

Summary – Oral testimony

**Hearing of the House Energy and Commerce Committee
Subcommittee on Energy, Climate, and Grid Security**

United States House of Representatives

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Senior Technical Executive – AI, Quantum, and Nuclear Innovation

EPRI

“The Role of Artificial Intelligence in Powering America’s Energy Future”

October 19, 2023

Chairman Duncan, Ranking Member DeGette, and members of the subcommittee, thank you for the opportunity to testify today. I am Jeremy Renshaw, senior technical executive for AI, quantum, and nuclear innovation at EPRI.

EPRI is an independent, non-profit, global energy research, development, and deployment (RD&D) institute organized under section 501(c)(3) of the Internal Revenue Code. EPRI’s experts collaborate with more than 450 companies in 45 countries, driving innovation to support clean, safe, reliable, affordable, and equitable access to electricity for the public across the globe.

AI, a technology that emulates human-style reasoning and problem-solving, is gaining prominence across various sectors. EPRI’s experience with AI spans more than ten years, emphasizing its significance and the need for responsible utilization. While AI holds the potential to augment human productivity, it also presents risks when misused.

EPRI has been involved in more than 70 ongoing or past projects utilizing AI. Several examples of applications for AI in the energy industry include:

- Predictive Maintenance
- Streamlining Work
- Grid Management
- Wildfire Risk Evaluation
- Vegetation Management and Storm Recovery
- Cybersecurity
- Load and Weather Forecasting
- HVAC Early-Stage Failure Detection
- Enhanced Efficiency and Reduced Emissions

AI has already benefitted the energy industry and its impact is expected to continue growing, which offers a promising future, with the potential to revolutionize energy industry operations. AI has the potential to contribute to the safety, affordability, and reliability in energy generation, delivery, and use.

However, EPRI has found it also poses new challenges, such as cybersecurity risks, ethical considerations centering around bias and explainability, and data privacy and security. These challenges must be proactively addressed to maximize the benefits while minimizing negative consequences.

In summary, EPRI's research shows how AI allows humans and computers to work more effectively together by allowing computers to do what they do best (rapid, accurate calculations) and humans to do what humans do best (creative thinking and implementation).

Thank you again to the subcommittee for the opportunity to share insights and comments on this important topic and I look forward to answering your questions.

Written Testimony

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Background

Chairman Duncan, Ranking Member DeGette, and members of the subcommittee, thank you for the opportunity to testify today. I am Jeremy Renshaw, senior technical executive for AI, quantum, and nuclear innovation at EPRI.

EPRI is an independent, non-profit, global energy research, development, and deployment (RD&D) institute organized under section 501(c)(3) of the Internal Revenue Code. EPRI’s experts collaborate with more than 450 companies in 45 countries, driving innovation to support clean, safe, reliable, affordable, and equitable access to electricity for the public across the globe.

EPRI brings together electric utility companies, scientists, and engineers, along with experts from academia, industry, and other centers of research to:

- Collaborate in solving challenges in electricity generation, delivery and use;
- Provide technical, scientific, and economic analyses to drive long-range research and development planning;

- Support multi-disciplinary, objective research in emerging technologies; and
- Help accelerate the commercial deployment of advanced electricity technologies for the benefit of the public.

EPRI has been working with artificial intelligence (AI) technologies for many years and has ramped up activities around AI and data science over the last 5 years.

AI techniques use a range of computational techniques to mimic human-style reasoning and problem solving, most notably with neural networks that mimic the structure and connections of human brains. Understanding how and when to use AI to benefit society is an important question to help guide the development and proper application of this technology. AI is a powerful tool for solving some of the world's most complex problems, but it is not yet a general-purpose tool to solve all challenges.

With the advent of ChatGPT, there has been significant hype around AI due to the potential to augment human productivity, but it comes hand in hand with the risk of harm from misuse.

While AI has come a long way in a short amount of time, there are still many more opportunities to solve existing challenges today as well as considerations for ethical and responsible use of AI to help avoid harm and misuse.

Applications

AI has already been successfully applied in a wide range of applications in the energy industry with the intent to improve safety, reliability, and efficiency as well as to reduce time and cost.

In addition, many pilot projects are underway to expand on existing applications in the near future. EPRI alone has been involved more than 70 ongoing or past projects related to applying AI for a range of applications in the energy industry. Below are several examples of applications for AI in the energy industry.

1. Predictive maintenance – AI tools can parse through substantial amounts of data and potentially identify early-stage trends in data that may lead to identification of future malfunctions and notify power plant and grid operators to schedule preventive maintenance ahead of these potential equipment failures. EPRI has already applied such principles to wind turbine gearboxes to predict the onset of failures such that lower cost preventive maintenance activities can be performed instead of larger-scale and more expensive repairs.
2. Streamlined work – AI tools have been shown to be able to help with automating a wide range of tasks, including tasks such as analysis of large, complex datasets, as in the case of transmission and distribution asset imagery as well as material inspections of power plant components, such as nuclear reactor pressure vessel weld inspections. AI systems can also assist with automating a wide range of dull, dangerous, or repetitive tasks to make better use of human workers in organizations.
3. Grid management – Electric grids are operated with remarkably high reliability today, which is an important foundation for a modern society. However, power grid operation is extremely complex and could benefit from enhanced optimization. Optimal power flow in a power grid is one of the most complex, computational problems in the world today. It is exponentially more complicated than even today's most powerful exascale

computers can handle, especially for real-time optimization (though future quantum computing systems show promise to assist with this issue). Reinforcement learning methods have shown promise in learning to run a power network (see: www.epri.com/l2rpn). While automated grid operation may still be more than a decade away, current models may be useful in assisting grid operators as decision support agents to provide recommended actions to maintain grid operation.

4. Wildfire risk evaluation and detection – Many parts of the world suffer from droughts and wildfires. AI tools can help address this challenge on multiple fronts. These include analyzing satellite data to identify areas of higher risk as well as conducting real-time analysis of observation station camera data to look for smoke and trigger faster responses to deal with fires at earlier stages when they are easier to contain.
5. Vegetation management and storm recovery – Combining satellite data with AI provides a number of unique benefits in addition to the wildfire use case above. Similarly, multi-spectral satellite data can be used to identify dead and dying trees in the vicinity of power lines for proactive vegetation management to prevent outages. In addition, as satellite imagery costs continue to decline, it may be possible to task a satellite to image large areas after a storm to deploy cleanup crews more efficiently and effectively.
6. Cybersecurity – Cybersecurity has become an increasingly large concern due to the potential loss of data, functionality of systems, and resulting societal impact. AI offers the opportunity to be both an offensive and defensive force-multiplier for cybersecurity applications. Several applications of AI-enhanced cybersecurity are already in use today.

7. Load/weather forecasting – The electric power industry strives to match load with demand to provide grid stability, which necessarily involves understanding weather impacts on solar and wind generation. AI methods can be used to augment both load forecasting to understand how much energy will be needed hours to days ahead as well as to better understand weather patterns and how much generation may be provided by solar and wind resources to help plan the most effective energy mix to keep reliability high and costs and emissions low.
8. HVAC early-stage failure detection – EPRI has worked on methods to utilize AI to identify electrical signatures already captured in existing or soon-to-be-deployed metering infrastructure to help utilities and end users identify and proactively repair or maintain HVAC units before small issues become larger-scale problems and system failures happen, leaving people without heat or A/C in summer or winter months when HVAC system losses are most impactful.
9. Efficiency and reduced emissions – AI tools can be utilized to improve the efficiency of energy generation through optimized use of generation assets, such as finding hidden losses or inefficiencies in power plant operations. The optimal use of these resources means less energy needs to be generated, which reduces emissions. In parallel, such tools can also be used to improve how and when customers use electricity to optimize low and zero carbon sources.

In summary, EPRI's research shows how AI allows computers and humans to interact more effectively to improve safety and reliability in electricity generation, delivery and use while reducing costs. This is done by allowing humans to do what humans do best (creative thinking

and dealing with new or unforeseen situations) while computers do what computers do best (rapid, accurate computations).

Considerations

While AI has many demonstrated and potential benefits across many industries today and in the future, there are several key considerations that need to be evaluated for ethical and responsible application of AI. While the list below is certainly not exhaustive, it covers a range of well-known potential issues EPRI has found with using AI in the energy industry.

1. Data – Data is at the heart of all AI technologies. Without sufficient quantity, quality, and cleanliness of data, AI systems can potentially produce erroneous results.
2. Bias – As mentioned above, AI systems are trained on data. The datasets that are used to train AI models may suffer from bias, which is then transferred into the AI model. This can cause existing biases in data (e.g., sexism, racism, etc.) to be perpetuated or reinforced in the AI models used. As such, AI practitioners need to be aware of such potential biases and attempt to remove or eliminate their effects, such as using alternative datasets, cleaning the data, etc.
3. Workforce training – AI can be a powerful tool, but can also be misused, whether intentionally or unintentionally. As such, it is an important consideration to teach people to understand how and when AI is the right tool to use. Often, a simpler solution will provide an equally good – and sometimes better – result compared to AI with less time, effort, and cost. Similarly, it is important to train practitioners to know when a

problem is best solved with AI versus other available options – whether AI or not, just because a tool could be used does not mean a tool should be used.

4. Data privacy & security – As mentioned above, AI models are typically trained on large datasets. In some cases, these datasets may contain personally identifiable information (PII) or other personal or sensitive data. If such training data are included in models, steps should be taken to provide for the security and privacy of the data. For example, if Internet of Things (IoT) data are used, it may be possible to infer when a garage door is opened and closed or when HVAC systems and lights are turned on, giving clues on when homeowners are at home or not, providing potential burglars data on optimal times to break into a home.
5. Explainability – One of the key weaknesses in AI models is the lack of explainability – a model can provide an answer, but few can provide an explanation or context clues of why it provided the response that it did. AI explainability is a rapidly developing field and will continue to improve. However, some additional considerations are warranted when discussing explainability.
 - a. First, most models in use today do not include explainable aspects.
 - b. Second, since AI models are trained on very large datasets that may contain complex interactions between parameters, an AI model could provide an explanation that would be beyond a human’s ability to comprehend (humans are good at thinking in one, two, or three – and sometimes four – dimensions, but struggle to comprehend higher dimensionality data whereas computers and AI models don’t suffer from that same limitation).

- c. Third, explanations may be counterintuitive and not trusted because they do not fit with current understanding.
- d. Fourth, consider human explainability. If you were to ask a human why they performed a particular action, you may get a response similar to “we’ve always done it that way” or “it felt like the right thing to do.” While we often allow such responses from humans, society typically requires a higher level of rigor from an AI model. It is an open question to determine what level of explainability is warranted to meet the demands of explainable AI.

The first four issues above can be largely addressed, and negative impacts minimized, with proper controls and testing, and there is considerable research underway to address the explainability question. AI models should also be trained and tested with large, clean, robust datasets covering the range of both past observations and potentially anticipated conditions to build confidence in the results they produce. Utilizing such controls for training and testing AI models can help to gain confidence in the results obtained from implementing AI models in practice.

Impact

Clearly, AI will have a significant impact on the energy industry, likely both positive and negative. It is anticipated that, through the introduction of AI, utilities will be able to utilize its benefits for maintaining or improving safety, affordability, reliability, efficiency, and environmentally friendly energy production. This testimony has provided several use cases that

could benefit the power and utilities space, though many more examples are currently being explored and deployed today.

However, AI does introduce new potential issues and threats, such as AI-assisted cyber attacks as well as reinforcing existing biases and potential data leaks. This could come in the form of more sophisticated or more pervasive cyberattacks as well as the potential to reinforce existing biases, such as leaving power restoration in certain neighborhoods to last, which could have outsized impacts in poorer neighborhoods. However, for the energy industry, most of the data and challenges are related to the physical generation, transmission/ distribution, and end utilization of energy, so there are fewer opportunities for biases to come into play in data compared to other use cases outside of energy. As such, cyberattacks and data releases are likely the most pressing challenges that must be proactively considered and addressed today.

Conclusions

In conclusion, AI provides a wide range of demonstrated and potential benefits to utility companies as well as the public from safer, cleaner, and more reliable energy provided at lower costs and with reduced emissions. The responsible use of AI for targeted applications has real, tangible benefits that can be realized today as well as additional benefits in the future. Several beneficial applications of AI in the energy industry have been discussed in this document, though many more exist.

The pace of AI development has been very rapid over the last decade and that pace is likely to continue, so additional uses and benefits may be developed in the near future that will benefit

the energy industry. Advances in computational power (exascale and quantum computing) combined with new AI models, methods, and architectures appear to be setting the stage for the continued advancement of these impactful tools in the future.

While AI has been shown to be highly beneficial for a wide range of applications, workforce training, data quality and security, ethics, and explainability are key considerations related to the responsible utilization of AI. Similarly, misuse of AI models has the potential to cause harm, so it will be important to prepare for the potential negative consequences that are also associated with the widespread implementation of AI.

In summary, the effective application of AI allows computers and humans to interact more effectively by taking advantage of each of their strengths and compensating for weaknesses, such as allowing humans to do what humans do best (creative thinking and dealing with new situations) while computers do what computers do best (performing rapid, accurate computations). This human-computer interaction facilitated by AI sets the stage for continued safe, reliable, affordable, and environmentally responsible energy generation and consumption both now and in the future. More information can be found at www.ai.epri.com.