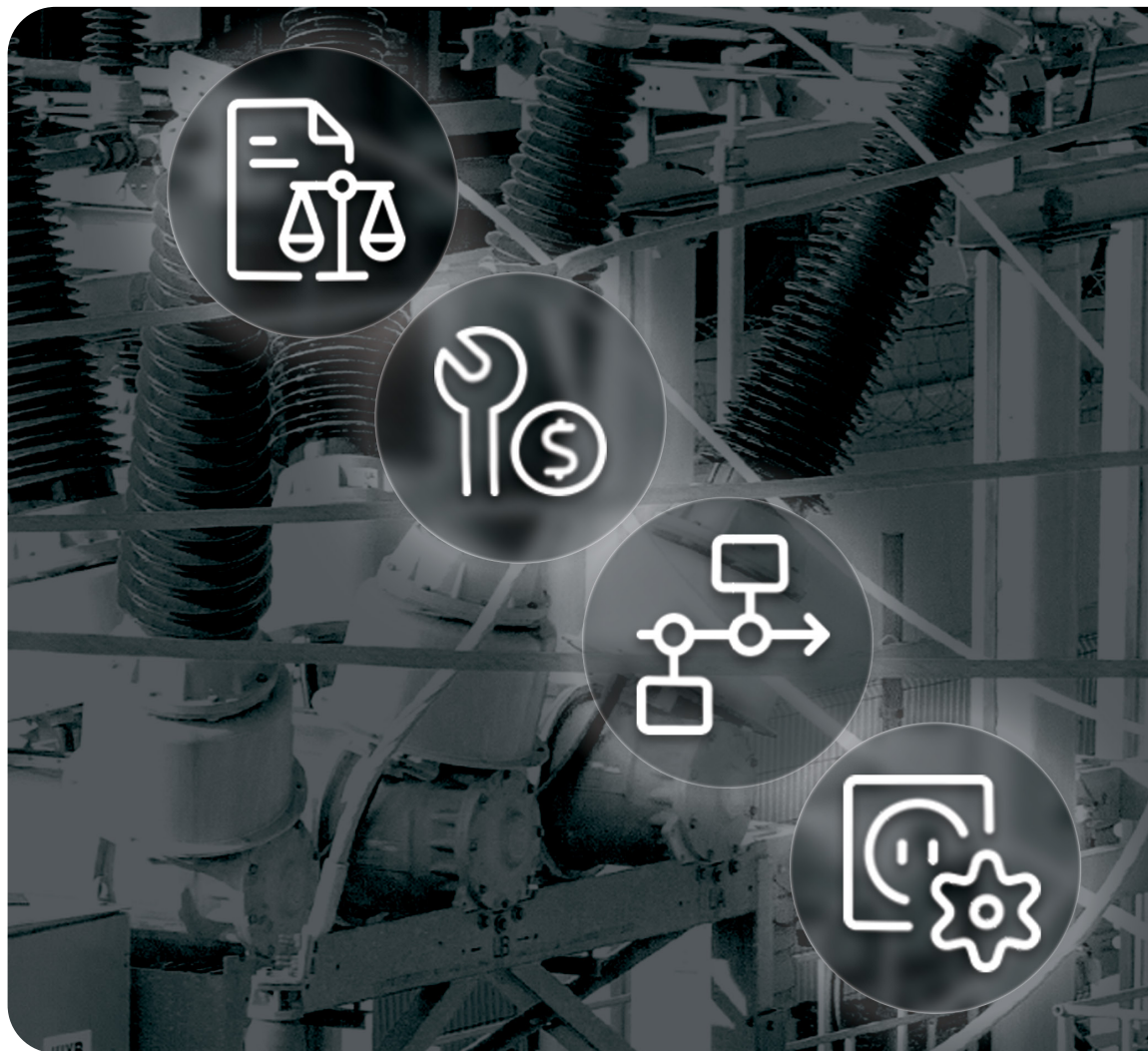


AI AND THE GRID

Unlocking the Potential of Artificial Intelligence for Electric Utilities





EXECUTIVE SUMMARY

The rapid advancement of artificial intelligence (AI) is transforming industries worldwide, and the electricity sector is no exception. AI-driven solutions are optimizing asset management, enhancing grid operations, improving customer engagement, and streamlining business processes. As the industry continues to evolve, AI's role in protecting against extreme weather and wildfire threats and facilitating grid flexibility and efficiency is becoming increasingly vital. This white paper explores key AI use cases in the electricity sector, providing insights into its current applications and potential for future innovation.

The GridWise Alliance embarked on a series of discussions around use cases for AI across the utility enterprise. GridWise membership includes utilities from around the country, technology companies developing AI platforms for utilities (some are also data center owners), grid equipment manufacturers and vendors incorporating AI into their products, national laboratories working on grid modernization, and engineering and consulting firms supporting utility grid modernization projects.

This paper is a result of multiple convenings of GridWise Alliance member companies and a handful of non-member voices in 2024 and 2025. In June 2024, GridWise Alliance convened an AI Roundtable in Washington, D.C., which brought together utilities, technology providers, federal officials, and policy stakeholders to share their accounts of how AI was beginning to be applied within their organizations — including enterprise-level applications and targeted deployments aimed at improving system visibility, vegetation management, permitting, and other operational challenges.

Building on this foundation, the GridWise Alliance established an AI Working Group in fall 2024 with the goal of developing a framework to capture how utilities and their partners are approaching AI adoption. The Working Group refined categories of use cases that now structure this paper, guided the design of a member survey intended to broaden input beyond the convenings themselves, and offered an additional forum for participants to contribute examples. These sessions elicited accounts of both current deployments and anticipated applications and prompted additional input on governance practices, cybersecurity and data management, and organizational readiness.

In December 2024, GridWise convened an AI Use Cases Workshop in conjunction with our annual gridCONNECT conference, which served as an additional forum for members to describe applications of AI within the emerging categories identified by the Working Group.

Policymakers are also taking note of AI applications for energy. The December 2024 House Bipartisan Task Force on Artificial Intelligence Report included a recommendation to “[p]romote broader adoption of AI to enhance energy infrastructure, energy production, and energy efficiency”; and the July 2025 White House Office of Science and Technology Policy AI Action Plan recommended using advanced technologies to increase the efficiency and flexibility of the existing electric grid. In November 2025, the Department of Energy (DOE) launched Genesis Mission to accelerate scientific discovery using AI. Under this initiative, DOE will use public datasets to develop new AI models for research. One of the focus areas will be using AI for an intelligent, resilient grid, including for improved forecasting and simulation.

Most recently, during the December 2025 grid-CONNEX conference, AI use cases featured prominently in panel discussions focused on flexible grid management and smart distribution infrastructure. In the short span of time since the June 2024 AI roundtable, AI use cases for the grid went from being the focus of a specialized meeting to being integrated into multiple main sessions of the annual GridWise Alliance conference. This reflects how quickly AI is advancing and the extent to which electricity sector stakeholders are deeply thinking about how to leverage new technology to modernize and strengthen the electric grid.



GRIDCONNEX2025 Conference, Washington, DC.

Taken together, these convenings, survey efforts, and industry input identified eight functional areas within the utility enterprise where AI is improving reliability, increasing efficiency, reducing costs, improving operational agility, and increasing customer satisfaction. This paper describes AI use cases in each of these functional areas, describes the benefits and value drivers of using AI for the grid, and lays out some challenges utilities have experienced in incorporating AI into existing operations. Finally, this paper offers the following recommendations for electricity sector stakeholders and policymakers to smooth the deployment of AI across the utility enterprise:

- **Industry Collaboration**
- **Standardization Efforts**
- **Regulatory Engagement**
- **Cybersecurity Investments**
- **Incentives for AI Adoption**
- **Open-Source AI Platforms**
- **Workforce Training Programs**

¹ “Bipartisan House Task Force Report on Artificial Intelligence” U.S. House of Representatives, December 2024, p. 175.

² “Winning the Race: America’s AI Action Plan” The White House, July 2025, p. 15.

USE CASES

A survey of AI use cases can be organized in several ways: from most widely deployed to those with just a few pilot projects, from AI use cases that tackle the largest problems facing the electricity sector to those that help with ordinary business challenges, or from the newest frontier use cases to those that have been around for several years under other terminology like machine learning.

In many cases, the AI use case examples that are the most widely deployed – such as customer engagement chatbots – are common in other industries as well because they have fewer risk issues to be ironed out. The electricity sector is unique in that it is heavily regulated and places a premium on reliability of service, which may slow uptake of AI solutions in areas like grid operations. This paper organizes the survey of AI use cases based on what is top of mind for policymakers, i.e., ensuring a reliable and affordable electric grid in the context of wildfire and extreme weather as well as surging demand for electricity





ASSET MANAGEMENT & MAINTENANCE

Predictive Maintenance.

Machine-learning algorithms can process sensor data from transformers, circuit breakers, cables, and other equipment along with asset age, manufacturer specifications, and historical failures to estimate remaining useful life and probability of failure. This allows utilities to schedule repairs in a way that extends the lifespan of assets, reduces downtime, and mitigates operational risks. Even without sensors, utilities can build models based on internal records and manufacturer specifications. Model accuracy requires, however, that utilities have good data on equipment condition and equipment failure history. In addition, digital twins of utility equipment allow utilities to simulate operations and optimize maintenance scheduling. In situations where multiple pieces of equipment need maintenance, AI tools can help prioritize repairs to minimize risks to the grid.

Vegetation Management.

AI is transforming asset management by integrating predictive maintenance models with LiDAR, line sensors, and satellite imaging technologies. AI and LiDAR can predict where fast-growing vegetation will threaten lines in future seasons, letting utilities shift from fixed trimming cycles to risk-prioritized scheduling. These tools reduce maintenance costs while ensuring compliance with safety and reliability standards. Utilities have reported significant outage reductions by using AI-driven vegetation management to focus crews on the highest-risk corridors first. For example, a software company representative said: "In the asset optimization space, one of the fastest growing use cases that we're seeing is around vegetation management and this is an enormous cost take out opportunity for many utilities—whether it's understanding equipment degradation, or if you have vegetation or a bird's nest on the line, or at a more advanced level, where you're looking to do advanced risk mitigation for storm disruption and preparedness and layering datasets for wildfire detection and risk prediction."

Asset Registry Validation.

Another example comes from utilities that are combining AI with remote sensing to improve asset management. With improvements in image recognition and image-to-text, AI can more rapidly ground-truth asset registries. Early pilots include correcting the labeling of poles as either wood or concrete, identifying degraded or at-risk assets, and correcting line designations as either overhead or underground. This is critical because capital planning, storm planning, failure prediction, and other initiatives typically rely on an asset management system to reflect an accurate assessment of the current state of equipment. In the future, we can expect the combination of these capabilities with database tools in an agentic fashion to allow automatic updates and cross-system updates (i.e., i.e., from the asset management system to GIS systems).



RELIABILITY, RISK MANAGEMENT, & SAFETY

AI plays a crucial role in enhancing safety across the electricity sector. AI-driven predictive maintenance solutions help identify equipment failures before they occur, reducing downtime and mitigating operational risks. A technology provider highlighted that drone-based AI inspections facilitate remote monitoring of transmission and distribution infrastructure, improving worker safety and reducing the need for manual field inspections. As physical AI and robotics technology advances, more tools will be available to use in the field. More broadly, AI turns large data streams into earlier warnings, better-targeted actions, and more resilient operating practices related to extreme weather, wildfire, and cybersecurity threats. AI can also help utilities understand and govern new risks from AI itself.

Transmission Contingency Analysis.

AI enhances transmission contingency analysis by making security assessment faster, more accurate, and more risk-informed, so operators can evaluate far more “what if” events (N-1, N-2, and beyond) in real time than is feasible with traditional tools alone. Utilities are facing rapidly changing real-time operating conditions, and reliance on operator training leads to risks in missing critical contingencies. Utilities are evaluating using AI for prediction of contingency violations and recommendation of remediation plans leveraging a combination of real-time data, operational forecasts, and system topology models. Using AI tools in this way could reduce the manual labor associated with contingency case development, increase the number of contingencies that can be assessed, and improve responsiveness with real-time data analysis.

Enhanced Extreme Weather Risk Analysis.

AI-based tools are being developed in-house and in collaboration with technology vendors to determine the potential impacts of upcoming extreme weather in advance. AI enables probabilistic weather and load forecasts, which are full distributions of likely outcomes. This expanded set of information helps operators and planners better manage risk under extreme events like heat waves and atmospheric rivers. Utilities and agencies use these probabilistic outputs to size reserves, stress-test operations, and design hedging strategies rather than relying on fixed safety margins. Once the highest impact areas are identified, work crews can be pre-positioned to efficiently manage resources and reduce power outage duration for customers.

Wildfire Risk Reduction, Response, and Recovery.

AI tools can help with many aspects of the wildfire crisis as the events increase in frequency and severity. In 2024–2025, utilities and regulators moved rapidly from piloting AI tools to deploying them, spurred by record wildfire losses.

AI-powered wildfire prevention tools, combined with climate modeling, can analyze satellite imagery and environmental data to better predict potential threats under different weather scenarios. They can help quantify risk, identify high-risk areas where hazard mitigation is needed, and suggest cost-effective infrastructure hardening measures.

To further reduce the risk of electric infrastructure igniting fires, computer vision models can analyze drone, satellite, and helicopter imagery to detect damaged conductors, corroded hardware, failing insulators, and encroaching vegetation faster and more consistently than manual inspection. Furthermore, utilities are tapping into more advanced use cases to enhance system reliability and safety concurrently by incorporating predictive insights afforded by intelligent line sensors and grid analytics systems into grid operations. By leveraging grid data at higher temporal and spatial resolutions, breakthrough use cases emerge.

For example, capturing higher resolution synchronized data (a.k.a. synchro-waveforms) at multiple locations allows utilities to identify grid anomalies that precede permanent faults. If the data capture is high resolution (e.g., orders of magnitude better than SCADA), AI can be applied to detect and identify seemingly minor disturbances such as precursor anomalies. When these anomalies increase in severity, the data can be used to predict and preempt outages caused by equipment failures or vegetation contact. In addition, higher resolution data can identify and address more complex grid challenges, like determining the root cause driving the anomalous behavior in the grid leading to potential grid-induced ignitions and wildfires. As large-scale deployments demonstrate, these solutions deliver meaningful impact to system reliability and wildfire mitigation plans while reducing the operating costs associated with unplanned outages.

AI tools also support wildfire response and recovery by using AI-powered camera networks and deep learning to detect smoke and fire more quickly. This is especially helpful in limiting the total area burned in the case of fast-moving fires. AI platforms can help operators and incident commanders make faster decisions about public safety power shutoffs, switching, and crew deployment based on fire perimeter, weather, and grid data. After the fire is over, AI tools can help utilities assess damage and strengthen transmission and distribution systems against future fires.

Cybersecurity.

Public infrastructure, including electric, water, and telecommunications infrastructure, is vulnerable to attack by malicious actors. This attack space is expanding as more smart devices and controls are being connected to the grid. While AI tools provide a boost to efforts to detect, analyze, and mitigate cybersecurity threats by continuously monitoring data and spotting anomalies faster than human analysts, their integration into these systems also expands the range of attack space. While similar dynamics are present throughout the economy, these risks in the electricity sector directly affect reliability outcomes, public safety, and the broader economic activity that depends on a stable and functioning grid.

As a result, ensuring the cyber and physical security of the electric grid will remain a top priority for utilities and regulators. As stakeholders work to develop AI risk management frameworks across the economy, additional effort will be needed to establish standards and human-over-sight requirements specific to the operational realities of the electric sector.



GRID PLANNING

There is bipartisan support for using AI tools to enhance grid planning. The Bipartisan House Task Force on AI Report highlights opportunities for AI to help with grid planning:

“

Given the grid's size and complexity, it is often difficult for planners to ensure sufficient generation meets the varying load requirements needed. AI can help meet this challenge by improving coordination, optimizing infrastructure resources, unlocking underutilized assets, and organizing the enormous amount of technical data that is generated daily.³

”

Indeed, AI-driven predictive models improve power flow analysis, enabling utilities to forecast load growth and optimize grid expansion plans. Generative AI assists in system modeling by validating data in real-time and refining investment strategies. According to a technology provider, “[c]lassical grid planning has been very much constrained by poor data quality in terms of your network models. But with AI, we can tie in measurement data and help validate and clean the source data from your network models.” As a result, utilities can accelerate interconnection using both wire solutions and non-wires alternatives.

AI use cases for grid planning focus on long-term decisions about what to build, where, and when. In contrast, AI use cases for grid operations focus on second-to-second and hour-ahead decisions about how to run what already exists. A growing set of AI use cases, including interconnection studies and weather and load forecasting, straddle both domains.

Accelerating Generator Interconnection.

Utilities face resource constraints as part of interconnecting new generation. Generator interconnection challenges exist on both the bulk electric system as well as on the distribution system for Distributed Energy Resources (DERs). At a high level, AI streamlines the interconnection process by using fast power system simulations and probabilistic analysis. Regional grid operators have partnered with technology vendors to deploy AI tools to automate and optimize generator interconnection studies to speed up approvals – a critical advancement given that average interconnection queue wait times have more than doubled from 22 months to 55 months between 2008 and 2024.⁴ In addition to easing capacity constraints and improving reliability, speeding up generation interconnection also advances efforts to reduce harmful emissions given that renewables make up the majority of the interconnection queue (of the 2,290 GW of capacity seeking interconnection at the end of 2024, solar accounted for 956 GW, storage for 890 GW, and wind for 271 GW).⁵

³ “Bipartisan House Task Force Report on Artificial Intelligence” U.S. House of Representatives, December 2024, p. 170.

⁴ Rand, Joseph, et al., “Queued Up: 2025 Edition, Characteristics of Power Plants Seeking Transmission Interconnection as of the end of 2024” Lawrence Berkeley National Laboratory, December 2025.

⁵ Ibid

AI-driven solutions help customers navigate complex regulatory requirements and submit the correct information efficiently, aligned with FERC and state mandates. One software company stated:

We're already using early forms of AI in customer engagement in the interconnection process to streamline the process and help the developers understand how they should respond to information requests.

Using natural language processing, AI tools can also support automated intake and screening of interconnection applications. Similarly, AI can accelerate distribution system interconnection of community solar, residential solar, and residential batteries by automating and improving every step, from hosting-capacity analysis and application screening to study execution and operational integration of these DERs on distribution feeders.

Weather and Load Forecasting.

AI weather models produce hyper-local, short- and medium-term forecasts for temperature, solar irradiance, and wind. These AI models can be significantly more accurate in forecasting the availability of solar and wind energy than physics-based models. Using these AI tools, operators can anticipate renewable energy ramps and load swings earlier, reducing curtailment and reliance on more expensive, fast-start generation. Utilities are increasingly exploring AI tools for short-term (day-ahead) load forecasting. The new DOE Genesis Mission will include a focus on developing AI tools for improved forecasting for a resilient grid.



Permitting.

AI tools have the potential to support grid planning by accelerating permitting of electric grid infrastructure. The AI Action Plan includes a recommendation to:

Expand efforts to apply AI to accelerate and improve environmental reviews, such as through expanding the number of agencies participating in DOE's PermitAI project.⁶

Led by the Pacific Northwest National Laboratory, the PermitAI initiative has developed a comprehensive public dataset of environmental review documents. It will also build custom AI tools for federal agency staff to help them glean insights from past environmental review documents. AI tools could also help categorize public comments to reduce staff workload and help agency staff draft new environmental review documents.

⁶ "Winning the Race: America's AI Action Plan" The White House, July 2025, p. 15.



GRID OPERATIONS

In the context of rising demand for electricity, policymakers are aware of the need to make the most of our existing electric grid. The AI Action Plan recommends the United States:

Optimize existing grid resources as much as possible. This involves implementing strategies to enhance the efficiency and performance of the transmission system. The United States must explore solutions like advanced grid management technologies and upgrades to power lines that can increase the amount of electricity transmitted along existing routes. Furthermore, the United States should investigate new and novel ways for large power consumers to manage their power consumption during critical grid periods to enhance reliability and unlock additional power on the system.⁷

- WHITE HOUSE AI ACTION PLAN (2025)

Working together, utilities, grid operators, and technology vendors can use AI tools to help accomplish these goals. There is bipartisan support for using AI in this way — the Bipartisan House Task Force on AI Report highlights opportunities for AI to help with grid operations:

With AI tools, system operators can achieve real-time operational awareness, enhancing decision-making processes and enabling rapid responses to dynamic conditions. AI can also be used to monitor the grid and protect it from potential vulnerabilities both in physical and cyber spaces.⁸

- BIPARTISAN HOUSE REPORT ON AI (2025)

Indeed, machine learning improves short-term forecasts for load, renewables, and grid congestion, giving operators earlier warning of emerging risks and allowing more proactive dispatch and reconfiguration. AI tools can help forecast inertia and system strength. AI-enhanced digital twins mirror real-time system conditions, letting operators visualize stress points, test options, and see the impact of actions before committing them on the live grid. The new DOE Genesis Mission will include a focus on developing AI tools for improved simulation for a resilient grid. Given the challenges of renewed load growth, some of the most important AI use cases for grid operations include enhancing grid flexibility and grid efficiency.

⁷ "Winning the Race: America's AI Action Plan" The White House, July 2025, p. 15.

⁸ "Bipartisan House Task Force Report on Artificial Intelligence" U.S. House of Representatives, December 2024, p. 170.

Flexible Large Loads.

In 2025, electricity sector stakeholders focused on identifying flexible approaches to integrating large loads. Rather than assuming large loads will use grid power for all 8,760 hours of the year, a flexible interconnection approach would ask large loads to use less grid power during peak times. During those peak times, large loads could switch to backup generation. A flexible interconnection approach helps large loads like data centers increase their “speed to power” and it can help avoid utility capital costs in the near-term.

Working together, utilities and technology vendors have successfully completed projects to use AI to for this purpose. Using AI load forecasting and modeling grid flexibility, utilities can unlock additional capacity from existing transmission infrastructure, enabling the connection of new load without major new transmission upgrades. Some data center developers are partnering with utilities, grid operators, and technology vendors to explore building data centers that are designed from the beginning to be power-flexible; they would use workload orchestration software to control operations and ramp power use up or down in response to grid needs.

Flexible Distribution Grid Power Flow and Management.

While the U.S. electric grid was originally designed to be a centrally run system, AI enhances system management by enabling decentralized analysis and operations and by bringing higher levels of intelligence to the edge of the grid. For example, advanced distribution network analysis functions apps, such as Fault Location Isolation and Service Restoration (FLISR), Automatic Feeder Reconfiguration (AFR), and Integrated Volt/Var Control (IVVC) require a large number of power flow simulations for analyzing and optimizing system configuration. Computational power constraints can limit the number of scenarios that may be considered in the analysis using traditional physics-based power flow calculations on a large grid.

Utilities are researching utilizing AI/machine learning algorithms to improve system security by evaluating contingencies based on real-time grid conditions. The goal is to create an approximate power flow simulation using deep learning models and enable simulation of complex cases with estimation of unknown state variables. Integrating these new AI models into advanced distribution applications would enable faster computation and rapid evaluation of contingency violations with AI power flow.

A representative from a data management firm cited their organization’s partnership with accelerated computing hardware providers to develop edge AI modules. She noted the application is “focused on solar and EV identification, disaggregation and forecasting, real-time hosting capacity analysis, and anomaly detection and classification,” and will be scaled by partnering with utilities across the country. Technology available today allows utilities to autonomously manage DERs from the meter in real time to reduce peak load. In this way, distributed AI at the grid edge can enhance energy affordability by creating bill savings. Grid-edge computing also would provide a large amount of data that utilities could mine with different tools to improve electricity reliability and lower costs.

Advanced Transmission Technologies to Increase Grid Efficiency.

Complementing grid flexibility is the opportunity to increase the efficiency of the existing electric grid. AI tools can help with power flow analysis, state estimation, and dispatch optimization. Advanced transmission technologies have become even more powerful with the incorporation of AI and machine learning. For example, dynamic line ratings (DLR) enable moving more electricity over existing transmission lines compared to static line ratings because DLR is based on more accurate, real-time analysis of weather conditions. Machine learning models trained on weather data and past DLR measurements can generate hyper-local forecasts of wind and temperature, which would enable hour-ahead and day-ahead rating forecasts instead of only real-time values.

Alarm Processing.

In addition to increasing grid flexibility and efficiency, AI tools can help combat alarm fatigue and speed operator response during emergencies. Today's control rooms can be flooded with alarms during major events like storms. Alarm monitoring systems built into Advanced Distribution Management Systems (ADMS) and Energy Management Systems (EMS) lack the efficiency to handle alarm floods that can distract control room operators from identifying root cause alarms in these abnormal situations. Utilities are using AI to reduce nuisance alarms without requiring configuration of rules through techniques like Graph Neural Networks (GNN) to identify sequences of alarms (causal chains) that indicate potential root causes and auto-encoders to highlight unusual or significant alarm events for the control room operators. These AI agents can improve operator response to events by grouping alarms into parent-child hierarchy, identifying critical alarms, and displaying alarm relationships on network diagrams.





CUSTOMER ENGAGEMENT

Like other customer-facing industries, utilities are tapping into AI to revolutionize how they connect with customers. AI tools can improve communication during emergencies and create personalized, proactive customer experiences.

Chatbots and Virtual Assistants.

AI-powered chatbots and virtual assistants offer 24/7 support for outage reports, service requests, and billing questions. These tools reduce call center volume and improve customer satisfaction by resolving issues quickly and conversationally. AI gives customer service representatives a 360-degree view of each customer, surfacing relevant data instantly. This reduces call times and improves resolution accuracy, making interactions smoother for both the customer and the utility.



Personalized, Proactive Customer Experiences.

AI can analyze usage patterns, weather data, and billing history to anticipate customer needs. AI segments customers based on behavior and preferences, tailoring messages and offers. Utilities can recommend energy-saving tips or programs that match a household's usage profile. If a customer's energy use spikes during a heatwave, AI can send a personalized alert explaining the increase before the bill arrives. Future enhancements in AI-driven customer interfaces will continue to address privacy and cybersecurity concerns to enhance the customer experience.





REGULATORY ASSISTANCE



AI tools assist utilities in navigating complex regulatory landscapes by automating data collection and summarization of regulatory changes and facilitating regulatory filings and compliance reporting.

Monitoring Regulatory Changes.

Large language models enable real-time search and retrieval of relevant new regulations, orders, and guidance, helping utilities respond more effectively to policy changes. AI-driven simulations provide insights into the potential impact of regulatory decisions, aiding stakeholders in scenario planning and policy compliance. A policy expert remarked: “We’ve heard people are using AI for regulatory assistance to search across proceedings, both over time and over location and I believe that there are some ready-made applications or services that utilities can use that use AI to help them with collecting information and analyzing Information proceedings.” The application of AI tools in this manner enables better tracking of evolving regulations, ensuring utilities remain compliant with minimal manual intervention. AI tools could also be helpful in understanding many of the Institute of Electrical and Electronics Engineers (IEEE) or other technical standards required for the operation of the distribution system.

Support for Regulatory Filings and Reporting.

AI tools can also help utilities with regulatory filings, contract reviews, and compliance reporting, reducing manual effort and improving accuracy. “[Companies] can load all of their regulatory documentation, and then instead of teams hunting and searching when they need to write regulatory summaries or provide information to external stakeholders, with AI, you can actually just auto-create a summary in seconds and provide that information publicly,” explained a representative from a software company.





WORKFORCE TRAINING & EMPLOYEE PRODUCTIVITY

Despite the job security fears resulting from AI's rapid advancement across the economy, there are use cases that can enhance workforce training and employee productivity as well as draw new, skilled workers to the electricity sector. These types of AI deployments at utilities may risk remaining pilot projects when it is hard to quantify their benefits, so additional research will be needed as technology continues to advance.

Knowledge Transfer and Employee Upskilling.

A technology provider explained the role AI can play in ensuring continuity as experienced workers retire. AI-powered training tools, such as AI co-pilots, support new grid operators and planners by providing real-time guidance and decision support. These AI agents are designed to preserve institutional knowledge and ensure that new employees can manage complex systems efficiently.

Utilities are also exploring how to use AI in training their customer service workforce to better understand customers' challenges and solve them in an efficient way. At D-TECH 2025, a utility talked about using AI tools to train employees to acknowledge the feelings and emotions of individual customers and respond based on that context.

Improving Worker Productivity.

AI-driven automation aids employees in administrative tasks, improving overall productivity. Currently, most utility companies are encouraging their employees to use AI-based tools in their daily work. IT and HR teams are among the early adopters, leveraging AI to streamline knowledge sharing and enhance organizational efficiency. A software provider explained that AI tools can make something as simple as an employee searching for information on their parental leave benefits a more streamlined process. Training is also being provided on how to use AI tools to summarize large reports, write emails in a structured manner, and summarize meetings with key notes. They can also help employees search engineering standards and prior analyses, and draft memos and presentations.

Recruiting New Workers.

As the technology sector is increasingly hiring workers with energy expertise and experience, utilities may benefit from using AI tools to find and compete for scarce talent. AI tools can help with recruiting tasks like reviewing resumes and scheduling interviews. They can also help provide market intelligence and conduct searches for workers with hybrid skills in both energy systems and data science. A commitment to using internal AI tools may also help utilities demonstrate to new workers that there is career growth and upskilling potential, which could help draw new talent into the electricity sector.



BUSINESS PROCESSES

Process automation powered by AI enhances data analysis and integration across multiple systems and supports back-office functions for utilities. As in many industries, one of the major challenges in scaling the use of AI tools for these purposes is winning buy-in, preparing datasets, and updating company processes.

Data Analysis.

Utilities leverage AI to manage disparate datasets, improving operational efficiency and reducing administrative overhead. Historically, data was siloed between Information Technology (IT) — which manages general computing, email systems, financial software, enterprise data centers, and cloud services — and Operational Technology (OT) like Supervisory Control and Data Acquisition (SCADA) systems and smart grid controls that apply to electric grid equipment. AI tools can integrate these data sets (IT/OT convergence) to support predictive maintenance, DER management, and customer engagement. Advanced analytics can also integrate IT/OT data sets to inform utility planning and investments.

Back Office Functions.

Generative AI models can help utilities with internal searches of contracts, easements, asset records, invoices, and Requests for Proposals to support legal and procurement teams. AI tools can also help utilities with accounting and billing. For utility staff to use these tools, they need to feel confident that they can trust the output. In some cases, workflows may need to be redesigned to incorporate AI tools which can take extra staff time up front. Additionally, there are many AI technology vendors with different tools for utilities, and this can cause fragmentation and inconsistent staff experiences across departments.





BENEFITS & CHALLENGES

The adoption of AI drives significant benefits for electric utilities, including:

Improved Reliability: By predicting equipment failures, enhancing extreme weather and wildfire risk analysis and mitigation, and automatically adjusting grid operations, AI helps utilities minimize outages and deliver consistent service.

Cost Savings: AI-powered efficiency and grid flexibility reduces operational expenditures, optimizes resource use, and maximizes asset lifespans.

Enhanced Sustainability: Better integration of renewables and demand-side management supports utilities in meeting climate goals.

Customer Satisfaction: Faster outage response, personalized engagement, and transparent communications boost customer trust and loyalty.

Operational Agility: AI enables utilities to adapt quickly to changing conditions and evolving market dynamics.

Despite AI's transformative potential, several challenges hinder its widespread adoption in the electricity sector. The biggest obstacles are not model accuracy alone, but data foundations, integration, governance, and human adoption in a risk-averse, regulated environment.

Responsible AI Standards.

Establishing industry-wide AI governance frameworks is critical for ensuring ethical and secure AI deployment. AI models must be transparent, explainable, and aligned with regulatory standards to avoid biased decision-making and unintended consequences.

Data Quality and Interoperability.

The electric grid generates vast amounts of data from various sources, including smart meters, grid sensors, and customer interactions. However, these datasets often exist in disparate formats, making it difficult to integrate and leverage AI-driven insights. With older assets, some asset management records may be inconsistent. Standardized data exchange protocols and open-source frameworks can enhance AI's effectiveness and scalability.

Integration Complexity.

As more AI tools for grid operations become available, utilities are encountering challenges launching pilot projects in environments built around legacy OT systems. Utilities must also create internal AI governance systems applicable to model ownership, monitoring, validation, and documentation.

Change Management Headwinds.

To move from pilot projects to broader deployment, utility leaders will be looking for quantifiable benefits from the various AI use cases. While the pilot project team is usually highly motivated, utilities must also obtain buy-in from other teams and departments. In many cases, the technical integration and change management challenges overlap because pilots often start with the most engaged teams with good data quality. Less motivated teams may have both lower engagement and more technical barriers. To help address these change management headwinds, internal decision-making processes should be transparent and explainable. Employees and stakeholders also need proper training to understand AI's capabilities, limitations, and role in operational decision-making.

Cybersecurity and Privacy Risks.

AI systems require access to sensitive operational and customer data, raising concerns about data security and privacy. Unauthorized access or malicious exploitation of AI tools could lead to critical infrastructure vulnerabilities. Robust cybersecurity strategies, including encryption, multi-factor authentication, and AI-driven threat detection, are essential.

Intellectual Property Concerns.

Public-private partnerships to develop AI tools are beneficial for the electricity sector, but they can also raise complex challenges. New AI models, like those to be developed under the new DOE Genesis Mission, will be a powerful tool to accelerate research. However, proprietary data held by the National Labs may be subject to existing Cooperative Research and Development Agreements (CRADAs) which forbid their use in training data. There is an existing Bayh-Dole legal and regulatory framework for inventions arising from federally supported research.

Regulatory and Compliance Barriers.

The utility sector is highly regulated, and AI adoption must comply with evolving policies and legal requirements. Engaging in collaborative discussions with policymakers and industry leaders is necessary to create an AI-friendly regulatory environment.

Workforce Adaptation.

The integration of AI in utilities requires workforce upskilling and cultural shifts. Employees must feel confident these AI tools will not replace their jobs and will have benefits. Employees must also be equipped with the knowledge and skills to work alongside AI driven systems, fostering a collaborative environment between human expertise and machine intelligence.

¹ "Sample Source Title" Source, Time, Location.



RECOMMENDATIONS FOR AI ADOPTION

To move from isolated AI pilots to durable, electricity sector-wide impacts, next steps should focus as much on governance, people, and policy as on technological advancements. Stakeholders should consider the following initiatives:

Industry Collaboration:

- Forming coalitions of business groups to define responsible AI governance, share best practices, and develop guidelines for AI ethics and transparency.
- Working together to define and track success metrics such as outage reduction and cost savings to demonstrate tangible business outcomes from AI use cases.
- Exploring learnings from AI deployment in other sectors such as finance and healthcare.

Standardization Efforts:

- Developing open data standards for edge devices and smart grid infrastructure to facilitate seamless integration and interoperability, reducing costs and improving efficiency.

Regulatory Engagement:

- Proactively engaging with regulators and policymakers to ensure AI implementation aligns with evolving industry standards while fostering innovation and grid modernization.
- Engaging customers and communities through transparency on AI use cases, explaining data privacy protections, and building trust.

Cybersecurity Investments:

- Implementing AI-driven cybersecurity tools to monitor threats, detect anomalies, and safeguard sensitive utility data from cyberattacks.

Incentives for AI Adoption:

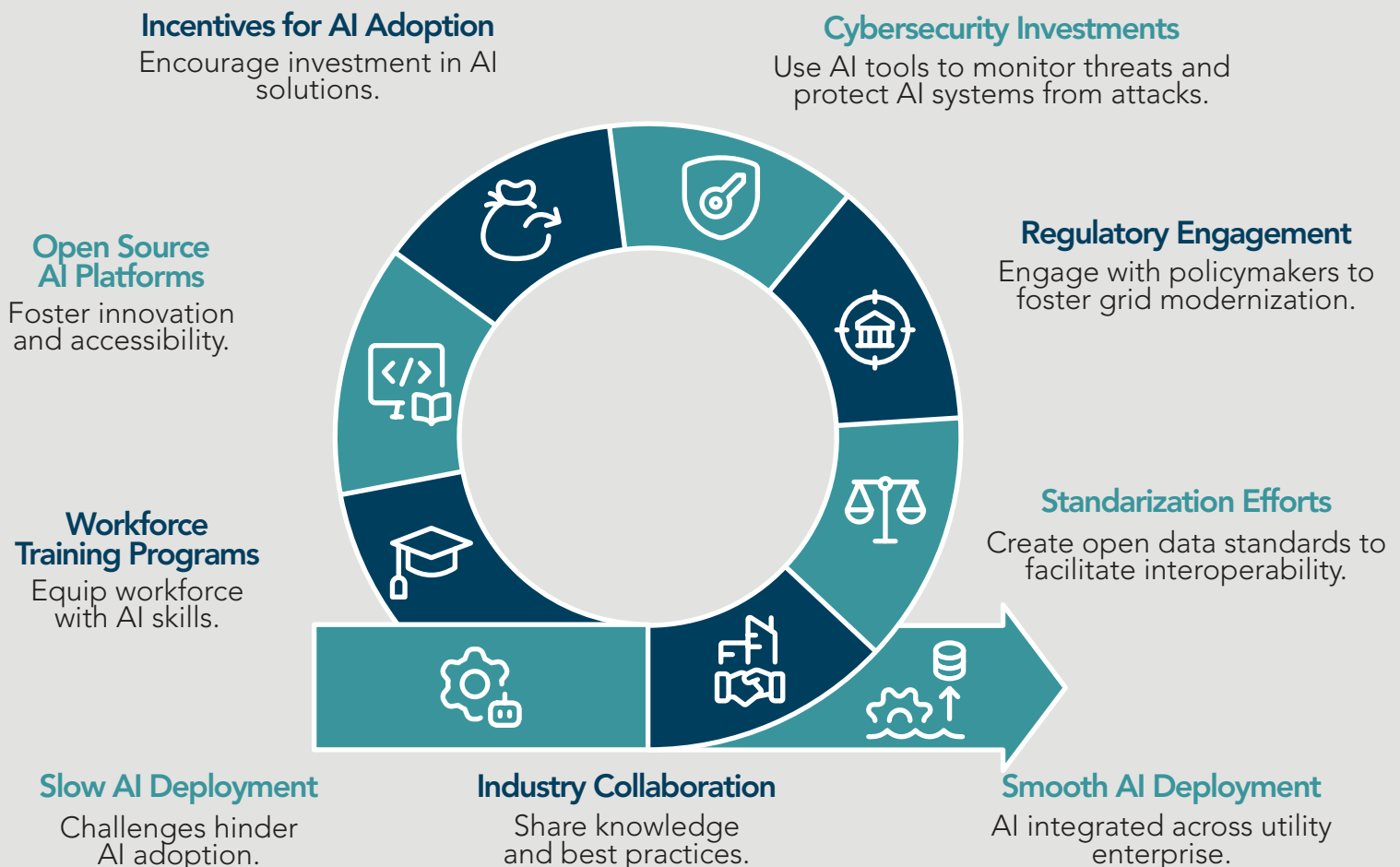
- Encouraging utilities to embrace AI by highlighting success stories, providing tax incentives, and funding pilot projects that showcase AI's tangible benefits.
- Exploring performance-based incentives that reward reliability and efficiency enabled by AI tools.

Open-Source AI Platforms:

- Promoting the development of open-source AI tools to lower barriers to entry and encourage industry-wide innovation, ensuring that utilities of all sizes can benefit from AI advancements.
- Working with the federal government to protect proprietary data held by the National Labs that is subject to existing CRADAs and should not be used in training data.

Workforce Training Programs:

- Communicating how AI augments workers rather than replacing them.
- Investing in employee training and education to ensure utility professionals are well-prepared to leverage AI technologies, minimizing resistance to adoption and fostering a culture of continuous learning.



CONCLUSION

As technology continues to advance rapidly, AI use cases for the electric grid will become more numerous and more helpful. Even based on today's technology, AI is poised to play a transformative role by increasing grid reliability and resilience, enhancing operational flexibility and efficiency to reduce costs, improving customer interactions, and supporting utilities with workforce training and businesses processes. While the sector is in the early days of deploying AI and challenges remain, proactive collaboration between utilities, policymakers, and technology providers can unlock AI's full potential. By adopting responsible AI strategies, fostering industry-wide innovation, and addressing key concerns such as cybersecurity and workforce adaptation, utilities can drive the next wave of digital transformation and build a smarter, cost-effective, and more resilient energy future.

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