



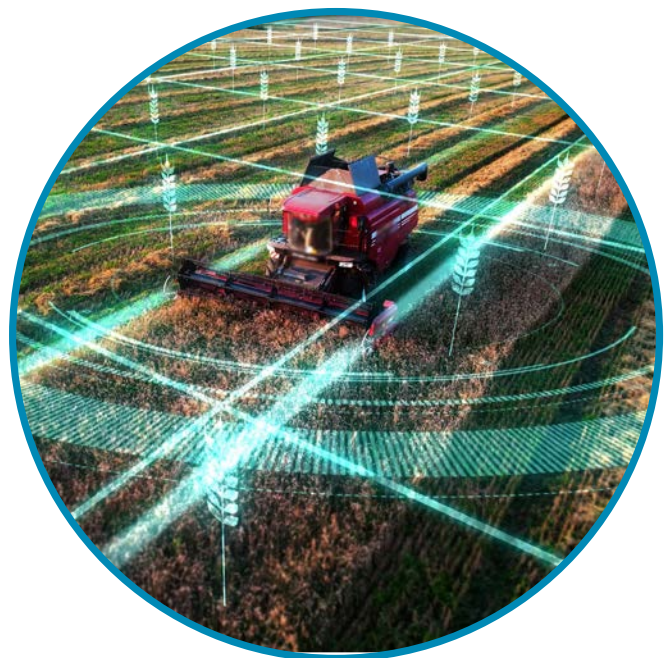
INSIGHT 20

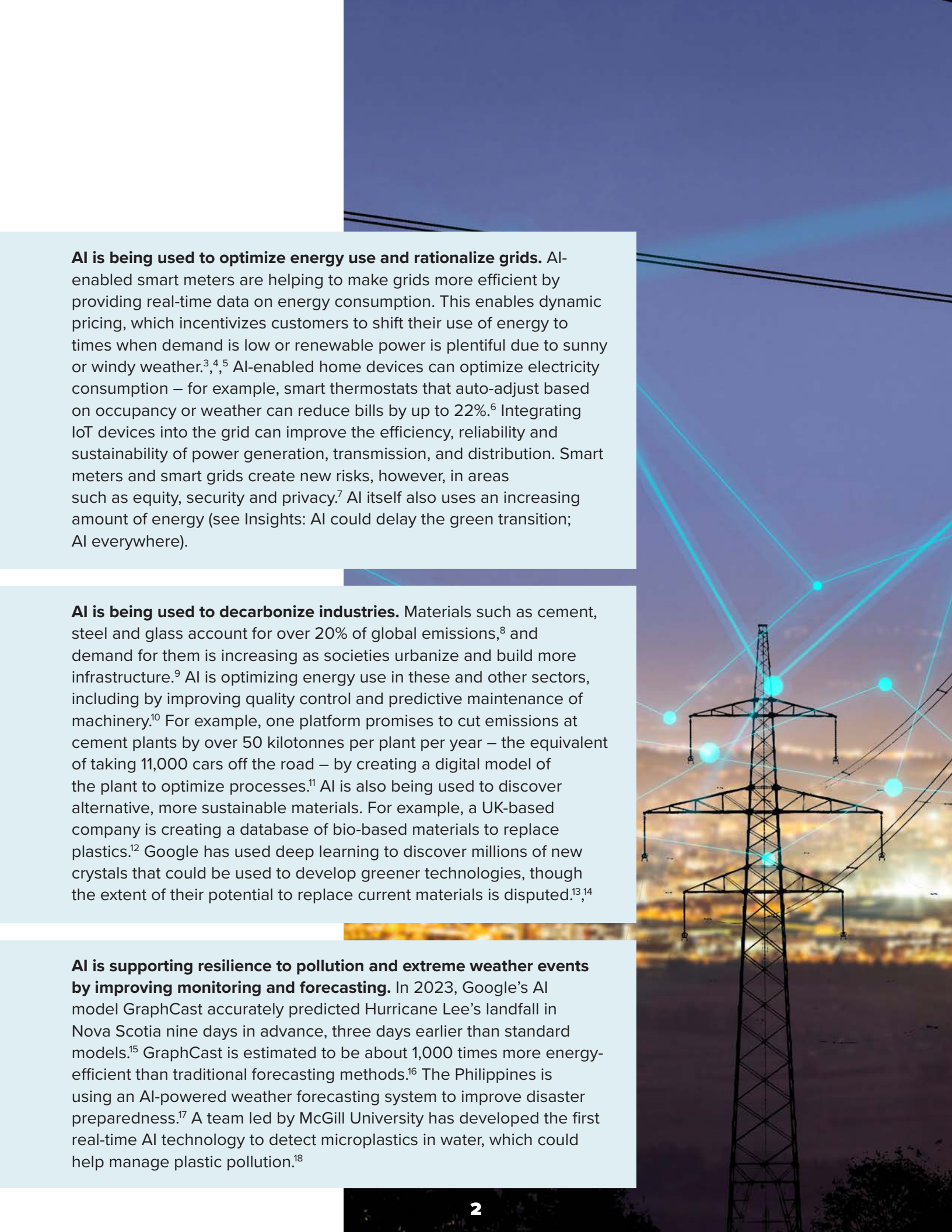
AI COULD HELP WITH CLIMATE MITIGATION

While increased uptake of AI could generate more emissions (See Insight: AI could delay the green transition), it could also create new opportunities to support climate adaptation and mitigation. These include making agriculture more resilient, optimizing energy use, accelerating scientific discovery, and improving weather forecasts.

PRESENT

AI is being applied to climate-related challenges in agriculture. As the climate becomes less predictable, AI models are advising farmers on the best times to plant crops. AI can develop more climate-resistant crop varieties up to five times more quickly than traditional breeding.¹ Combined with advances in sensing, automation and robotics (see Insight: Robotics), AI is helping to minimize use of inputs including energy, water, and chemicals, as well as tackling shortages of human labour. In 2021, 87% of businesses in the US agriculture industry used AI in some form.²





AI is being used to optimize energy use and rationalize grids. AI-enabled smart meters are helping to make grids more efficient by providing real-time data on energy consumption. This enables dynamic pricing, which incentivizes customers to shift their use of energy to times when demand is low or renewable power is plentiful due to sunny or windy weather.^{3,4,5} AI-enabled home devices can optimize electricity consumption – for example, smart thermostats that auto-adjust based on occupancy or weather can reduce bills by up to 22%.⁶ Integrating IoT devices into the grid can improve the efficiency, reliability and sustainability of power generation, transmission, and distribution. Smart meters and smart grids create new risks, however, in areas such as equity, security and privacy.⁷ AI itself also uses an increasing amount of energy (see Insights: AI could delay the green transition; AI everywhere).

AI is being used to decarbonize industries. Materials such as cement, steel and glass account for over 20% of global emissions,⁸ and demand for them is increasing as societies urbanize and build more infrastructure.⁹ AI is optimizing energy use in these and other sectors, including by improving quality control and predictive maintenance of machinery.¹⁰ For example, one platform promises to cut emissions at cement plants by over 50 kilotonnes per plant per year – the equivalent of taking 11,000 cars off the road – by creating a digital model of the plant to optimize processes.¹¹ AI is also being used to discover alternative, more sustainable materials. For example, a UK-based company is creating a database of bio-based materials to replace plastics.¹² Google has used deep learning to discover millions of new crystals that could be used to develop greener technologies, though the extent of their potential to replace current materials is disputed.^{13,14}

AI is supporting resilience to pollution and extreme weather events by improving monitoring and forecasting. In 2023, Google's AI model GraphCast accurately predicted Hurricane Lee's landfall in Nova Scotia nine days in advance, three days earlier than standard models.¹⁵ GraphCast is estimated to be about 1,000 times more energy-efficient than traditional forecasting methods.¹⁶ The Philippines is using an AI-powered weather forecasting system to improve disaster preparedness.¹⁷ A team led by McGill University has developed the first real-time AI technology to detect microplastics in water, which could help manage plastic pollution.¹⁸



FUTURES

AI could accelerate scientific discoveries that support

decarbonization. AI could speed up the discovery process by generating better hypotheses and identifying areas that have been overlooked.¹⁹ It could help develop new materials for applications such as construction and packaging. It could improve the efficiency of mining elements that are critical for clean energy technologies – such as copper, lithium, and cobalt – by speeding up exploration, improving processes, and reducing risks for investors through better planning and maintenance.²⁰

AI could become more important in weather forecasting.

Weather predictions currently depend on supercomputers that model the workings of the atmosphere using real-time inputs from a network of sensors, and human experts to interpret their results.²¹ As this infrastructure is expensive, most forecasts are made by government agencies. Differences in access to infrastructure and data means that weather forecasts are more accurate in high-income countries than in low-income ones.²² In the future, AI could make weather forecasting more accessible to a wider variety of actors and help to foster greater “forecast equity” between nations.^{23, 24} However, the drawbacks of AI compared to current methods – it relies on past data, its workings are not transparent, and it is less able to account for probability – could mean it is more difficult to audit for errors and less likely to anticipate unusual weather events.^{25, 26}

As climate change accelerates, AI might find it harder to

analyze. Because AI models rely on historical data, it can be hard for them to anticipate events that have not commonly happened in the past.²⁷ The more the climate changes, the more common unusual events are likely to become. It could be difficult to collect enough data for AI models to make sense of complex ecosystems.



IMPLICATIONS

- **AI could enhance preparedness for extreme weather events.** If their accuracy continues to improve, **AI forecasting models could give more time for evacuations and preparations that save lives** and property.
- AI could improve **private alternatives to government-run weather forecasting infrastructure and reduce global inequality in access to weather forecasts.**
- **Breakthroughs in environmental and climate science could accelerate**, as AI generates stronger hypotheses, increases the speed of research, and lowers its costs.²⁸
- AI could help propel **transitions toward materials that are more sustainable and less polluting.**
- The positive climate impacts of AI may be cancelled out as its use generates **more e-waste, increases energy demand, and leads to higher levels of production and consumption across the economy.**
- The integration of AI coupled with more efficient and sustainable strategies for energy generation could lead to **an increase in negative electricity prices in some jurisdictions.**²⁹ This could increase demand, or it could lead to more efficient energy use by shifting consumption patterns. It could also lead to increased investments in new kinds of battery storage.
- Dynamic energy pricing could harm vulnerable groups, for example by leading to unaffordable price hikes for cooling during heat waves or heating during extremely cold weather.
- **AI-enabled IoT devices, meters, and smart grids could improve efficiency but increase privacy and security risks.**
 - › Insecure AI-enabled devices could create more opportunities for cyber criminals to access personal data, or allow energy consumption readings to be manipulated.³⁰
 - › A coordinated **attack targeting smart grids could manipulate energy flows, cause cascading failures, disrupt power to critical infrastructure, and damage grid infrastructure.**³¹

Endnotes

- 1 Bearne, Suzanne. “We Are Creating New Crops Five-Times Faster.” BBC, June 12, 2024. <https://www.bbc.com/news/articles/c9xxjx7e2gjo>.
- 2 Becker, Sam. “US Farms Are Making an Urgent Push into AI. It Could Help Feed the World.” BBC. Accessed November 5, 2024. <https://www.bbc.com/worklife/article/20240325-artificial-intelligence-ai-us-agriculture-farming>.
- 3 Hussain, Abbas, and Maria Paula Torres. “Time to Pick up Pace of Dynamic Electricity Pricing.” Frontier Economics, nd. <https://www.frontier-economics.com/uk/en/news-and-insights/articles/article-i6106-time-to-pick-up-pace-of-dynamic-electricity-pricing/>.
- 4 Hussain, Abbas, and Maria Paula Torres. “Time to Pick up Pace of Dynamic Electricity Pricing.” Frontier Economics, nd. <https://www.frontier-economics.com/uk/en/news-and-insights/articles/article-i6106-time-to-pick-up-pace-of-dynamic-electricity-pricing/>.
- 5 Frizis, Iakov, and Stijn Van Hummelen. “Research on Consumer Risks and Benefits of Dynamic Electricity Price.” Cambridge Econometrics for the European Consumer Organisation (BEUC), 2022. <https://policycommons.net/artifacts/11343360/beuc/12232376/>.
- 6 Dabrowska, Magda. “Smart Home Technology Saves Money and Helps Protect the Planet | IoT Now News & Reports.” IoT Now News - How to Run an IoT Enabled Business (blog), April 22, 2024. <https://www.iot-now.com/2024/04/22/144080-smart-home-technology-saves-money-and-helps-protect-the-planet/>.
- 7 Gordon, Roya. “Internet of Things and the Increasing Threats to the Electric Grid.” Accessed October 30, 2024. <https://www.asisonline.org/security-management-magazine/monthly-issues/security-technology/archive/2024/february/Internet-of-Things-Increasing-Threats-Electric-Grid/>.
- 8 Alliance for low-carbon cement & concrete. “Carbon Re – AI-Powered Decarbonisation for the Cement Industry.” Alliance for low-carbon cement & concrete, nd. <https://allancelccc.com/story/carbon-re-ai-powered-decarbonisation-for-the-cement-industry/>.
- 9 Purton, Michael. “4 Ways to Make the Cement Industry More Sustainable.” World Economic Forum, September 13, 2024. <https://www.weforum.org/agenda/2024/09/cement-production-sustainable-concrete-co2-emissions/>.
- 10 Claussen, Heiko. “Five Ways AI Can Help Industry Reach Sustainability Goals,” Forbes, April 15, 2024. <https://www.forbes.com/councils/forbestechcouncil/2024/04/15/five-ways-ai-can-help-industry-reach-sustainability-goals/>.
- 11 Alliance for low-carbon cement & concrete. “Carbon Re – AI-Powered Decarbonisation for the Cement Industry.” Alliance for low-carbon cement & concrete, nd. <https://allancelccc.com/story/carbon-re-ai-powered-decarbonisation-for-the-cement-industry/>.
- 12 [How gen AI supports sustainable futures and crisis response | Google Cloud Blog](#)
- 13 Google DeepMind. “Millions of New Materials Discovered with Deep Learning,” October 30, 2024. <https://deepmind.google/discover/blog/millions-of-new-materials-discovered-with-deep-learning/>.
- 14 Koebler, Jason. “Is Google’s AI Actually Discovering ‘Millions of New Materials?’” 404 Media, April 11, 2024. <https://www.404media.co/google-says-it-discovered-millions-of-new-materials-with-ai-human-researchers/>.
- 15 Rowlatt, Justin. “AI Could Predict Hurricane Landfall Sooner - Report.” BBC, November 14, 2023. <https://www.bbc.com/news/science-environment-67383755>.
- 16 Edwards, Benj. “AI outperforms conventional weather forecasting for the first time: Google study.” Ars Technica, November 14, 2023. AI outperforms conventional weather forecasting for the first time: Google study
- 17 Trinchera, Gilbert. “Innovation and the Convergence of AI and ESG in the Philippines.” KPMG, July 15, 2024. <https://kpmg.com/ph/en/home/insights/2024/07/innovation-and-the-convergence-of-ai-and-esg-in-the-philippines.html>.

- 18 Wang, Zi, Devendra Pal, Abolghasem Pilechi, and Parisa A. Ariya. "Nanoplastics in Water: Artificial Intelligence-Assisted 4D Physicochemical Characterization and Rapid In Situ Detection." *Environmental Science & Technology* 58, no. 20 (May 21, 2024): 8919–31. <https://doi.org/10.1021/acs.est.3c10408>.
- 19 Hutson, Matthew. "Hypotheses Devised by AI Could Find 'Blind Spots' in Research." *Nature*, November 17, 2023. <https://doi.org/10.1038/d41586-023-03596-0>.
- 20 Vespignani, Joaquin, and Russell Smyth. "Artificial Intelligence Investments Reduce Risks to Critical Mineral Supply." *Nature Communications* 15, no. 1 (2024): 7304.
- 21 Leffer, Lauren. "AI Weather Forecasting Can't Replace Humans—Yet." *Scientific American*. January 9, 2024. <https://www.scientificamerican.com/article/ai-weather-forecasting-cant-replace-humans-yet/>
- 22 Linsenmeier, Manuel, and Jeffrey Shrader. Global inequalities in weather forecasts. No. 7e2jf. Center for Open Science, 2023.
- 23 Leffer, Lauren. "AI Weather Forecasting Can't Replace Humans—Yet." *Scientific American*. January 9, 2024. <https://www.scientificamerican.com/article/ai-weather-forecasting-cant-replace-humans-yet/>
- 24 Mohamed, Shakir. "Responsibilities of the Pioneer." 2023 HAI Signature Fall Conference: New Horizons in Generative AI: Science, Creativity and Society. Stanford University. <https://www.youtube.com/watch?v=RISkLc38hL4&t=2593s>
- 25 Leffer, Lauren. "AI Weather Forecasting Can't Replace Humans—Yet." *Scientific American*. January 9, 2024. <https://www.scientificamerican.com/article/ai-weather-forecasting-cant-replace-humans-yet/>
- 26 Hope, Lauren. "AI Models Outperform Traditional Weather Forecasting, but Won't Replace Them Yet." *NBC News*, August 21, 2024. <https://www.nbc-2.com/article/ai-hurricane-forecasting-artificial-intelligence/61840508>.
- 27 Harvey, Chelsea. Climate Change Could Stump AI Weather Prediction. *Scientific American*. July 12, 2023. <https://www.scientificamerican.com/article/climate-change-could-stump-ai-weather-prediction/>.
- 28 Agrawal, Ajay, John McHale, and Alexander Oettl. "Artificial Intelligence and Scientific Discovery: A Model of Prioritized Search." *Research Policy* 53, no. 5 (2024): 104989.
- 29 Buli, Nora, and Forrest Crellin. "Europe's Solar Power Surge Hits Prices, Exposing Storage Needs." *Reuters*, June 21, 2024, sec. Energy. <https://www.reuters.com/business/energy/europes-solar-power-surge-hits-prices-exposing-storage-needs-2024-06-21/>.
- 30 Gordon, Roya. "Internet of Things and the Increasing Threats to the Electric Grid." Accessed October 30, 2024. <https://www.asisonline.org/security-management-magazine/monthly-issues/security-technology/archive/2024/february/Internet-of-Things-Increasing-Threats-Electric-Grid/>.
- 31 Gordon, Roya. "Internet of Things and the Increasing Threats to the Electric Grid." *Security Management*. Accessed October 30, 2024. <https://www.asisonline.org/security-management-magazine/monthly-issues/security-technology/archive/2024/february/Internet-of-Things-Increasing-Threats-Electric-Grid/>.

© His Majesty the King in Right of Canada, 2025

For information regarding reproduction rights: <https://horizons.gc.ca/en/contact-us/>

PDF: PH4-230/2025E-PDF

ISBN: 978-0-660-78234-8

Aussi disponible en français sous le titre : L'IA pourrait aider à atténuer le changement climatique.

DISCLAIMER

Policy Horizons Canada (Policy Horizons) is the Government of Canada's centre of excellence in foresight. Our mandate is to empower the Government of Canada with a future-oriented mindset and outlook to strengthen decision making. The content of this document does not necessarily represent the views of the Government of Canada, or participating departments and agencies.