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## Eugenie Dugoua: Data centres are the factories of our modern lives

*Our lives today increasingly depend on data centres for simple activities like writing emails or watching videos. The arrival of large language models such as ChatGPT has caused a significant uptick in the use of digital services that also depend on data centres. **Eugenie Dugoua** discusses what this dependence means for the environment in a Q&A with **Anna Bevan** for LSE's IQ Podcast.*

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### Why are data centres so problematic for the environment?

In the past couple of years, we've seen a massive increase in the electricity consumed by data centres. We have to think of data centres as the factories of our modern lives, in a sense, because so many things we do on a daily basis—like checking emails or watching short videos on YouTube—rely on them.

More recently, with the advent of large language models (the so-called LLMs), such as ChatGPT or models developed by Anthropic—typically referred to as GenAI—there has been a significant uptick in the use of digital services that also depend on data centres. Their electricity consumption has increased far more rapidly than it did over the previous decade. The development of LLMs has played a major role in this.

It's difficult to assign exact figures to this, so we need to be cautious. But estimates suggest that data centres consume around one per cent of global electricity. In regions like the EU or the US, that figure is likely higher—possibly three or four per cent of total electricity consumption. That's a substantial amount just for data centres.

### How does this translate into carbon emissions?

That's a bit trickier. It depends on the electricity source. If a data centre is powered entirely by renewables, then emissions could be zero. But if it relies on a grid powered primarily by gas or coal, the emissions could be much higher. So, emissions vary significantly depending on location.

I've seen estimates suggesting that data centres are responsible for about one per cent of all energy-related greenhouse gas emissions—though that may not include sectors like agriculture. If we were to count all types of greenhouse gases, the share attributed to data centres would be slightly lower.

The ICT and AI sectors are increasingly being compared to aviation in terms of emissions. Aviation accounts for about three to four per cent of global emissions. While data centres aren't at that level yet, they are catching up quickly due to their rapid growth. And it's not just AI. A simple Google search, watching a YouTube video, or sending an email all rely on data centres. Even if AI isn't involved, the infrastructure is. One per cent might not sound huge, but it's not negligible either. Many industrial sectors emit more, but the growth rate of this sector means we need to start taking it seriously.

## Are you concerned about the impact of data centres on the environment?

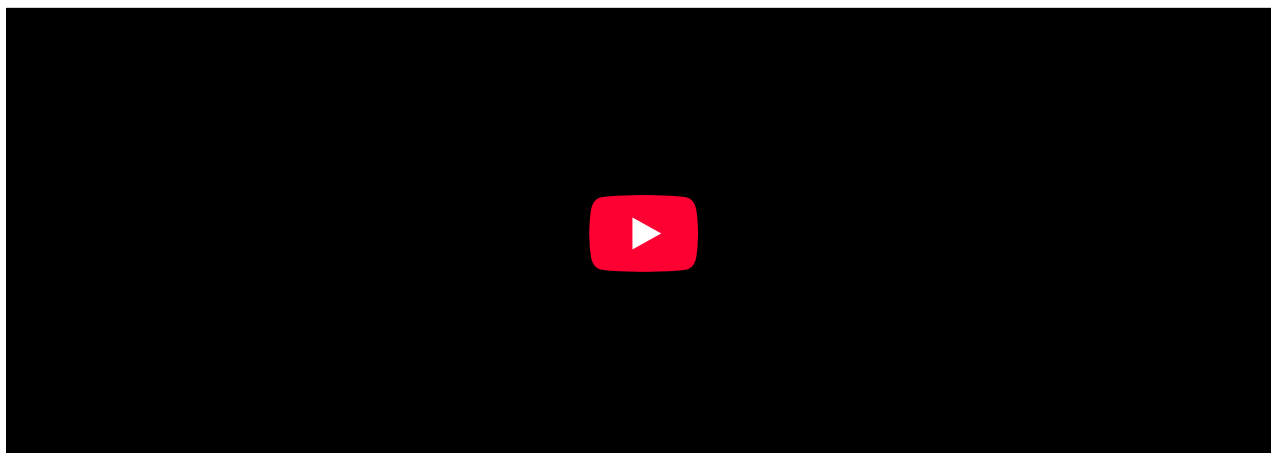
That's quite a personal question. I wouldn't say I'm concerned—at least not yet—because, as I said, it's still a small fraction. But the fact that the sector is growing so quickly is a good reason to pay attention and start thinking carefully about regulation.

What kind of regulation would be most effective? What are the best ways to ensure that this sector contributes to the net-zero targets that many governments have committed to? I'm concerned to the extent that there's nothing automatic about data centres becoming greener.

That said, some factors are working in our favour. Data centres have become increasingly energy-efficient over time. The gains have been remarkable. I recall figures suggesting that energy efficiency has improved by around 20 per cent per year over the past decade. Between 2008 and 2018, for instance, electricity use in one of Google's data centres rose by six per cent, while the number of compute requests increased nearly sixfold. So, while AI usage is scaling up and electricity demand is increasing, the demand isn't growing proportionally, because of these efficiency gains.

It's very expensive to operate data centres. Companies are incentivised to improve efficiency—the less electricity required for a given number of compute requests, the cheaper it is for them. At least when it comes to efficiency, incentives are aligned. But when it comes to using low- or zero-carbon energy, those incentives may not be in place. That's where broader environmental policies and regulations come in.

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## And what about water usage?

Water usage is another key issue. As you can imagine, data centres consist of many computers running side by side—and they generate a lot of heat. One of the main engineering challenges is how to cool them and a common cooling method involves water. In some cases, data centres use vast amounts of it. When they're located in areas with abundant water, that might not be a big issue. But in more arid regions, it's increasingly a concern.

For example, in the US state of Oregon, a major tech company established a data centre that reportedly uses around half of the local city's water supply. Residents have raised concerns, and scientists have pointed to falling aquifer levels. In response, companies are trying to demonstrate they're thinking proactively about water and energy efficiency. One approach is to rely on air cooling instead of water. But that tends to be far more energy-intensive, so you face a trade-off between electricity and water use.

It's interesting that companies like Google and Microsoft have reported a 20 per cent increase in water usage over the past few years. Many people suspect this is linked to the expansion of AI as a core business function. Climate change is also making water scarcity more severe in many regions.

## One data centre company, Equinix, used its excess heat in Paris to heat the Olympic swimming pool.

That's one way to reduce environmental impact—repurposing excess heat. Instead of releasing it into the air, some cities, like Stockholm and Helsingør, redistribute it via district heating networks. This helps substitute away heat that would otherwise be generated using fossil fuels.

In Paris, some Olympic pools are heated with excess heat from nearby data centres. These sorts of initiatives should absolutely be encouraged and incentivised.

## Is it realistic to expect all data centres to offset their water or energy use?

No, there's no silver bullet. There are many ways to reduce energy and water consumption, but the best solutions depend on geography and local climate.

One obvious strategy is to avoid placing data centres in deserts. Building them in cooler climates helps with natural cooling. Countries like Iceland—with abundant geothermal energy and cool temperatures—are ideal. Norway and Denmark also host many data centres that no longer need water cooling, as they can simply use outside air.

## Could data centres be designed differently to use fewer resources?

Yes—and I haven't even mentioned critical minerals. There's no shortage of ideas for making data centres less energy-hungry and less water-intensive.

One approach is reusing waste heat—for example, heating nearby homes. Some countries are exploring how to better integrate data centres into urban infrastructure. The Netherlands, for instance, had a brief moratorium on new data centres. One reason for rejecting a Google application was the failure to adequately reuse excess heat.

Although the moratorium has been lifted, the government now requires high environmental standards. They're more likely to approve a new data centre if it is designed to be environmentally responsible.

## Are there other incentives that could encourage renewable energy use?

Yes. Location plays a key role. Some data centres are now co-locating with solar, wind or even nuclear energy sources.

One fascinating example is Microsoft's deal in Pennsylvania to purchase power from the Three Mile Island site. This location, known for the worst nuclear incident in US history, is now being repurposed to provide zero-carbon electricity to a data centre.

The Inflation Reduction Act (IRA) is also helping. It incentivises the adoption of low-carbon energy sources, and some tech firms are already taking advantage of this to secure renewable electricity contracts.

Interestingly, the IRA channels a lot of funding to Republican-leaning areas—former coal mining regions, for instance. This bipartisan design makes the policy more politically resilient. It's harder to reverse a law that delivers tangible economic benefits across political divides.

## Should data centres be incentivised to go renewable?

Yes. Given the scale and growth rate of the industry, we need to think carefully about incentives. Many companies—Google and Microsoft among them—claim to be carbon-neutral. But often that's achieved via carbon offsets or renewable energy certificates.

Offsets might involve paying to prevent deforestation in South America, for example. But there's scepticism about whether those offsets are truly “additional.” Was the land ever really at risk of being deforested?

Economists are particularly critical of offset schemes. They question the transparency, permanence, and real impact of such claims. Until offset markets become more robust, we need better mechanisms to ensure genuine carbon reductions.

It's also difficult to know how much energy and water data centres actually use. Much of the data comes from what companies are willing to disclose in their environmental reports, which are inconsistent. If they don't share it, we don't know.

The first step is transparency. The EU has made progress here. As part of the EU Energy Efficiency Directive, the European Commission now requires mandatory disclosure of data centre energy performance. They're not yet mandating renewable usage or efficiency standards—but this is a start. With more data, the EU could introduce sustainability ratings and “name and shame” the worst performers, which could encourage progress through public pressure.

China is going further. They've set binding standards—not just on disclosure, but also on efficiency and renewable energy targets. The goal is 100 per cent renewable power for data centres by around 2033.

## Have there been other attempts to regulate and improve data centre efficiency?

So far, the EU has introduced mandatory disclosure requirements. China's policies are the most ambitious, with specific efficiency and renewable energy targets.

In the US, regulation is patchy and varies by state. California is leading, as usual. It may be one of the only states mandating disclosure of energy use in data centres. There's talk of setting renewable energy targets, but nothing concrete has been implemented yet.

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