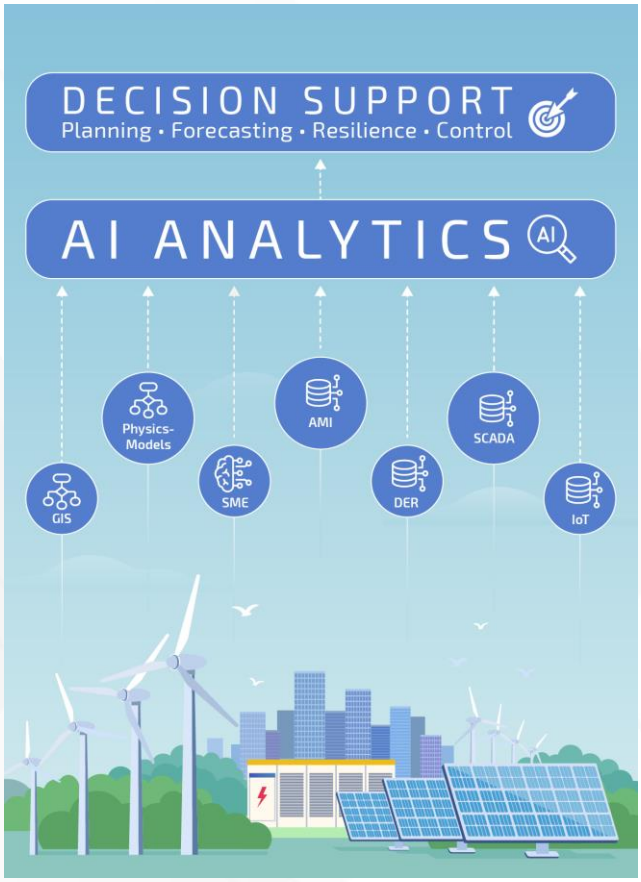
Electric Grid: Artificial Intelligence and Machine Learning Research at Sandia

Sandia National Laboratories has a vision to revolutionize the electric power grid through applied artificial intelligence and machine learning research.

The nation's security and economy depend on an abundant, affordable energy supply, as well as energy systems that are resilient to threats and instability. To tackle climate change and increase energy security, the nation also needs better ways to deliver and store energy. Power grid modernization and electrification are critical goals for a secure and resilient energy future, and artificial intelligence (AI) will be a critical part of the grid of the future.

Applying AI and ML to the Electric Grid

The term 'AI' covers many different methodologies of building a degree of reasoning ability into algorithmic form to accomplish tasks, ands and machine learning (ML) leverages large quantities of data to infer rules and characteristics from that data. Power systems presents a perfect application for AI because of the complex, but still contained, systems and large amounts of data. The modern power grid is producing massive amounts of sensor data every day that can be leveraged by AI algorithms transformed into insights and presented to grid planners and operators for intelligent decision support.



Sandia's electric grid AI research is driven by the following goals:

- Develop cutting-edge, trustworthy AI algorithms to support a modern grid.
- Focus on explainable AI methods which incorporate uncertainty quantification, physics-informed methods, and interpretable results to build trust for critical infrastructure applications.
- Integrate independent data sources including geographical information systems (GIS), physics-models, time-series data, IoT devices, distributed energy resources (DER), and subject matter experts.
- Characterize new grid sensors and data sources and innovation of real-time data streaming practices,
- Implement AI pilot projects to demonstrate real-world impact.
- Create power systems standards for AI.
- Engage with regulators to advocate for the safe and reliable adoption of AI technologies in the power sector.
- Form strategic partnerships with power sector AI industry leaders.

Artificial Intelligence and Machine Learning Applications and Impacts

AI has the potential to impact every area of the data-driven grid of the future, including design and planning tasks, forecasting, control schemes, and resilience challenges.

Sandia's leadership in AI electric grid research focuses on applied testing and real-world impacts including:

- Creation of open-source system modeling software for researcher, co-op, and utility application
- Development of data-drive algorithms to characterize and assess solar behavior, locational value, and scalable impacts, as well as other distributed energy resources (DER).
- Application of data fusion techniques and end-to-end methodologies to process and evaluate cyber-physical threats.
- Development of data-driven methods to evaluate and mitigate the impact of resilience events such as wildfires and earthquakes.
- Use of AI-based protection embeds machine learning in protective relays, allowing the team to test of real field data of actual system faults.

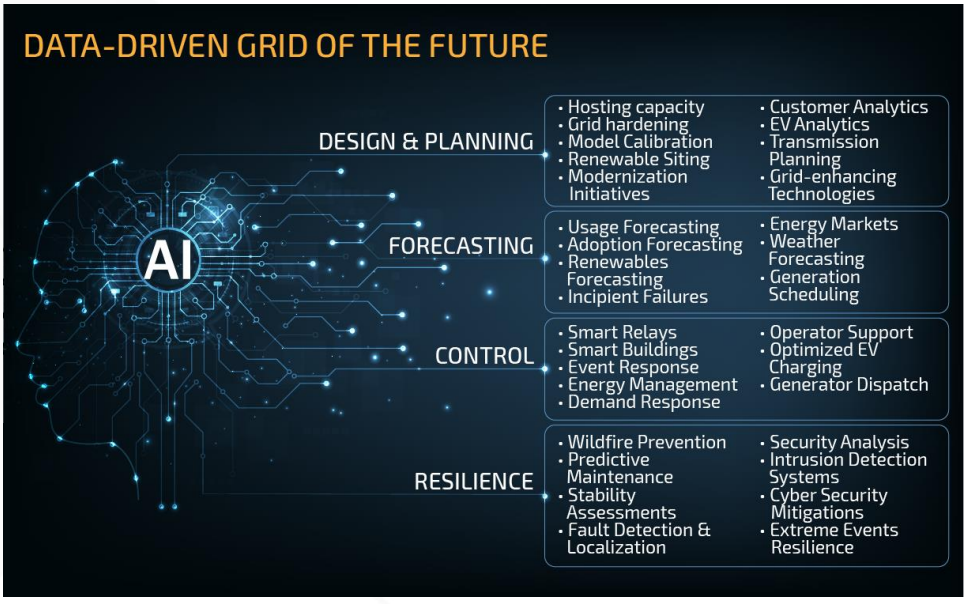
Sandia's electric grid research and development contributes novel AI-based methodologies to multitude of applications within the electric grid. Current utility processes, operators, and traditional analytics cannot keep up with the influx of new data and the emerging challenges for the modern grid. Challenges with electrification, extreme weather, DER, resilience, and emerging cyber-physical threats require new capabilities to address. This capability lag presents many potential applications to use data-driven AI. Incorporating AI into the electric grid will be critical and provide unprecedented efficiency, resiliency, and sustainability.

Scan the QR code below to learn more about Sandia's electric grid research and development, capabilities, facilities, and potential partnership opportunities by visiting our website.

Electric Grid

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Sandia National Laboratories

U.S. DEPARTMENT OF ENERGY
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