MEMORANDUM October 17, 2023

TO: Members of the Subcommittee on Energy, Climate, and Grid Security

FROM: Committee Majority Staff

RE: Hearing entitled "The Role of Artificial Intelligence in Powering America's Energy Future"

I. INTRODUCTION

On Thursday, October 19, 2023, at 10:30 a.m. (ET) in 2322 Rayburn House Office Building, the Subcommittee on Energy, Climate, and Grid Security will hold a hearing. The title of the hearing is "The Role of Artificial Intelligence in Powering America's Energy Future." Witnesses are by invitation only.

II. WITNESSES

- **Edward Abbo,** President & Chief Technology Officer, C3 AI;
- **Paul Dabbar,** Former Under Secretary for Science, U.S. Department of Energy; Distinguished Visiting Fellow, Center on Global Energy Policy, Columbia University;
- **Jeremy Renshaw,** Senior Technical Executive - AI, Quantum, and Innovation, Electric Power Research Institute; and,
- **Sreedhar Sistu,** Vice President, Artificial Intelligence, Schneider Electric.

III. BACKGROUND

A. History and Development of AI

Artificial intelligence (AI) can be traced back to the mid-1900s. In 1950, Alan Turing created "The Automatic Machine," which could solve problems without human intervention. Turing's machine was deterministic – it could only do what was instructed by its programmer. Following Turing's invention, in the 1970s, experts predicted that AI could be as smart as, or smarter, than humans within the decade. In the 1980s, supercomputers became a commodity that could perform numerous tasks like data mining, statistical processing, and threat detection.[1] Modern applications have evolved with growth in computing power to increase the capabilities and speed of AI.

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[1] Electric Power Research Institute, *Artificial Intelligence: Concepts for Electric Power*, https://www.epri.com/research/products/000000003002010236.

Today, AI is comprised of three main components: machine learning (ML), deep learning (DL), and neural networks. A subfield of AI, ML automatically improves its performance on a task, through past experiences, not rules-based programming. ML functions with a goal to teach itself to process data that it has not previously seen or worked with. While DL learns from large data sets to classify similar but unseen data. However, neural networks consist of numerous processing nodes, similar to the human brain. These nodes make neural networks a type of DL, which can be implemented in autonomous vehicles for voice recognition technologies.[2]

Historically, AI was deterministic and could only perform functions that were directed by inputs or programming, allowing AI to understand information. While this type of AI is still used, advancements in AI allow it to be "generative," wherein AI can identify information and recognize patterns to generate or create new content and recommendations. For example, generative AI can turn text into images or, with programs like ChatGPT, write entire documents from a single text request. Deterministic and generative AI's uses are growing in all sectors of the economy, including energy and environment. With this growth comes great opportunities for development and progress, as well as potential challenges and threats to infrastructure and security.

B. Artificial Intelligence at DOE and National Labs

While the U.S. Department of Energy (DOE) was formally founded in the 1970s, the Advanced Scientific Computing Research program, part of DOE's current Office of Science, has explored AI since the 1960's and is in part responsible for the modern technologies known today.[3] DOE and the national labs currently use AI and supercomputers to research and solve challenges associated with energy systems. For example, Oak Ridge National Laboratory's Summit supercomputer is being used to simulate particle behavior in plasma to better predict the performance of nuclear fusion experiments.[4] Additionally, the National Energy Technology Laboratory (NETL) uses the Joule 2.0 supercomputer to, among other things, develop optimal reactor designs and simulate research of carbon capture technologies.[5]

In 2022, several of the national labs held workshops to identify opportunities for and challenges that come with expanded use of AI.[6] In May 2023, DOE and six national labs – Argonne, Lawrence Berkeley, Lawrence Livermore, Los Alamos, Oak Ridge, Sandia – released a report detailing potential uses of AI in energy. The report identified opportunities to modernize energy systems through AI-enabled design of control systems, load forecasting, decision-

[2] CRS Report R47644, *Artificial Intelligence: Overview, Recent Advances, and Considerations for the 118th Congress,* by Laurie A. Harris

[3] Department of Energy, *DOE Explains…Artificial Intelligence*, https://www.energy.gov/science/doe-explainsartificial-intelligence.

[4] Oak Ridge National Laboratory, *Summit: America's Newest and Smartest Supercomputer*, https://www.olcf.ornl.gov/summit/.

[5] National Energy Technology Laboratory, *Joule 2.0 Supercomputer*, https://netl.doe.gov/sites/default/files/rdfactsheet/R-D190_2.pdf.

[6] Argonne National Laboratory, *Advanced Research Directions on AI for Science, Energy, and Security*, https://www.anl.gov/sites/www/files/2023-06/AI4SESReport-2023-v6.pdf.

making, and monitoring of fluctuations on the grid.[7] The report also noted that that the United States' leadership in semiconductors are tied to leadership in AI and presented ways in which AI can transform DOE's science, energy, and security mission areas.[8]

C. Applications in the Electricity, Gas, and Oil Sectors

There are numerous energy sector use cases for AI that have the potential to accelerate innovation and strengthen America's energy security. AI can be used to manage large data sets and solve complex problems needed to improve the efficiency and performance of existing technologies and processes, as well as develop new technologies. In the electricity sector, AI can expedite data intensive processes and operations such as dispatch and optimization. Each day, grid operators optimally schedule and commit power generation through a method called security constrained unit commitment (SCUC). Grid operators have tested AI that can solve unit commitment calculations twelve times faster than current methods.[9] AI can also optimize the dispatch and utilization of individual generators, resulting in operational savings.[10] Finally, AI is used to inspect equipment as well as to detect physical disruptions like wildfires and downed power lines.

Like the electric sector, oil and gas companies use AI to make process efficiency improvements, enhance production, and limit disruptions. Through AI, oil and gas companies can improve exploration and drilling to drive higher production output by thousands of barrels or more per day. AI can also mitigate risks to personnel and systems. By monitoring equipment and trends, AI can anticipate the need for restoration and limit human exposure to hazards.

D. Potential Challenges with AI in the Energy Sector

While AI can provide great benefits, it also creates new challenges and risks for the energy sector. The hardware and software used in technology that powers AI are critical infrastructure that is susceptible to adversaries and malicious acts. Semiconductors from foreign nations like China can be programmed to undermine their operation. Algorithms are also susceptible to programming misuse as biases in data can skew results, recommendations, and ultimately decisions made by humans.

Further, the supercomputers AI uses to solve complex problems require significant and growing amounts of electricity, with some estimates for the coming years showing AI electricity use matching or exceeding small countries. The nation's largest grid operator, PJM, attributes

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[7] *Ibid.*
[8] *Ibid.*
[9] Federal Energy Regulatory Commission, *Machine Learning for Expediting Security Constrained Unit Commitment Solution*, June 2019 Technical Conference, https://www.ferc.gov/sites/default/files/2020-09/W3-A-1-Qiu.pdf.
[10] McKinsey & Company, *An AI Power Play: Fueling the Next Wave of Innovation in the Energy Sector*, https://www.mckinsey.com/~/media/mckinsey/business%20functions/mckinsey%20digital/how%20we%20help%20clients/inside%20an%20ai%20power%20play/an-ai-power-play-fueling-the-next-wave-of-innovation-in-the-energy-sector-may-2022.pdf.

data center demand as a primary driver for load growth in its footprint requiring immediate, additional infrastructure.[11]

IV. ISSUES

- The application of AI in expediting complex optimization processes to improve operations and performance.
- The potential for AI for energy discovery, both existing energy types and new technologies.
- The impact AI has on electricity demand, the potential growth in electricity demand as use of AI increases, the need for affordable and reliable electricity for AI functions, and the impact AI will have on an already constrained grid facing reliability issues.
- The cybersecurity risks that AI hardware and software face as use grows and expands to processes affecting the operation of critical infrastructure.
- The concerns surrounding accuracy and completeness of data, sometimes called data bias, and how this affects findings and recommendations from AI.

V. STAFF CONTACTS

If you have any questions regarding this hearing, please contact Brandon Mooney, Peter Spencer, Elise Krekorian, David Burns, or Mary Martin of the Committee staff at (202) 225-3641.

[11] PJM, *Data Center Planning & Need Assessment Update*, (January 2023), https://www.pjm.com/-/media/committees-groups/committees/teac/2023/20230110/item-04---data-center-load-planning.ashx; PJM, *PJM Regional Transmission Expansion Planning (RTEP) Process*, (May 2023), https://www.pjm.com/-/media/committees-groups/stakeholder-meetings/ipsac/2023/20230523/20230523-item-02-1-pjm-regional-transmission-expansion-planning-process.ashx.