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Artificial Intelligence in Renewable Energy

By Robert A. James, Aimee P. Ghosh, Cara M. MacDonald and Jerry McNerney*

In this article, the authors explore the opportunities, risks and regulations in the specific applications of artificial intelligence to renewable energy and to the electric power ecosystem into which renewables fit.

Artificial intelligence (AI) discussion has crossed from the countercultural fringes to the cultural mainstream. We hear about AI all the time, from college papers to the Hollywood writers' strike to the battlefield. The actual and potential reach of this technology is vast and touches virtually every aspect of our lives and businesses. This very breadth makes generalizations difficult and renders the basic principles all the more mysterious. To understand the new landscape, it helps to stay concrete and focused. To that end, this article explores the opportunities, risks and regulations in the specific applications of AI to renewable energy and to the electric power ecosystem into which renewables fit.

This article begins with a working description of AI, centered on what is both common and distinctive in its application to energy systems. It then provides a tour of the AI applications already in use in renewable energy, and in the grid and end-user systems with which renewables connect. AI law is intertwined with information technology (IT) law, and some of the background legal principles that should not be far from our minds as we explore the reaches of this new technology are discussed next.

With those examples and that background in mind, this article turns to discussion of the particular risks – in terms of both cybersecurity and actors abusing AI tools – of AI in renewable energy and how governments and private parties are currently responding to them. It then describes the new U.S. executive order and other federal, state, and international initiatives that are transforming the regulatory picture.

This article concludes with observations on the energy needs of AI itself and on human elements with AI as a factor in energy project permitting and career development. There is much to cover and this article is only a start.

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ARTIFICIAL INTELLIGENCE AND RENEWABLES: THE WHAT AND THE WHY

We approach descriptions in the realm of AI gingerly and with a large dose of humility. As a matter of first principle, artificial intelligence can be described as the raw science and applied technology of producing and operating hardware and software that can think *like* humans think (note the emphasis on the word "like"). The drivers of the recent explosion of interest in AI have been (i) the harnessing of huge amounts of data, far larger than previously available, and (ii) the increased processing speed with which that data can be parsed or generated.

As a result, we now have systems that compare data, recognize patterns, apply the patterns using algorithms, make predictions, make decisions, release those decisions into the outside world, and monitor and learn from results. The combination is said to produce judgments *like* those that humans make. Philosophers, theologians, neuroscientists, computer scientists and other specialists can and do debate what exactly is thinking or making a judgment "like a human." For our purposes, we simply take at face value the concept that AI undertakes the described activities that would otherwise be conducted by people.[1]

Two hallmarks of AI, which are also inherent in its application in renewable energy, are prediction and automation. Prediction is the ability to quickly review a large amount of fit-for-purpose data and make and test better and better guesses of the outcomes most likely to follow a given fact or event. This process can be trained to anticipate the best succeeding sentence for a high school report on "The Scarlet Letter," or predict the next month's likely weather conditions for a wind farm.

The "fit-for-purpose" data limitation is significant. AI is very sensitive to data, which means that AI is very sensitive to bad data – wrong or biased data, incomplete data or even too much data. For example, an important early application was the review of mammograms for indications of breast cancer. Researchers found that the system was making spurious connections. They ultimately realized they were using mammograms that indicated the make of the x-ray machine. The system was trying to find connections between all mammograms that were run with a GE or a Siemens machine. They had to limit the amount of input data to make the output useful. (In renewable energy, the opposite might be true: we might well be concerned with the make of the

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[1] See Henry Kissinger, Eric Schmidt & Daniel Huttenlocher, The Age of AI 14 (2022); Melanie Mitchell, Artificial Intelligence: A Guide for Thinking Humans (2019); Sascha Brodsky, How Neural Networks Can Think Like Humans And Why It Matters, AI Business, https://aibusiness.com/ml/how-neural-networks-can-think-like-humans-and-why-it-matters#close-modal.

wind turbine – and it would be the details like a gust of wind or temporary cloud cover, akin to the lines that the cancer reviews are looking for, that we would screen out.)

The second hallmark is automation. Humans have been involved in every aspect of the various steps of receiving inputs, weighing those inputs, sending them back out as an output for a decision, and testing whether that decision was successful. All of those actions can be integrated through a rapid processing of sensory data, making decisions, implementing them, and then learning from the results of that output.

AI is not just a brain floating in a jar; it is connected to the outside world through "fellow-traveler" technologies. AI is associated with peripherals, if you will. Sensors, drones, robots and the entire internet of things, each with its own peculiar limitations, relate the system to our lived environment.

Renewable energy presents many informational challenges that can be streamlined with artificial intelligence. A common difficulty, familiar to solar and wind developers, investors and counterparties everywhere, is the intermittence of the resource. Though wind does not always blow and the sun does not always shine, there are patterns that can be recognized, leading to decisions on siting, orientation and operation that can be made and tested.

Another informational hurdle of renewable energy is storage, which is a vital response to the intermittence of green energies. Storage could take the form of a nineteenth-century gravitational or mechanical process like pumped water, or a chemical process like a battery.

There are many different technologies out there, lithium-ion cells being predominant, with others on the horizon. Storage has its own informational aspects. How quickly is the storage going to be able to be released? Over what period of time? At what recharging rate and with what degradation? That data must be taken into account and performance can be optimized with the help of AI.

When renewable generation and storage are collectively tendered for supplying energy to consumers, we encounter the grid and the entire system of generation, interconnection, transmission and local distribution. The information requirements are critical because baseload and peaker generation plants use heavy machinery, and advance notice is required to begin overcoming their inertia; they cannot start on a dime. The grid itself is complicated to describe and monitor – having not only centrally located power plants but also dispersed generation. An increasing amount of generation is behind the meter or beyond the meter, including the recent expansion of distributed generation, storage and electric vehicles that can plug back into the grid.

Finally, not specific to renewables but characteristic of our age, is the variable demand of customers of all types – businesses, farms, public facilities, transportation, buildings and residences. Knowing when they are using energy and how they are using it is another source of valuable information. As we survey the applications and their risks, we will reference these attributes of AI and the informational needs and challenges of renewable energy.

AI APPLICATIONS IN RENEWABLE ENERGY

The range of AI uses in wind and solar, as well as the grid and end-user energy ecosystem, is already vast. To provide some taxonomy, we divide the existing applications into four spaces. Project-side AI deals with the generation and storage assets themselves. Grid-side AI concerns how renewable energy projects feed into the system integrating baseload and peaker generation, transmission and local distribution. Demand-side AI flows information about the users and their usage of energy back into the generating, storage and grid systems. And policy-side AI feeds all these sources of information into the formulation of collective government initiatives and rules. (We also leave room for other AI, in case there are some uses that do not fit neatly into those four categories.)

Project Side

On the project side, the questions addressed by AI are fundamental to energy developers and financers. Should we build this energy facility at all – does it pass the investment hurdle conditions? If we are going to build one, where should we build it, and with what sort of engineering, procurement and construction (EPC) practices? If we build it in a particular location, how should we best orient the turbines or panels to optimize the output over its useful life? How can we efficiently operate the facility, taking assets out of service for maintenance only at optimal times? When do we sell generation into the grid, when do we store it for later discharge, and when and how should we make alternative use of the resource for green hydrogen, desalination or other industrial products? These are all judgments that humans currently make, and they are judgments of the type that AI can make, or to which it can contribute.[2]

Companies are already deploying AI products for the solar industry. Glint Solar is modeling insolation and interconnection conditions to identify

[2] See Contributing Author, Artificial Intelligence Can Expand Solar Energy. Here Are 7 Great Examples, SOLAR BUILDER (Feb. 6, 2023), https://solarbuildermag.com/featured/artificial-intelligence-can-expand-solar-energy-here-are-7-great-examples/; Rene Morkos, AI Applications in Wind-Energy Systems, WIND SYSTEMS (Feb. 15, 2023), https://www.windsystemsmag.com/ai-applications-in-wind-energy-systems/.

recommended places to locate a solar farm.[3] AI is supplementing or replacing detailed planning aimed at optimizing how we design and construct farms – potentially manufacturing solar arrays offsite with a factory model, rather than custom-built in each individual location. In Denmark, Enfor AI is being used to sense local meteorological information in real time to orient solar trackers, operating either independently of or in tandem with the nearby weather bureau data.[4] The program learns from experience and revises its algorithm in an application of Bayes' theorem. The Heliogen SOHOT technology installs cameras atop solar towers to measure the sun's intensity in the mirrors, and then compares the intensities from mirror to mirror to calculate beam directionality and mirror orientation.[5]

AI applications in wind include Envision, a British database used across Central Asia[6] where there are few reliable weather stations over great swaths of the region. This AI technology identifies the wind project locations that are most likely to pass investment hurdle rates. Similar to solar applications, AI is used to update meteorological data at the actual site rather than at some remote weather station, and in real time.[7] SparkCognition runs an AI-assisted program that can detect and correct the alignment of each individual wind turbine in the face of the wind.[8] (The company's marketing materials speak of correcting the yaw and the pitch. It did not mention roll. If a conventional wind turbine rolls, something has gone seriously wrong.) GE Vernova promotes machine learning tools to report when their own equipment (gearboxes and turbines) might need servicing – based on general useful life recommendations and on real-time measurement of performance.[9] Offshore wind has novel information demands, given further variables such as marine mammal and fish migration and reproduction, naval operations and other exogenous factors.[10] AI is playing a part there as well.

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[3] Glint Solar, https://www.glintsolar.ai/.

[4] Enfor, https://enfor.dk/services/solarfor/.

[5] Heliogen, https://www.heliogen.com/technology/.

[6] Envision, https://www.envision-group.com/en/windturbines.html.

[7] See Rene Morkos, AI Applications in Wind-Energy Systems, Wind Systems (Feb. 15, 2023), https://www.windsystemsmag.com/ai-applications-in-wind-energy-systems/.

[8] See Artificial Intelligence Solutions for Renewable Energy, SparkCognition, https://www.sparkcognition.com/industries/renewable-energy/.

[9] See GE Using AI/ML to Reduce Wind Turbine Logistics and Installation Costs, GE, https://www.ge.com/news/press-releases/ge-using-aiml-to-reduce-wind-turbine-logistics-and-installation-costs.

[10] See Cody Sibulo, Orsted Deploys SparkCognition's AI Solution to Enhance Wind, Solar,

Grid Side

The grid of course is not exclusively renewable – at least not yet – but it is particularly important to how renewable energy projects operate. Distributed generation and storage cannot be financed or developed without assurance of interconnection and stable power purchase arrangements.

In the short term, grid performance can be affected by natural disasters. AI can help identify the best way to resolve the effects. If you have a wildfire that is threatening multiple places, where do you direct your response? How do you prioritize your response efforts? Where is the next location to be threatened, so you can cut down foliage or shut down a segment to avoid further risks? AI is being used in the Carolinas to help inform these decisions for risks of immediate outage on the transmission lines.[11]

On a long-term basis, utilities know that these conditions will recur. The icy outages in the isolated ERCOT territory of Texas are prime examples. But in the medium term, how do you prioritize such investments? The State of New York has been using AI to help decide which locations get immediate funding and rehabilitation.[12] There will be issues if the program indicates that one urban location should wait for assistance while a rural area gets top attention, or vice versa. The adversely affected residents will ask, "Who made AI the king of that decision? And with what data and algorithm did it make that decision?"

The discussion of prioritization is also relevant to the topic of curtailment. Renewable energy is valued for decarbonization and low variable cost supply, but there are times on many grids when it oversupplies. There are times of days or weeks in which more renewable energy is being potentially generated than the grid has room for, because of bottlenecks in the infrastructure or decreased demand. AI can generate forecasts for when that renewable energy is going to be in an oversupply condition.[13] These programs are expected to be more accurate than other forms of prediction. It follows that they may be involved in

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and Storage Asset Performance and Increase Energy Production¸ SPARKCOGNITION (Nov. 7, 2023), https://www.sparkcognition.com/orsted-deploys-sparkcognitions-ai-solution-to-enhance-wind-solar-and-storage-asset-performance-and-increase-energy-production/.

[11] See David H. Freedman, To Shore Up the Electrical Grid, Robert Kabera Uses AI to Probe Its Flaws, NEWSWEEK (Aug. 19, 2023), https://www.newsweek.com/shore-up-electrical-grid-robert-kabera-uses-ai-probe-its-flaws-1815314.

[12] See Jennifer Kite-Powell, Using AI To Determine the Health of the Electrical Grid, FORBES (June 29, 2023), https://www.forbes.com/sites/jenniferhicks/2023/06/29/using-ai-to-determine-the-health-of-the-electrical-grid/?sh=6c9e1652294f.

[13] See John Carrington, How AI Is Transforming Decarbonizing and 'Cleaning Up' the Grid, WORLD ECONOMIC FORUM (Sept. 16, 2021), https://www.weforum.org/agenda/2021/09/how-ai-is-transforming-decarbonising-and-cleaning-up-the-grid/.

critical decisions when a system operator (a utility, an independent system operator (ISO) or a regional transmission operator (RTO)) says it will not purchase from certain renewable sources – that it will "curtail" procurement. The operator's curtailment authority shows up in physical or virtual power purchase agreements, or in the tariffs and system rules. AI might make or contribute to a decision that power should continue to be purchased from my recently built solar facility, while someone else's older windfarm should be curtailed. That windfarm's owner is going to be adversely affected by curtailment, and instead of humans making this decision, the judgment call might have been generated deep inside some algorithm.

Demand Side

On the demand side, the consumers themselves are generating prodigious amounts of information. Businesses as well as residential consumers utilize energy in ways that can easily be monitored. In Switzerland, administrators are using AI to predict when the electricity needs will hit peaks or troughs. Researchers have reported that AI-assisted programs can accurately anticipate highs and lows two to six hours in advance, which is better than the exclusively human methods that they were using before.[14]

We are entering a new chapter in the relation between users and the grid, where we not only have consumers taking energy from the grid, but also consumers using distributed generation, batteries and electric vehicles as external storage sources and potentially selling back into the grid.[15] As home storage, electric vehicles and electric appliances of all types proliferate (especially given the emergent bans on natural-gas appliances in some jurisdictions), we will see more energy flows in both directions.

AI is aiding in the pursuit of sustainable construction practices through energy optimization, intelligent material selection and predictive maintenance.[16] AI-assisted designs are incorporating renewable energy directly into structures, with wind turbines attached to skyscrapers and photovoltaics built into the skin of the curtain walls for building construction.

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[14] See Fermi National Accelerator Laboratory, Artificial Intelligence Can Predict Electricity Loads from Road and Rail Usage Data, TechXplore (Apr. 24, 2023), https://techxplore.com/news/2023-04-artificial-intelligence-electricity-grid-road.html.

[15] See David Curry, Researchers Use AI to Predict Electricity Deman, RT Insights (June 5, 2023), https://www.rtinsights.com/researchers-use-ai-to-predict-electricity-demand/.

[16] See The Role of Artificial Intelligence in Green Building Design Engineering Solutions, Utilities One (Oct. 25, 2023), https://utilitiesone.com/the-role-of-artificial-intelligence-in-green-building-design-engineering-solutions.

AI systems can influence power use. They can use access card turnstile swipe data from an office building to detect how many people are inside, and accordingly make judgments on heating, ventilating and air conditioning. They can spot anomalies where somebody has left something running and correct that situation. But card swipes bring up the question of consumer privacy issues. We also enter the realm of proprietary information of consumers, some of which are companies engaged in fierce competition with one another.

Policy Side

Policy-side AI applications are just emerging. We note an article referring to "AI-enabled circular economy policies."[17] Circular economy refers, among other aspects of the renewable energy transition, to the ways in which recycled or recyclable materials are gleaned at the end of a product's life. We still have not been through a full life cycle of many renewable energy facilities. Some components like wind turbine blades cannot be easily recycled. How do you make the judgment of which parts can be recycled? Which parts can instead be efficiently repurposed? What constitutes the end of a useful life? Where do used materials go – here in the United States or abroad, and with what environmental and economic consequences? AI is touted as assisting the development of policies on those topics.

We have seen agencies express enthusiasm for using AI all the way from early planning of potential regulations, to "real-time agency decision making," a phrase that may strike fear into the hearts of most regulated parties. We are unsure what kind of appeal process is available for real-time agency actions.

Even renewable energy lawyers are using AI in daily practice to digest and communicate the implementation of policies.[18] We have seen AI employed to parse the 700-page Inflation Reduction Act (IRA) to produce succinct summaries of subparts suitable for forwarding to clients that have the most need in a given area.

We certainly have not covered the entire universe of AI applications relevant to renewables. For example, we have not touched on the research and development of next-generation technology and components themselves. The foregoing infrastructure-based examples do provide some foundation for discussing the ways in which AI is being used: to improve the development of

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[17] See Mir Sayed Shah Danish and Tomonobu Senjyu, Shaping the Future of Sustainable Energy Through AI-Enabled Circular Economy Policies, Circular Economy (Vol. 2, Issue 2) (June 2023), https://www.sciencedirect.com/science/article/pii/S2773167723000171.

[18] See Exploring Artificial Intelligence in the Legal Energy Sector, Thomson Reuters, https://legal.thomsonreuters.com/en/insights/articles/artificial-intelligence-in-the-legal-energy-sector.

renewable energy and storage projects; to improve the operation and ongoing maintenance of the grid; and to take real-time customer demand data into account. However, as with all technological growth, AI can bring both improvements – and risks – to the energy transition.

BACKGROUND INFORMATION TECHNOLOGY LAW RELEVANT TO AI

AI is fundamentally a use of information, receiving data from various sources, transforming it and releasing the product for implementation and feedback. Thus, AI law is connected to IT, privacy and data law.

In the current landscape of data harnessing and usage, regulatory bodies are applying existing laws, regulations and agency policies to AI. Sometimes there is a good fit between the rules and the new technology, and sometimes they are in opposition.

The principal rules that agencies deal with are those applicable to the gathering and use of data. AI systems thrive on learning from and consuming large quantities of inputs. When you hear data, you should be thinking first and foremost of generally applicable data protection and privacy laws.

Landmark pieces of legislation include the General Data Protection Regulation (GDPR) of the European Union and the California Consumer Privacy Act (CCPA). There are other state laws in the United States and legislation in other countries that govern the commercial collection, processing and sharing of personally identifiable information. These are fundamentally consumer protection laws, requiring those organizations subject to the laws to be transparent about their data practices and providing individuals with rights over how their data is used.[19] There is a natural push and pull for companies that are seeking to use and process data sets that include personally identifiable information, as they plan for compliance with these laws. If you are unleashing an AI system on a quantity of consumer personal data, you must ask, "Are we getting the proper consents? Are we appropriately informing people of how we're using their data in the context of an AI model? Are we able to remove and delete data if requested to do so?"

Take the example of biometric data – retina scans, fingerprints, voice data, DNA and the like. The Illinois Biometric Privacy Act, enacted in 2008, sets guardrails and limitations on this data by requiring companies that collect or possess biometric information to obtain written consent and disclose how the

[19] See EU General Data Protection Regulation (Regulation (EU) 2016/679); Cal. Civ. Code §§ 1798.100 to 1798.199.100.

information is collected, used and retained.[20] One might assume energy companies would never use personal information, but AI systems are already being used by employers across industries to evaluate energy demand through data on workers entering or leaving buildings, vehicles and other locations, or engaging in high-energy activities. In Illinois, the use of a system that collected workers' fingerprints to track building access, for example, would require informed consent, and failure to comply with the law could carry consequences. Since 2018, there have been over 2,000 lawsuits brought under the Illinois Biometric Privacy Act for the improper use of biometric data.[21]

Intellectual property rights are another relevant background source of concern. Generative AI programs like ChatGPT are trained by "learning," based on vast amounts of information, including information on the internet. This practice raises questions about how we account for the rights of the creators of the original data that is being used to "teach" the AI programs, as well as the output of the models. In 2023, the U.S. Copyright Office started to study these issues in order to establish responsive policies. In the meantime, we are seeing copyright lawsuit upon lawsuit from artists, musicians, comedians, authors and other creators of information both profound and mundane. Recently, the New York Times sued the major generative AI system proprietors, saying they have a problem with using their copyrighted materials to train a model that then generates an output that looks a lot like (and competes with) the materials it trained on.[22]

AI is used in the oil and gas industry to interpolate data from well logs and infer the presence or absence of hydrocarbons in reservoirs leased to competing companies. Companies might not be able to copyright a well log, but they submit their seismic data for an oil and gas reservoir to agencies under binder of confidentiality to prevent it from being used by competitors, either directly or through large learning models. Geothermal energy is a renewable resource that will be subject to the same concerns about protecting subsurface data. One can expect comparable attempts to ensure confidential or proprietary treatment of meteorological, insolation or other conditions in the renewable energy space.

A third source of background principles relevant to AI is the prohibition of discrimination and unfair practices in civil rights and consumer protection laws. There is much activity here, enforced by the Department of Justice, the Equal

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[20] See 740 ILL. COMP. STAT. 14/1 to 14/99.

[21] See Hannah Meisel, Court Rulings Supercharge Illinois' Strongest-in-Nation Biometric Privacy Law, NPR ILLINOIS (Feb. 28, 2023), https://www.nprillinois.org/illinois/2023-02-28/court-rulings-supercharge-illinois-strongest-in-nation-biometric-privacy-law.

[22] See Louis Menand, Is A.I. the Death of I.P.?, THE NEW YORKER (Jan. 15, 2024).

Employment Opportunity Commission (EEOC), the Federal Trade Commission (FTC), and state analogues. The Civil Rights Act, the Americans with Disabilities Act and many state and local laws, for example, prohibit discrimination and bias in hiring. When AI models are trained and used to aid in hiring or employment decisions, there is a risk that the models produce discriminatory or biased results, in violation of non-discrimination laws. For example, in 2023 the EEOC settled a discrimination lawsuit with a tutoring company, alleging that the company used AI recruitment software that discriminated against older applicants.[23] Both federal and state laws also prohibit unfair and deceptive trade practices in dealing with consumers. The FTC, for example, has already warned companies that failing to uphold privacy commitments in deploying AI tools could be considered a deceptive trade practice.[24]

Until there is a national framework, or even a state-by-state framework, specific to AI regulation, we will rely on these existing laws and regulations to govern a novel field. What does this uncertain legal landscape mean for corporate compliance? Privacy obligations, intellectual property rights and nondiscrimination laws and compliance programs must be observed even while we turn to laws more specifically targeted at AI.

RENEWABLE AI RISKS AND REGULATIONS

AI tools and implications are new and emerging. All of us, agencies as well as companies and advisors, face a situation where we don't know what we don't know. In that circumstance, we tend to conceive of the risks and policies that we have learned about from previous technology evolutions. When there has been a transformation of how we do business, or how we incorporate technology into our business processes, we learn from stumbling blocks of past transformations. We take that forward to identify and protect against risks across the sector and inside individual organizations.

Cybersecurity Risks

The first sets of risks, blaring loud and clear, are electric grid cyber vulnerabilities. We have seen for several decades that the energy sector is particularly susceptible to attacks. High-profile incidents have caused disruption of generation, transmission and energy consumption that have become national security concerns.

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[23] See Annelise Gilbert, EEOC Settles First-of-Its-Kind AI Bias in Hiring Lawsuit, Bloomberg Law (Aug. 10, 2023), https://news.bloomberglaw.com/daily-labor-report/eeoc-settles-first-of-its-kind-ai-bias-lawsuit-for-365-000.

[24] See Federal Trade Commission Office of Technology Staff, AI Companies: Uphold Your Privacy and Confidentiality Commitments (Jan. 9, 2024), https://www.ftc.gov/policy/advocacy-research/tech-at-ftc/2024/01/ai-companies-uphold-your-privacy-confidentiality-commitments.

There are attacks and espionage incidents that we know about, and a host that have not become public knowledge. Whenever the Department of Energy (DOE) or the Department of Homeland Security provide reports to Congress, the common theme is that our critical infrastructure, including the energy sector, are under constant threat from nation-states and private actors.

- The 2019 Denial of Service attack caused disruptions to electrical system operations of an undisclosed U.S. utility.
- In 2017, a Kansas nuclear power plant's computer networks were penetrated, targeting senior engineers for control system access.
- In the international realm, we saw the 2015 attack on the Ukrainian grid, where hackers sponsored by the Russian government knocked out the power for 200,000 people.[25]

Attacks on the energy sector can be directed at regular corporate network information technology (IT) systems – general operation, billing, e-mail systems and all the tools for operating a business on a day-to-day basis. But we are also seeing attacks directed at the operational technology (OT) systems, the production networks – what is going on the back of house or in the field – as well as the links between those two networks. Formerly, IT and OT systems were largely separate and isolated. With web-based operating software the dividing line has become blurry, creating many vulnerabilities to exploit.

AI models are susceptible to cyberattacks because they are based on code; there can be vulnerabilities in the code itself that can be exploited. Exploitation of an AI model or system – depending on its use, how it is connected to other network systems, and the data it accesses – can result in data breaches or damage to system integrity or operations. AI platforms can store and process vast amounts of confidential or sensitive information. These systems can be attacked, or they can be left alone and used as an entry point past weak security protocols, resulting in a data breach of the confidential or sensitive information.

Additionally, programs could be leveraged by bad actors to foster attacks in which adversaries manipulate input data to cause errors and misclassification that bypass security measures and control the decision-making processes of the system. This approach might include evasion attacks, in which the training system is given bad data in order to evade security protocols, or extraction attacks, when data is input to extract and exploit the model itself. AI systems

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[25] See Alicia M. McKnight & Brian Finch, Power Grids and Points of Vulnerability: Keeping the Lights on Amid Cybersecurity Concerns, 9 PRATT'S PRIVACY AND CYBERSECURITY LAW REPORT, 265-70 (2023); Zack Whittaker, Denial of Service Condition Disrupted US Energy Company Operations, TECHCRUNCH (May 2, 2019).

can be used as vectors for malware and ransomware attacks, which are increasingly commonplace within the energy sector. AI can be used to create malware and ransomware tools themselves. Specifically, AI can be used to generate malicious code, making the generation of that code cheaper and easier, putting affected companies at heightened risk.

Cyber-Incident Reporting Compliance

Increased cyber risk as a result of AI is certainly something that demands attention. In the current regulatory landscape, if there were to be a cyberattack, what should be done by the impacted organization? Right now, we are looking at a patchwork of cyber-incident reporting requirements, rules and best practices.

For an AI-driven or AI-exploited cyberattack that compromises critical infrastructure, regulated companies would refer first to their respective reporting requirements. The Cyber Incident Reporting Council (CIRC), established to assess and harmonize cyber notification requirements within the federal government, issued a report in September 2023 that identified no fewer than 52 independent cyber incident reporting requirements, either in effect or proposed, across the federal government. These mandates are issued by different agencies requiring different time periods to report, and different reporting formats for entities in their purview.[26] As such, currently, an entity that reports to more than one agency may face multiple cyber incident reporting requirements.

Such requirements will be impacted going forward by the implementation of the Cyber Incident Reporting for Critical Infrastructure Act, enacted in 2022, which requires regulators to harmonize the patchwork of existing federal notification requirements and create consistent reporting across the federal government for critical infrastructure (including energy).[27] Regulated critical infrastructure owners and operators must monitor changing regulatory notification requirements.

In addition to mandatory reporting requirements, there are reporting regimes that are generally agreed upon within a sector or voluntary. In many cases companies may elect to report cyber incidents to law enforcement or information sharing and coordinating councils, like the E-ISAC within the electric industry.

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[26] Department of Homeland Security, Cyber Incident Reporting Council, Harmonization of Cyber Incident Reporting to the Federal Government, September 2023, https://www.dhs.gov/sites/default/files/2023-09/Harmonization%20of%20Cyber%20Incident%20Reporting%20to%20the%20Federal%20Government.pdf.

[27] Cyber Incident Reporting for Critical Infrastructure Act of 2022, Pub, L. No. 117-103, March 14, 2022.

There are data breach notification requirements at the state level, depending on the nature of the information that is exposed. If there is a data breach or a data exploitation that involves personally identifiable information, all 50 states and the U.S. territories have their own data breach notification requirements that could come into play and require action to notify impacted individuals and, potentially, government agencies.

Further, in July 2023, the Securities and Exchange Commission (SEC) adopted final rules that require public companies and foreign private issuers to disclose material cybersecurity incidents promptly and to make periodic disclosures regarding cyber risk management, governance and strategy.[28]

Managing Cyber Risk

How should an energy company using AI manage all these requirements before and after an attack, and how should an AI user be looking at cyber vulnerabilities? The response will center on the expansion to the new technology of existing cyber-vulnerability programs.

The cybersecurity risk management framework of the National Institute of Standards and Technology (NIST) has long been the voluntary best practice guide applicable to organizations of any size. In January 2023, NIST promulgated an AI Risk Management Framework that centers on organizational processes to map, identify, assess, prioritize and manage risk stemming from AI.[29] NIST's guidance and voluntary frameworks very often become foundational, including by being incorporated into industry-wide best practices and regulatory requirements. As such, in managing AI-driven cyber risk, the NIST AI Risk Management Framework will be an important starting point.

It will be important to ensure that AI-related risk management processes are integrated into existing policies and procedures. Take, for example, existing vendor management processes. Companies are being approached by vendors who offer a solution in the form of an AI tool that can use predictive power to make businesses more efficient. All of that sounds good, but when a company procures and implements this tool, it should ask: How do we make sure that we are adequately managing our vendor relationship when incorporating such a solution into our business processes? How are we contracting with them,

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[28] SECURITIES AND EXCHANGE COMMISSION, Final Rule on Cybersecurity Risk Management Strategy, Governance, and Incident Disclosure, July 26, 2023, 88 Fed. Reg. 51896, https://www.sec.gov/files/rules/final/2023/33-11216.pdf.

[29] National Institute of Standards and Technology, AI Risk Management Framework, January 2023, https://csrc.nist.gov/projects/risk-management/about-rmf.

ensuring that we understand what data we own and what data they own? Have we updated our incident reporting response protocols to account for new or heightened risks?

Another important tool for managing cyber risk is auditing and self-assessment. When jumping into the world of AI systems and tools, companies must consider how they are assessing the performance of the new system or tool. It will be critical to use a regular audit process to ensure that employees and vendors are trained and that the new tool is performing as expected.

Identifying and Managing Other AI Risks

In addition to cybersecurity-related risks, companies should identify additional risks that can impact the usefulness of AI systems and tools and/or create business vulnerabilities.

Data Integrity

Companies should be mindful that AI applications themselves are dependent on the quality of data inputs to perform. With AI, garbage data inputs mean garbage results. High-quality data is critical to the effectiveness and reliability of an application. Incorrect, incomplete, or biased data will not yield the desired results, leading to untrustworthy or even unusable model behavior. Data quality issues can be the result of the type of data selected, the realities of collecting hard-to-collect data, or even malicious compromise of inputs. In the energy context, if an AI tool designed to analyze grid performance depends on data from remote locations, what is the impact to the AI model if that data is inaccessible because of unreliable cell service or because sensors are compromised by severe weather? An energy company relying on that AI tool needs to ask themselves "What does that do those vulnerabilities do to our data set, and in turn, what does an incomplete data set do to performance of our system?"

To preserve the integrity of AI models, companies should look at the completeness and correctness of the data and make sure there is widespread understanding between the people who are integrating AI systems and the decision makers about what that AI system can actually do. Regular audits and self-assessments should be undertaken to verify that the application is working as intended.

Distrust in AI Systems

Another issue companies may face is widespread distrust in AI systems. Across industries and the general public, people have different understandings of what "AI" means or might do for them. Studies evidence that more people than not have some trust issues with AI. Skepticism is typically centered on concerns that models will be unsafe or unfair. Distress can be caused by any new

technology, and AI is exacerbating existing trust issues, which can erode the gains that this tool might achieve. Trust can be gained or regained by institutional safeguards, technical knowledge, and confidence in leadership within an organization and an industry.

Data Ownership

Within the energy sector, other risks that repeatedly crop up are concerns about ownership of the data going into an AI system, making certain that you are not giving away any competitive advantage by using an AI system, and trying to get a return on your data investment that helps the machine learning system grow or become more mature.

Uncertain Regulatory Landscape

The relationship between risks, mitigation, regulation and legal exposures is a familiar one. We are already seeing guidance that comes from agencies and industry groups. There is a well-worn path between guidance, best practices and voluntary frameworks turning into regulatory mandates.

As new management frameworks are rolled out within the AI space, it is wise to prepare. The first step is assessing whether the company has correct organizational oversight and coordination, such as being thoughtful about adopting AI systems and implementing it in a way that includes full oversight of the technology.

THE NEW AI EXECUTIVE ORDER AND OTHER GOVERNMENT INITIATIVES

The most recent and consequential new AI initiative at the federal level is President Biden's October 30, 2023, Executive Order (the Order).[30] The Order seeks to accomplish the following:

- Provide safety, security and privacy from AI, or for AI, clarifying how to use AI in a way that does not impact the interests of individuals and businesses;
- Ensure responsible competition and innovation in AI;
- Protect employees and build up the domestic workforce (i.e., making sure AI enhances payrolls rather than simply replacing employees);
- Focus on equity and civil rights to prevent the abuse of AI and

[30] The White House, FACT SHEET: President Biden Issues Executive Order on Safe, Secure, and Trustworthy Artificial Intelligence, https://www.whitehouse.gov/briefing-room/statements-releases/2023/10/30/fact-sheet-president-biden-issues-executive-order-on-safe-secure-and-trustworthy-artificial-intelligence/.

problems with bias;

- Develop and use AI within the federal government, and put steps and processes in place that build up a credible AI capability and competent AI workforce within the federal government; and
- Maintain U.S. leadership in artificial intelligence within the international community. AI is such a powerful tool that it will have a large impact on productivity on the national economy, including through the international flow of goods and services.

To achieve these top-line ambitions, the Order launches several initiatives.

First, it encourages businesses to increase training for the use of artificial intelligence. For energy businesses specifically, the Order emphasizes using AI for grid improvement by using the technology to make the grid more efficient, responsive and resilient.

Second, the Order establishes a multilayered defense against cyberattacks and malicious actions against AI. The administration wants businesses to calculate the risks and benefits of using AI, and to do that they will need to understand how to use AI in a beneficial way. That is going to take some calculation. What are the risks? What are the costs? What are the benefits? A very important aspect for businesses is protecting intellectual property – and learning how to protect it.

There are several risk mitigations that flow from these aspects of the Order. One facet is cyber insurance: it is vital that a business is protected if there is a cyberattack. For risk transfer to be effective, companies should be able to prove that they took the steps that are required in regulation and have made the necessary or recommended follow-up.

Entities involved in critical infrastructure (like most energy companies) should have a "red team" looking for breaches and vulnerabilities. The team should explore what attacks and failures are possible. This process also relates to AI products that can cause a risk to your business. The presence of AI risks implies the necessity, under many regulatory requirements, of incident response and reporting. If an incident takes place, companies must have training in place and then be able to report that incident to the DOE or other regulator.

One general counsel shared how excited the company's business leaders were about the potential of AI, but concluded, "That's an IT thing that our IT department will have to deal with." If there was ever an area for a cross-functional group to engage with one another, to assess and manage the potential benefits and risks, it is here with the implementation of AI.

AI can even help streamline permitting and environmental reviews. Energy businesses must use approved and accredited tools and explain to all stakeholders how the AI operates, but doing so can boost competitiveness and aid in meeting federal regulations.

The Order also encourages collaboration on climate change mitigation, with the DOE and with other energy suppliers and energy users. And finally, the Order encourages use of the DOE computer models and test beds. These tools will be built up over the next year or two, and entities that produce energy or manage a grid will want to have access to them, as they can make business more responsive and effective.

As noted above, the Order wants to build up an AI-savvy workforce in the United States. It wants to boost training programs, protect workers, and prudently manage immigration in a way that can bring in top talent. The Order calls for a United States that can outcompete and outproduce the competition, and yet maintain environmental security and environmental protections.

In addition to President Biden's order, Congress is reacting strongly to the public reaction to ChatGPT and other chatbots, with the introduction of at least 30 bills in 2023. Many bills have to do with national security, and others are still coming. However, it will take time for Congress to act responsibly and effectively, and they may have difficulty doing so.

On the whole, the Order creates some organization in the AI space and gives Congress time to act responsibly. Congress, historically, is a very slow-moving body. So far, the federal effort has been rather bipartisan, which is beneficial. Once the opposing parties start pointing fingers at each other, progress becomes very difficult.

Congressman McNerney introduced the AI in Government Act of 2020, which was successfully passed into law.[31] It establishes the General Service Administration (GSA) as a Federal Center of Excellence in Artificial Intelligence. This designation ensures that the federal government has the resources in AI to react to the needs and interests of the various agencies. It also enables the Office of Management and Budget (OMB) to carry out creating federal AI capabilities.

Transitioning from the federal to the state governments, we have seen over 115 pieces of legislation proposed on artificial intelligence. The states are en route to creating a patchwork of AI requirements across the country that will make it more difficult for the federal government to act. For example, in

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[31] AI in Government Act of 2020, Div. U, Title I of the Consolidated Appropriations Act, 2021, Pub. L. No. 116-260, Div. U, Title I, 134 Stat. 1182, 2286-89 (2020).

California, the governor issued his own executive order;[32] in the absence of implementing state legislation, this order uses the executive branch's purchasing power to guide AI-responsible behavior and establishes some tools for approval of AI programs within the state government.

Both the California executive order and the European Union's recently enacted regulation take a "risk-based approach," meaning that the degree of regulation imposed depends on the degree of risk to the public well-being, with the applications having the highest risk being banned outright and the applications with no risk being left unregulated. The EU's regulation is a good step, though it is somewhat narrow and at risk of becoming obsolete on such a rapidly developing technology.[33] This case illustrates the difficulty of regulating technology through legislation, as opposed to regulators working with industry to set standards.

RENEWABLE ENERGY AND THE HUMAN ELEMENT OF AI

It is well known that Bitcoin cryptocurrency mining consumes large quantities of energy. Training AI will be even more energy intensive.

One analysis estimated, in a middle-ground scenario, that by 2027 AI servers may be responsible for consuming between 85 and 134 terawatt-hours annually.[34] This level of energy consumption is close to the total energy consumption for Argentina, the Netherlands and Sweden each per year, and would account for around 0.5 percent of current global electricity use.[35] Chatbots in particular require immense energy and training. The user of generative AI is tempted to hit the refresh button to play the probabilities of a better result, without any conception of the energy use.

We will need high power, of high quality and reliability, to train these large language models. Zero emission sources like renewables must be the solution,

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[32] Office of Governor Newsom, Governor Newsom Signs Executive Order to Prepare California for the Progress of Artificial Intelligence, https://www.gov.ca.gov/2023/09/06/governor-newsom-signs-executive-order-to-prepare-california-for-the-progress-of-artificial-intelligence/.

[33] See The Atlantic Council, Experts react: The EU made a deal on AI rules. But can regulators move at the speed of tech? https://www.atlanticcouncil.org/blogs/new-atlanticist/experts-react/experts-react-the-eu-made-a-deal-on-ai-rules-but-can-regulators-move-at-the-speed-of-tech/.

[34] Alex de Vries, The Growing Energy Footprint of Artificial Intelligence, Joule (Volume 7, Issue 10, pages 2191-2194) (Oct. 10, 2023), https://www.cell.com/joule/fulltext/S2542-4351(23)00365-3.

[35] Delger Erdenasanaa, A.I. Could Soon Need As Much Energy As An Entire Country, The New York Times (Oct. 10, 2023), https://www.nytimes.com/2023/10/10/climate/ai-could-soon-need-as-much-electricity-as-an-entire-country.html?unlocked_article_code=1.Qk0.rmly.YD-e55qZrv3m&smid=em-share.

because we do not want to emit incremental carbon while producing incremental electricity. Permitting for all this new generation and storage is going to be an issue, especially because many of the data centers are in urban areas. AI will ultimately make our grid more efficient, but we do not want that efficiency gain to be overcome by the energy draw.

We finally turn to two aspects of what we term the human element in AI as applied to the renewable energy sector. The first aspect is public acceptance of AI outcomes. The Holy Grail goal of AI is being able to internalize complicated judgments, make predictions and implement decisions without the usual unpacking of all of those things in a human environment. It is inevitable, however, that folks are going to want to look under the hood. People will want to understand how those decisions were made. In our curtailment example, where a solar facility gets to keep selling into the grid while a windfarm is shut off, the windfarm owner is not going to be satisfied with the utility saying, "well, that's what our contractor told us to do." (Or with the contractor saying, "that's what our vendor said to do" and the vendor saying, "that's what my technology licensor said to do," and the technology licensor saying, "that's what my coder group said and they are now off in a new startup.") Stakeholders are going to want to know how that work was done and by whom.

This scrutiny will not be efficient. Imagine a chess-playing computer that on each move had to defend why it played a particular piece and not others. If your renewable project is applying for a permit and you want to support your application with mitigation measure data and plans that have been processed and developed through AI, you need to make sure that the algorithm has been unpacked in a form that the agency is going to accept. Bringing AI to a non-AI dance is going to be a challenge.

There are a number of public forums where renewable energy project applications are vetted. Building up confidence in the science and the algorithms of the AI will be critical in these settings. It is not going to be enough to say, "just trust this black box, it's been developed by people smarter than you, and trust the output that comes out of it." That is why we began this article breaking down AI in terms of its predictive and automation powers, with specific examples, to demystify what is going on inside that black box. You should be prepared to tell your audience, in all candor, "Here is the input data; here are the sensors; here is the decision model; and here's an example, a simplified model, of a way in which this information is being used. That is why we propose to build this facility in your hometown, and why we are curtailing this renewable source and not this other renewable source."

That approach does not remove the possibility of challenges to your project or decision. But if we make AI more accessible and less of a "high priest" kind

of technology, it will help. This task will not be easy, especially at a time when entrepreneurial companies are developing proprietary systems. Each wants to keep its particular black box rather opaque. We may ultimately see mandatory disclosure or mandatory licensure of core AI subroutines, in the interest of securing greater public acceptance of the results.

The second human element relates to careers. There will be upheavals in the energy labor market, as in other industries across the country and the world.[36] We anticipate the continuation of growth in "green jobs" in the renewable sector. But the adoption of AI will shift the specific occupations for which demand will be strongest. New jobs will be created – for example, "prompt engineers" well versed in formulating chatbot inquiries. Other positions will be superseded. The energy industry has historically had challenges with finding, recruiting and retaining top-notch talent in the areas that they need, often competing with the high technology industry.

Within the technology field, we have been telling students for years that if you want to have a job that is safe in the new environment, you should learn how to code. But even today you can open a generative AI program and say, "make me a Pong program that uses a frowning pumpkin as the ball," and a couple of seconds later it will pop out a .exe file that you can launch. It is vital for anybody involved in the career development process – which includes the employers, the human resources professionals, the educators and especially young people and lifelong learners – to be mindful of the transformations in the roles that humans will play.

We remain excited about the benefits and opportunities of AI. At the same time, we look forward to resolving the challenges and participating in planning and implementing the individual and collective actions that will facilitate the safe and productive use of this technology.

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[36] See Electric Power Research Institute (EPRI), The Role of Artificial Intelligence in Powering America's Energy Future, testimony of Dr. Jeremy Renshaw before the House Energy and Commerce Committee Subcommittee on Energy, Climate, and Grid Security (October 19, 2023), https://publicdownload.epri.com/PublicAttachmentDownload.svc/AttachmentId=86002.