul Whitney (paul.whitney@pnnl.gov).

ABOUT PNNL

Pacific Northwest National Laboratory is a Department of Energy Office of Science national laboratory where interdisciplinary teams advance science and technology and deliver solutions to America's most intractable problems in energy, the environment and national security. PNNL employs 4,900 staff, has an annual budget of nearly \$1.1 billion, and has been managed by Ohio-based Battelle since the lab's inception in 1965.

For more information, please visit the FPGI website or contact one of our Initiative Leads:

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