Aquila Capital

DATA CENTRES:
REAL ESTATE, INFRASTRUCTURE OR TECH? DOES IT MATTER?

Preface

Data centres form the basis of the advancing wave of digitalisation, which has long since found its way into the everyday life of our society and is becoming the decisive criterion for the competitiveness of companies. The resulting steadily increasing demand for capacities and space, based on exponentially growing data volumes and increasing demand for computing capacities, form the foundation for attractive and growth-oriented opportunities for investors. Analogous to the development in the logistics sector, which evolved from a niche area to a fixed component of institutional real estate portfolios in the last decade, increasing institutionalisation supports the development of the data centre market. However, the enormous demand for electricity and the infrastructure requirements based on it pose new challenges for the industry. Sustainability criteria in particular are coming into focus in the midst of the European energy transition, and the availability of renewable energy capacities is becoming the decisive factor.

We see ecological aspects as the basis for promising investments geared towards long-term growth. Building on the development of green logistics properties, we offer a unique combination of property-specific as well as infrastructural aspects for the development of sustainable data centres. Synergies within the Aquila Group come from a renewable energy capacity portfolio of more than 10 GW, many years of experience in structuring private power purchase agreements, a professional focus on energy efficiency and expertise in sustainable construction.

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Please find in this Paper,
On-site Market Knowledge from:

Carl von Hessen
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Carl von Hessen is involved in the data centre segment across Europe, where he was able to secure the first development project in this segment for Aquila Group. When joining Aquila Group in 2015 he initially oversaw the identification, valuation and acquisition of green-field investments in the residential and logistics segment in southern Europe. Carl has been in the real estate sector since 2013. Prior to joining Aquila Group, he worked for ECE Projektmanagement in Hamburg as a development manager for an office development project in Northern Germany. Carl holds a bachelor's degree in international business administration from the Erasmus University of Rotterdam.

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Jan-Henrik Kohler works as an investment manager in the Data Centre Team. His current position involves monitoring of existing and managing of new data centre investment projects in Europe. Furthermore, he supports the strategic positioning and development of AQ Compute, the data centre brand of Aquila Capital. He has more than 5 years of experience across industries in the energy market. In 2020, Jan-Henrik joined Aquila Group from Roland Berger and initially worked in the Corporate Development Team, in which he also accompanied the data centre strategy together with the Real Estate Investment Team. Jan-Henrik holds a bachelor's degree in environmental science and a master's degree in management & finance from Leuphana University.

Executive Summary

- Data centres are the essential foundation of digitalisation, which is already an integral part of everyday life and a substantial factor influencing the competitiveness of companies.
- The rapid development of digital technologies and the resulting opportunities lead to self-reinforcing processes that result in exponential growth of data volumes and thus create an extremely dynamic demand for data centre capacities.
- The outsourcing of own IT infrastructures to private cloud environments, which is largely driven by the demand of private companies, creates an enormous demand for space.
- Co-location data centres provide a cost-effective and flexible solution to this demand, creating attractive opportunities for real estate investors.
- Investors can profit from diversified multi-tenant structures and steadily exponentially increasing demand, while the technical risk is borne by tenants.
- The need to build out digitalisation nationwide among the EU is leading to a decentralisation of the market structure, which has been very concentrated to date, resulting in considerable growth potential beyond the FLAP-D markets.
- Scandinavia in particular offers the ideal framework conditions for sustainable data centres.
- Data centres place high demands on the required infrastructure, especially due to their enormous power consumption.
- In the midst of the energy transition, sustainability and thus the availability of renewable energy capacity as well as energy efficiency are becoming the decisive determinants of property quality, competitiveness and future viability.
- Data centres themselves also represent critical infrastructure, as they are the basis of all progress in the tech industry and thus the prerequisite for the 4th Industrial Revolution.
- In this context, data centres offer an ideal combination of an investment in real estate, infrastructure and tech.
- Competitive advantages can be generated through experience in the development of green logistics – due to the parallels – as well as expertise in infrastructure – especially renewable energy – while the risks of the rapidly advancing technical development of digital components are not borne.
- Therefore, assignment to one of the three categories doesn't matter. Data centres offer long-term, physical, alternative investment opportunities that benefit from exponentially increasing demand in the midst of green as well as digital transformation.

1. Data centres – the basic prerequisite of digitalisation

Data centres form the foundation of a digitalised and networked world. As usually independent, physical buildings, they enable the consolidation of critical IT infrastructure in one central location. Consisting of centralised computing and storage resources, they provide the capacity for data storage, applications and processing. Although data centres are hardly or not at all noticeable due to their location criteria, network connection and rather inconspicuous building shells, almost all of us access their capacities several times per day. Bank transfers via app, e-mails on the smartphone, video conferences and social networks are just a few examples relying on data centre capacity.

Data centres are thus the key physical component of a wave of digitalisation that is increasingly driven by immaterial and application-related characteristics. The crisis triggered by the pandemic made our society and the economy aware of the competitive aspects of a digital representation of our reality. The possibility of moving business areas, operational activities, but also school education and administrative areas into the digital domain was a decisive factor in successfully maintaining business. The course for this development was set much earlier. In the retail sector in particular, it became apparent that purely stationary retailers lost a lot of their competitiveness without serving digital channels. The pandemic showed itself to be a catalyst in many areas of digitalisation, accelerating already existing megatrends in the long term.

Data centres form the physical counterpart to the mostly immaterial developments in areas such as Big Data, Industry 4.0, e-commerce and cloudification. In particular, the shift to the cloud, i.e. to an imaginary data cloud, illustrates the discrepancy between the general perception and the real need for investment in hardware data centres. However, the specific characteristics of data centres, in particular the relatively inelastic and dynamically growing demand, are increasingly bringing them into the focus of investors. In an environment of persistently low interest rates, the demand for alternative investment opportunities continues to grow unabated. In this context, data centres offer a unique combination of real estate, infrastructure and tech.

Primarily, data centres are buildings whose equipment features and location criteria show similarities to the requirements in the logistics segment. Analogous to logistics, which in turn benefits in particular from growing online trade, data centres have shown a high degree of crisis resilience or even benefited from rapid growth. Regardless of the fact that they can't be used by third parties, they promise steadily increasing tenant demand. The commitment to the property – through extremely difficult relocations – offers long-term stable cash flows. In PWC's latest real estate trend survey[1], data centres ranked in first place in terms of investor sentiment. In all subcategories (investment, development, income), the prospects for data centres are rated highest, ahead of logistics. Nevertheless, data centres are special properties that also pose new challenges for traditional real estate investors and managers.

Data centres themselves already form a critical infrastructure, comparable to access to water, heating and electricity, as numerous economic, private and public applications absolutely require these capacities. In addition, the enormous power demand results in high interdependencies – both positive and negative – with the general energy supply and related sustainability aspects.

Moreover, they are the backbone of the tech industry, whose vanguard has developed into the world's most valuable companies since the beginning of the millennium and is thus responsible for a significant share of the development of the stock markets. The associated applications and opportunities became everyday essentials. The resulting developments and opportunities are changing the corporate environment and are increasingly reinforcing each other.

[1] *PWC Emerging Trends in Real Estate (2021)*

2. Data the resource of the 21st century

Data is nothing other than information that can be stored – as long as enough capacity is available – endlessly in digital form and can be retrieved regardless of place and time. The mapping of the analogue world by digital data opens up ever-increasing possibilities for analysis and control. If one considers the worldwide generation of data as well as the resulting flows, the required capacities for storage and processing become obvious. Data is the basis for digital applications, which generate further data through their use and the growing number of users, thus enabling ever new applications. This feedback loop effect leads to an exponentially increasing amount of data.

Figure 1: Global data volume (in zettabytes)[2]

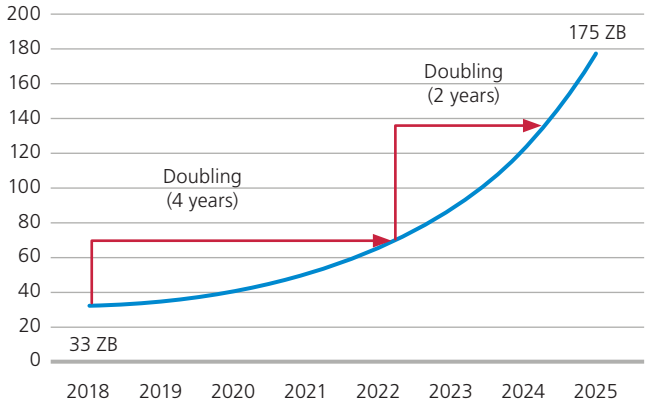
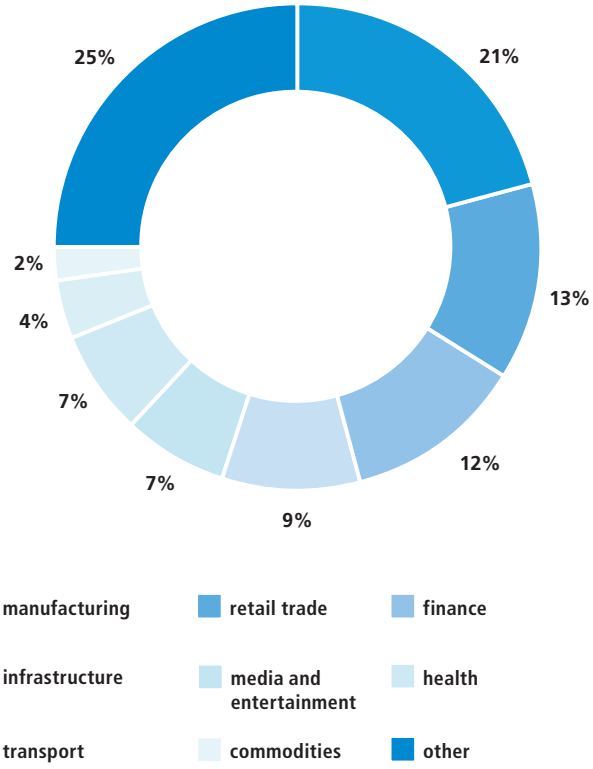


Figure 2: Data producers by industry 2018[4]



BOX 1

Classification Zettabyte (ZB)

A zettabyte is equal to one billion terrabytes (TB) and a terrabyte is equal to one million megabytes (MB). A 90-minute film in standard quality requires about 500 MB of storage space. That means one ZB is equivalent to about two trillion films (2,000,000,000,000).

This enormous growth, which is doubling at ever shorter intervals, requires a proportional growth in data centres so that processing and storage capacity can keep pace.

The main driver of data growth is the increasing networking of mobile devices. On the one hand, the number of private users is increasing – by 2023, 71% of the world's population is expected to have mobile access to the internet – and on the other hand, the application possibilities are increasing, producing enormous data streams – mobile data traffic in Western Europe will increase fivefold by 2022, starting from 2.4 GB in 2017[3]. But beyond private users, companies are by far the biggest data producers.

Data-intensive applications such as automated manufacturing and networking across company boundaries make the manufacturing sector the number one data producer. This is followed by the retail sector – driven by: online trading and data analysis for advertising purposes – and financial services, where mobile payments, online banking and online brokerage are key drivers.

However, data production is in constant flux and future developments will keep growth at an exponential level in the long term, creating continued high demand for data centre capacity.

[2] *International Data Corporation (2019)*
[3] *Cisco – Annual Internet Report (2020)*
[4] *International Data Corporation (2019)*

„The digitisation of society has only just begun. Computing capacity must be provided for the myriad possibilities from emerging technologies, such as artificial intelligence or augmented reality. In addition to the large number of data centres required, this asset class will also increasingly be classified as critical infrastructure for society."

(Carl von Hessen, Head of Data Centre Investments, Aquila Capital)

Drivers of exponential growth

Multi-layered technological developments are the basis of the enormous growth. The boundaries between them merge smoothly. When considering the following systematised areas, it should be noted that they are all interconnected and characterised by close interdependencies. However, their direction of action in relation to dynamic positive growth is the same.

Cloud computing:

Corporate data or entire IT infrastructures are increasingly being migrated to the "cloud". However, the capacities used are by no means in the sky, but physically present in the form of data centres. Outsourcing offers enormous advantages due to the high scalability and ongoing flexibility in the IT infrastructure. So-called co-location data centres rent out suitable space as needed and offer growth potential to manage data growth and the accompanying demand. Market researchers from Gartner expect that by 2025 80% of companies worldwide will switch off traditional data centres – such as their own server rooms (racks) – and use cloud solutions.[5] Interaction with end devices requires the transfer of large amounts of data and the increasing use of applications continues to generate additional data.

Internet of Things (IoT):

The IoT is a system of networked computing devices that enable communication between machines – for example in automated manufacturing. This M2M (machine-to-machine) communication is at the heart of Industry 4.0, which will usher in a new era, especially in manufacturing. The required sensor technology that enables measurement and resulting communication continuously generates huge amounts of data. The processing of these data streams must take place in real time in order to ensure correspondingly short reaction times, which means that latency (see Box 2) is becoming increasingly important. According to Cisco's Networking Index[6], M2M modules will be responsible for 55% of all mobile networked devices by 2022, even pushing smartphones into second place. Further data growth of 30% is expected in the manufacturing sector by 2025.

BOX 2

Latency

In telecommunications, latency refers to the delay time that an information or data packet requires from the source to the destination point. Along with bandwidth and error rate, latency is one of the most significant factors for the quality of a data transmission or network connection. In particular, real-time applications such as autonomous driving cars make latency a decisive factor, as a few milliseconds make a significant difference. Despite the near speed of light at which data can be transmitted in fibre optic networks, the actual distance imposes physical limits on latency. Applications that require a latency of around one millisecond need a data centre at a maximum distance of 100 km.[7] Processes that are less dependent on latency, such as the simulation of crash tests in the HPC segment, can benefit from locations in cooler regions. The latency from Oslo to the most important European locations is only 12-20 ms.[8]

Autonomous driving:

Analogous to the IoT, advances in autonomous driving will generate enormous amounts of data. Intel estimates that an autonomous car generates and consumes around four terabytes (TB) of data – with sensors and M2M – during an 8-hour drive. 4 TB is roughly equivalent to the data volume of 1.2 million photos. In addition, latency plays a key role, as fractions of a second can be decisive at 100 km/h.

Edge Computing:

Real-time responses are a crucial prerequisite for the IoT and especially for autonomous driving. To minimise latency, sufficient computing power must be available in the immediate vicinity of machines and cars. Edge computing, i.e. at the edge of the cloud, brings the corresponding resources closer to the data source and the user. These developments are accompanied by a change in the data centre infrastructure. The expansion of data centre networks and the cloud must be significantly more decentralised in the future in order to meet the increasing requirements. According to the Data Age 2025 study, it is expected that around a quarter of all data will be generated "on the edge" by 2025.

[5] *https://www.silicon.de/experten-tipp/mit-der-cloud-das-datenwachstum-beherrschen*
[6] *https://www.netzwoche.ch/news/2019-02-22/mobile-netzwerke-uebertragen-2022-fast-1-zettabyte-daten*
[7] *https://www.telekom.com/de/konzern/details/was-ist-latenz-in-echtzeit-durchs-netz-435638*
[8] *https://invinor.no/industry-opportunities/data-centers/*
[9] *International Data Corporation und Seagate (2018)*

5G mobile:
As the 5G mobile standard is rolled out, the connectivity of mobile devices and the associated data growth will continue to increase significantly. Higher transmission speeds make 5G an essential component of Industry 4.0. Accelerated expansion can avoid network bottlenecks and help manage the enormous data volume. Transmission speeds will increase by a factor of 13 with the expansion of 5G by 2023. Among other things, the new generation of mobile communications will also enable the e-health sector to develop its full potential. With a growth rate of 36% by 2025, the health sector is expected to see the most dynamic development in a sector comparison. Telemedicine and health portals will make the most significant contribution.

Blockchain technology:[10]
The origin of the blockchain lies in decentralised accounting systems and is comparable in business terms to a cash book or general ledger. This is distributed decentral to a large number of computers in exactly identical form. Blockchain technology gained fame through the cryptocurrency Bitcoin, but its potential applications extend far beyond that. Applications arise across industries for seamless and trustworthy documentation depending on predecessors. In addition, the blockchain offers opportunities for "smart contracts" that react flexibly to changes. In this context, intelligent and efficient automated solutions are emerging, also for energy suppliers. A chain of blocks is created with the help of successive data blocks that are stored unchangeably across all users. As the number of this chain grows, a steadily increasing computing capacity is required for the creation of new blocks (mining). For so-called mining, capacities are increasingly being rented in data centres and own data centres are being built exclusively for this purpose in order to be able to solve the complex mathematical problems. With the increasing fields of application and the resulting chains, a considerable rise in demand for computing capacities can be assumed.

High Performance Computing:
The generic term Big Data covers the systematic processing and evaluation of the ever-growing data stock. The evaluation of huge amounts of data, for example in the area of research and development, as well as further advances in the area of artificial intelligence, require enormous computing power. Continuously, the need for high-performance computing (HPC) will also increase significantly across industries. Examples include elaborate animations in the entertainment sector and simulations that are as close to reality as possible in the technical environment. Thus HPC, i.e. the use of high-performance computers with a significantly higher number of computing nodes and a higher computing power density, is taking on a central role in the further development of digitalisation. By 2024, the global HPC market is expected to grow by 40% to a volume of 55 billion USD. The expansion of HPC capacities also plays a central role in the EU's digital strategy, "(...) for the development of innovative solutions in the fields of medicine, transport and the environment".[11]

Digitalisation is a significant competitive factor for companies. In the course of this process, data volumes will grow steadily across all industries and increasingly exceed companies' own capacities. Outsourcing to the cloud offers cost-efficient and structural advantages. But especially in the corporate sector, security aspects play a central role. A distinction must be made between the public cloud and the private cloud. While public cloud services from e.g. Amazon, Microsoft or Google and their IT infrastructure can be used for data and applications that do not pose a data protection risk, critical data and applications require a private cloud environment with their own IT hardware. Accordingly, demand for data centre space will remain at a high level in the long term, creating ideal conditions for real estate investors.

„Meanwhile, the dynamic is completely different: The building is put up, and in no time at all, after a few weeks or months, it is already fully occupied." (Paul Fay [2020], deputy head of Frankfurt's energy department on environmental requirements for data centres)[12]

[10] Leadvise (2021)
[11] European Commission (2020)
[12] https://www.datacenter-insider.de/ich-kann-die-entscheidung-von-amsterdam-gut-verstehen-a-910872/

3. Real estate perspective – a new and different building type

The so-called hyperscalers, which include the FAANG[13] companies, are the focus of attention with huge data centres of their own. But in addition to these own capacities, the majority of these providers rent so-called co-location data centres in order to make their services available everywhere. These are also focused by a large majority of companies. Co-location refers to "private" data centres that are set up in the building of a third-party provider. This means that space for servers and other IT hardware can be rented in specially designed properties. As a rule, co-location data centres have several tenants occupying separate units of the building. This constellation results in advantages for both sides. In addition to avoiding high investments for building their own data centre, tenants benefit from decreasing running costs – which are due to economies of scale – and a high degree of flexibility. Costs incurred for cooling, electricity, network connection, security and system monitoring only pay off once a critical size is reached and are distributed proportionately among the tenants in the co-location data centre. Since flexibility is particularly important in a dynamic growth environment, landlords can gain competitive advantages by having existing reserve space for data centre expansion. Tenants only have to rent the space they actually need, while perspective growth does not pose any capacity problems. In turn, the landlord can reduce dependence on individual tenants and achieve a high degree of diversification. In addition, the tenants' commitment to the property is usually much more stable compared to other types of use. High investment costs in the respective IT hardware and the set-up of the data centre make relocations technically and economically very costly. As a rule, the turnover rate is low, resulting in stable occupancy rates with corresponding long-term rental income.

It should be noted, however, that data centres are special properties whose structural and location-specific requirements differ significantly from those of established building classes such as office and retail. Whilst the enormous and continuously rising demand for data centre capacity is steadily increasing the attractiveness of the segment, new challenges also, or especially, arise for traditional and established real estate investors and managers. Various factors such as access to power supply, electricity prices, connection to fibre optic networks, proximity to large internet nodes, security, building cooling and the underlying operational management, which is very different from classical building management, have a significant influence on the real estate value. Based on these fundamentals, other key indicators are needed for qualitative assessment and valuation.

Primary criteria are the provided power, internet connection and associated latency as well as technical performance data. Instead of, as is usual in the commercial real estate sector – rents in euros per square metre and rental space in square metres – the focus is on euros per kilowatt and inventory in megawatts. Rather dispassionately, cool assessments of technical performance and resource availability are the decisive parameters.

In view of the enormously high power consumption, the requirements with regard to environmental aspects are also increasing. The goal of making European data centre capacities climate-neutral by 2030[14] is extremely ambitious and also poses additional challenges for building concepts.

Parallels to the logistics sector

Looking at the universe for traditional real estate investments, data centres are most comparable to the logistics market. Besides the resilience of demand proven in the recent crisis, the types of use show further parallels. Analogous to logistics halls, data centres also have structurally simple building shells. The focus is on practical and efficient uses inside the buildings. The connection to the regional infrastructure is also essential in both areas. Similar to the importance of transport infrastructure for the logistics segment – this means connection to long-distance transport networks and important transport hubs – access to the broadband network and connection to internet nodes is essential for data centres. Strong growth impulses from online trade in the logistics segment and digitalisation for data centres ensure stably rising demand clusters, but result in bottlenecks in inner-city supply. Whilst logistics companies are designing new routes for the last mile, especially in the parcel business, critical latency times also require a decentralisation of data centre locations. In this context, edge computing is becoming increasingly important to bring storage and computing capacity closer to the point of use.

Furthermore, data centres as well as the transport sector are at the centre of the EU's intensified climate efforts. Both sectors have a key role to play in achieving the ambitious targets. Project developers with experience and expertise in the construction of sustainable buildings, especially green logistics, are well placed to transfer this edge to the data centre asset class. Following the EU targets, the requirements of urban planning in terms of sustainability are steadily increasing and are becoming increasingly decisive for approval processes.

[13] FAANG – Facebook, Amazon, Apple, Netflix, Google
[14] European Commission (2020)

„Over the last decade, logistic infrastructure investments have evolved from a niche market to an integral part of institutional investment portfolios. A similar development is expected for the data centre market, whereas the process of establishment is currently accelerating significantly."

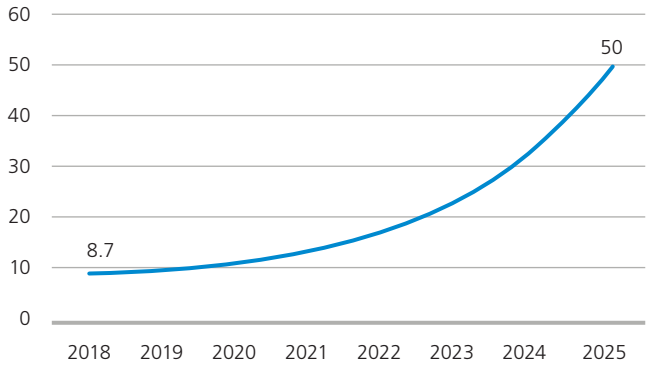
(Carl von Hessen, Head of Data Centre Investments, Aquila Capital)

Expected growth Ex-FLAP-D

Data centre development in Europe has long focused on five markets. These were grouped under the acronym FLAP-D. Frankfurt, London, Amsterdam and Paris attracted the most activity due to strong economic infrastructure and deep financial sector roots. Dublin added to this list with the strong expansion of hyperscalers, whose locations for European business have been anchored in Ireland for years – not least for tax reasons. Frankfurt in particular attracts interest due to DE-CIX, the world's largest internet node in terms of data throughput.

But the data centre capacities in these metropolises, in terms of space and energy requirements, are not unlimited. The expansion of European capacities of cloud structures alone is expected to grow by a factor of almost 6 in the five years from 2019 -2024.

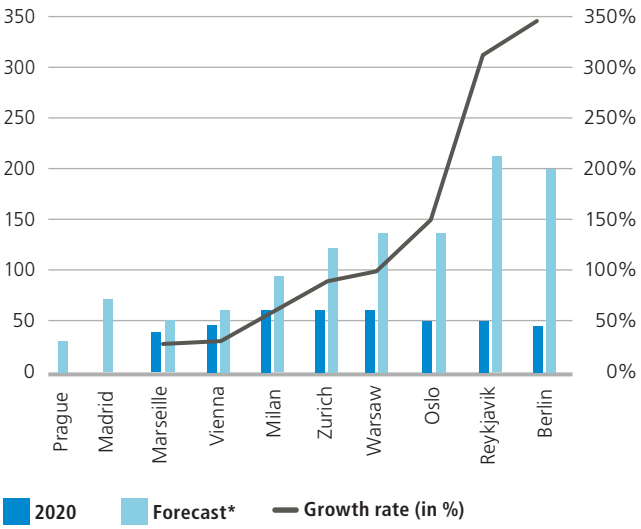
Figure 3: Forecast of European cloud data centre investments (in billion EUR)[15]



The exponential growth of investments, as shown in Figure 3, is proportional to the growth of data volumes. Amsterdam was the first of the FLAP-D markets to introduce strict regulations in 2019, which amounted to a quasi moratorium. Due to energy capacity constraints and environmental reasons, Amsterdam halted data centre expansion for an initial period of one year. Similar bottlenecks are also looming in Germany's number one market, Frankfurt. The Australian real estate investor Cromwell, which announced a one billion dollar data centre strategy, withdrew from plans for a data centre in Frankfurt because it was foreseeable that the required amount of renewable energy could not be provided at the location.[16]

In addition to the capacity problems of the FLAP-D markets, structural and technical changes that require a decentralisation of the digital infrastructure are also contributing to a significant acceleration of growth in other European markets.

Figure 4: Forecast of additions (in MW)[17]



*Under construction or planned

Current data centre developments in FLAP-D with a volume of 500 MW contrast with planned expansions of 680 MW in the emerging markets shown in chart 4. While there has been little movement in the data centre market in major European capitals such as Prague and Madrid, this is set to change in leaps and bounds. Locations heavily influenced by the financial sector, such as Zurich and Warsaw (nearshoring of business processes), expect a doubling of the data centre capacities available to date, at 90% and 100% respectively. More than doubling can be observed in the locations of Oslo and Reykjavik, which offer ideal conditions for data centres due to cool weather conditions and access to cheap renewable energy. Norway, in particular, will experience further growth impetus from a new 175 km fibre-optic connection to mainland Europe. The list is headed by the booming business location of Berlin, whose start-up and tech scene, as well as the renewable energy capacity secured by its proximity to the coast and the surrounding countryside, exude enormous appeal.

The further penetration of cloud services as well as new technologies reinforce the trends of further decentralisation of the data centre market and will create sustainable momentum in the emerging

[15] *Structure Research (2020)*
[16] *Australian Financial Review (2021)*
[17] *Structure Research (2020)*

markets beyond FLAP-D. While non-critical data can be stored in the public cloud of appropriate companies anywhere in the world, critical applications and corporate data will continue to require private data centres in co-locations. Not least for cost reasons associated with the transfer of large amounts of data, near-device storage is increasingly becoming the focus of business activities. Besides latency times, access to the data centre by own employees is also tied to regionality. Furthermore, edge computing is becoming a key requirement for realising the potential associated with the Internet of Things. Reactions in real time require sufficient computing power in close proximity to the user. The smaller edge computing units form the bridge for communication between users and central data centres. This will be accompanied by a change in data centre infrastructure that will significantly increase the breadth of coverage and thus decentralisation. Deloitte expects 75% of companies to be using some form of edge computing by 2023. Co-locations will play a central role in ensuring the economic viability of these smaller units. As a result, demand for co-location space will continue to grow significantly.

In addition, investors in markets beyond FLAP-D can generate much greater momentum by catching up. In Frankfurt, for example, prices have already risen massively due to the high demand from data centre operators, which on the one hand reduces the prospects for returns and on the other hand highlights the capacity problems as other businesses are increasingly displaced.

"As much is already being paid for a commercial square metre in the Main metropolis as would normally be paid for the construction of a detached house." (Paul Fay [2020], deputy head of Frankfurt's energy department on environmental regulations for data centres)[18]

„Since the availability of power is the limiting factor in FLAP-D markets, growth in these markets will decelerate. At the same time, we anticipate attractive investment opportunities in secondary markets with high expansion potential."

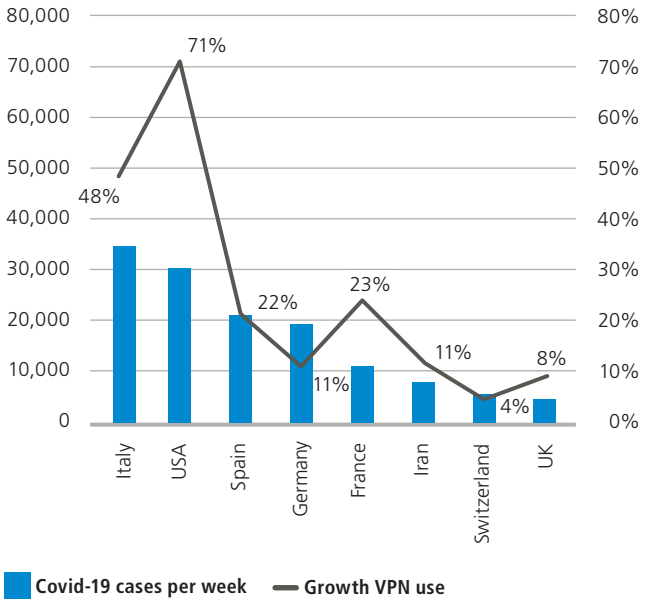
(Jan-Henrik Kohler, Investment Manager, Aquila Capital)

[18] *https://www.datacenter-insider.de/ich-kann-die-entscheidung-von-amsterdam-gut-verstehen-a-910872/*

4. Infrastructure importance – enormous power demand and the green transition

Data centres are the foundation of digital ecosystems, and their importance is increasingly equal to the basic provision of water, electricity and heating. As the use of cloud solutions becomes more widespread – meaning across industries – data centres are central to maintaining business operations. The pandemic showed how significant the shift to digital channels can be for businesses. Home office and home schooling solutions set new standards and will add to the wave of digitalisation.

Figure 5: Covid-19 and the growth of VPN use (15.03.-22.03.2020)[19]



Already in the early days of the pandemic, the effects were evident in the enormous growth in the use of VPN (Virtual Private Networks) connections, which allow secure access to internal company data (possibly in the cloud). This development will continue after the pandemic. Many companies do not see the adaptations as a short-term change, rather see them as a permanent change in the way we work and do business. New technologies and applications will help manifest the centrality of data centres to the digital ecosystem that surrounds them. There is also increasing pressure to ensure connectivity at the very edges of networks. Thus, the ability to ensure connectivity in increasingly branched hybrid networks is becoming an essential part of the data centre infrastructure, reinforcing the trends of growing network decentralisation.

The already high integration of digital applications to control, for example, telecommunications, traffic and security, reveal that data centres are part of the critical infrastructure. The continuing deepening of these developments, which are increasing at a rapid pace, is also accompanied by special challenges. Data centre infrastructure failures would have severe consequences in this context. For this reason, depending on the criticality as well as the importance of data, processes and applications in the corporate sector, the uptime requirements are constantly increasing.

BOX 3

Uptime[20]

Uptime is the time during which a system, in this case a data centre, can be used as planned. Periods of disruption that restrict availability or cause it to fail, on the other hand, are referred to as downtime.

For one year and a required 90% uptime, the following calculation results:

- 1 year corresponds to 8,760 hours
- Availability of the system in the period = 7,840 hours
- Uptime: 7840 h/8,760 h=0.9=90%

Geared to the needs of the customers, four levels (tier levels) are distinguished on the basis of the underlying infrastructure of data centres.

[19] *AtlasVPN (2020)*
[20] *Uptime Institute (2021)*

Figure 6: Tier classification data centres[21]

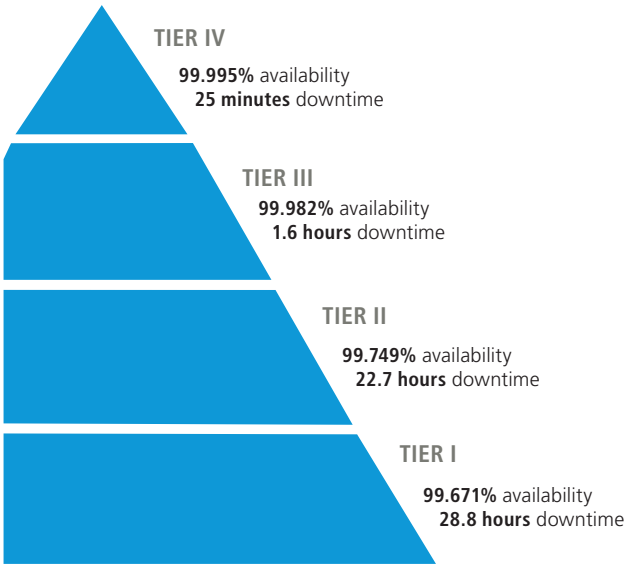


Figure 6 illustrates the strict basics for the operation of data centres. Even in the lowest tier, Tier 1, an availability of 99.671% must be given. Tier I and II data centres are usually for smaller companies that can compensate for certain delays and minor data losses. However, critical applications and data require higher stability, which must be ensured by redundancies. In Tier IV, power supply, cooling and the network connection must be fully redundant. This architecture allows even the most extensive technical faults to be remedied without interrupting the availability of the servers located in the data centre.

At the heart of the availability of digital infrastructures is the power supply. Whilst the use of videoconferencing and working from home seems to have a positive impact on the emissions budget by reducing travel, there is a significant discrepancy due to the indirect perception of energy consumption.

Requirements for energy supply

Today, the information and telecommunications industry is responsible for 5-9% of global electricity consumption.[22] This is associated with about 2% of the world's climate-damaging emissions, which corresponds roughly to the same amount of global air traffic.

Within the European Union, data centres were already responsible for 2.7% of total electricity demand in 2018. At 77 TWh, this is roughly equivalent to Austria's annual electricity consumption.

Figure 7: Development of electricity demand for data centres within the EU (in TWh)[23]

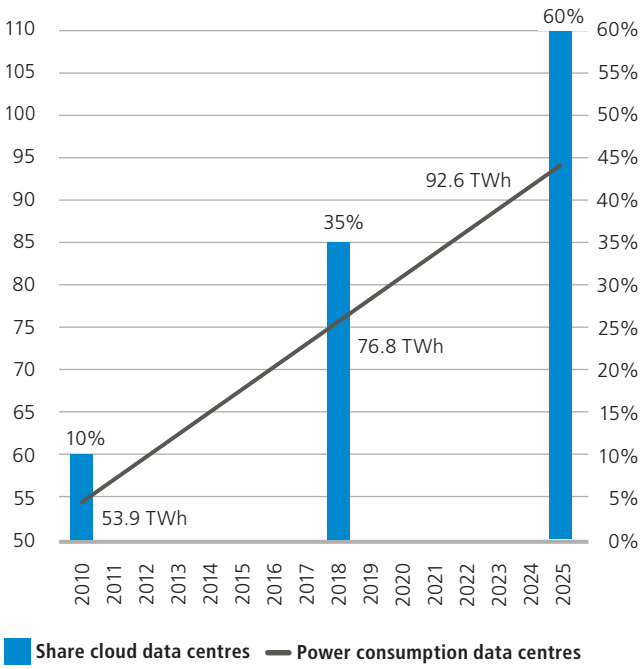


Figure 7 illustrates that the trend in this shows only linear growth – not exponential – due to ongoing efficiency gains through the modernisation of hardware, software and infrastructure in data centres. But the enormous growth of the sector outweighs these measures, resulting in also significant growth rates. By 2025, electricity demand is expected to increase by more than 20%. By 2030, data centres are expected to account for 3.2% of the EU's total electricity consumption. The main driver of this development is the massive growth of cloud computing. While cloud data centres accounted for 10% of electricity consumption in 2010, their share will increase to around 60% by 2025. In addition, computationally intensive applications in the HPC segment, which are steadily gaining in importance, require increasing energy use, and the new mobile communications standard 5G is estimated to exceed the energy requirements of 4G by a factor of 3.5.[24]

The power consumption results primarily from the storage, processing and transmission of the ever-increasing amounts of data. Another significant factor is the required cooling of the hardware, as it releases the consumed energy in the form of heat. Efficient use is measured by the PUE (Power Usage Effectiveness).

[21] *Uptime Institute (2021)*
[22] *European Commission (2020)*
[23] *Borderstep Institut (2020)*
[24] *Vertiv (2021)*

BOX 4

PUE (Power Usage Effectiveness)

The PUE is a key figure that can be used to evaluate the energy efficiency of a data centre. To calculate it, the actual energy consumption of the IT infrastructure (e.g. servers, storage) is put in relation to the total energy consumption.

$$PUE = \frac{\textit{Total facility energy consumption}}{\textit{IT equipment energy consumption}}$$

The main determinant in this context is the energy required for cooling. Consequently, a PUE of 1.0 would be ideal. Data centres are considered very efficient from a PUE of a maximum of 1.2.

According to this measure, it becomes clear that cooling plays a supporting role in the efficiency of data centre structures. Colder climatic conditions, such as in Northern Europe, therefore offer good framework conditions. While highly efficient results can also be achieved in Scandinavia by means of air cooling, the more efficient water cooling will become increasingly important in the course of decentralisation. Water cooling systems will also be increasingly used considering increasing server power density in order to increase efficiency. Regardless of the location of the data centre, the Borderstep Institute expects that by 2030 around 80% of servers will be connected to a water cooling system.[25] Developers are therefore well advised to consider corresponding devices already in the construction phase in order to adapt modernisations to new standards in a cost-effective manner.

The size of data centres has increased significantly with a view to economies of scale, which results in capacity problems with regard to the required power connection. A modern data centre consumes about the same amount of electricity as a medium-sized city.[26]

BOX 5

Average power consumption[27]

"In total, this results in an electricity consumption of 876,000 kWh per year for the smallest data centre with 100 square metres and low IT power. At the upper end is the data centre with 1000 square metres and a high IT performance. According to IBM's research, it requires 26,280,000 kWh per year. The energy costs incurred range from 131,400 euros to 3,942,000 euros. IBM has assumed an electricity price of 15 cents per kWh. For a medium-sized data centre with approximately 500 square metres and an energy density of 15 kWh per rack, this results in approximately 1.3 million euros in electricity costs per year."

Beyond the technical challenges, sustainability aspects, especially within the EU, will play a key role with regard to the development of the coming years.

„About three per cent of all electricity generated on earth is consumed by data centres and the amount of data is steadily increasing worldwide. We need to invest in sustainable data centres now, both to meet growing demand and to support the achievement of global climate goals."

(Carl von Hessen, Head of Data Centre Investments, Aquila Capital)

Sustainability

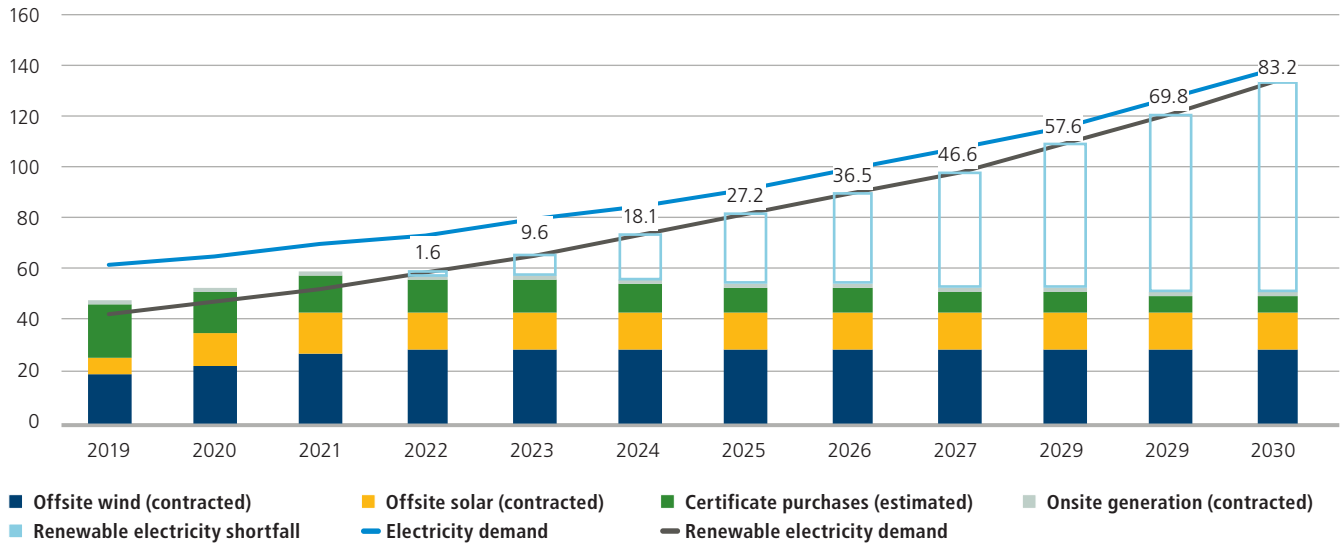
The European Green Deal sets the political guidelines for the ambitious goal of a climate-neutral Europe by 2050. Special emphasis is placed on the digital transformation. The declared goal is the climate neutrality of data centres and the entire information and telecommunications industry by 2030. Energy providers and the data centre industry are thus at a turning point that marks the beginning of a simultaneous green and digital transformation.

As the amount of global data continues to grow, creating new opportunities for value creation and control, the focus is on renewable energy supply. With the announcement of the European Green Deal, leading data centre and cloud operators joined forces and declared their intentions to achieve carbon neutrality by 2030 with an "EU Data Centre Pact". This voluntary self-regulation initially avoided strict regulations on the part of the EU. The pact contains the goal of supplying 75% of the electricity needs of data centres with renewable energy as early as 2025. By 2030, the share is to rise to the required 100%.

Looking at the tech companies that already follow the RE 100 global initiative, it becomes clear how much additional renewable energy needs to be purchased to reach this target.

[25] *https://www.datacenter-insider.de/green-deal-wasser-ist-d-a-s-medium-fuer-datacenter-a-942483/*
[26] *https://www.datacenter-insider.de/ich-kann-die-entscheidung-von-amsterdam-gut-verstehen-a-910872/*
[27] *https://www.datacenter-insider.de/die-energie-bilanz-von-rechenzentren-faellt-negativ-aus-a-328335/?p=2*

Figure 8: RE 100 global technology companies (in TWh)[28]



A decline in the number of certificates that can be used to offset CO_2 emissions can be clearly observed. On the one hand, this is due to a decline in supply, on the other hand, it can be explained by the high competitiveness of renewable energy production. However, Bloomberg Energy Finance estimates an additional demand of 83.2 TWh for renewable energy by 2030. The situation is similar with regard to the EU Data Centre Pact. In order to achieve the ambitious goals, the expansion of renewable generation capacities must also keep pace. Advantages arise from private power purchase agreements (PPAs). Through PPAs, data centre operators are able to buy contractually fixed amounts of renewable energy without having to build their own capacities. In this context, a win-win situation arises. On the one hand, there is the possibility to purchase renewable energy for the operation of the data centres at long-term fixed prices below the market level, and on the other hand, renewable energy investors receive long-term predictable and secured income from the electricity production. Under these general conditions, i.e. the direct demand for renewable energy, the expansion of renewable energies will increase sustainably and also continue to be less dependent on state subsidies, which reduces the regulatory risks.

„In addition to powering our data centres with 100% renewable electricity, we are also highly committed to implement waste heat reuse concepts at our data centre sites, aiming for reasonable sector coupling and further contribution towards sustainable development."

(Jan-Henrik Kohler, Investment Manager, Aquila Capital)

Another point is the increase in energy efficiency, which is significantly linked to efficient cooling technologies. Within the EU Data Center Pact, the participating companies commit to not exceeding a PUE of 1.3 in cool climate regions and a maximum of 1.4 in warmer regions for data centres with construction start in 2025. Data centres built in earlier years must achieve these targets by 2030. In addition to the PUE targets, however, the focus is particularly on the use of waste heat. Thus, data centres that ensure operation with 100% renewable energies and feed the waste heat into district heating networks or use it directly in the commercial environment can even achieve climate-positive balances.

„Reductions of up to 4,000 tons of CO_2 per megawatt per year can be achieved by relocating computing capacity from Germany to Norway. 4,000 tons of CO_2 equal to approximately 12 hours of video conference by the entire population of Hamburg. With our in-house expertise from AQ GreenTeC, we are able to offer our customers tailored CO_2 measurement, reduction and offsetting services to improve their sustainability performance."

(Carl von Hessen, Head of Data Centre Investments, Aquila Capital)

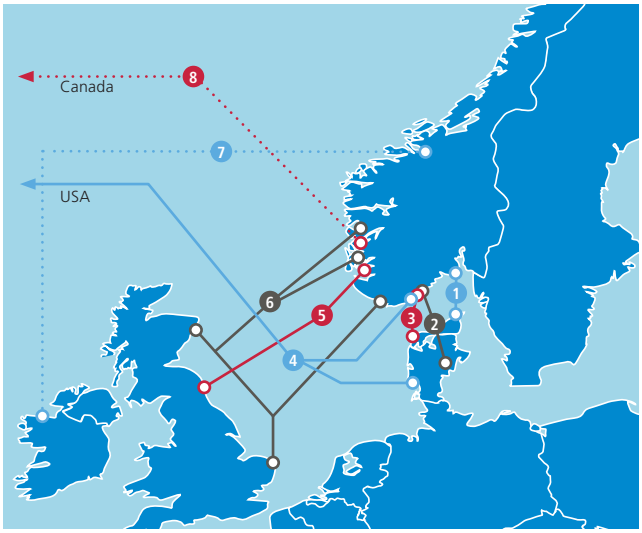
Based on these criteria, Norway offers ideal location conditions for the expansion of data centres in Europe. The cool climate, sufficient and cheap renewable energy as well as an expanded connectivity via a new fibre optic network to the European mainland fulfil the essential criteria. Projects that meet the highest sustainability standards could serve as a model for the further development of the data centre market in Europe.

[28] *BNEF (2021)*

„Norway makes an ideal location for green and efficient data centres based on key parameters such as: cold climate, 98% electricity supply from renewable sources, most competitive electricity prices within Europe as well as proactive support by the Norwegian government for the data centre segment." "

(Carl von Hessen, Head of Data Centre Investments, Aquila Capital)

Figure 9: Subsea Network Map Norway[29]



Pre 2020	1. Skagenfiber West	6. Tampnet Offshore Foc Network
2020	2. Skagerrak 4	7. Celtic Norse
2021	3. Havsil	8. Leif Erikson
2022	4. Havfrue / AEC-2	9. Arctic Connect
2023	5. Englandskabelen / No-UK	

Regardless of its geographical location at the edge of Europe, the expansion of network connections is increasingly putting Norway at the centre of European data traffic. In addition to the expansion that has already taken place in 2020, further improvements of the networks to the UK and mainland Europe are planned. Beyond decreasing latencies, there are valuable alternatives in case of disruptions. Furthermore, Norway's location offers a high level of security. Although Norway is not a member of the EU, it is bound by EU standards as a member of the European Economic Area.

Synergies

While new challenges arise from the significant increasing demand for energy, positive effects on the transformation of the energy system are possible at the same time. Energy and digital infrastructure are inextricably intertwined but can efficiently and purposefully revolutionise supply by significantly improving the integration of renewable energies into the supply infrastructure. Problems arising from fluctuating production can be managed via digital applications. Smart applications such as electricity meters collecting data in real time can, in combination with artificial intelligence, develop new models for utilities to set appropriate incentives. This will result in benefits aimed at the necessary flexibilisation of demand.

For example, the EU Commission estimates that the technology sector, of which data centre infrastructure is at the heart, can help reduce global emissions by up to 15%.

"Artificial intelligence, supercomputing and Big Data will enable better analysis and decision-making on the climate crisis and the environment. This will lead to better policy making."[30]

Achieving climate-neutral data centres by 2030 will become the deciding factor. If the voluntary commitment is not met, the EU will exert influence with strict regulations. Thus, the availability of sufficient renewable energy resources will become the decisive location factor, whilst in return the direct demand for renewable energies will promote the expansion of capacities.

„With a renewable energy portfolio of 10 gigawatts in Europe and combined with the Merchant Market Desk that structures power purchase agreements, Aquila Capital is uniquely positioned to offer one-stop renewable power procurement for our data centres."

(Jan-Henrik Kohler, Investment Manager, Aquila Capital)

[29] *Invest in Norway (2021)*
[30] *European Commission (2020)*

5. Reference to the tech segment – the fourth industrial revolution

In addition to the increasing networking of private individuals via smartphones, which are already a general part of everyday life, the corporate sector in particular is generating demand for data centre capacities. Achievable productivity gains through analysis and control options as well as a new type of automation within Industry 4.0 require a more powerful IT infrastructure. Private cloud solutions that offer a high level of security and data protection as well as sufficient capacity and flexibility are a cost-effective way to further develop digitalisation. By 2025, 80% of companies worldwide are expected to use cloud solutions.[31] Accordingly, the demand for co-location data centres, which are the private counterpart to the public services of the largest tech companies, will continue to grow dynamically.

Figure 10: Share of companies using cloud services (in %)[32]

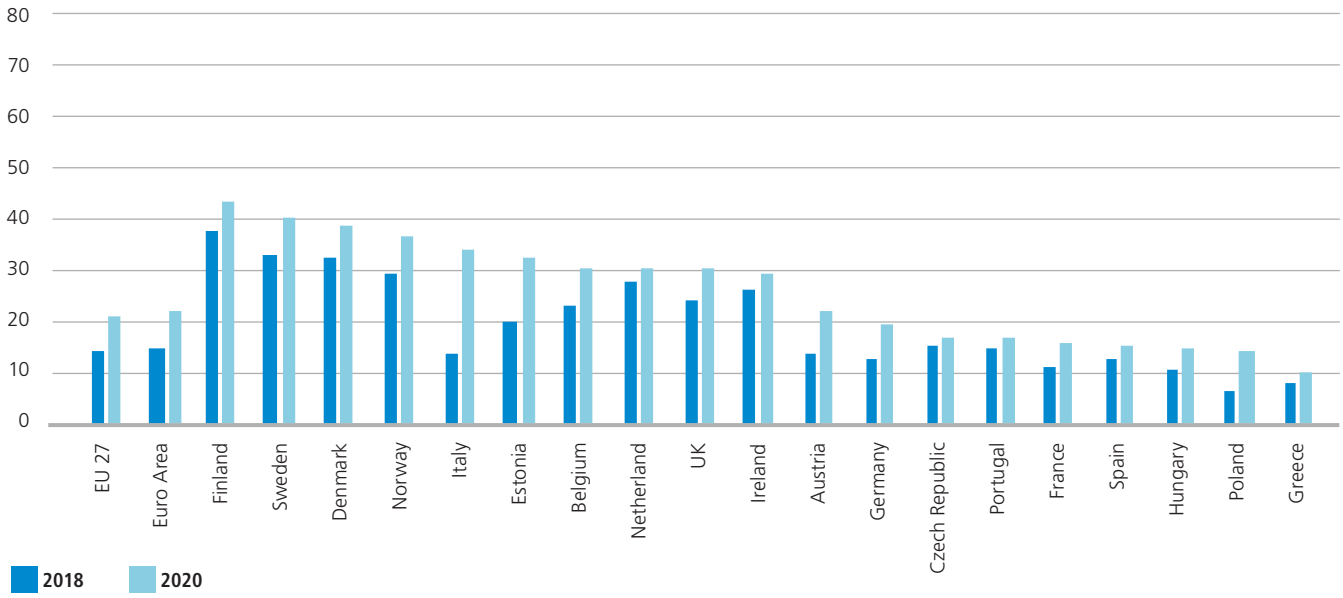


Figure 10 illustrates the enormous dynamics of companies using cloud services within the European business landscape. In relation to the EU member states, a growth rate of 50% was recorded in the past two years. On average, more than every third company already uses external cloud services. With 75% to 65%, the Scandinavian countries are at the forefront of this development across Europe.

Data centres form the physical infrastructure of these developments. As a central building block, they are indispensable for realising the far-reaching possibilities. This offers investors opportunities to participate in the development of the tech sector through tangible assets. Furthermore Co-Location data centres are not at risk regarding the fast technological progress of hardware components, because they only offer appropriate space, the IT equipment is owned by the tenant itself or by a third party.

[31] *https://www.silicon.de/experten-tipp/mit-der-cloud-das-datenwachstum-beherrschen*
[32] *Eurostat (2021)*

Requirements for the development and operation of data centres

The construction of data centres – supplemented by the components for cooling – has many similarities to sustainable construction in the logistics segment. However, additional specific requirements arise due to the:

a) Power supply:

Power supply is the foundation of any development in the digital sector. Stability and capacity of the connection to the redundant power supply thus become a basic requirement. Challenges arise from the enormous power requirements of computing power. In addition, the operation of data centres requires that the power supply is secured, even in the event of malfunctions. In addition to emergency power generators, the focus in this context is increasingly on storage solutions to enable uninterruptible power supply (UPS). While on the one hand these ensure the power demand in times of disturbances, on the other hand, they offer the possibility to balance the fluctuating production of renewable energies and thus create ideal framework conditions for sustainable operation. The availability of sufficient renewable energy capacities at the lowest possible cost is becoming the most important factor in future location decisions.

b) Broadband connection:

To ensure data transmission, access to a fibre optic network that is as widely branched as possible is essential. The speed (latency) of transmitting large amounts of data is substantial. In particular, the growth of M2M and the resulting need to transmit and analyse data in near real time to ensure control will steadily increase connectivity requirements. Depending on the specific focus of the data centre – for example: HPC, data storage or edge computing – latency must meet individual customer requirements. However, the general foreseeable demand for data centre capacity in Europe will also lead to an increasing decentralisation of the market to avoid bottlenecks. In this context, the infrastructure must continue to be created to ensure potential growth.

c) Technical operations:

Continuous advances in technology are constantly changing the requirements for data centre operators. The focus is on efficiency gains, such as those that can be achieved with increasing power density, the use of economies of scale and increasing energy efficiency. Higher power densities require efficient cooling systems with performance geared to this. In this context, water cooling will become increasingly important, especially outside cooler climatic regions. Increasing energy efficiency, on the one hand through the use of renewable energies, but also through modernisation, supports the ambitious climate goals of the EU while at the same time reducing energy costs. Large data centres enable the use of economies of scale, but also lead to a higher complexity of the entire IT infrastructure. With this in mind, software-based models are increasingly being used to make the structure manageable and efficient.

„In order to reach high energy efficiency, AQ Compute considers most innovative and state of the art cooling- and infrastructure technologies. The combination of location and very efficient technologies allow us to host high-density servers, i.e. for high performance computing applications. In addition, we help our clients to meet their climate targets with a significant reduction in CO_2 emissions, while at the same time, offering very competitive operating costs."

(Carl von Hessen, Head of Data Centre Investments, Aquila Capital)

Experience and expertise in these core areas is fundamental to a successful strategy in the data centre sector. The dynamics in the depth of these areas are leading to increasing specialisation. Since the labour market for appropriately qualified personnel is very scarce, third-party services are often used, whereby already existing know-how is an extremely valuable component. A successive build-up of own capacities should only take place once the data centre portfolio reaches a critical size. Increasing specialisation in areas with already existing internal resources enables the use of competitive advantages. Sustainability aspects will be a particular focus of the next decade, as the fulfilment of the initially voluntary commitment is the basis for strict legal requirements that do not yet exist. Data centres that do not meet the forward-looking modern requirements are threatened with cost-intensive modernisation or even the loss of competitiveness.

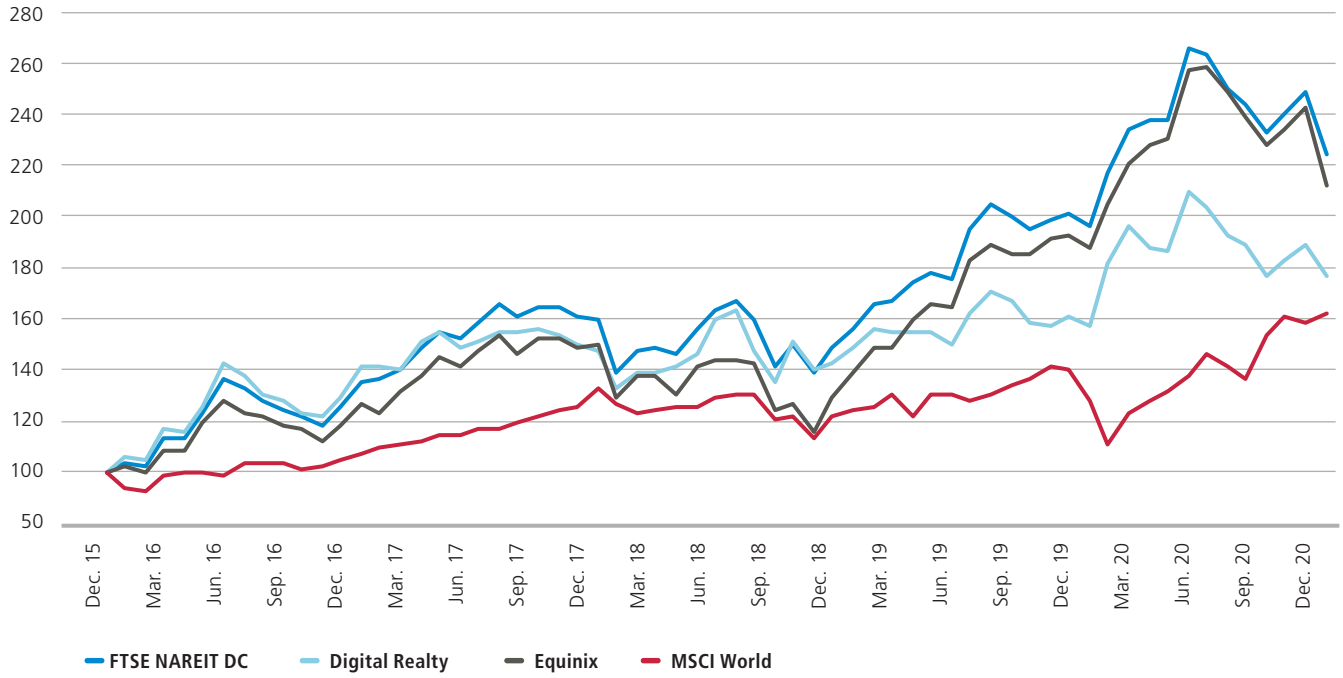
„In addition to the essential availability of renewable electricity , a bottleneck is also arising in the accessibility of suitable personnel. Managing data centers to the highest standards requires dedicated IT professionals. Therefore, it is particularly important for us to work with responsible as well as highly specialised partners and, additionally, to build up a dedicated team along the value chain."

(Carl von Hessen, Head of Data Centre Investments, Aquila Capital)

6. Return expectations

The data centre transaction market is characterised by M&A activity, resulting in a relatively high degree of opacity. The world's leading co-location providers Equinix and Digital Realty – both based in the US – have the largest transactions. Together they are responsible for almost a third of all transactions.

Figure 11: Development of data centre REITs (index 2015=100)[33]



The FTSE NAREIT for data centres – a recognised benchmark for real estate investment trusts (REITs) – has seen growth of almost 170% over the past 5 years, to its peak in the first half of 2020. Over the entire period (01/15-12/20), annual returns of between 10% and 20% were achieved:

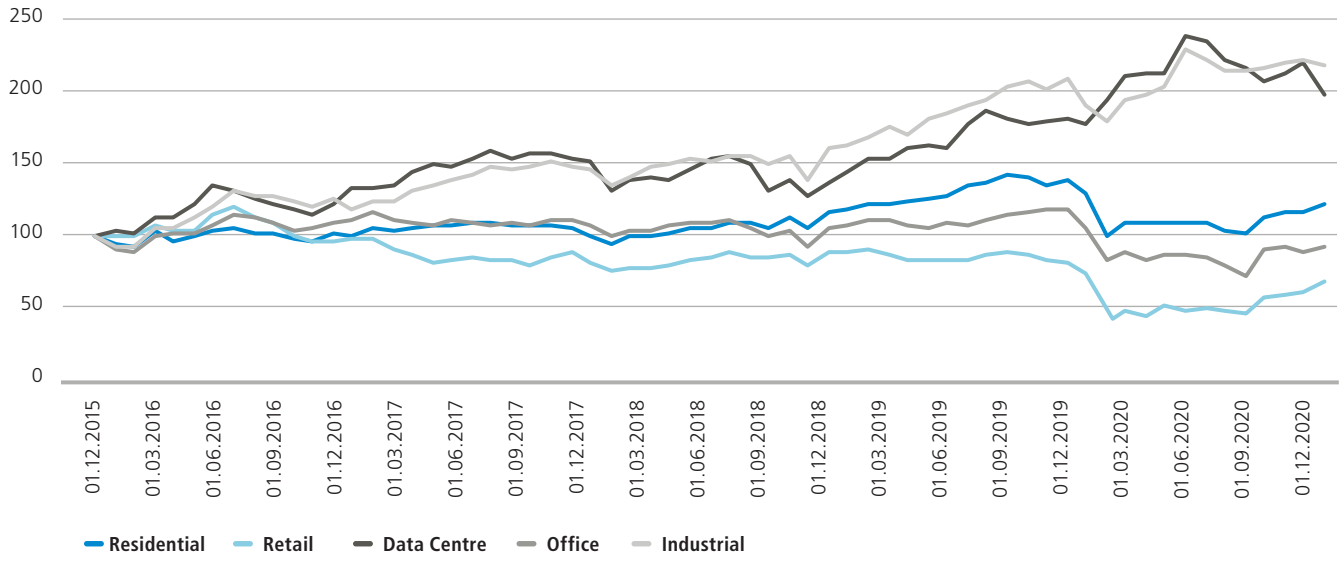
FTSE NAREIT Data Centres :	+19% p.a.
Equinix :	+18% p.a.
Digital Realty :	+12% p.a.

With the outbreak of the pandemic and the resulting demand for digital solutions, share prices rose sharply. After peaking in June 2020 prices fell significantly, as expected due to the unrest on the markets as the pandemic continued. Nevertheless, they significantly outperformed the market over the entire period if the MSCI World is used as a benchmark.

Data centre REITs also show a much more dynamic performance compared to the traditional real estate asset classes of residential, office and retail, despite the demand for real estate in general being driven by low interest rates.

[33] *Bloomberg*

Figure 12: FTSE NAREIT Index by sector (2015=100)[34]



Similar to the development in the data centre sector, the rediscovery of logistics properties helped corresponding REITs to gain high momentum. Moreover, both types of use proved their resilience compared to the other sectors, especially in the crisis triggered by the pandemic.

An analysis by Savills from the end of 2020 shows that the return expectations for European data centres are between 5% and 7%. The main determinant is the quality of the building. In this context, future viability, i.e. sustainability, will play a central role in the valuation. Comparable to the development in other real estate sectors, strong yield compression is expected within the next 2 years.

The high investor demand, from traditional real estate investors as well as data centre REITs aiming for economies of scale and market share, meets a relatively low supply. The resulting pricing pressure will shrink returns, but offers opportunities for greenfield projects. Companies that are able to manage the complex requirements in data centre developments can leverage additional potential through the construction of new data centres and meet exponentially increasing tenant demand in the market.

Scandinavia is currently the clear winner in Savills' investment index, which evaluates the attractiveness of European countries as locations. In addition to the cool climate, there is sufficient capacity for renewable energy generation at very favourable prices compared to other European countries. At the same time, investments are being made in connectivity to the mainland and there are also attractive incentives for the construction of new data centres.

These framework conditions are expected to be joined by other European countries in the coming years, as the importance of digitalisation and the associated data centre infrastructure has already manifested itself as the centrepiece of future developments. This development and the tendencies towards further decentralisation will keep the dynamics within Europe at a high level in the coming years.

[34] *Bloomberg*

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