What does a data center's life cycle look like?

Introduction

Data centers have become the invisible pillars of our digital lives. Each time we send an email, visit a website, or store a photo in the cloud, data centers are there operating behind the scenes. The computing and storage power of all those internet activities relies on physical infrastructure whose construction and operation require energy, materials, and natural resources.

As part of its efforts to create a more sustainable digital sector, Data4 uses scientific and transparent means to measure the environmental footprint of each of its data centers. In the interest of transparency, and to inspire its broader ecosystem, Data4 is now unveiling and publishing for the first time at the global level the full environmental profile of a data center with 5 megawatts of IT capacity (5 MW IT) located at the company's campus in Marcoussis, France (near Paris).

The environmental analysis relied on the leading international methodology, known as life cycle assessment (LCA).

What is life cycle assessment?

LCA is an international methodology (ISO standards 14040 and 14044) for measuring the environmental impacts of a product or service throughout its lifespan.

LCA accounts for **all aspects**:

Construction

Extraction and production of materials (concrete, steel, wiring, technical equipment, etc.).

Transport and installation

The transport and installation of equipment.

Operations

Consumption of energy and water, maintenance of systems.

End-of-life

Demolition, waste management, recycling of metals and other materials.

The LCA approach offers a comprehensive view that goes beyond just electricity consumption, a factor people often focus on. It helps companies avoid simply shifting their impacts from one category to another and orients their decision-making towards the most environmentally friendly solutions.

The main insights from this LCA

Carbon footprint

Data centers mainly contribute to global warming in two ways:

• The electricity they consume: if it doesn't come from carbon-free sources, that electricity consumption will generate significant CO_2 emissions.

• The materials used in their construction: particularly concrete, whose production requires lots of water, sand, and energy.

Over 20 years, the carbon footprint of a 5-MW IT data center is estimated to be **12.6 million kg CO_2 eq**, about equal to the carbon emissions of **just under 300 French people**.

The operations phase accounts for 48% of those emissions (consumption of electricity by the cooling systems, UPSes, and security systems), while the DC's construction accounts for 39%, particularly linked to the production of the concrete and steel used.

Water resources

People often believe that data centers are constantly pumping water to cool their equipment.

Actually, data centers' direct water consumption is minimal, representing less than 0.1% of their total consumption. The amount is equivalent to the annual water needs of just 12 people.

Most of the water extraction tied to a data center's life cycle is indirect consumption: 57% tied to electricity generation and 36% tied to the extraction and transformation of materials.

As such, choosing a low-carbon energy source that consumes little water makes a big difference.

Mineral and metal resources

A data center's construction and operations require mineral and metal resources equivalent to the construction of **12 km of railway**.

These resources include copper (wiring, transformers), aluminium, and rare earths found in batteries and uninterruptible power supplies (UPSes).

Data4's eco-design initiatives

LCA is more than just a diagnostic: it enables effective action.

With life cycle assessment, Data4 systematically measures its progress towards reducing its environmental impacts. In light of its efforts for the eco-friendly design of its data centers, Data4 projects that it will reduce by 38% the carbon footprint of each new MW IT constructed by 2030, setting a positive example for players in the digital sector.

Here are some examples of the major initiatives already launched to reduce the impact of Data4's infrastructure:

Low-carbon construction

Use of low-carbon concrete and innovative prefabricated slabs, reducing by half the volumes of concrete required. Since 2022, this initiative has led to a 13% decrease in the carbon footprint per MW of capacity constructed.

Obtaining BREEAM* certification

For all our new buildings.

Energy optimisation

A 9% reduction in the power usage effectiveness (PUE) between 2021 and 2024 thanks to real-time control of energy consumption and more efficient cooling systems.

Renewable energy

The signing of power purchase agreements (PPAs) to secure supplies of carbon-free electricity.

Alternative fuels

Gradual adoption of hydrotreated vegetable oil (HVO) fuel for generators, reducing their emissions by 70% compared to the use of diesel.

Responsible procurement policy

Integration of corporate social responsibility (CSR) criteria into selection at all levels of Data4's supply chain.

Repurposing of heat

Data4 is running an experiment with Paris-Saclay University to create a "biocircular" data center reusing the heat produced by its servers to cultivate algae, which can then be transformed into food, cosmetics, and biomass for fuel.

Low direct consumption of water

Data4 does not use cooling towers or adiabatic cooling systems. The result is a water usage effectiveness (WUE) of 0.039 L/kWh IT, which is 25 times lower than the industry average.

*BREEAM (Building Research Establishment Environmental Assessment Method) is a method for assessing environmental criteria. It is used to measure and certify the environmental performance of buildings.

Why is this approach essential?

Data centers are often scrutinised for their energy consumption. However, **thanks to LCA, Data4 has shown that the reality is more complex and there are powerful opportunities for reducing the overall environmental footprint**.
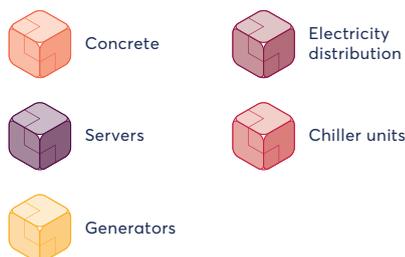
Life cycle assessment helps a company:

• **Prioritise the right actions**, like reducing the amount of concrete used, optimising cooling, and recycling metals.

• **Be transparent**, using reliable scientific data.

• **Contribute to the environmental transition of the economy**, supporting the growth of the digital sector while conserving the planet's resources.

Data4 has served as a pioneer by systematically integrating LCA into its data center projects and by sharing the results with its entire ecosystem.

LCA aggregates and analyses all of the direct impacts (scope 1) and indirect impacts (scope 2) of all the equipment and materials used to build, maintain, and operate a data center.

Conclusion

The LCA of the 5-MW IT data center illustrates a core belief held by DATA4: **measuring impacts brings the knowledge of where to take action.**

To summarise:

• Taking action on electricity consumption is key. If the energy used is carbon-free, that simultaneously reduces the data center's carbon footprint and water footprint. Additionally, every kWh of energy conserved reduces pressure on resources, particularly water resources.

• It is equally crucial to take action in the construction phase: this can include avoiding the use of scarce resources or opting for recycled materials, selecting low-carbon materials, and developing a streamlined, optimised design to limit the amount of equipment required.

A data center designed and built to professional standards can fit harmoniously into its local community, with minimised water consumption. The major components of a DC's environmental impact are largely determined upstream of the facility itself and can be reduced by choosing sustainable electricity and eco-friendly materials.

Every bit of progress in these areas brings the digital sector closer to carbon neutrality.

> **A sustainable digital sector can't be created through rules and policies alone: it must be built. At Data4, that sustainable digital sector is being built brick by brick, one data center after another, relying on science and innovation, but also on a whole host of technical partners that make up the digital value chain.**

Simplified representation of a data center

Major components that make up a data center

- Concrete
- Electricity distribution
- Servers
- Chiller units
- Generators

DATA CENTER