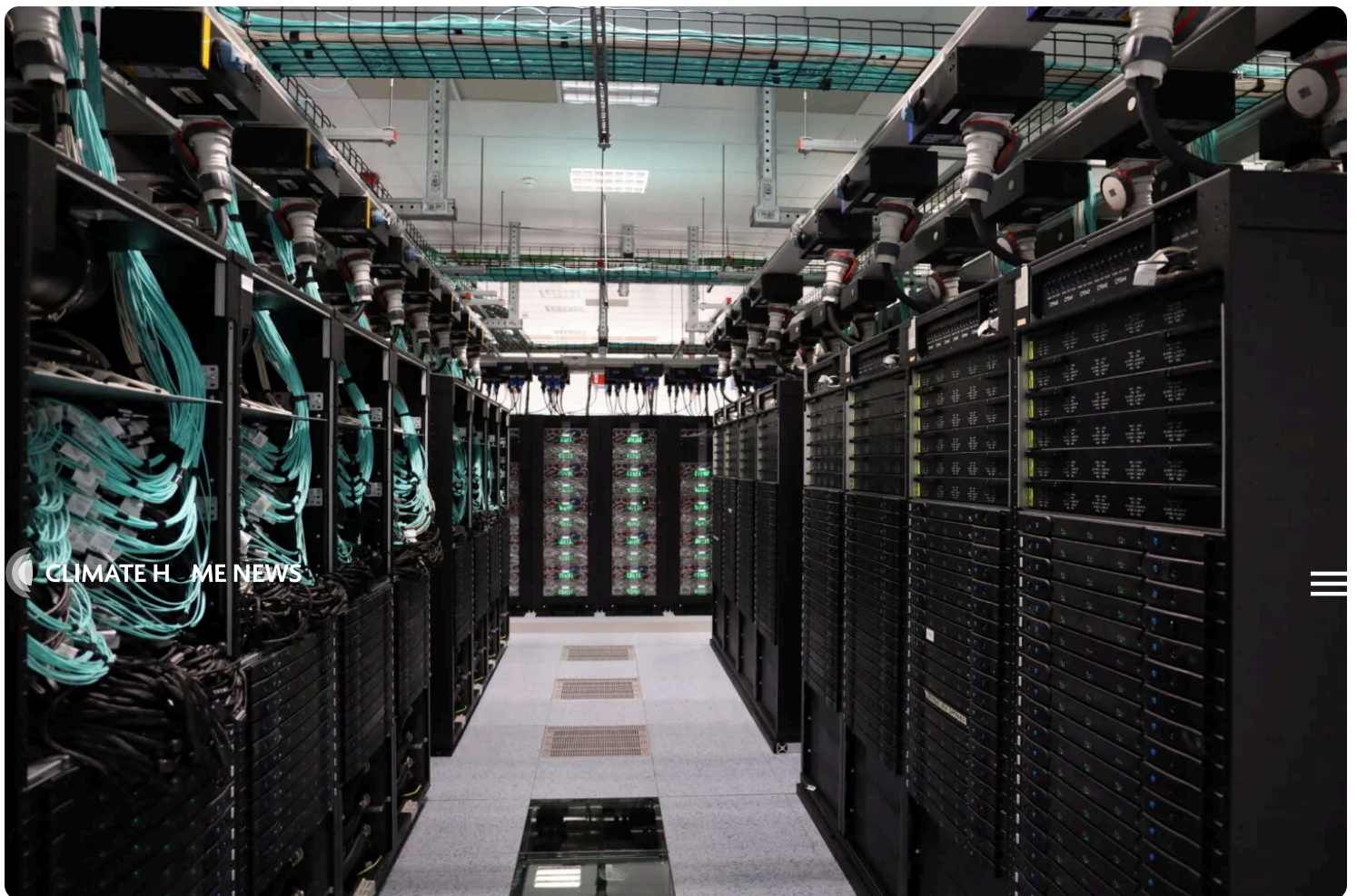


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# Using energy-hungry AI to detect climate tipping points is a paradox

AI-driven climate monitoring systems should operate according to defined carbon budgets and become more efficient in their use of energy and water



A view of the supercomputer at the European Centre for Medium-Range Weather Forecasts in Bologna, Italy, September 17, 2025. (Photo: REUTERS/Ali Withers)



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**As climate scientists warn that we are approaching irreversible tipping points in the Earth’s climate system, paradoxically the very technologies being deployed to detect these tipping points – often based on AI – are exacerbating the problem, via acceleration of the associated energy consumption.**

The UK’s much-celebrated £81-million (\$109-million) Forecasting Tipping Points programme involving 27 teams, led by the Advanced Research + Invention Agency (ARIA), represents a contemporary faith in technological salvation – yet it embodies a profound contradiction. The ARIA programme explicitly aims to “harness the laws of physics and artificial intelligence to pick up subtle early warning signs of tipping” through advanced modelling.

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We are deploying massive computational infrastructure to warn us of climate collapse while these same systems consume the energy and water resources needed to prevent or mitigate it. We are simultaneously

investing in computationally intensive AI systems to monitor whether we will cross irreversible climate tipping points, even as these same AI systems could fuel that transition.

## **The computational cost of monitoring**

Training a single large language model like GPT-3 consumed approximately 1,287 megawatt-hours of electricity, resulting in 552 metric tons of carbon dioxide – equivalent to driving 123 gasoline-powered cars for a year, according to a recent [study](#).

GPT-4 required roughly [50 times](#) more electricity. As the computational power needed for AI continues to double approximately every 100 days, the energy footprint of these systems is not static but is exponentially accelerating.

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And the environmental consequences of AI models extend far beyond electricity usage. Besides massive amounts of electricity (much of which is still fossil-fuel-based), such systems require advanced cooling that consumes enormous quantities of water, and sophisticated infrastructure that must be manufactured, transported, and deployed globally.

## **The water-energy nexus in climate-vulnerable regions**

A single data center can consume up to [5 million](#) gallons of drinking water per day – sufficient to supply thousands of households or farms. In the Phoenix area of the US alone, more than [58 data centers](#) consume an estimated 170 million gallons of drinking water daily for cooling.

The geographical distribution of this infrastructure matters profoundly as data centers requiring high rates of mechanical cooling are disproportionately located in water-stressed and socioeconomically vulnerable regions, particularly in Asia-Pacific and Africa.

At the same time, we are deploying AI-intensive early warning systems to monitor climate tipping points in regions like Greenland, the Arctic, and the Atlantic circulation system – regions already experiencing

catastrophic climate impacts. They represent thresholds that, once crossed, could trigger irreversible changes within decades, scientists have warned.

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Yet computational models and AI-driven early warning systems operate according to different temporal logics. They promise to provide warnings that enable future action, but they consume energy – and therefore contribute to emissions – in the present.

This is not merely a technical problem to be solved with renewable energy deployment; it reflects a fundamental misalignment between the urgency of climate tipping points and the gradualist assumptions embedded in technological solutions.

The carbon budget concept reveals that there is a cumulative effect on how emissions impact on temperature rise, with significant lags between atmospheric concentration and temperature impact. Every megawatt-hour consumed by AI systems training on climate models today directly reduces the available carbon budget for tomorrow – including the carbon budget available for the energy transition itself.

### **The governance void**

The deeper issue is that governance frameworks for AI development have completely decoupled from carbon budgets and tipping point timescales. UK AI regulation focuses on how much computing power AI systems use, but it does not require developers to ask: is this AI's carbon footprint small enough to fit within our carbon budget for preventing climate tipping points?

There is no mechanism requiring that AI infrastructure deployment decisions account for the specific carbon budgets associated with preventing different categories of tipping points.

Meanwhile, the energy transition itself – renewable capacity expansion, grid modernization, electrification of transport – requires computation and data management. If we allow unconstrained AI expansion, we risk

the perverse outcome in which computing infrastructure consumes the surplus renewable energy that could otherwise accelerate decarbonization, rather than enabling it.



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## **What would it mean to resolve the paradox?**

Resolving this paradox requires, for example, moving beyond the assumption that technological solutions can be determined in isolation from carbon constraints. It demands several interventions:

First, any AI-driven climate monitoring system must operate within an explicitly defined carbon budget that directly reflects the tipping-point timescale it aims to detect. If we are attempting to provide warnings about tipping points that could be triggered within 10-20 years, the AI system's carbon footprint must be evaluated against a corresponding carbon budget for that period.

Second, governance frameworks for AI development must explicitly incorporate climate-tipping point science, establishing threshold restrictions on computational intensity in relation to carbon budgets and renewable energy availability. This is not primarily a “sustainability” question; it is a justice and efficacy question.

Third, alternative models must be prioritized over the current trajectory toward ever-larger models. These should include approaches that integrate human expertise with AI in time-sensitive scenarios, carbon-aware model training, and using specialized processors matched to specific computational tasks rather than relying on universal energy-intensive systems.

## The deeper critique

The fundamental issue is that the energy-system tipping point paradox reflects a broader crisis in how wealthy nations approach climate governance. We have faith that innovation and science can solve fundamental contradictions, rather than confronting the structural need to constrain certain forms of energy consumption and wealth accumulation. We would rather invest £81 million in computational systems to detect tipping points than make the political decisions required to prevent them.

The positive tipping point for energy transition exists – renewable energy is now cheaper than fossil fuels, and deployment rates are accelerating. What we lack is not technological capacity but political will to rapidly decarbonize, as well as community participation.

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Deploying energy-intensive AI systems to monitor tipping points while simultaneously failing to deploy available renewable energy represents a kind of technological distraction from the actual political choices required.

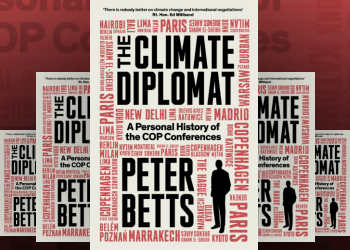
The paradox is thus also a warning: in the time remaining before irreversible tipping points are triggered, we must choose between building ever-more sophisticated systems to monitor climate collapse or deploying available resources – capital, energy, expertise, political attention – toward allaying the threat.

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