The Hidden Cost of Your Next AI Query Explained

Anisia Hassan Ferreira Evangelista, March 2026

Artificial intelligence can advance environmental monitoring and research, but its infrastructure also carries significant energy and material costs. Systems-level analysis helps reveal the full environmental footprint of digital technologies.

What powers your prompt?

When you use ChatGPT to help write a paper, you probably don't think about the cobalt mined in the Congo for the chip that processed your request, or the water used to cool the data center. Every AI interaction leaves a physical mark, even if it is invisible to us. Professor Yuan Yao at Yale's School of the Environment studies what most AI users overlook: the entire life cycle of computing. This includes not only the electricity for data centers, but also the mining of rare earth minerals, the water needed to make semiconductors, and the e-waste that ends up in developing countries when hardware is thrown away. As she says, "Artificial Intelligence is advancing rapidly and holds the promise of fostering a more sustainable future. However, it also poses significant environmental challenges, such as the generation of greenhouse gases and waste from the manufacturing and disposal of chips and devices, as well as the impact associated with energy consumed during operations." Every day, we hear about ai's bright future, but what does it really cost us?

YALE

MacMillan Center

Regional Futures Lab

Anisia Hassan, a senior in Silliman College, studies Economics and Statistics & Data Science with an Energy Studies certificate. Raised in Brazil's Atlantic Rainforest region, she works on climate, health, and environmental economics projects. Fluent in Portuguese and English, she plans to work in renewable energy after graduation and enjoys Sephardic/Mizrahi history, cooking, and footvolley.

Can AI really help the environment?

Yao explains that AI can track deforestation in the Atlantic Rainforest almost in real time, help rice farmers reduce methane emissions, and identify species from a single water sample using environmental DNA. Her team uses AI to speed up life cycle assessments, which she says is "a task that is quite time-consuming using traditional methods." But the context matters enormously: Running these tools at Yale, powered by a grid actively transitioning to renewables, is fundamentally different from running them in Southeast Asia, where over 70% of the grid still depends on fossil fuels and there are no concrete plans to change that. In Malaysia alone, data center emissions could jump from 5.9 million tons of co_2 to 40 million tons by 2030. Hence, using AI to fix environmental issues on a coal-powered grid is a contradiction. As Yao puts it, "the tool is only as clean as the system it depends on."

So where does that leave us?

Yao co-leads the NSF-funded Carbon Connect initiative, a $12-million project that aims to cut the carbon footprint of computing by 45% in ten years. She says the real challenge is tracking every part of the process: not just carbon emissions, but also environmental degradation and human health and well-obeing. The people who pay the extended price: Congo miners who are exposed to toxic dust, West African recyclers who dismantle old hardware by hand, and families all over the world who lose water to server farms - are often unseen and rarely benefit.

The systemic cost is not just about the climate impact or the environmental damage and as AI CEOs' pledge that this technology will serve the planet there is a need to account for the full life cycle. When AI conservation tech is used in areas with fossil-fuel-heavy grids, or when environmental data is taken from communities without giving them ownership or benefits, it repeats old patterns of injustice. When people pay the price without the rewards, they will resist.

Yale Expert

[Yuan Yao]
Associate Professor of Industrial Ecology and Sustainable Systems
Director, Center for Industrial Ecology
Yale School of the Environment

Resources & Further Reading

- NSF Carbon Connect Initiative (Expeditions in Computing)
- Yale Center for Environmental Justice

Regional Futures Lab

Galvanizing the MacMillan Center's regional expertise and its international partnerships, the Regional Futures Lab documents, amplifies, visualizes, and publicizes impactful regional approaches to global threats. The Next Generation Futures project engages student researchers in the concept, offering them opportunities to explore and explain topics that reflect their academic interests and career aspirations.

MACMILLAN.YALE.EDU/
REGIONAL-FUTURES-LAB