

Ramboll's guide to developing sustainable data centres

Data centres are important, mission critical facilities essential to many aspects of modern life – and their scope continues to expand. Consequently, electricity demand from data centres is growing rapidly, set to reach 130GW by 2028 according to BCG, comprising 3% of total global consumption. With this continued growth comes increased concern over the impact on the environment.

If this is not addressed, this necessary capacity increase in data centres may be frustrated through regulatory barriers and negative public reaction. Ramboll's first-of-its-kind report addresses each aspect of these concerns directly, providing a holistic, detailed, and multi-pronged approach to reducing the climate impact of data centres.

For the next generation of data centres to be sustainable and net zero, several key aspects of their construction and operation must be changed in line with these principles.

Our white paper examines each aspect in turn and gives data centre operators actionable steps to transform their data centres to minimise carbon and environmental impact.

01

Energy

The total electricity demand from data centres is forecast to grow by 16% annually to 2028. AI workloads are the fastest growing segment, accounting for 60% of data centre energy demand growth from 2023 to 2028.

➤ **Make data centres more energy efficient**

Energy efficient design can reduce the energy consumption of a data centre throughout its entire lifecycle. Alternative cooling solutions, such as liquid cooling, hot/cold aisle containment, and free air cooling can also reduce a data centre's energy consumption.

02

Water

Water usage effectiveness (WUE) quantifies the amount of water used in cooling annually relative to the energy consumed. This is expressed as litres per kilowatt-hour (L/kWh) and a lower WUE value indicates better water efficiency.

Most data centres use water-based cooling which is highly water intensive. This has increased in use to accommodate higher rack power densities. This can cause issues in water-stressed areas and contribute to public outcry at the growth of data centres, which could place roadblocks to building the vital capacity needed to meet demand.

➤ **Make data centres water neutral**

Water consumption requirements in a data centre depends on the cooling, humidification and ventilation strategies in use. Water efficiency strategies can minimise the water consumption of data centres in their operation phase.

To work towards water neutrality to conserve water resources, data centre operators should use cooling systems that minimise water usage, recycle cooling water and use greywater for non-potable applications, and collect and use rainwater for cooling and other facility needs.

03

Emissions

Using fossil fuels to power data centres produces more carbon compared to other methods. For example, coal-powered data centres produce 975gCO₂e /kWh, and oil-powered data centres produce 775gCO₂e /kWh. Data centres powered by natural gas produce up to 550gCO₂e /kWh.

> Use renewable energy to power data centres

The amount of carbon that a data centre produces depends on the energy mix used to power it. Renewable energy significantly reduces the amount of carbon dioxide produced in data centre operation. Wind powered data centres produce the lowest amount of carbon, only 5gCO₂e /kWh. Switching to renewable energy is one key way to reduce these emissions.

04

Biodiversity

Data centres can contribute to biodiversity loss directly and indirectly, such as through land use change, habitat fragmentation, resource extraction, and pollution. Poorly planned landscaping may also introduce invasive species, further disrupting local ecosystems.

> Improve site selection and implement nature-based solutions

It is vital to integrate biodiversity considerations into planning, design, construction, and operation of data centres to minimise the negative impact on ecosystems, protect existing natural habitats, and promote diversity of species within and around the data centres.

Data centre developers should implement early-stage ecological surveys to identify protected species, habitats, and ecological corridors, as well as engage landscape architects early in the process to influence site layouts. Through these measures, data centres can lead to a biodiversity net gain and improve ecosystems.

05

Circularity

Continuous extraction means finite resources become increasingly scarce leading to higher costs and supply chain vulnerabilities. Much of the electronic equipment used in data centres is high in rare earth elements and precious metals, particularly gold, silver, platinum, tantalum, lithium, cobalt, copper and nickel. Several of these finite elements are at critical depletion levels due to limited supply, geopolitical issues, and excess demand resulting in increased costs.

> Implement circularity and reuse excess heat for district heating

Data centres can further minimise their environmental impact by implementing circularity practices. The proposed circularity benchmark for data centres is that all materials are reused, reusable or recyclable, with zero output to landfill or incineration.

“There are economic benefits for data centres owners if they focus on circular practices. For instance, the sole physical byproduct of data centre energy consumption is heat, which has historically been unused and released to atmosphere. Data centres are in an excellent position to export what would otherwise be wasted energy.”

Ed Ansett,

Global Director of Technology and Innovation, Ramboll

Ready to develop next generation, sustainable data centres?

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