Data Center Revolution

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As the world becomes increasingly interconnected, data centers are rising to prominence like never before.

Bringing together multiple disciplines/expertise, in the most simplistic of terms, a data center is real estate infrastructure, typically a building or a dedicated space within a building, housing IT systems that enable clients to store, process and share data.

Originating first in the 1950s, data centers as we recognize them today first sprang to life in the mid-1990s, in step with the internet boom. The mid-2000s saw a sharp acceleration of digital infrastructure demand, multiplying cloud computing sites, and thus the need for more data centers. Looking to the future, the democratization of High Performance Computing (HPC) and AI, in particular, are expected to constitute a formidable tailwind for the sector and to have a highly transformative impact on the entire ecosystem.

Eric Benoist, **Ivan Pavlovic**, **Roméo Yombo-Nguitongo** and **Thierry Cherel** share their insights into the future of this complex asset class.

What are the defining features of a data center?

Data centers sit at a juncture between real estate, infrastructure, telecommunications, and energy, positioning them as a distinct, dynamic, and evolving asset class in today's economy.

Roméo Yombo-Nguitongo

> ***Data centers are a distinct, dynamic, and evolving asset class, sitting at a juncture between real estate, telecommunications, and energy.***

Due to the infrastructure that makes up a data center, they require space – they often resemble large warehouse. The weight of all the IT equipment also necessitates a distinct structure to accommodate the rack servers. To host and run the IT equipment, data centers need network connectivity and a reliable supply of power and water, as well as technical equipment such as the electrical equipment (to manage entering power) and the cooling equipment (to manage waste heat generated).

They also need to ensure 24/7 functionality - and to do this many data center operators double their power and cooling capacities.

How is the market structured?

The market, in fact, is highly segmented – by ownership, use, size, power density and strategic location.

Enterprise data centers are owned and operated by the companies that use them (think: big tech, telecoms, social media and financial institutions), while outsourced data centers are owned by public cloud operators, colocation providers, wholesale operators or investors.
For security reasons, most data centers are made to be leased to only one tenant. Where wholesale caters to large clients that require significant space and power to run their businesses, the retail data center market refers to the colocation market.

Then, there are “hub” and “edge”. As the terms suggest, hub data centers are more central in well-connected regions – and tend to be larger, while edge data centers are smaller in size and tend to be located on the peripheries of the network – often located near telecom towers.

What are the dynamics of the real estate market for data centers?

Hyperscalers are expanding their data center footprint in order to grow their cloud services but also to develop their Artificial Intelligence services. In digitizing their processes and optimizing their IT systems, corporates are outsourcing their data from in-house data centers to cloud providers. With data sovereignty becoming critical, governments too are following the same trend.

Over the last decade, vacancy rates have continuously declined despite construction growing at a fast pace. Since 2020, demand for more IT capacity from all players, cloud providers, colocation operators and corporates has put supply under pressure.

Thierry Cherel

> ***Despite a boom in data center construction over the past decade, vacancy rates have continuously declined as demand has surged.***

In this regard, it's clear that markets which have the highest future electricity capacity and the lowest lead times are the best place to attract operators and investors.

According to the data center professionals we spoke to while researching our recent paper, the market has entered into a phase of rental growth and this trend is expected to continue as supply shortage does not look to ease anytime soon.

What challenges do data centers bring in terms of energy consumption?

With their energy intensive activity, the development of data centers brings high energy demand, and in parallel, high operating expenses.

Electricity demand from data centers remains relatively modest today, but it is set to grow swiftly and significantly in the coming years, with energy demand from data centers in 2030 roughly equivalent to Japan's current electricity consumption (905 TWh in 2023).

Ivan Pavlovic

> ***The energy hungry nature of data centers is exacerbating the demand on our energy supply at a time when the world is also trying to decarbonize electricity sources while starting to deploy new energy-intensive fuels (electrolytic hydrogen) and technologies (CCUS, DAC, etc.).***

While the increase in energy demand itself is a challenge – it is amplified by the fact that not only is the world in the process of trying to decarbonize its energy supply to meet with 2050 net zero targets, but overall electricity demand is expected to increase through the same period. Thus, the incremental demand from data centers adds an additional challenge to an electricity sector already under pressure.

Already today there are cases where the development of data centers and their new digital infrastructure that connects the center to the grid, poses a major threat to the entire electricity system due to lack of sufficient generation capacity. In Ireland, for example, transmission system operator EirGrid has had to introduce a de facto moratorium on data center development in the greater Dublin area, saying it would not accept any applications until 2028 due to a lack of capacity.

Significant challenges aside – where are the opportunities?

As a result of energy and sustainability challenges, there are significant opportunities in terms of new avenues of electricity sourcing and new strategic schemes.

An interesting area to focus on is the business case data centers present for development/implementation of Small Modular Reactors (SMRs) [for more detail on this sector, which can be seen as a means to address the various challenges raised by the deployment of additional renewable capacity.

Smaller than conventional reactors, and modular as their name suggests, SMRs are more affordable and simpler to build, quicker to deploy, and can be located closer to the source of consumption (due to lesser core inventories and improved safety systems). They require long-term contracting with creditworthy off-takers - which is where data centers come in, as they face increasing challenges to source stable electricity supply that can meet their increasing demands.

As Ivan mentioned, data centers are energy hungry entities – is it possible to track just how efficient (or inefficient) they are?

The efficiency of a data center can be measured in different ways, but the “gold standard” of the industry is the notion of power usage effectiveness (PUE), which takes the total amount of energy used by a facility divided by the energy used to run the IT hardware inside it. A ratio close to 1 signifies a higher degree of efficiency.

While it’s a popular method, due to its simplicity and easy interpretation, there are a number of limitations to the method, and it remains open to manipulation too. That said, PUE was not developed to be a virtue signaling tool or a comparison metric for tenants to choose between different providers or investors to satisfy their ESG targets. It was primarily introduced to measure efficiency progress in each separate facility whilst

keeping things as straightforward as possible – and in that regard it is useful.

How is technology driving development of efficiency within data centers?

Many elements come into play here, but perhaps one interesting area to focus on is cooling.

Eric Benoist

> ***Data centers not only have significant energy demands but consume considerable amounts of water. Developments in technology could bring important change in the near future.***

Cooling typically accounts for between 25% and 40% of the energy consumed by a data center and current methods consume a significant amount of water, but there are a number of technologies under development that seek to lessen the water demand.

In this regard, liquid cooling is increasingly considered to be the way forward. This sees a liquid coolant (usually a mixture of water and glycol) absorb the heat directly from the servers and carry it outside the premises – as opposed to managing the airflow around the racks and transferring the heat to external water loops for extraction as per traditional methods.

Direct to chip cooling, which sees water circulating racks close to microchips, is another possibility. Water is more efficient than air when it comes to absorbing heat – as such, cooling happens more quicky and it requires less water than traditional methods.

A potentially better technology is on the horizon too – immersion cooling. Here, hardware is submerged in dielectric fluid – a type of mineral oil that conducts heat but not electricity. This method of cooling doesn't consume

water, *BUT* it does necessitate rather considerable building adjustments (health and safety, robotics, difficult to retrofit) and not every server is compatible.

As an aside, there is also an important debate ongoing within the industry regarding operating temperatures. Typical guidance suggests an operating temperature of between 22-27◦C. There is no evidence to say that 30-31◦C cannot be supported – and every 1◦C increase could lead to significant energy cost savings. That said, without clear evidence that this temperature increase would not impact the operationality of the data centers, end clients are reluctant to risk their expensive technology to find out.

So, there you have it – a fascinating and complex asset class with investment opportunities abound across infrastructure, real estate, and indeed the technology and equipment that make up the data centers themselves.

As data center growth has increased considerably in recent years it only looks set to continue (quite rapidly) as users' needs become increasingly sophisticated.