



# Quo Vadis, Data Center? Between growth and regulation

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## Preface



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Companies that want to plan an economical and future-proof data center have to consider both the purpose of use and the likely market development. A key aspect is the search for suitable locations. Depending on the intended goal, the initial search radius can be very large or is already limited from the start. For various reasons, previously less relevant locations such as Dublin, Stockholm and Prague, but also regional markets such as Cologne / Düsseldorf or Berlin, are gaining in relevance for data center operators.

The ideal location is often a compromise between latency, availability of space, power supply and, increasingly, sustainability. In addition to the location, the management concept is decisive for trouble-free and economic operation. In a dynamic market, cooperation with a service partner can bring time and cost advantages when site search, transactions, operating concepts and operational technical and infrastructural services are bundled.

This whitepaper was written in response to the frequently discussed question of which factors will influence the siting of data centers in the coming years. The authors are not aware of any compilation to date that provides



## PREFACE

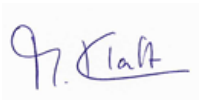
### Quo Vadis, Data Center? Between growth and regulation

those responsible for site selection and operator concepts with an initial overview and orientation. These are both investors and operators/owners of data centers.

Economic operation depends not only on the choice of location, but also on cooperation with the right partners.

We look forward to entering into an in-depth exchange with you.

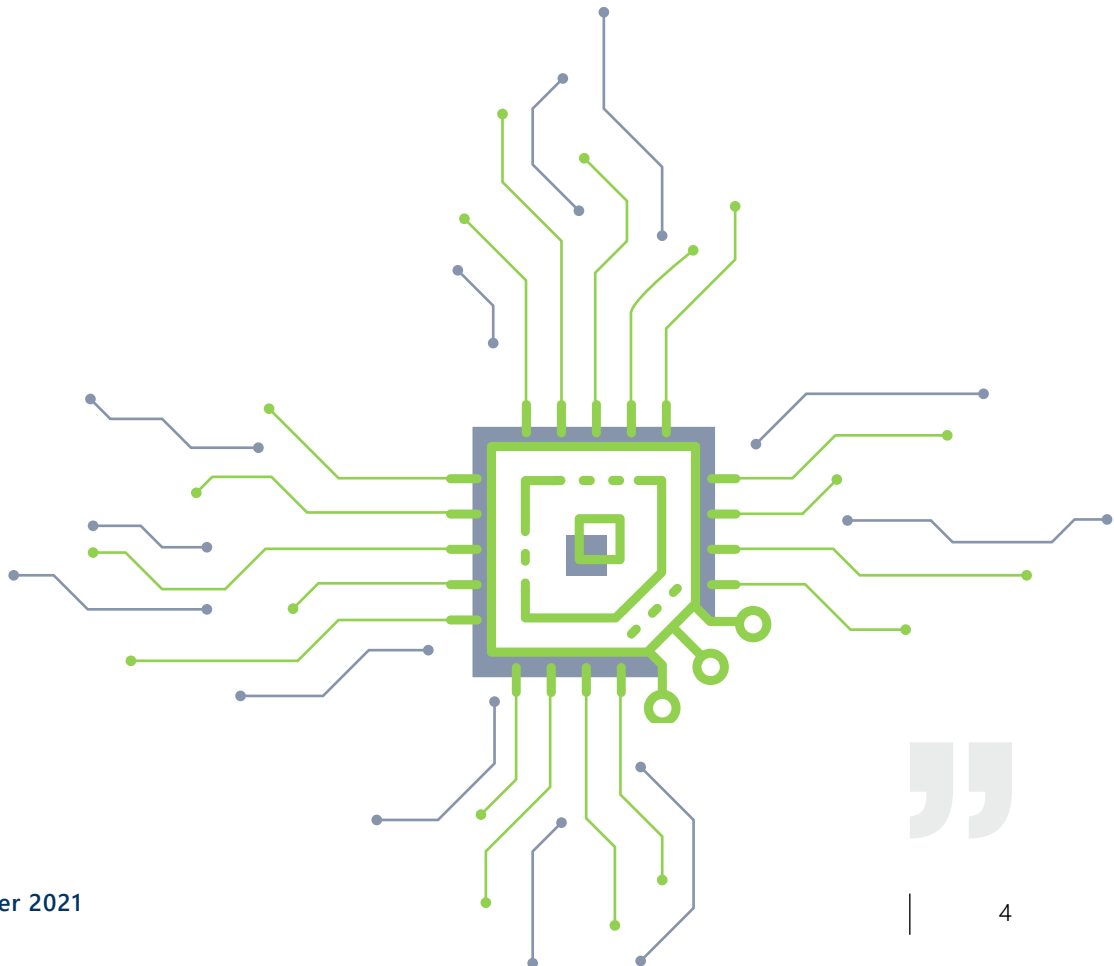
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Anna Klaf



Thomas Ball





## Quo vadis, data center?

The traditionally highly dynamic market for data centers is no longer shaped solely by the sharp rise in demand, but is increasingly becoming the focus of public attention due to its growing importance for mankind: high power consumption, societal sustainability goals, increasingly scarce space in the vicinity of Internet nodes and stricter recommendations for the distance from potential sources of danger are challenges that had considerably less significance five years ago. In addition to advances in IT technology, these developments complicate the search for the ideal data center location. At the same time, the requirements for facilities management companies, which are essential for trouble-free operation, are also changing.

Since the discussion about data protection and the introduction of the General Data Protection Regulation, the demand for data centers in Europe has increased significantly. But even within Europe, operators must balance operating costs, latency, operational security and customer demand. In view of global efforts, sustainability is playing an increasingly important role.



When looking for a new data center location, there is no simple recipe for success. The best possible compromise between the various influencing factors depends on the operators' business model and the intended use. Hyperscalers with latency-critical applications will weigh proximity to international network nodes in Frankfurt, London, Amsterdam and Paris more heavily than low electricity prices. Companies offering computing power for smart cities and autonomous driving will prioritize 5G stations and proximity to many users over international internet nodes. Furthermore, not every application requires low latency. Enterprise operators value redundancy and security as well as low cost of ownership. What they all have in common is that they depend on highly qualified personnel to ensure trouble-free operation. This can be an additional challenge, especially for peripheral locations.

The highly dynamic development in network charges and electricity prices, legal requirements, urban planning specifications, possibilities for increasing the energy efficiency of data centers and in the offer of services for management regularly requires a compilation of the current central challenges. In addition, customer requirements are changing: New business models require new data centers - both in terms of capacity and optimization for the respective application purpose.

In addition, many companies want and need to improve their CO<sub>2</sub> balance along the value chain. This will play an even greater role in the planning and operation of data centers in the future. In the next years, data centers could mitigate peak loads in the power grid by feeding electricity back into the grid. However, due to the high availability requirement, this contribution is associated with risks for the operators and will therefore probably not be used across the board.

Four main developments are expected to play a major role in the coming years:

- the increasing importance of Internet nodes for choosing a location - especially against the background of the discussion about changing requirements for data center performance
- the influence of the electricity grid and electricity prices on the choice of location
- ways to increase the sustainability of data centers
- technical and infrastructural services beyond IT

## There are no ideal locations

The best compromise depends on the intended use.



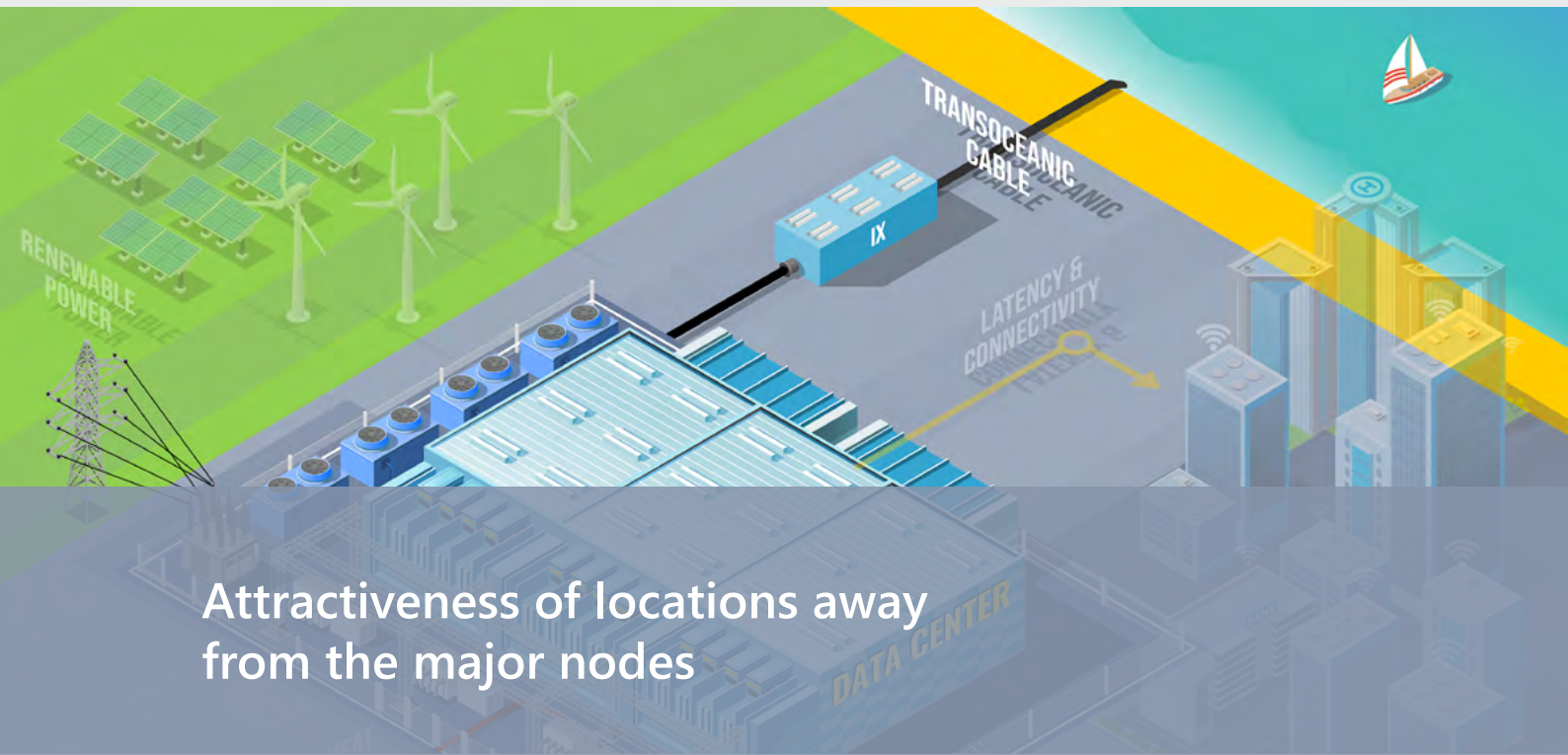


This whitepaper is deliberately designed as a contribution to the debate about the future of data centers. It aims to summarize current discussions and influencing factors and to provide orientation for further consideration of the matter. The first part is deliberately kept theoretical, while the second part offers possible solutions for the potential issues of concern raised.



## ATTRACTIVENESS OF LOCATIONS AWAY FROM THE MAJOR NODES

Quo Vadis, Data Center? Between growth and regulation



### Attractiveness of locations away from the major nodes

Most data centers require proximity to an international network node such as DE-CIX in Frankfurt am Main or AMS-IX in Amsterdam. This minimizes the distance that information must travel over fiber optic lines between the originating and receiving points. This applies at least to all data centers that connect receivers at many different points in Europe and the world. Particularly cloud service providers with high-performance data centers, such as Amazon Web Services, Google, Apple or Microsoft, and colocation operators are currently dependent on spatial proximity to the major international network nodes due to the necessary critical latency, and will continue to be so in the future. But: Most data centers are operated by companies for their own benefit (enterprise data centers).

The demand for web-based applications that require central computing power and storage capacity will continue to increase significantly in the coming years. This applies to the regions around the large data nodes as well as to the periphery, which still plays a subordinate role today. Internet of Things embedded in Smart Home and Smart City, Industry 4.0 and other applications such as autonomous driving will also increase the importance of data centers in the periphery. The emerging 5G mobile communications will enable local applications that require low latency and therefore increase the demand for smaller data centers in the area (edge

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and enterprise). However, this development is not an alternative to large data centers, but a complement.

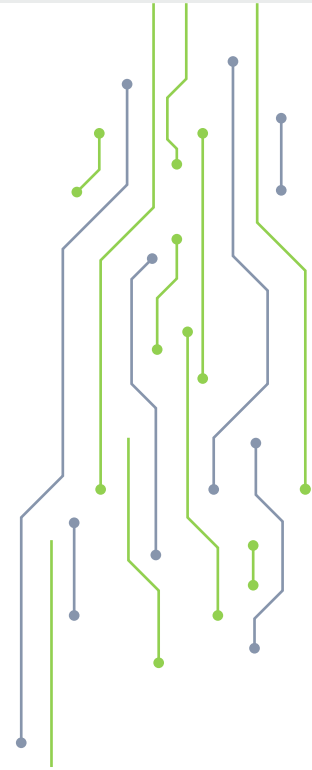
Experts like Dr. Béla Waldhauser, CEO of Telehouse Germany, and Data-Center-Insider-Editor-in-Chief Ulrike Ostler expect that Edge data centers, which are difficult to define, will gain in importance as a relevant niche in the future. Ostler predicts that its number will triple by 2025<sup>1</sup>. In addition, Waldhauser expects that tier-II-markets such as Hamburg, Berlin and Munich will gain in importance for colocation companies due to the expected further increase in demand for computing power and storage capacity. In Europe, Waldhauser expects Dublin to develop into another key market.

#### INTERNET NODE AS A LOCATION FACTOR

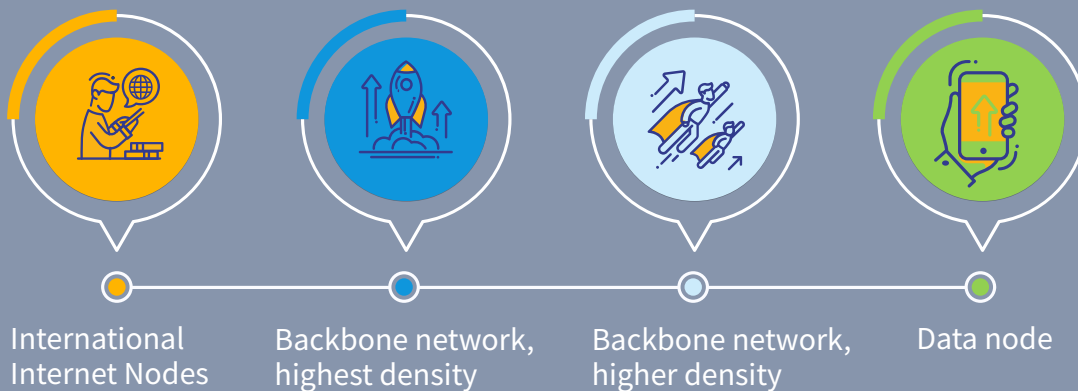
Despite fiber optic connections, latency is largely determined by the distance to the Internet nodes that connect different network layers and operators. Thus, proximity to the essential Internet nodes is an essential location factor for all latency-critical applications. Similar to power grids, international Internet nodes are interconnected via (trans-)continental cables and satellites. The closer a data center is located to an international node, the lower the latency. At the next lower level, regional nodes are connected to the backbone networks. Residential and commercial end users are usually connected via regional networks. If the majority of the expected users are located in the region, regional nodes may be a suitable alternative for data center operators to the international nodes.

#### LATENCY AND CHANGING DATA CENTER REQUIREMENTS

Not all data centers can be built in direct proximity to the major nodes and to each other. The German Federal Office for Information Security (BSI) recommends a distance of 200 kilometers as the minimum distance between redundant data centers. This is a significant tightening of the previous recommendation, which was five kilometers. For a high level of failure protection, these are challenges not to be sneezed at, which make synchronous mirroring, for example, impossible or significantly more difficult. At a distance of 200 kilometers or more, the latency becomes too high for synchronous mirroring. In order to follow the distance recommendations, companies have to invest in new data center locations that are further away from each other or relocate to colocation data centers<sup>2</sup>.



## INTERNATIONAL AND REGIONAL INTERNET NODES AS WELL AS BACKBONE NETWORKS IN GERMANY, AUSTRIA AND SWITZERLAND



*Presentation based on the backbone networks of selected carriers in the DACH region*



Figure 1: International and regional Internet nodes as well as backbone networks in Germany, Austria and Switzerland

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#### Solution approach

The necessary low latency is achieved in compliance with this recommendation if the computing power takes place in sufficient proximity to the user. 200 kilometers is regularly too far a distance<sup>3</sup>. Enterprise operators can consider relocating to colocation data centers instead of operating their own data centers.

#### ECONOMY OF EDGE DATA CENTERS

Even high-performance fiber optic lines are reaching capacity limits. The expansion often does not keep pace with the increasing demand. The problem is exacerbated by a centralized data network along the major international nodes. If the data remains in one region, the large Internet nodes and backbone lines are relieved. The periphery is an attractive location, especially for data centers that are designed for only one or a few users and regional data requirements.

One solution approach that maintains low latency concerns Edge data centers. "Edge computing" is understood to mean the "processing of data as close as possible to its point of origin". By analogy, "Edge data centers" are those data centers that are "placed close to the point of origin of data." <sup>4</sup> A significant increase in this type of data center has been observed on the market for around five years.<sup>5</sup> The central motivation for the shift closer to the data center customer is the fact that large, unprocessed data volumes can no longer be transported to a distant data center without losing time. Edge data centers circumvent this latency problem by processing close to the edge of the network.<sup>6</sup> However, a clear definition of Edge data centers to distinguish them from other types has not yet been developed. Edge data centers can at best be understood as a negative definition in distinction to colocation and hyperscale.

If globally active IT service providers already speak of Edge data centers in the case of national locations, the definition includes both campus data centers (up to 20 MW connection capacity) and small, actually locally installed micro data centers in the form of a single rack. However, common to all these subjective classifications is the aspect that Edge data centers are offering "cloud-like functions similar to those in centralized data centers, but with much lower latency and data transport costs due to their proximity to the end user".<sup>7</sup>



## ATTRACTIVENESS OF LOCATIONS AWAY FROM THE MAJOR NODES

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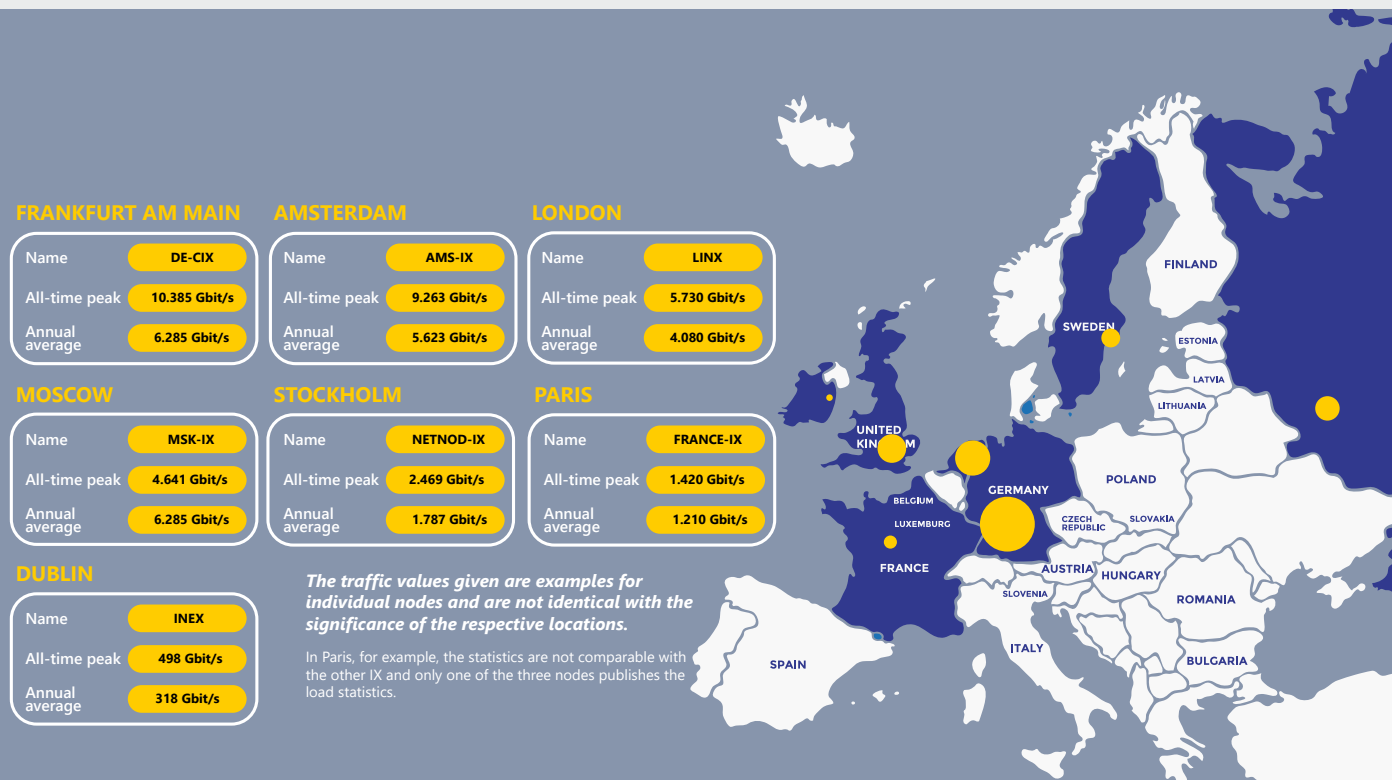


Figure 2: The largest Internet nodes in Europe: listing by data throughput at peak times. Please note: The specified data throughput of the France-IX node only includes the traffic of the customer and member ports measured by the provider; sources: respective traffic statistics (2021).

#### Edge data centers will increase

Experts consider the growth of this type of data center to be very dynamic. Accordingly, forecasts vary widely: with over 20 percent annual growth, a global volume of around 15 billion US dollars is expected to be reached in 2025; current forecasts even speak of 20 billion US dollars.<sup>8</sup> Gartner market researchers even assume that Edge data centers will overtake the classic data center type in the area of data processing by 2025. The share of data volume stored and processed in Edge data centers is expected to rise to 75 percent by then.

Despite their clear double-digit growth rates, it cannot be assumed that Edge data centers will lead to a paradigm shift away from hyperscale and colocation data centers. Their overall share of the global, highly diverse market is currently (still too) small. However, the demand for this type is expected to increase significantly in the medium and long term due to developments such as Industry 4.0, autonomous driving, smart grids and smart cities.<sup>9</sup> Participants in a global survey of operators expect Edge computing locations to increase by 226 percent by 2025.<sup>10</sup> Nevertheless, their numerical increase does not mean a replacement of classic data centers. After all, the two are closely linked: If the demand for Edge data



centers increases, the need for central data centers will continue to grow as capacity increases.

Experts from industry and research also see advantages in Edge data centers with regard to the necessary higher sustainability. They expect high efficiency potentials, especially with regard to compact data centers. Cost-effective air conditioning solutions with, for example, liquid-cooled servers and adsorption chillers are currently in the trial phase.<sup>11</sup>

#### Edge Data Center 2025

20 percent growth per year

20 billion US \$ turnover

Process 75 percent of the data volume

226 percent increase





## Electricity grid and regional price structures

In addition to the Internet connection and proximity to Internet nodes, the power supply is the second important factor for the operation of data centers - and is therefore significant when looking for a location. This applies both to the availability of network capacities and to electricity costs. Electricity consumption and prices significantly determine the operating costs of data centers.

With latency-related and legal exceptions, it is of secondary importance where data is stored and computing operations are performed. Data centers can therefore make an important contribution to stabilizing the power grid as part of load management. This has an impact on the operator's electricity costs, as grid operators flexibly remunerate loads that can be switched on and off for grid stability.

The levy on CO<sub>2</sub> emissions, which has been in place since 2021, will make electricity prices in Germany even more expensive when fossil fuel-generated electricity is purchased. According to the industry association Bitkom, the costs for levies, taxes and grid fees amounted to 113.11 euros per megawatt hour (MWh) in 2019. The lowest costs were incurred in the Netherlands at 17.08 euros per MWh. According to Bitkom, the main driver for the high electricity costs in Europe is the EEG levy, from which data centers are not exempt, unlike other energy-intensive companies.<sup>12</sup>

CO<sub>2</sub> emissions levy  
boosts demand for  
environmentally friendly  
electricity

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Sweden, for example, already decided in 2016 to significantly reduce the electricity tax for data center operators. When looking for a location for a data center, regionally varying structural costs - such as grid charges - can also play a significant role. However, the CO<sub>2</sub> emissions surcharge currently under discussion as an additional burden is only part of the electricity price: In Switzerland, this levy has been in place for a long time - and electricity prices are significantly lower due to other lower levies.

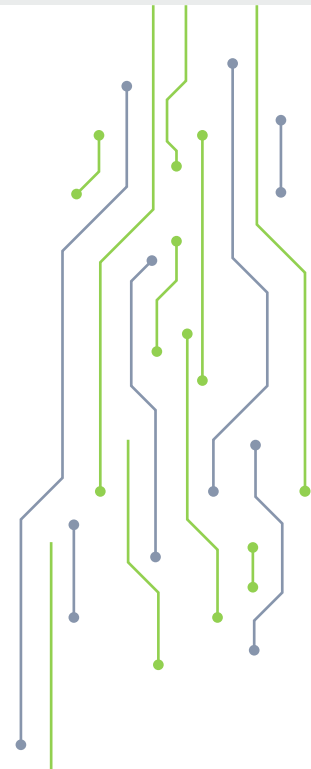
In addition to the proximity to Internet nodes (latency), power availability is another key factor when searching for data center locations. The transformation to carbon neutrality will in many cases increase power consumption. In the future, power shortages may become a relevant threat for data center operators.

Scandinavian countries such as Sweden are ideal for data center operators who attach more importance to renewable and carbon-free electricity as well as low energy costs than to low latency when choosing a location.

#### PERFORMANCE OF THE ELECTRICITY GRID USING THE EXAMPLE OF GERMANY

In view of the high demand for electricity, proximity to the medium and high-voltage electricity grid is a key location factor. The prices for grid usage are lower for withdrawals from the extra-high voltage grid than for those from the transformer levels. For example, the annual power price at the grid operator 50Hertz is a net 65.21 euros per kilowatt and year for electricity drawn from the extra-high voltage level for at least 2,500 hours and 85.50 euros for electricity drawn from the transformer level.<sup>13</sup> Operators who want to use this advantage should therefore take into account the proximity to the extra-high voltage grid and the necessary space for a transformer station to be built when looking for a location.

On the one hand, Germany scores points with operators as a location with a secure and stable power supply despite comparatively high energy costs. How will this shape up in the coming years when the production and use of sustainable energies are the central building block for climate protection and the energy transition in Europe? According to the German Association of Energy and Water Industries, the share of sustainable energies in the total electricity supply in Germany has already increased more than fivefold between 2000 and 2020.<sup>14</sup>



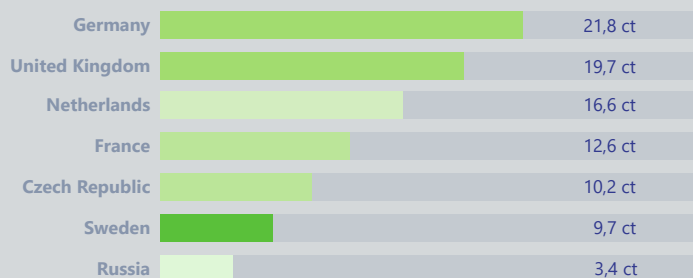
Availability of electricity  
becomes a location factor

## ELECTRICITY GRID AND REGIONAL PRICE STRUCTURES

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#### Electricity price for non-household customers per KWh (1/2020)



Share of renewable energies in gross final energy consumption (2018)

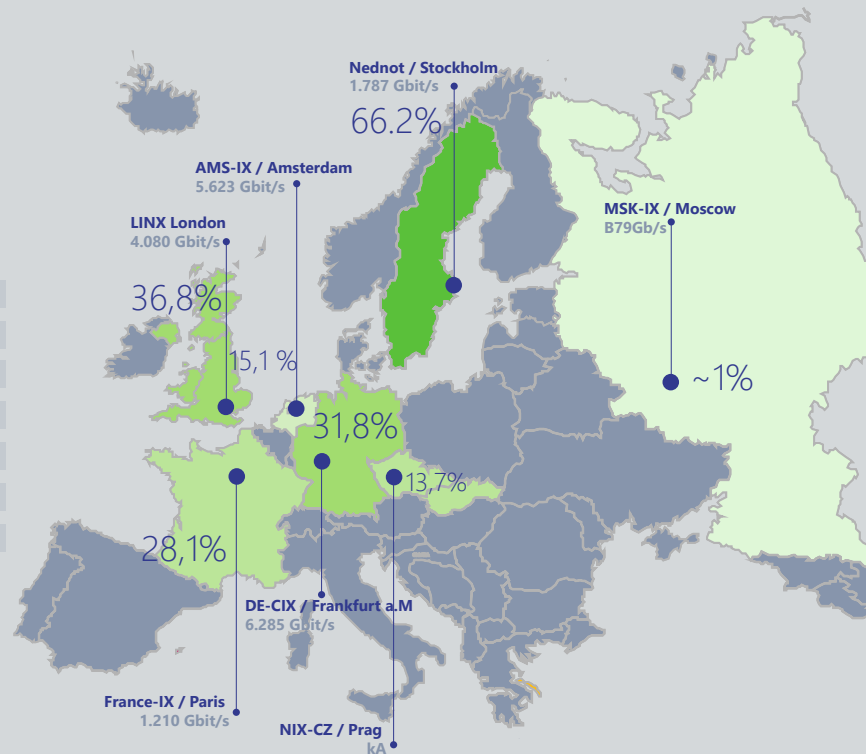


Figure 3: Share of renewable energy in gross final energy consumption (2018), data throughput by internet node and industrial electricity price (2020). Please note: The reported data throughput of the France-IX node includes only the traffic of customer and member ports measured by the provider; Sources: Eurostat (2020), gov.uk (2020), German-Russian Chamber of Commerce Abroad (2019).

On the other hand, Germany is an important location for many energy-intensive industries. The chemical industry in particular is currently in the process of converting production processes in order to significantly reduce CO<sub>2</sub> emissions by 2050. This will lead to a significant increase in electricity consumption. In the course of the transformation of the automotive industry towards battery-electric mobility, numerous plants for battery production are currently being built and commissioned in Germany and will be placing a further burden on the electricity grid in the coming years. These developments must be included in the considerations when selecting a location.



#### REGIONAL DIFFERENCES IN GRID CHARGES FOR COMMERCIAL CUSTOMERS (2019)

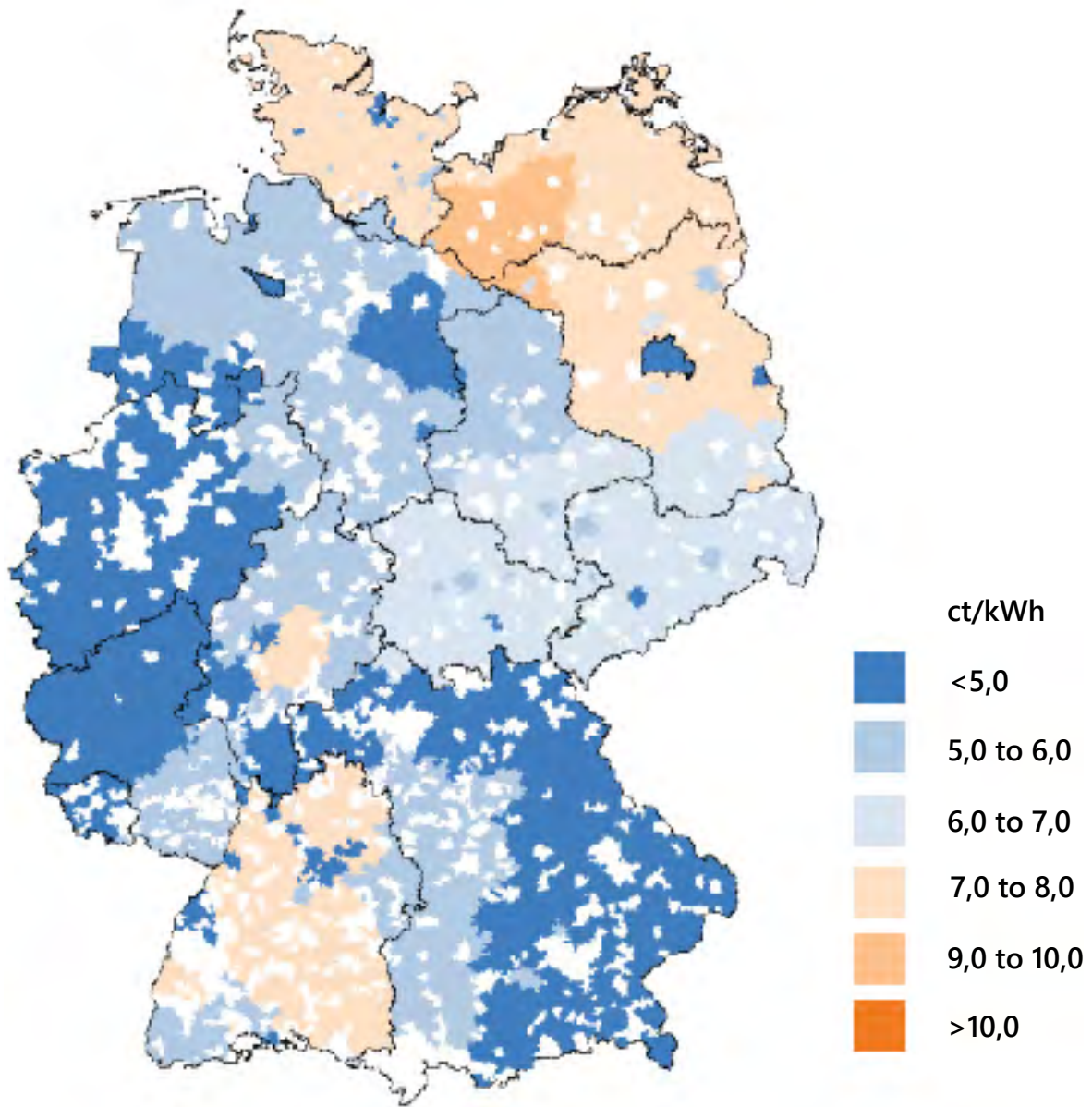


Figure 4: Regional differences in grid fees for commercial customers, 2019; source: Federal Network Agency

## INCREASING THE SUSTAINABILITY OF DATA CENTERS

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### Increasing the sustainability of data centers

Since 2017 many countries have been tightening their measures to reduce CO<sub>2</sub> emissions. When Ursula von der Leyen took office as President of the EU Commission, she placed Europe's contribution to limiting global warming at the center of her agenda. In the meantime, numerous countries have adopted far-reaching measures to regulate greenhouse gas emissions, which have significant economic implications for the power-intensive data center industry.

Many international operators and customers are striving for carbon neutrality. The American investment company BlackRock, for example, now invests primarily in sustainable companies that focus on the entire supply chain, including data centers.

A September 2020 survey by 451 Research and Schneider Electric found that 50 percent of data center operators already focus on sustainability.<sup>15</sup>



### Quo Vadis, Data Center? Between growth and regulation

As a result, there is a lot of pressure on data center operators to improve their carbon footprint. Possible approaches include:

- Purchase of CO<sub>2</sub>-free generated electricity
- Compensation of CO<sub>2</sub> emissions through the purchase of certificates
- Use of waste heat by third party users to improve the climate footprint

Key measures within the data center are:

- Upgrade of the power distribution infrastructure in the data center
- Optimization of the cooling efficiency of the existing data center
- Upgrade of the cooling infrastructure of the data center<sup>16</sup>

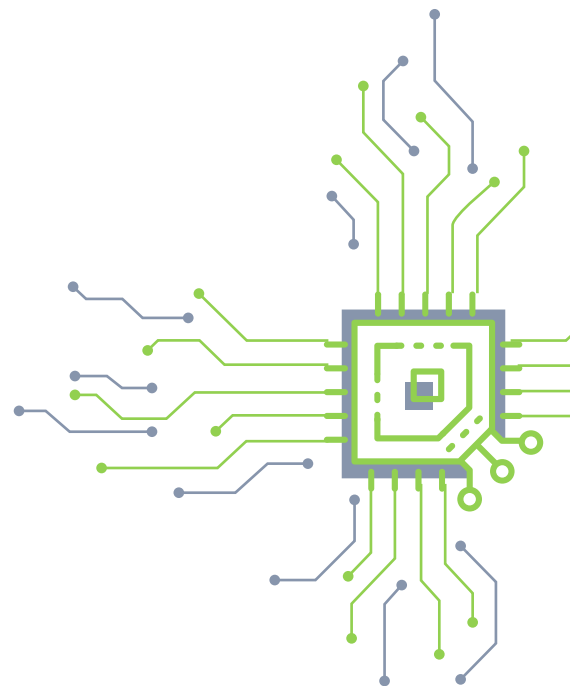
Data center operators for whom the direct purchase of CO<sub>2</sub>-neutral generated electricity - i.e. without compensation through certificates - is highly relevant often opt for locations such as Scandinavia, where a particularly high proportion of electricity is already generated sustainably today. In contrast, German locations such as the coastal regions or Lower Saxony/ Brandenburg, where wind turbines play a significant role in electricity generation, are not the first choice for most major suppliers. The economically relevant location factor of electricity price is in some cases significantly lower in other countries.

#### SUSTAINABILITY THROUGH WASTE HEAT RECOVERY

The environmental balance of data centers can be improved not only by the purchase of environmentally friendly generated electricity, but also by the subsequent use of the waste heat. This can contribute to saving electricity requirements and thus emissions elsewhere.

What power output are we talking about and is it sufficient for waste heat recovery to provide significant relief elsewhere? In Germany, the energy demand of data centers has increased by about 50 percent since 2010. In total, they consumed 15 billion kilowatt hours of electricity in 2019, more than Berlin.<sup>17</sup> A further significant increase is expected in the coming years.

In Frankfurt am Main, the existing data centers consume more than 20 percent of the city's total electrical energy. This amount of energy would



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be enough to heat about 15 percent of the buildings in Frankfurt and supply them with hot water.<sup>18</sup> Efficiency-enhancing solutions such as the use of waste heat help cities like Frankfurt achieve climate neutrality.

Companies planning a new data center in the future can therefore choose locations that allow the waste heat to be fed into the local and district heating network. To achieve the necessary temperature of 60 to 70 degrees Celsius for feeding into modern district heating networks, direct liquid cooling at the board is advantageous. If the district heating network is designed for this, the otherwise necessary heating by means of heat pumps, which also consume energy and are then also subject to EEG apportionment, is unnecessary. Conventional district heating networks require a temperature between 80 and 110 degrees Celsius. Airwaste heat of 30 to 35 degrees Celsius of the computers is usually only sufficient to directly heat surrounding buildings. Due to the heat generation for residential and commercial properties saved in this way, the environmental impact of data centers decreases.



Waste heat can also be put to good use outside of building heating:

The Windcloud 4.0 data center in North Friesland makes the heat of 35 degrees dissipated via air cooling available to a nearby algae farm. The farm grows microalgae, which are used as food supplements or in cosmetics (a growing industry), and these in turn bind CO<sub>2</sub>.<sup>19</sup>

#### SUSTAINABILITY IN THE DATA CENTER 2030

The European Data Centre Association (EUDCA), together with Cloud Infrastructure Providers in Europe (CISPE), announced an initiative at the end of January 2021 to build an exemplary sustainable data center in Brussels by the end of the year. Companies that join the "Climate Neutral Data Center Pact" commit to,

- New buildings to be operated with a Power Use Effectiveness of 1.3 or 1.4 from 1 January 2025, depending on the climate (existing data centers to be retrofitted by 1 January 2030),
- To initially obtain 75 percent of its electricity from renewable energies by 31 December 2025 (the share is to be increased to 100 percent by 31 December 2030),
- To achieve an annual target value for water consumption,





## INCREASING THE SUSTAINABILITY OF DATA CENTERS

### Quo Vadis, Data Center? Between growth and regulation

- Repair, reuse or recycle 100 percent of servers and electrical equipment by 2025, if possible; and
- Develop concepts for the productive use of waste heat.<sup>20</sup>

The initiative is supported by numerous national associations, including the German Datacenter Association in Germany. As of January 2021, 32 companies are signatories, including Atos, Amazon Web Services, Interxion, Equinix, Google, Microsoft and NTT.<sup>21</sup>



Only a few data centers in Europe feed waste heat into heating or district heating networks. The European Union is promoting the use of waste heat through the "**ReUseHeat**" project, which includes four different use cases in four cities. The expected savings from the use of waste heat, for example from a data center, amount to 5.5 gigawatt hours or 1,135 tons of CO<sub>2</sub> per year.

Data centers have been able to be certified with the "**Blue Angel**" environmental seal since 2011. Since 2020, this now also applies to a particularly good environmental performance of colocation data centers. In particular, data centers of the federal government are to comply with corresponding criteria with regard to energy efficiency. If data center services are purchased from colocation providers, these providers are also required to comply with the standards.





## Facilities Management

Given the high importance of data centers as critical infrastructure, secure and failure-free operation is at the top of the priority list. Low prices are usually the deciding factor only once the qualitative requirements have been met.

Management strategies vary from company to company, but patterns can be identified that are influenced by the type of operator.

- Colocation operators: The business model of colocation operators is to offer data center capacities securely and economically to third parties. Typically, these operators consider it their task to ensure security and technical availability. As data center operators, they define required services, negotiate prices and manage operational service providers. Colocation operators maintain specialist staff with a high level of expertise.
- Hyperscalers: The business model of hyperscalers is to offer web-based applications that require large data storage and high computing power. Operating own data centers makes economic sense for them, but does not form part of their core business. Hyperscalers operating their own data centers therefore tend to outsource management to external service providers who are also responsible for service organization and management.



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- Enterprises: Enterprise data centers are often operated to provide high computing power for (internal) enterprise applications. Data center management is further removed from the core business than colocation companies and hyperscalers. Management is often done as part of enterprise-wide facility management (not only for data centers).

What challenges typically influence the choice of service providers? The rapidly increasing number of data centers in Germany and the other core markets overlaps with an ever-increasing shortage of skilled workers, who are essential for reliable operations.

#### DATA CENTER TYPES ACCORDING TO THEIR AVAILABILITY

Data centers can be categorized according to the availability of their services:

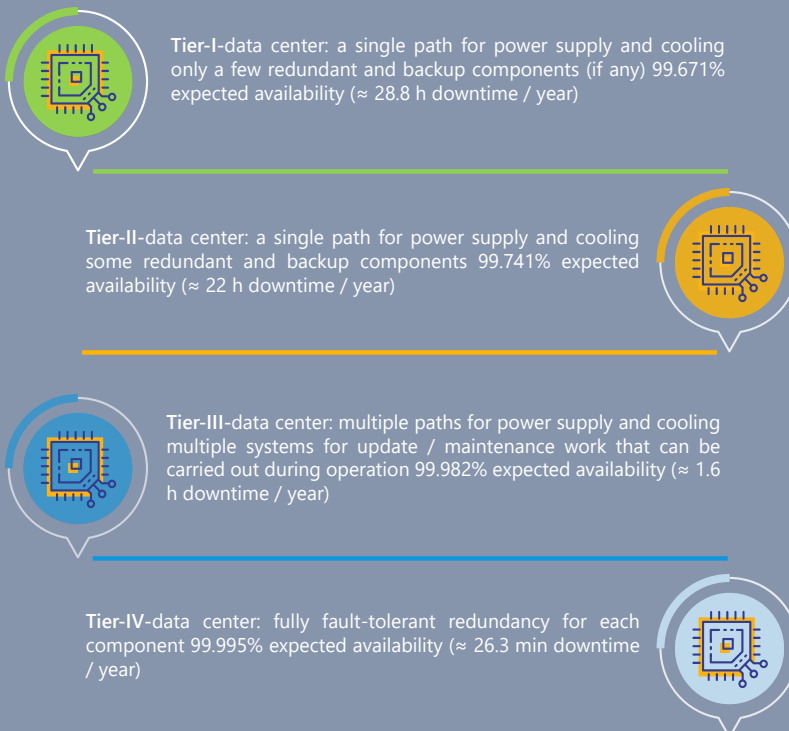


Figure 5: Data center types according to their availability

IN THE OVERALL MARKET, MORE AND MORE CLIENTS ARE FOCUSING ON THE MANAGEMENT STRATEGY

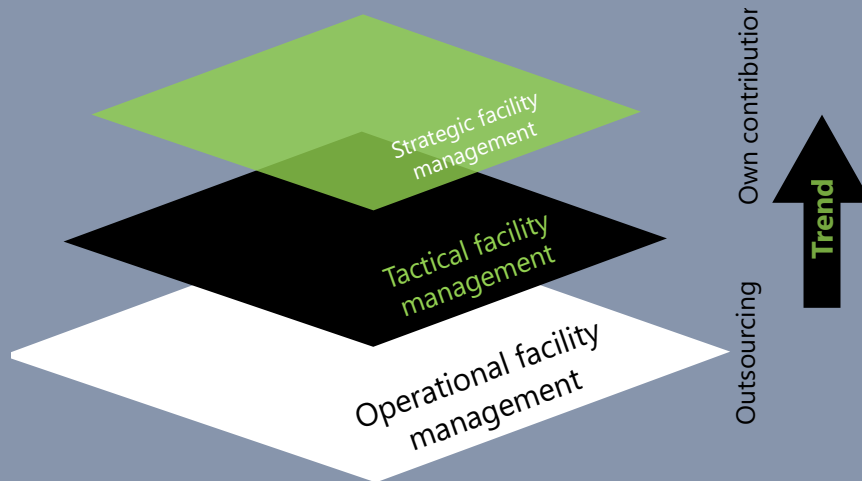


Figure 6: Simplified development of vertical outsourcing of facility services

#### Choice of service providers

Data center operators have the choice of bringing in specialists for these services or providers of a (transnational) overall service portfolio. The more management services are outsourced to external service providers, the less control remains with the operator. In the market as a whole, a concentration of service providers and an outsourcing not only of operational but also of tactical facility management to external partners has been observed as a trend for more than ten years.

When choosing a service provider, it is essential to demonstrate the competencies of both the company and the personnel to be deployed for the management of the objects. Improper service execution can, in the worst case, lead to downtime of the data center or even data loss.

Professional service partners make a significant contribution to the efficient management of data centers. For example, the share of energy consumption by building services has fallen from an average of 50 percent in 2010 to 40 percent ten years later. State-of-the-art data centers now achieve a share of around 25 percent.<sup>22</sup> Especially for companies whose expertise is not the planning of efficient building operation, the choice of service partner is therefore critical to success.

Up to now, the market has been dominated by an operational separation of facility services and classic real-estate-industry-services, such as asset and property management as well as the search for and evaluation of properties or locations.

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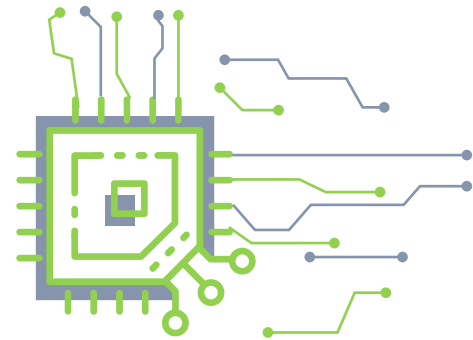
In recent years, more and more clients have done away with this separation. In a dynamic economic development, the advantages of service providers who can not only manage facilities but also demonstrate competence in the identification of locations generate additional value for their clients.

#### Technical facility services for data centers

Building technology is of particular relevance for data center operations: it ensures uninterrupted power supply, enables temporary operation or controlled shutdown in the event of a power failure via emergency power generators, and is essential for efficient and energy-efficient cooling. A detailed knowledge of the building technology for data centers and the interaction between the different systems is central, since necessary maintenance and servicing work must not jeopardize operation.

An increasing proportion of data center operators are focusing either on tactical or exclusively on strategic operational control; the latter outsource operational and tactical services to external partners. In order to keep pace with the development of building technology and thus, among other things, continuously increase energy efficiency without jeopardizing operational reliability, the service partner must have a high level of competence. Mere plant maintenance is not sufficient in this service model: Service providers must observe the market in detail in order to be able to advise their clients.

In recent years, there has been an increase in the number of contracts awarded for facility services in which expertise in renting and leasing as well as in the purchase and sale of real estate was a relevant factor. The clients expect this to result in additional synergy effects and greater flexibility in terms of real estate costs. If demand increases, a service company that already knows the client can identify additional suitable space more quickly and process the transaction once it has been approved. Particularly in the data center industry, which is characterized by rapid cycles, additional advantages are offered to operators: Service providers who have expertise in site selection for real estate transactions increase the flexibility of operators. In the event of a relocation or the establishment of additional data center capacities, they can accompany the customer as early as the planning phase and then during the commissioning phase and contribute competencies in management at an early stage.



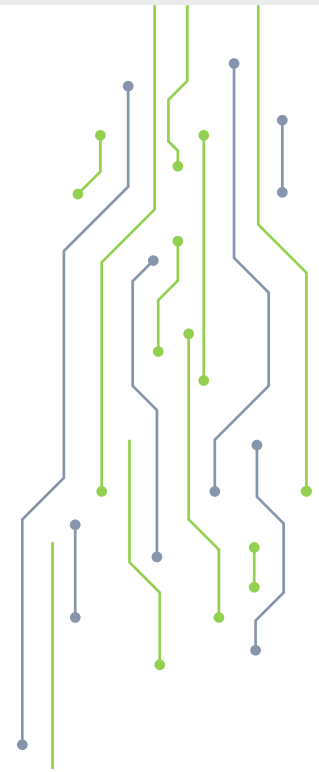
#### QUO VADIS?

Finding suitable locations for data centers and subsequently operating them has always been a challenge. The requirements are changing continuously: technological progress and demand are constantly increasing the relevance of this growth market. History shows that almost inevitably an increase in regulation via voluntary commitments by the industry and by the legislator follows. For the data center of the future, aspects that go beyond the pure performance of IT will therefore play a particular role.


The data center market is still a growth market after more than 20 years of boom. There will be a flattening of the growth curves at some point in the future because demand will increase less strongly or legislators will enact stricter regulations. Companies planning to future-proof their data centers today should take a hard look at the future requirements discussed in this whitepaper. This applies to all types of data centers. In particular, the sustainability will gain in importance for the foreseeable future.

Assistance is provided by external partners whose core business is building efficiency, site search, recruitment, management and quality assurance of technical and infrastructural services for data centers. These are almost always considered secondary services, albeit with a high impact on the performance of the core business. The decision whether to provide services in-house or outsource them should also depend to a large extent on the willingness to deal with the continuous changes in the market. In the strategic make-or-buy discussion, this question is often given too little attention.

Depending on the purpose, the future location of a data center is not limited to a region such as Frankfurt, London, Amsterdam or Paris; Stockholm, Dublin, Vienna or Prague can also be viable alternatives. Even within countries, tier-II-locations are good options for some purposes. For a comprehensive partnership, service providers who know the regional conditions well and can thus advise their customers comprehensively are particularly suitable in these cases.







## New property types require new location criteria

The current boom in the data center industry is accompanied by strong demand for land to develop new properties. In this context, the emergence of so-called hyperscale data centers has fundamentally changed the requests from clients to real estate consultants: Previously predominant requests from colocation operators or owner-occupiers (such as banks, telecoms and large corporations) have been limited to site sizes of 1 to 2 hectares, and therefore existing properties could also be considered. New requests for hyperscale data centers, which are made available to cloud service providers, often start at 4 hectares and relate exclusively to land for completely new development. Any existing buildings are valued by demolition costs alone.

### LAND APPLICATION FOR A HYPERSCALE DATA CENTER IN A GERMAN METROPOLITAN REGION

In 2020, CBRE was retained to find a site for the developer of a hyperscale data center. The request was based on proximity to existing data centers as an extension of cloud capacity. It included a size of at least 4 acres with a supply of 20 megawatts at startup. Major private and public landowners in the region were contacted to create a longlist, and a query of their own database for undeveloped and developed land was conducted. In the first phase of analysis, the plots of land were filtered out which were not suitable due to environmental risks, mostly areas in the vicinity of railway tracks with freight traffic.

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#### AN EFFICIENT SITE SEARCH FOR DATA CENTERS FOLLOWS A STRUCTURAL PROCESS

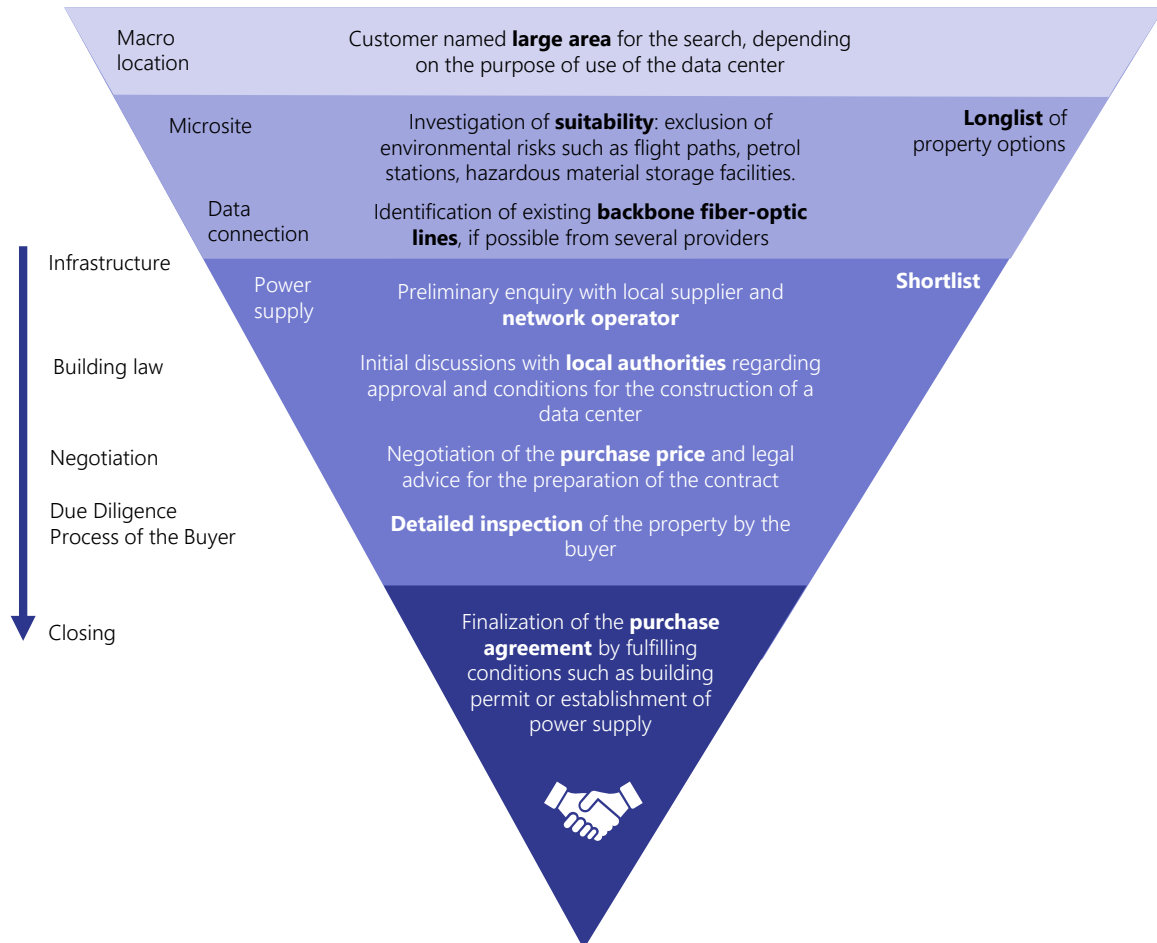


Figure 7: Due to the increasing importance of additional location factors such as waste heat recovery and environmental risks, the search for land is becoming more demanding. Professional real estate service providers ensure an efficient site search.

During further review of site options, the connection to fiber optic routes and the distance to data nodes (Internet exchange points) as well as existing data centers were measured. Often, just a few hundred meters can determine whether the required latency (time delay between two data centers) can be achieved at a site.

Power supply is a challenge in all German metropolitan regions, especially when it is considered that the consumption of a single data center can correspond to that of several tens of thousands of households. Experience shows, however, that availability varies within a supply area. Also, for the actual connection costs, the distance to substations must be taken into



### Quo Vadis, Data Center? Between growth and regulation

account, as development could become uneconomical if too great a distance is bridged. For the hyperscale data center mentioned at the beginning, the necessary power supply was only available after the planned commissioning, which is why a temporary supply was planned on site to bridge the gap.

However, even if all the criteria are met, complications can arise due to building law and the local political situation. Depending on the demand on the land market, municipalities show varying degrees of willingness towards a data center. The political support of a municipality depends on the question of how many jobs will be created, what business tax revenue can be expected and how the data center will architecturally integrate into the city. For our client, it was necessary to convince the municipality, which was otherwise in a positive mood, that the adjacent residential buildings would not be disturbed by the operation of the air conditioning systems, emergency power generators and the gas-fired power plant.

As usual, the purchase also took place in several steps: After signing an exclusivity agreement, the prospective buyer was given several months to study the property extensively, as well as to prepare the power supply, design planning and building permit. Even after signing a purchase agreement, it was necessary - as with numerous similar projects - for conditions such as planning permission and power supply to actually be fulfilled before the purchase price was due and a transfer of benefits and burdens took place.



#### PROFOUND KNOW-HOW AND TOP PERSONNEL

Smaller data centers can quickly run into trouble if, for example, the entire crew is in quarantine or critical parts of the workforce are otherwise absent. This is not the case for service providers with a broad staff. All processes, workflows and documentation are the same in all data centers, so customer operations can always be maintained. However, this absolute reliability is not the only advantage of outsourcing. As a global player with hundreds of data centers in the market, CBRE is also able to negotiate better terms and pass on price discounts to customers. Thanks to their internationality, the company can cover all countries with their facility management services and also provide other services across the entire life cycle of real estate in all commercial asset classes.

The CERM™ process (Critical Environment Risk Management) from CBRE - a specially developed process landscape to describe all work processes, procedures and documentation using standardized templates - is geared towards the seamless operation of data centers at all times (24/7/365). This includes ensuring the uninterrupted operation, training and further education, planning, analysis, development and continuous improvement of the services. The services include guaranteeing the supply of electricity and cooling, physical building security, video surveillance and maintenance. Regular tests and inspections are a matter of course, for example in the case of monthly diesel tests, fire protection and emergency lighting - with quick replacement for any component that may fail.

The entire workforce - from managers and technicians to data center staff - is regularly certified. For this purpose, CBRE cooperates closely with an international company CNet, which specializes in education and training in data centers. Thanks to 22 different training courses, the specialists can be deployed on site in a variety of ways. In addition, CBRE specifically encourages their employees to have an entrepreneurial mindset and a high degree of personal responsibility and flexibility. The experts do not just work through checklists, but actively come up with new ideas and ways of improving things for their customers.

#### CERM™-Process

Critical Environment  
Risk Management



#### INVESTMENTS IN THE DIGITAL FUTURE

In order to maintain its role as a digital pioneer, CBRE is making targeted and large-scale investments in new technologies. Virtuality - the representation of a virtual, computer-generated world - is playing an increasing role in data centers. Always on the cutting edge, the CBRE innovation department is constantly working on new projects.

One exciting example is the HoloLens - hybrid glasses in the field of augmented reality that are used by technical staff on site. Technicians can display documents on the glasses, such as manuals, or transmit their view from the workplace to equipment manufacturers via the network in order to identify sources of error. In addition, checklists for methods of operation (MOP) - i.e. instructions for every single action, no matter how small - can be viewed, while both hands remain free to work on the hardware.



#### Microsoft HoloLens

is a completely self-contained computer.

#### ROMONET – FOR EFFICIENCY AT THE HIGHEST LEVEL

Data centers must operate quickly, reliably and efficiently - even the smallest disruption can have serious consequences. CBRE has found a solution for maximum performance and security with the Romonet service. For more than a decade, Romonet has delivered technical analytics to the data center industry, enabling hyperscale, enterprise, co-lo and edge operators to ensure their facilities are designed, built and operated at peak efficiency. The platform simulates how a data center handles power and cooling, and whether the technology fits the site. Based on this, accurate space and hardware planning is possible to ensure optimal operation.

To predict what event is coming next, a patented physics model provides results and fully simulates the performance of the entire facility. The model continues to adapt to weather, IT load, control strategy, cost and individual equipment performance.

At the same time, thanks to Romonet, there is better energy efficiency as well as a positive environmental footprint and therefore a dramatic reduction in the carbon footprint: in one year alone, CBRE has saved more than \$2.2 million and 20.3 million kilowatt hours for clients in this way.

Three different models are used in the analysis. The design model is populated with manufacturer performance data to evaluate or calculate, whe-



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reas the calibration model is calibrated at the site to meter data to reflect the actual performance of the plant.

This is completed by the operational model, which routinely compares the calibrated model with meter data from the site. This enables operational inefficiencies to be uncovered, project results to be proven, predictive maintenance and accurate energy, cost and asset performance reporting.

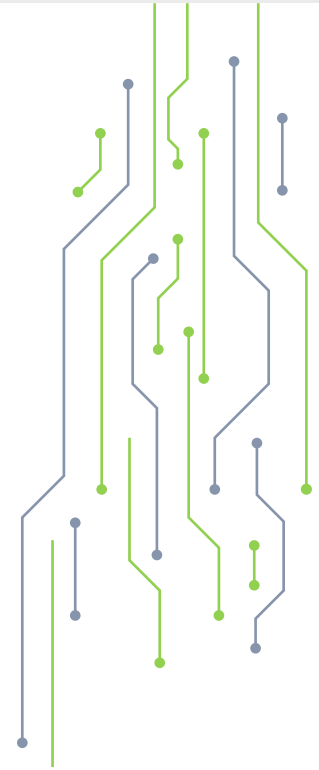
In this context, CBRE offers their customers individual approaches to solutions, depending on the requirements situation. In the design analysis, customers can have their design evaluated to match their own business hours and carry out a precise supplier selection. Performance validation ensures that the plant design offers maximum efficiency from day one. Identifying energy saving opportunities and calculating ROI (return on investment) is what the opportunity analysis does. Operational analysis stands for routine tracking of plant performance, condition-based maintenance, automated site operations and validation of ROI.

#### CASE STUDY: ANALYSIS OF THE CONSTRUCTION

CBRE | Romonet was engaged by a global colocation provider to help achieve a tight Power Usage Effectiveness (PUE) target of outsized scale. PUE is a technical metric that can be used to represent and optimize the energy efficiency of a data center. The model was used to improve the performance of the concept design and help the customer select the best vendor and control options to achieve a PUE below 1.2 at all load levels.

#### CASE STUDY: OPPORTUNITY ANALYSIS

CBRE | Romonet created a calibrated model and used it to determine \$150,000 per year in no CAPEX energy savings and \$428,000 per year in savings with some CAPEX investments. The client benefited from an asset strategy to bring older equipment up to code. The total annual energy opportunities amounted to 35 percent of the facility's annual energy consumption. The client is in the process of implementing the proposed projects and tracking their implementation using CBRE | Romonet's operational analysis.





## COMPANY PROFILE

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## COMPANY PROFILE

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CBRE is the largest global real estate services provider - in terms of revenue in fiscal year 2019. With more than 100,000 employees in over 530 offices, CBRE serves investors and real estate users as a partner for all real estate needs worldwide.

As the world's largest operator and service provider of data centers, CBRE Data Center Solutions (DCS) has outstanding know-how and expertise. CBRE manages more than 800 data centers in 43 countries. In total, more than 6,000 data center specialists work for CBRE, equivalent to approximately four million operating hours per year. CBRE provides real estate, facilities and technology solutions to data center owners, occupiers and investors around the world. As a dedicated business unit within CBRE, DCS strives to solve complex challenges at every stage of the data center lifecycle reaching from strategic and technical/commercial advice, such as on acquisitions and sales or leasing and rentals, to property management and valuation, to portfolio, transaction, project and facility management, even across countries if required.

CBRE Group, Inc. (NYSE: CBRE), is a Fortune 500 and S&P 500 company headquartered in Dallas, Texas. CBRE Germany has had its headquarters in Frankfurt am Main since 1973, with further branches in Berlin, Düsseldorf, Essen, Hamburg, Cologne, Munich and Stuttgart.



## COMPANY PROFILE

Quo Vadis, Data Center? Between growth and regulation

## COMPANY PROFILE

# Lünendonk & Hossenfelder GmbH

L Ü N E N D O N K ”



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Lünendonk & Hossenfelder, based in Mindelheim (Bavaria), has been analyzing the European business-to-business service markets (B2B) since 1983. The market researchers focus on the sectors management and IT consulting, auditing, tax and legal advice, facility management and maintenance as well as personnel services (temporary work, staffing).

The portfolio includes studies, publications, benchmarks and advice on trends, pricing, positioning and award procedures. The large amount of data enables Lünendonk to derive knowledge for recommendations for action. For decades, the market research and consulting company has published the “Lünendonk® lists and studies”, which are considered a market barometer.

Many years of experience, sound know-how, an excellent network and, last but not least, a passion for market research and people make the company and our consultants sought-after experts for service providers, their customers and journalists. Every year, Lünendonk, together with a media jury, awards deserving companies and entrepreneurs with the Lünendonk Service Awards.



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## ABOUT LÜNENDONK & HOSSENFELDER

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