Balance the Environmental Perils and Promises of Generative AI

By Analyst(s): Kristin Moyer, Sarah Watt, Pieter den Hamer, Gabriele Rigon

Initiatives: Executive Leadership: Sustainability; CIO Technology and Innovation Leadership; Executive Leadership: Artificial Intelligence

> Generative AI consumes a lot of electricity and water. The technology can accelerate positive sustainability and financial outcomes, but executive leaders need to be selective about use cases to make sure they are doing more good than harm.

Analysis

The rapid adoption of ChatGPT and similar general purpose tools has elevated the negative environmental impacts of generative AI from a nerdy, insider topic to an immediate concern for executive leaders. Plenty of seemingly good use cases powered by this emerging technology will do more harm than good in terms of greenhouse gas (GHG) emissions and electricity and water consumption. Generative AI, however, is not automatically or entirely bad news for sustainability. For example, Orbital Materials, a U.K.-based startup, is seeking to apply it to accelerate the development of clean energy technologies. [1]

If used in the right way and with human oversight, generative AI can potentially help companies mitigate sustainability risk, optimize costs and drive growth. Executives should balance the perils and promises of this technology by simultaneously:

- Recognizing and reducing generative AI's energy footprint

- Identifying, evaluating and prioritizing its environmental sustainability use cases

Recognize That Tech Has a Consumption Problem

Generative AI relies on huge models trained with massive amounts of data, making it thirsty for cooling water and hungry for electricity. In some cases, the technology can consume vast quantities of both. Electricity-related GHG emissions will decline in the long term, as the generation capacity of renewable energy grows. However, more powerful generative AI models will likely require increased computing capabilities.

The problem of tech-related electricity and water consumption goes well beyond generative AI. Information and communications technology (ICT) consumes less than 1% of global electricity today, but it is forecast to use 6.4% of total output by the end of the decade. [2] If new power-hungry technologies scale quickly, ICT energy consumption could be even higher.

By 2030, 75% of executives will experience technology-related electricity constraints. [3] For example, Singapore "implicitly imposed" a moratorium on building new data centers in 2019 (but lifted it in 2022). [4] The Dutch government tightened rules for hyperscale data centers in 2022. [5] As the needs of technology and society compete more intensely with each other, CIOs do not want to be caught in the position of vying with local communities for finite resources.

Reduce Generative AI's Energy Footprint

Executive leaders can make their organizations' generative AI more environmentally friendly by leading efforts to:

Make it as efficient as the human brain. One of the reasons the brain is so energy-efficient is that it organizes knowledge in network structures. Consider adopting so-called composite AI, which uses similar techniques, such as knowledge graphs, causal networks and other "symbolic" representations to complement the current brute force, deep learning method.

Put it on an electricity and water diet. Monitor energy consumption during machine learning. Improve awareness across the company about AI's environmental footprint. Stop training AI as soon as improvements flatten out and no longer justify the costs of continuing. Keep data for model training local, but share improvements at a central level — this "federated machine learning" reduces electricity consumption and bolsters data privacy. Reuse models that have already been trained, contextualizing them if needed. Use more energy-efficient hardware and networking equipment. Balance "follow the sun" data center workloads (which are better for clean energy production) with "unfollow the sun" measures (which are better for water efficiency).

Run it in the right place and at the right time. When and where a generative AI workload happens matters. The carbon intensity of the local energy supply varies by country, generating authority, time of day, weather conditions, transfer agreements, fuel supply and other factors. Best practice is to use energy-aware job scheduling for generative AI, along with carbon tracking and forecasting services to reduce related emissions.

Aim to buy new clean power where you plan to consume it. Not all renewable electricity purchases are equal. Buying renewable energy certificates (RECs), which reduce or offset GHG emissions, does not guarantee that the clean energy was actually consumed or that any new renewable power generation capacity was built to match increasing demand. Power purchase agreements (PPAs) can help, but are not always available. The Greenhouse Gas Protocol, a global standard-setting body, is considering requiring companies to provide more detailed analysis of clean power by location, time of day or both. [6]

Until then, executives should procure PPAs when possible, or source RECs from recently commissioned projects (thus adding new renewable energy to the grid) from the region where their company will consume the electricity. For example, IBM, [7] Walmart [8] and Salesforce [9] have policies to purchase renewable energy generated in the same grid region as they consume it and/or to add new clean power to the system.

Identify Potential Environmental Sustainability Use Cases

We picked out examples of valuable, illustrative generative AI use cases that will accelerate environmental sustainability by mitigating risks, optimizing costs or driving growth. From there, we used ChatGPT to jointly develop descriptions of each. We found that the tool frequently overestimated its abilities, but that we underestimated the breadth of its potential.

Mitigate Risks

- **Comply with regulations.** Generative AI can identify relevant sustainability laws, standards, directives and reporting requirements, including updates over time. It can interpret complex regulatory language and provide explanations in simpler terms. Generative AI can develop an action plan to achieve compliance, including insights on how to establish internal controls and auditing. It can develop training materials to educate employees on specific regulations.

- **Avoid stranded assets.** Generative AI can identify trends, regulations and technology disruption that increase the risk of stranded assets.

- **Develop organizational sustainability policies.** Generative AI can help employees identify sustainability policy best practices, develop a framework for such policies and draft statements, guidelines, procedures and protocols.

- **Develop sustainability KPIs.** Generative AI can help identify key performance indicators to evaluate sustainability efforts and progress.

Optimize Costs

- **Support decision making.** Generative AI can analyze internal sustainability data and identify patterns, trends, areas for improvement, feasibility, risks and benchmarks that support decision making. It can provide insight into how organizational decisions will impact sustainability and forecast likely future performance. Enterprises can therefore plan and select optimal pathways to reach GHG emissions reduction goals.

- **Improve corporate sustainability communications.** Generative AI can generate press releases, website content, articles, social media posts and campaigns, blogs, and external and internal communications on sustainability. It can suggest key messages and best practices for conveying information. ChatGPT can develop frequently asked questions and answers.

- **Engage supply chain partners.** Generative AI can develop criteria for supplier assessment, create a code of conduct, suggest engagement strategies, develop training content, provide suggestions for incentives and corrective actions, and answer questions.

- **Train employees.** Generative AI can develop employee training materials, create sustainability awareness communications, provide insight on sustainable work practices, explain sustainability concepts, answer employee questions and support learning by recommending materials and courses.

- **Embed Generative AI in products to make them more sustainable.** Generative AI can suggest sustainable product uses to customers by automating reply generation, using the right response tone and gamifying the customer experience through rewards.

Drive Growth

- **Discover alternative resources and materials.** Generative AI can provide suggestions for sustainable substitutes for conventional inputs, insights on technological innovation such as nanomaterials and information on availability, performance and environmental impact.

- **Support sustainable product development.** Generative AI can help with new, sustainable product ideation and insights on its viability, market research on trends, suggestions on prototyping, sustainable design principles, information on patents, trademarks or copyrights, competitive analysis and pricing advice.

- **Leverage generative design for buildings, parts and products.** Generative AI can suggest alternative design approaches and parameter and constraint options, as well as provide insight on design strengths and weaknesses.

- **Accelerate sustainability innovation.** Generative AI can support ideation, opportunity assessment, risk and compliance mitigation and business case development.

Evaluate the Positive and Negative Impacts

Executive leaders weighing generative AI use cases for sustainability should analyze their:

- **Business value** — financial and sustainability benefits, as well as feasibility (the level of difficulty and cost to implement the use case).

- **Negative environmental impact** — as measured by GHG emissions and electricity and water consumption.

We evaluated sustainability use cases, employing general-purpose generative AI tools (such as ChatGPT) based on a combination of primary and secondary research, Gartner proprietary data and analyst experience (see Figure 1).

Analysis of Generative AI Use-Case Examples

Higher ● ◕ ◑ ◔ ○ Lower

		Business Value			Negative Environmental Impact
		Financial Value	Sustainability Value	Feasibility	
Mitigate Risks	Comply with regulations	◑	◔	◕	◔
	Avoid stranded assets	◕	◕	◔	◔
	Develop organizational sustainability policies	◑	◔	◕	○
	Develop sustainability KPIs	◑	◑	●	○
Optimize Costs	Support decision making	◕	◑	◑	◑
	Improve corporate sustainability communications	○	○	○	○
	Engage supply chain partners	◕	●	◑	◑
	Train employees	◑	◕	◕	◑
	Embed GenAI in products to make them more sustainable	◕	◕	◔	◕
Drive Growth	Discover alternative resources and materials	●	●	◑	◔
	Support sustainable product development	◕	●	○	◔
	Leverage generative design (buildings, parts, products)	●	●	◑	◑
	Accelerate sustainability innovation	◕	◑	◑	◑

Source: Gartner
795278_C

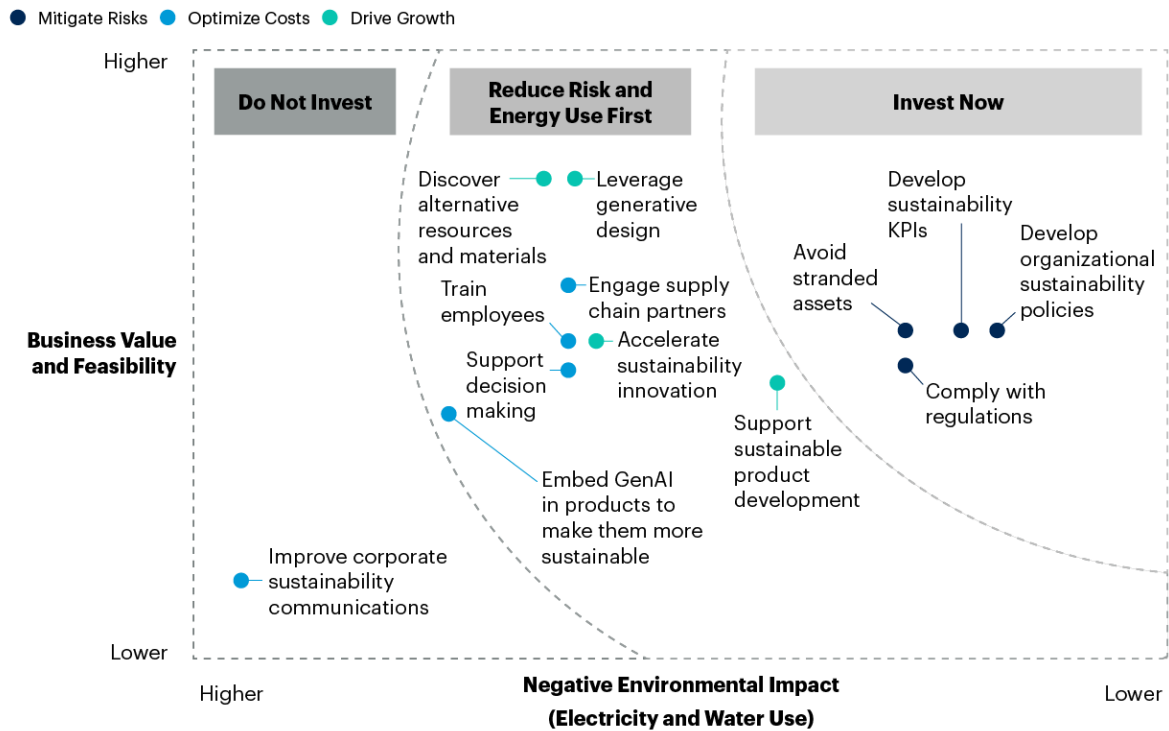**Gartner**

Prioritize Generative AI Pilots

Based on this assessment, executives should categorize generative AI use cases into three levels of priority (see Figure 2):

- **Invest now.** Invest in pilot projects immediately to advance use cases that will drive business value with a relatively low negative environmental impact.

- **Reduce risk and energy use first.** Lower intellectual property and proprietary data risk, and/or improve the energy efficiency of generative AI before proceeding.

- **Do not invest.** Avoid use cases that could damage business value or the environment.

Generative AI can help organizations accelerate positive sustainability outcomes, provided they leverage those use cases that create more value than they destroy.

Figure 2: Prioritization of Generative AI Use-Case Examples

Prioritization of Generative AI Use-Case Examples

Source: Gartner
795278_C

This article is from the Gartner Business Quarterly — 3Q23.

Evidence

[1] DeepMind Alum Wants to Use AI to Speed the Development of Green Materials, Bloomberg.

[2] The Decadal Plan for Semiconductors, Semiconductor Research Corporation.

[3] World Energy Outlook 2022 — Stated Policies Scenario, International Energy Agency.

[4] Maverick Research: Net Zero Will Stall Tech Growth and Innovation

[5] Gartner prediction based on Semiconductor Research Corporation's Decadal Plan Update and the International Energy Agency's World Energy Outlook 2022 — Stated Policies Scenario.

[6] [Singapore Hits Pause on Building New Data Centres; Short-Term Rents Up](#), The Business Times.

[7] [Singapore Authorities Invite Applications for New Data Centers](#), DCD.

[8] [Dutch Call a Halt to New Massive Data Centres, While Rules Are Worked Out](#), DutchNews.

[9] [Survey on Need for GHG Protocol Corporate Standards and Guidance Updates](#), Greenhouse Gas Protocol.

[10] [Energy and Climate](#), IBM.

[11] [Climate Change](#), Walmart.

[12] [Inside Salesforce's Clean Energy and Carbon Programs](#), Salesforce.