

Developing sustainable Gen Al

Gen AI has a significant environmental impact

Gen AI consumes vast quantities of resources and leaves notable financial and environmental footprints

Manufacturing carbon footprint	Model pre-training footprint	Model fine-tuning footprint	Model reinforcement learning footprint	Model inferencing and usage footprint	End-of-life footprint	
 Materials and hardware Around half of the GHG emissions from producing the graphics cards required for Gen Al operations come from the mining of rare earth elements Software development and optimization Training a model of size GPT-4 (1.76 trillion parameters) consumes between 51,772 and 62,319 MWh of electricity – enough to power at least 5,000 US homes for a year 		Ongoin • In 2022, 60% of Google's M	کی e-waste • Gen Al could create			
		and 62,319 MWh of electricity 5,000 US homes for a year	 with the remaining 40% to Just a single query on Chate times the energy a Google s Running an inference of 20 about 500 ml of water 	between 1.2 to 5.0 million metric tons of e-waste by 2030, which is around 1,000 times more e-waste than was produced in 2023		
	 The International Energy Age TWh in 2022 to 1,000 TWh Water consumption at IT in 					

Source: Capgemini Research Institute analysis, Harvard Business Review, "How to make generative AI greener," July 2023, IEA, Electricity 2024: Analysis and forecast to 2026, January 2024, Financial Times, "US tech groups' water consumption soars in 'data centre alley'," August 2024, Vox, "AI already uses as much energy as a small country. It's only the beginning," March 2024, OECD, "How much water does AI consume? The public deserves to know," November 2023, ARXIV, "The carbon footprint of machine learning training will plateau, then shrink," April 2022, Frontline Magazine, "E-waste from AI computers could 'escalate beyond control': study," October 2024.

 Gen AI's hardware requirements put a strain on natural resources and habitats Gen AI models are energy-hungry and water-thirsty

 Gen AI training and inferencing drive-up energy requirements in data centers Widespread Gen AI adoption will see e-waste levels shoot up

Gen AI is one of the reasons for the rise in GHG emissions in nearly half of the organizations

47%

say their organization's GHG emissions have increased in the past 12 months, by nearly **6%** on average

48%

agree that Gen AI is one of the reasons for increase in their organization's GHG emissions **42**%

say they have had to relook at their sustainability commitments due to Gen Al

The sustainability of Gen AI remains a low priority

Most organizations fail to measure the impact of Gen AI

- Only 12% of organizations measure environmental impact of Gen AI
- 74% say a lack of transparency from Gen AI providers makes measurement challenging
- Organizations look to the tech sector to drive sustainable Gen AI



Source: Capgemini Research Institute, Gen AI and Sustainability survey, August-September 2024, N = 2,000 executives from organizations that are Source: Capgemini Research Institute, Gen AI and Sustainability survey, August-September 2024, N = 1,767 executives from organizations that are currently not measuring their Gen AI footprint.

Sustainability isn't a consideration during Gen AI model evaluation

Percentage of executives ranking the below among the top five factors taken into consideration when selecting or building a Gen AI model



Source: Capgemini Research Institute, Gen AI and Sustainability survey, August-September 2024, N = 2,000 executives from organizations that are working on Gen AI initiatives.

Only **27%**

say they compare Gen AI models on the energy implications before selecting one

58%

say their organizations puts a premium on the cost and quality benefits of Gen AI, with environmental footprint only a minor consideration

Organizations are just beginning to incorporate sustainability measures throughout the Gen AI lifecycle

Organizations are at the early stages of reducing Gen AI's environmental impact

	Percentage of executives implementing/planning the following measures to reduce environmental footprint	Gen Al's						
Hardware- related measures	Ensuring/using energy-efficient hardware specifically designed for AI applications	13%		42%		37%		7%
	Ensuring recyclability of AI/Gen AI hardware in use	11%	26%		47%		16'	%
	Ensuring/implementing e-waste management for Gen AI hardware	5%	36%		4	7%	12	2%
Algorithm- related measures	Ensuring/using energy-efficient coding for Gen Al		37%	2	4%	31%	6 δ	8%
	Ensuring/employing efficient algorithms for training and operating Gen AI models	26	%	429	6	21	% 1 [·]	1%
Model architecture- related measures Opt	Fine-tuning models	9%	35%		41	1%	15	%
	Using smaller models	8%	4	8%		32%	13	3%
	Optimizing models* (with model compression, pruning, quantization, or knowledge distillation, etc.)	<mark>8%</mark> 13%	3	2%		52%)	
Data related measures	Processing data in batches to improve computational efficiency	14%		43%		35%	,	8%
	Minimizing the amount of data required for training Gen AI solutions	7% 1	5%	32%		47	7%	
Data center-related measures	Optimizing cooling systems in data centers		41%		25%	2	6%	9%
	Powering Gen AI infrastructure with renewable energy sources		35%	2	9%	269	%	9%
	Utilizing energy-efficient/green data centers	26	%	26%		4%	23%	,
Infrastructur e- related measures	Transitioning to green cloud architecture	[%] 14%	21%		44%		21%	6
	Utilizing edge computing for Gen Al	7%	29%		35%		29%	
Usage- related measures	Continuously monitoring and reporting Gen AI usage to identify/eliminate unnecessary use	25	%	23%		37%	15	5%
	Implementing query optimization techniques	10%	28%		25%		38%	
	Already implementing Planning to implement in next 12 months Planning to implement in next	t 24 mon	ths 🔳 N	∙ot planni	ng to imp	lement		

Source: Capgemini Research Institute, Gen AI and Sustainability survey, August-September 2024, N = 660 technology executives from organizations that are working on Gen AI initiatives.

A roadmap to responsible Gen AI for sustainable business value



Source: Capgemini Research Institute analysis.



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