Advanced Grid Institute
Strategic Long-Range Plan
Version 2021

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CORE IDEOLOGY *(timeless focus)*

Core Mission

(our purpose as an Institute – our reason for being)

To promote the research and evolution of advanced grid modeling to support planning and operations of complex power systems of the future and its workforce.

Core Values

(what we believe in – values that guide us in our work)

- **Collaboration** – productive, common collaboration, transparent, synergistic, institutional strengths, willing to share ideas and strategies; able to tackle problems larger than any individual laboratory or university would undertake; working with industry to solve problems.
- **Impact** – our work is relevant, making a difference and producing results, measurable impact of R&D efforts with regional, national, and global impact.
- **Innovation** – creative, flexible, and non-incremental progress.
- **Integrity** – open and honest communication; transparent; trusted for unbiased, technology-agnostic solutions.
- **Stewardship** - social responsibility, engaged communication with stakeholders, working toward sustainable and clean energy infrastructure futures.

ENVISIONED FUTURE *(10-year focus)*

Vision Statement

(what we seek to become in the future)

To be recognized as a leading engineering source that will enhance the North American power system and will influence the rest of the world.

Vivid Descriptions

(what will happen when we achieve this vision)

1. AGI will be seen as an innovator, taking ideas from basic science, partnering with others, and moving technology out into the world. We will be a leader in bridging fundamental research with applied science, and in modeling and control of the uncertainties and intermittences in the power system. With PNNL and WSU working together, we will be a model for synthesis of pure and applied science. Our work streamlining communications between industry, academia, and the federal government, will be valuable in the creation of an innovation pipeline.
2. AGI will be viewed as a trusted thought leader by our clients, an honest broker for technical knowledge, and a preferred knowledge source. We will be the place to go to understand the big picture about the national power system. We will be valued as unbiased and technology-agnostic. Our scientific reputation will provide a leading source for answers.

3. Industry will view AGI as an impartial authority and a valued partner. Regionally, AGI partnerships will bring together multidisciplinary energy modeling groups such as gas and others. On a national level, we will partner with a broad set of stakeholders and funding agencies including NSF, DOE, DHS, DOD, and state agencies, and be known as an impartial actor by federal and state governments on energy issues.
4. AGI will be the preferred partner/liaison to utilities. Utilities and technology partners will rely on AGI because we have the best modeling and operations capabilities. Our software methods and tools will be used extensively by the power industry through vendor adoption, open-source platforms, and a software-as-a-service model.
5. AGI will provide unbiased, science-based source for answering the most challenging questions on the power grid for government and media. We will be at the forefront of regional and national conversations about the power grid. We will be at the table during conversations about the system of energy systems. We will be at the table to contribute essential technical input to discussions where the interdependencies of the critical integrated national energy infrastructures are discussed.
6. AGI will be the research partner of choice. We will be the research hub for large scale activity related to better understanding and modeling the power grid. We will provide leadership characterizing uncertainties and provide insights into challenges facing the grid as it evolves over the next several decades. Working together, our clients and stakeholders will benefit from AGI's multi- domain expertise for modeling and simulation that is not available in other organizations. Our success will be measured by how many other universities, labs, and industry partners are working with us. AGI will be so well known that organizations will be coming to us for solutions.
7. AGI will attain international recognition because of the multi-domain skillsets of our faculty and staff. The diversity of thought that AGI possesses, because of the unique partnership between PNNL and WSU, will be seen as essential to our success. AGI's diversity of teams and broad perspectives of stakeholders will create a synergistic educational experience for students and the future industry workforce. AGI will help both students and industry with workforce training and development.

ASSUMPTIONS ABOUT THE RELEVANT FUTURE

(external factors we may need to address as we work toward our vision)

Demographics

1. Changes in demographics will affect the power industry in coming years. If we focus on Northwest region only, we may miss nationwide issues. The PNW region has different problems than the rest of the nation, due to more extensive clean energy infrastructure.
2. Urban and rural divides will affect AGI and the power industry as a whole, including technical and social implications.
3. Utilities intrinsically cannot function 100% remotely and this may lead to worker turnover. Today's workers may change jobs and companies more frequently.
4. There will be changes in load behaviors. For example, we are already seeing significant post-pandemic migration patterns. Electrification of other end uses, especially including transportation, will be profound. Climate change may impact energy utilization for heating and cooling.
5. Global climate change implications are likely to have profound political, social, and economic implications that will impact the siting and operational challenges for the future power grid. Examples include impacts of wildfires and increased severe weather events on sustainability and resiliency as well as acceleration of decarbonization and realignment of energy sources.

6. While the workforce relevant to AGI is contained within the Pacific Northwest, the impact of AGI will not be confined to the region.
7. The greening of other industries will affect the power industry. Electrification of other industries will represent an increase in demand as well as an increased emphasis on resilient infrastructures.
8. Cybersecurity for critical operations and privacy protection for customers will continue to be an issue.
9. Consumers going off-grid must be accounted for in terms of industry business models and financial viability.
10. The demand for clean energy and evolution of other industries, formerly unconnected with the electric grid and unfamiliar with how their changes impact electric power and demand profiles, may impact our industry's future planning and operational strategies.

Societal, Cultural, and Consumer Values

1. There will be a move toward a greener and more resilient industry, and this may in part be consumer-driven. A move to solar may change the way utilities do business with owners of private solar arrays.
2. Climate change will change our available sources and interactions with the grid. Because the regional hydroelectric power relies on snowpack for seasonal energy storage, if there is a shift in precipitation patterns, or a transition from a snow-based watershed to a water-based watershed, there will be significant ramifications.
3. Accessibility and environmental justice will be an issue. The industry must make sure that costs are distributed fairly, and innovations are affordable and equally accessible.
4. Data and privacy will continue to impact our industry.
5. Electric transport will have a large impact on load, especially buses. It will grow more common as costs are reduced. Fleets will need specialized charging stations. Electrifying other sectors will add new load types, e.g., Port of Seattle.

Regulatory Environment

1. Electric grid-related legislation and policy will be controlled more by socio-political environments than technology innovations, including going from an abstract goal for clean energy transition to viable technical solutions and concrete regulations.
2. Often conflicting prioritizations of minimized environmental and economic costs will have an impact on our industry. Balancing affordability, sustainability, and reliability will remain a profound challenge for regulators.
3. 100% renewables may not necessarily be easy to achieve, especially considering resiliency expectations.
4. Policy regulators will need more technical training to understand the issues being discussed more effectively.
5. The role of utilities will be in flux; a question is, how much will the regulators be entwined with them.

Economic Climate

1. The uses of electricity related to standard of living around the globe will evolve. The issues will be around balancing economics and standard of living with affordability, environmental impact, and stability.
2. There will be questions on who benefits and who pays, in terms of equity and social justice.

3. There will be continued uncertainty in federal budgets, with varying incentives to support.
4. Utilities will be challenged to fund all the changes that will be needed. Opportunities will exist for public/private partnerships to advance business model transformation.
5. The rate structures will vary. Competitiveness dollars are being spent in Europe, China, and other countries around the world for R & D, and this will continue.
6. Infrastructure investment will continue.

Nature of the Field

1. Due in part to societal decarbonization goals, coupled with the reducing cost (and increased capability) of batteries, electric vehicles are becoming more predominant, and are expected to rapidly expand in the coming decades. This will drive unprecedented changes to the power grid that will have an increased role in the electrification of society's transportation sector.
2. Humans are an integral and engaged part in the electric power system, both from an operational perspective and empowered customers. We will need to better understand cognitive behavior and decision-making skills based on research into human behavior modeling and assessment.
3. As many renewable energy sources are inherently less dispatchable (because they cannot control when the sun shines or the wind blows), better harnessing of complementary technologies, such as electricity storage or flexible demand, will be important to fully utilize their resource potential. The operation and control of this increasingly complex electricity landscape will require new technologies for prediction and dispatching.
4. Power electronics are becoming ubiquitous in both the supply and demand side of the power system. Inverter-based resources, predominant across multiple classes of renewable energy sources, as well as inverter-based load, such as variable speed drives for more efficient motors, will dramatically change the way that the power grid operates. Inherently faster than their synchronous machine-based ancestors, power electronics devices will have unprecedented opportunity to either enhance, or destabilize, the power system depending on how they are designed, deployed, and programmed to operate. Power quality considerations are also important.
5. Enhanced cybersecurity of advanced control systems will be essential to ensure that they are able to operate with high degrees of availability and integrity.
6. With the development of advanced methods, models, and tools by software vendors and the critical infrastructure nature of the power grid, balancing proprietary and open-source requirements for integrating new technologies with legacy systems may slow progress.
7. The rate of change associated with these developments has been accelerating rapidly during the past few years. Part of this has been driven by technical innovation, and part of it has been driven by the political climate that is pursuing deep decarbonization goals.

Scientific and Technological Advances

1. The integration of computer science tools such as artificial intelligence and data science will impact modeling and operations solutions. Additional work will be needed for human-machine interactions to ensure industry standards.
2. Advanced nuclear power generation technology will be demonstrated and promises to be a cost-effective option in the long-term. (But the speed of deploying new facilities may represent a limit on the national impact for the foreseeable future.)
3. AGI will remain primarily focused on the electricity delivery infrastructure and will most likely not be linked to specific generation sources. But as the mix and their location of generation sources evolves,

there will be significant implications for the power grid. These include the attributes of these generation technologies, in terms of their dispatchability, and the technical characteristics of the generation technologies.

4. Given the importance of new storage technologies, the AGI will be positioned at the forefront of grid integration for all forms of storage: centralized and distributed, fast acting and long-term, etc.
5. Better harnessing the inherent flexibility of buildings and other end-use loads to provide grid services will remain a key area of emphasis for the Institute.
6. There will also be profound architectural implications of how the microgrids are deployed: they will increasingly be used as building blocks associated with the interconnected grid and customer-centric solutions to solve specific issues.
7. As the cyber-physical infrastructure and its interactions become more complicated, the cybersecurity solutions will need to evolve so that they can adequately protect these complex systems. The power grid's interdependencies of related supporting infrastructure, such as natural gas, communication networks, and other supporting infrastructures, will become increasingly important. Fully understanding the implications will require comprehensive modeling and assessment efforts.
8. Models to assess the risk, and risk mitigation strategies, for extreme events across the system will be needed. These models should include all-hazard assessments of credible contingencies and increase our collective understanding of extreme events that are beyond the normal design basis requirements.

OUTCOME-ORIENTED GOALS *(3-5-year focus)*

(actions that will move us toward achievement of our vision)

Research

Goal:

The AGI will have a robust portfolio of high-impact research projects that are aligned with our clients' key technology challenges.

Objectives:

1. Increase stable, sustainable, and reliable routes to funding.
2. Increase national and international partnerships (#'s of universities and labs participating).
3. Increase alignment and connection to industry.
4. Increase the AGI's leadership of larger R&D projects.
5. Improve portfolio management of our projects, including stable and larger projects.
6. Increase evidence of impact with publications, tech transfer, and demonstrations.

Possible Strategies

1. Develop new simulations, models. and tools.
2. Quantify how investment into our projects results in measurable returns, such as publications or IP benefits for companies that use the technology.
3. Identify new funding sources for AGI related activities.
4. Create AGI Industrial Advisory Board.

Education

Goal:

AGI will excel in workforce development, both current and future. Students will be more connected with industry challenges through their interactions with AGI. AGI will be a source of training for the existing power engineers to keep up with the rapid pace of changing technologies.

Objectives:

1. Increase the number of students that are involved in AGI activities.
2. Increase the number of industry engineers that are involved in AGI projects.
3. Increase the number of future workforce members with integrated skill set related to computer science applications in electric grid space.
4. Improve industry perception of AGI as a source of workforce training.
5. Increase placement of students in key organizations.
6. Expand the number of WSU graduate students in power engineering-related fields.
7. Increase educational and training opportunities by leveraging programmatic funding.
8. Increase the number of women and other underrepresented individuals involved in AGI activities.

Possible Strategies

1. Help future workforce to understand cyber security, AI, communications, power electronics, and human interaction which is a much broader set of knowledge than what was needed in the past.
2. Increase student participation with PNNL staff through projects and classes to have a much broader understanding by getting students more engaged by linking them to the impact of AGI's work.
3. Develop open-source software for courses and more open online course material.
4. Expand workforce development for non-engineering technical workers, including relay techs. Partner with the IBEW for vocational training opportunities.
5. Develop communication platforms for sharing AGI technical impact with non-technical audiences including public, elected officials, and regulators.
6. Pursue large traineeship proposals that integrate electric power and computer science areas including cybersecurity, artificial intelligence, and data science.
7. Partner with existing PNNL and WSU Diversity, Equity, and Inclusion programs to provide interaction opportunities around AGI technical areas.
8. Develop programs to increase number of WSU graduate students eligible for security-clearance related work.

Influence

Goal:

AGI will increasingly become known as a thought leader and influential knowledge source for technology and policy development for advanced power systems.

Objectives:

1. Increase AGI name recognition, both in regional strength but also national reach.
2. Increase national visibility of our individual researchers.
3. Improve policy makers and the public's understanding of advanced grid challenges and technical trade-offs.
4. Expand AGI research visibility on the national stage.
5. Increase citations and reach of papers, publications, and presentations.

Possible Strategies

1. Increase high visibility reports and policy exposure. Develop series of reports espousing on visions of the future power grid, and the necessary research, development, and demonstration projects that will achieve this vision.
2. Publish a series of white papers that others use as a reference so that we are seen as the thought leaders.
3. Host seminars and other workshops to enhance visibility regionally, nationally, and internationally.
4. Develop training materials that are valued and utilized by industry, technical partners, government, and regulatory groups.
5. Communications strategy to provide additional visibility including multiple stakeholders: government and other potential clients, industry and other research partners, and general public. This will include news and updates about our research portfolio of activities, as well as information relevant to AGI.

Institutional Collaboration

Goal:

Both WSU and PNNL will benefit from AGI collaboration.

Objectives:

1. Increase incentives to collaborate - Robust internal investment mechanisms that we can leverage to encourage new activities.
2. Lower the barriers for collaborations and sharing of data between the PNNL and WSU.
3. Leverage internal investments by both PNNL and WSU and demonstrate impact in organizations and AGI technical space.

Strategies

1. Create joint white papers on key aspects of each program at least annually.
2. Establish ongoing, regular collaborations to increase effectiveness.
3. Expand connections across WSU System including all campuses with engineering.
4. Develop programs to facilitate exchanges and interactions in formal and informal settings.
5. Develop internal communication plan to disseminate past accomplishments and future opportunities.