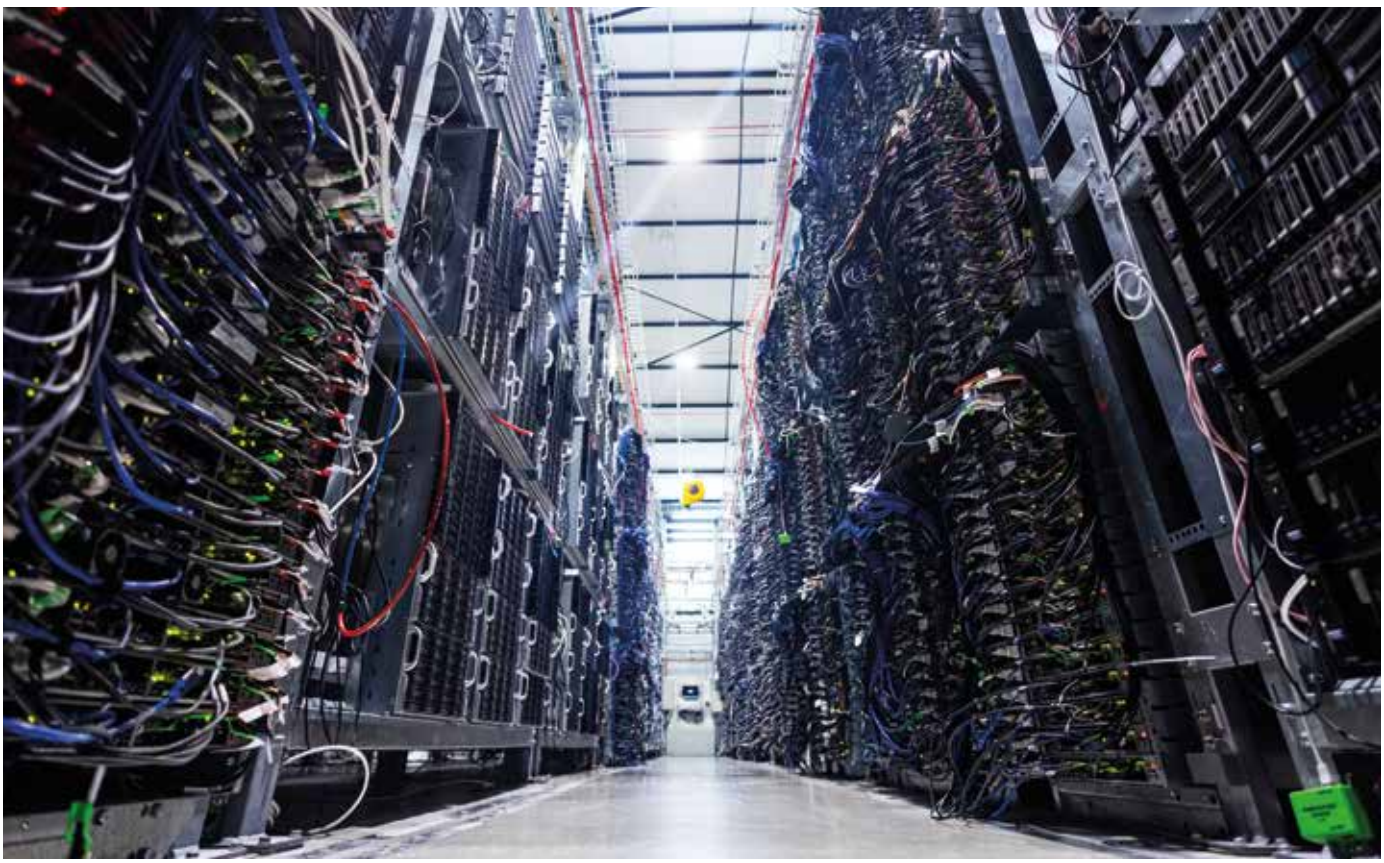


IMAGE: GETTY

Big Tech's big footprint

As power-hungry data centres proliferate, **Karen Lawrence** examines the impact of online activities on the material world

Wireless streaming, digital downloads and cloud storage might all sound light as air, but the data centres that underpin online services leave a heavy footprint on the physical environment. The recent boom in artificial intelligence (AI) has increased the energy demand and carbon emissions of computing at an alarming rate.

Simply put, a data centre is a physical building, or group of buildings, that houses the IT equipment needed for creating, delivering and maintaining applications and services online, and storing all the data needed to make this possible. While you might think of the internet as an ethereal, floating 'cloud', there are tangible and energy-hungry servers behind everything we do online, and these need to be housed somewhere. Data centres have been around since the advent of digital computing but, while they once housed a single mainframe computer, they have now evolved into mega-warehouses full of globally networked servers that typically consume as much electricity as 100,000 households.

London is a major data centre market for Europe, and the UK is home to more than 500 data centres. Only the USA (the world leader) and Germany have more. The government recently outlined its ambition for the UK to become an 'AI superpower', envisioning AI growth zones and billions of pounds of private investment in data centres.

But data storage requires phenomenal energy use. At a time ➳

➤➤ when other industries are focused on making energy efficiencies and reducing carbon emissions, what does this boom in digital power demand mean for the National Grid? And where does our own online activity fit into the global picture?

Worse than aviation

Digital and online services are a crucial part of modern life. As our reliance on technology continues to grow, so too does our need for data centres.

But this comes with a large environmental footprint. Around 40% of the electricity consumed by data centres is used for computing processes; another 40% is used for cooling, which also requires a lot of water. The remaining 20% is used by other associated IT equipment.

Data Centre & Network News magazine reported that data centres are responsible for producing around 3% of worldwide carbon dioxide emissions, which is more than global aviation (around 2.5%).

AI tools such as ChatGPT, Microsoft CoPilot and Google Gemini use far more energy than non-AI online tools, resulting in a surge in energy consumption. The International Energy Agency reported that data centres accounted for around 1.5% of the world's electricity consumption in 2024, or 415 terawatt-hours (TWh). It expects this will more than double to around 945TWh by 2030. That's around three times the annual electricity consumption of the UK.

This casts doubt on the ability of big tech companies to achieve their public climate goals. Microsoft has previously pledged to become carbon negative, water positive, zero waste, and to protect ecosystems by 2030. However, the company is a major investor in OpenAI, the maker of ChatGPT, and has positioned AI tools at the heart of its product offering. Microsoft's latest sustainability report, for 2023, revealed a 30% increase in emissions since 2020 due to data centre expansion.

Similarly, Google reported that its 2023 greenhouse gas (GHG) emissions were almost 50% higher than those in 2019, largely due to the extra energy used by data centres. Google has an ambitious plan to achieve net zero (ie to release no more greenhouse gases into the air than it removes) by 2030, but its emissions are currently heading in the wrong direction.

And this self-reported data may not tell the whole story. A 2024 analysis by *The Guardian* suggested that from 2020 to 2022 the real emissions from the in-house, company-owned data centres of Apple, Google, Meta and Microsoft were probably more than seven times higher than officially reported.

Dr Mike Hazas, professor of human-computer interaction at Uppsala University, Sweden, says that there is a lack of transparency from tech companies around data centres and AI energy consumption. He predicts that we're likely to see energy demand increase the more people get comfortable with AI processes, saying that 'as a process becomes more efficient, more people use it'.

AI can be immensely useful, completing certain tasks much more efficiently than humans. Andy Davies, of Wholegrain Digital (an agency that specialises in digital sustainability), explained that it is 'almost impossible to benefit from AI without increasing

EMISSIONS WERE PROBABLY MORE THAN SEVEN TIMES HIGHER THAN REPORTED

energy use, but task-specific "Narrow AI" – for example, for medical research – uses a limited dataset, which is very different from generative AI'.

When used responsibly and in a targeted way, the associated energy and carbon costs may be easily justified. But we should use AI software knowingly, where it's needed, and understand the additional costs.

Powering up the UK

According to research from DC Byte, more than 4GW of data centre capacity is under construction or in development in Britain, compared with 1.5GW currently operating.

Amazon recently announced plans to invest £8bn over the next five years building new UK data centres and maintaining those it already has. Google is spending £1bn on a new 133,500sq m facility in Hertfordshire, and Microsoft has committed to £2.5bn of investment in the next three years, more than doubling its data centre footprint in this country.

In 2024, the CEO of the National Grid said that demand from commercial data centres will increase six-fold in the next 10 years, alongside increased consumption from the electrification of homes, transport and industry.

In Ireland, the energy used by data centres rose by 400% between 2015 and 2023, accounting for 21% of the country's total metered electricity use. Pressure on the electricity grid reached such a level that the country placed a moratorium on new data centres being built in Dublin until 2028.

Singapore imposed a moratorium in 2019 to moderate the growth of new data centres, and the Netherlands also ordered a temporary ban in Amsterdam from 2019. Both countries have since lifted the bans but have introduced greater restrictions on new developments, requiring data centres to be more energy efficient.

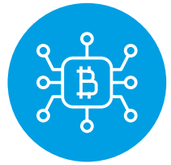
A 2024 *Washington Post* article reported that huge areas of the USA are at risk of running short of power as electricity-hungry data centres pop up around the country. Tech companies are investing in their own nuclear plants to power new data centres and reduce their reliance on the public supply. Microsoft has signed a deal to recommission the Three Mile Island nuclear site in Pennsylvania, while both Google and Amazon Web Services are investing in new small modular reactors to meet their anticipated energy needs.

On a global level, as more and larger data centres are needed, the UK may be well placed to build them. Our power grid is less polluting than many, with a lower carbon intensity due to the growth of renewable energy sources such as wind farms, and the phasing out of coal-fired power stations.

At the same time, data centre energy use is a very local issue. It's much quicker to build a data centre than to add electricity generation capacity, so planning authorities must consider the impact on the grid when approving new developments. As households switch to electric vehicles and home heating, we must ensure that renewable energy supply keeps pace with demand from both data centres and consumers alike. ●

ENERGY-HUNGRY DIGITAL ACTIVITY

Some online activities use a lot more energy than others. For context the UK power grid uses around 320TWh a year



Crypto

Cryptocurrency mining accounts for 0.4% of global electricity use. Bitcoin, the largest cryptocurrency, is based on blockchain technology; computers perform millions of computations to ensure the network's security and receive 'coins'. Bitcoin mining uses around 175TWh a year, with a carbon footprint of 95m tonnes.

AI

Research suggests an AI-assisted Google search uses around 3Wh, or 10 times more energy than a standard keyword search. The AI generation of music, photos, and videos requires much more. If every standard Google search became an AI interaction, Google's AI alone could consume as much as 29TWh per year.

Gaming

Online gaming uses significantly more energy than offline, as it requires constant data transmission; the latest high-performance consoles use more power than older models. A 2019 estimate suggested that US online gaming alone consumed up to 27TWh of electricity, producing as much as 9.9m tonnes of carbon dioxide emissions.

Video streaming

An hour of video streaming typically uses 55-80Wh. With 300m subscribers worldwide, Netflix alone is estimated to consume 94TWh annually. Individual consumption depends on the device, resolution and network connection. A 50-inch LED TV consumes 100 times more electricity than a smartphone and five times more than a laptop.

Social media

TikTok is the most energy-intensive of the popular social media apps. Due to its non-stop video feed, an hour on TikTok produces around 57g of GHG emissions. Other apps are focusing on video as well. But with 3bn users worldwide, Facebook (38g/hr), generates more than 1m tonnes of carbon emissions a year.

USING TECHNOLOGY SUSTAINABLY

KAREN LAWRENCE, WHICH? SENIOR RESEARCHER

Online services such as banking, shopping, search engines and entertainment are here to stay. As we move further into the digital era, it's important that we balance this against the everyday energy needs of our homes, businesses and transport.

As individual consumers, our digital footprints are minuscule. Streaming an hour of Netflix produces less carbon dioxide than boiling a kettle. But we need big companies to be transparent about the environmental impact of the online services we use, so we can make informed choices.

You might choose not to use an AI-assisted search or chatbot if you were warned that it used 10 times the energy of an alternative option, for example, especially if the results aren't particularly helpful anyway.

Felippa Amanta, a researcher at Oxford University's Environmental Change Institute, has found that AI is already changing us and our habits – according to her research, 'AI integration is leading to overconsumption'. She explains that 'we are seeing unintended consequences, where initial AI-led efficiency savings are later undone as consumers use or buy more of a product or service'. This is known as the 'rebound effect'.

As consumers, we can be more mindful of the impact of the online services we use, but tech companies must do much more to help. We need energy-efficient data centres that use less electricity and water, a rapid switch to low-carbon electricity supplies to power them, and greater transparency about the real-world impacts.