Gauging the climate threats to data centre investments

Data centres have a unique set of conditions which make their decarbonisation extra challenging.

By **Conor Hubert**

Data centres are uniquely vulnerable to climate change as they can withstand close to no variation in conditions to function effectively.

Their connectivity needs, huge energy consumption and high heat output also add a very specific transition risk to their profile – it is particularly challenging to shift them to any kind of sustainable business model.

The EDHEC Climate Institute's ClimaTech research project provides investors with a wealth of data to assess the climate risks to this sector and the wider global infrastructure universe.

A UNIQUE AND EVOLVING CLIMATE RISK

Investors need to consider many types of risk exposure when making portfolio decisions and today, one of the considerations at the top of their agenda is climate risk. Historically, this had been hard to quantify, and we aim to bridge that gap, merging cutting-edge research with rigorous academic analysis to produce financial insights.

The ClimaTech project presents a comprehensive matrix to give stakeholders throughout the infrastructure value chain insights into climate-related risks. We evaluate the effectiveness of transition and resilience strategies for the sector.

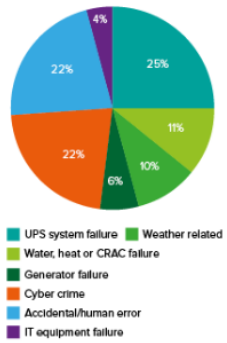
Additionally, the ClimaTech database is a comprehensive tool that combines a structured classification of infrastructure assets with rigorous, evidence-based assessments. It's the largest global repository of decarbonisation and resilience measures tailored for infrastructure and includes a listing of the most effective strategies and technologies, accompanied by expert analysis and quantified indicators.

The data infrastructure sector is uniquely vulnerable – something that we highlight in our ClimaTech risk assessments – given its needs for an uninterrupted and massive supply of electricity, constant need for water for cooling, and its interdependency on other aspects of vulnerable infrastructure.

THE PHYSICAL RISKS THREATENING THE SECTOR

Climate change brings a raft of physical risks to the sector (see Figure 2), including extreme heat, wildfires, floods and storms, with risk levels varying strongly by geography and site location. Any one of these can directly trigger outages and costly downtime, but they also threaten the connectivity, power and water systems that data centres rely on, exposing them to climate-change-driven events happening entirely remotely from their own location.

Figure 2: Causes of data centre failures (potential climate linked causes in green)



Source: Ponemon Institute

Our research estimates that, under severe "hot-house" scenarios without adaptation, extreme weather-related physical risk can reach around 54% of asset value at the portfolio level, making protection of data infrastructure economically critical.

Without proactive resilience measures, data infrastructure owners face the prospect of substantial value erosion from more frequent and severe climate-driven events.

HEAT AND COOLING STRESS...

Rising average temperatures and more frequent heatwaves increase cooling loads, raising the likelihood of server overheating, equipment failure and thermal shutdowns.

Higher cooling demand also fuels energy use and operating costs, while water-intensive cooling is increasingly constrained by climate-driven water scarcity.

... BUT LITTLE MARGIN FOR ERROR

It's remarkable how much variation in temperature and humidity people can casually tolerate, certainly for short periods of time. UK guidelines for office temperatures are as broad as 16-30°C , and even down to 13°C in locations where physical exertion is required. Automated facilities have even more impressive tolerances – industrial robots can operate in ambient temperatures ranging from -29°C in winter to above 38°C in summer.

Not so the cutting-edge electronics required to store and process the exabytes (billions of gigabytes) of data that hyperscale centres are required to cope with. Indeed, data centres have the most strict and precise environmental requirements. The acceptable operating temperature range is narrow – just 18-27°C, according to the American Society of Heating, Refrigerating and Air-Conditioning Engineers, widely considered the gold standard for data centre heat guidelines.

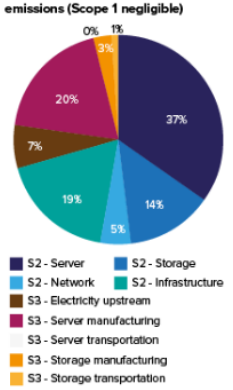
The contrast is striking: office requirements have a practical range of up to 17°C while robot warehouses can operate across a 67°C+ band. Data centres, meanwhile, sit in the opposite tail; they require precision control within a 9-12°C range. It's worth noting that they also have strict humidity bands and require clean filtered air.

That means even small variations in ambient temperature can have catastrophic results – quite the Achilles heel in a world experiencing extreme heat events of growing frequency and duration.

TRANSITION RISKS FACING THESE ASSETS

Transition risks expose data infrastructure to regulatory, market, technological and reputational pressures that can significantly alter asset values (see Figure 3). These risks arise from the global shift to a low-carbon and climate-resilient economy. Our research signals plausible asset value losses of up to 30% if emissions are not reduced.

Figure 3: Data centre operational emissions (Scope 1 negligible)



Source: iScience Vol 28, Issue 1

Because data infrastructure emissions are expected to grow with rapid sector expansion, the transition risk will increase unless emissions are cut in line with tightening climate policy.

Global data infrastructure currently accounts for about 1.5-4% of global greenhouse gas emissions, with emissions concentrated in electricity use (Scope 2). Rapid advances in energy-efficient hardware, cooling and software optimisation risk making older, less efficient data centres commercially obsolete or 'stranded', as clients and regulators favour low-carbon, high-efficiency platforms. While that's good for the environment operationally, it has high up-front embodied carbon costs and is yet another climate risk investors need to bear in mind when assessing asset vulnerability.

That's particularly challenging for data centres, given their massive energy requirements. Rising electricity demand from digitalisation and artificial intelligence is already under scrutiny – substantial increases in data centre energy use could trigger stricter caps, higher tariffs or carbon-related charges on intensive users.

Their cooling requirements also give them a unique climate-risk profile given their need for another resource that's becoming even more precious in a hotter, drier world: water.

IT'S NOT GOOD TO BE THIRSTY IN A DROUGHT

There's been a wealth of bad press about the amount of water new data centres are drawing to cool their operations, particularly those needed to fuel the

Figure 4: Evolution of the carbon tax for the various scenarios in the Oxford Economics model, expressed as a fraction of the same-time GDP

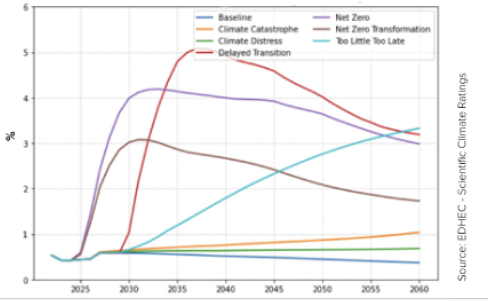
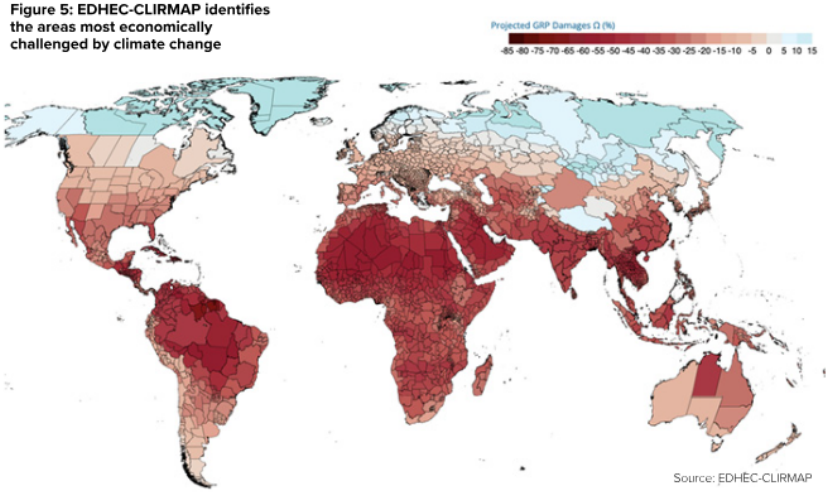


Figure 5: EDHEC-CLIRMAP identifies the areas most economically challenged by climate change



Source: EDHEC-CLIRMAP

demand for AI processing power. A recent UK report noted a fourfold rise in data centre water use since 2021. That's only going to grow: *the Guardian* reports that the largest tech companies are preparing to almost double their data centre assets as demand surges.

However, due to the selection of cost-effective areas in terms of development, many of data centres are being constructed in regions where water scarcity is already a concern, putting operators in direct competition with households, industry and agriculture in areas where droughts are intensifying. (EDHEC Climate Institute's CLIRMAP project shows many of these areas are the most highly threatened by the impacts of climate change, with water shortage due to rising temperatures among a raft of concerns, see Figure 5).

Climate change is projected to make those locations hotter and drier, amplifying both physical scarcity and political pressure over how water is allocated, and raising the spectre of enforced curtailment or shutdowns during drought emergencies.

Local authorities and communities are already challenging new data centre developments, and responses are likely to include tighter abstraction limits, higher tariffs, stricter permitting and requirements for water-positive or recycled water operation, all of which add to costs.

In our ClimaTech focus on the sector, we look at opportunities for data centre assets to reduce their transition impacts. Several of the most material decarbonisation and physical risk strategies, for example, reduce the need for water by cutting overall cooling demand. These include switching to natural and evaporative cooling, optimising operational practices and locating new centres in cooler climates.

These measures lower energy use and emissions from cooling, but also reduce reliance on resource-intensive mechanical systems. This enables them to mitigate transition risk, improve resilience to extreme heat, and ease pressure on local water supplies. The latter also supports the capacity to respond to wildfires in stressed regions.

CONCLUSION

In summary: climate change is bringing challenges for the data infrastructure sector in the form of direct physical impacts and the cost of adapting to mitigate them. There are also stranding risks when assets cannot comply with legislation to become greener.

This sector is particularly vulnerable given its needs for an uninterrupted and massive supply of electricity, constant need for water, and interdependency on other aspects of vulnerable infrastructure.

The ClimaTech project demonstrates to investors what strategies work to reduce these risks to their assets. ■

Conor Hubert is a sustainability research engineer at the EDHEC Climate Institute