Oct 2024

EUROPEAN DATA CENTER OVERVIEW

COLOPHON

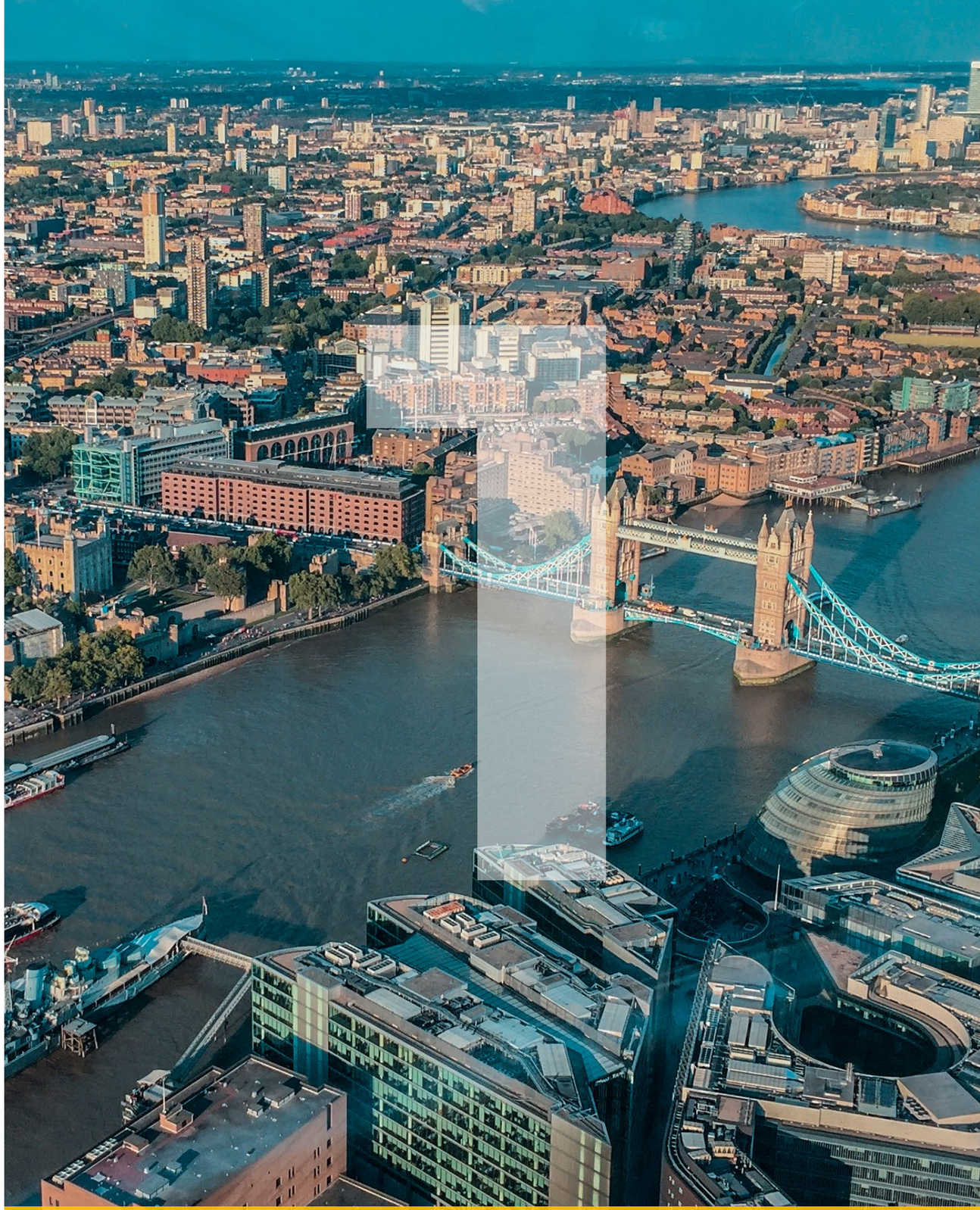
Coordination
Dutch Data Center Association
France Datacenter

Contribution
Belgian Digital Infrastructure Association
Dutch Data Center Association
France Datacenter
German Datacenter Association
Italian Datacenter Association
Norwegian Data Center Industry
Polish Data Center Association
Swedish Datacenter Industry
techUK

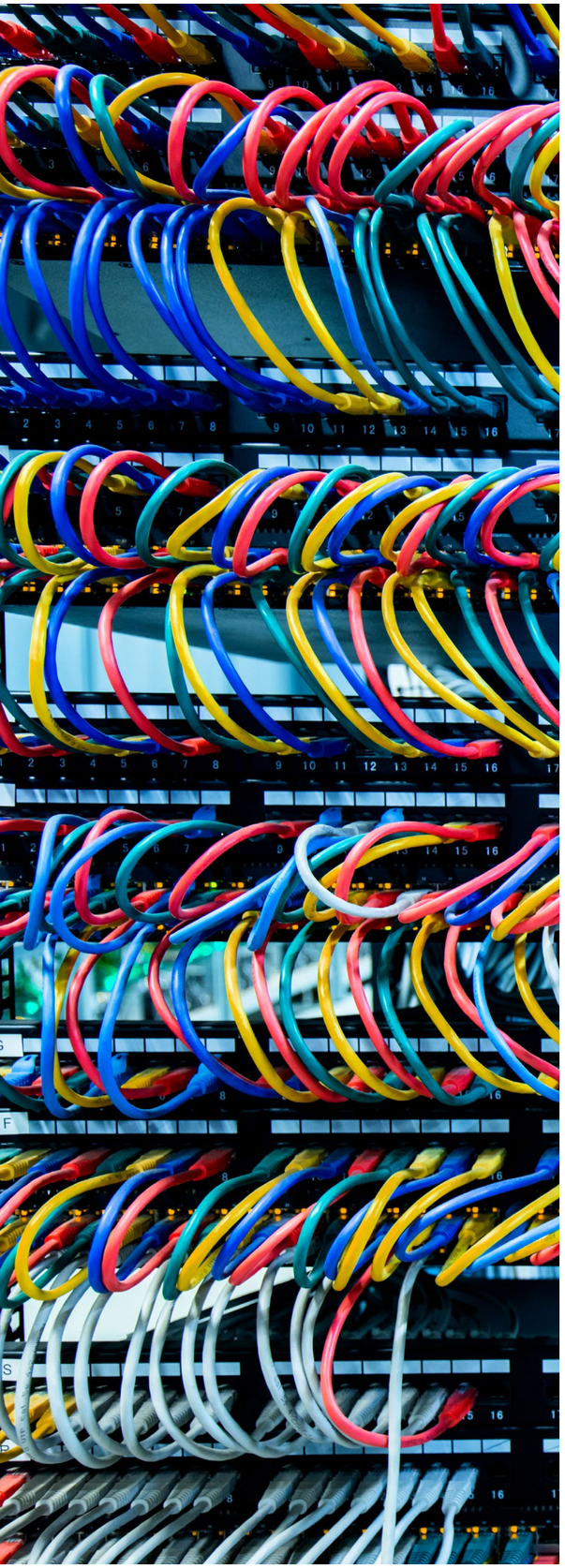
Edition
October 2024

Terms of use and disclaimer

TABLE OF CONTENTS



1 INTRODUCTION



INTRODUCTION

THE IMPACT OF DATA CENTERS ON THE CONTINENT'S DIGITAL ECONOMY

The European data center market is at the center of the transitions in our society today. With the increasing dependence on digital services, **data centers are the backbone of the continent's digital economy**. Interconnected through robust networks, these data hubs facilitate seamless access to the internet, **supporting vital sectors like life sciences, medicine, and banking**.

Demand for digital services continues to increase rapidly. Since 2010, the number of internet users worldwide has more than doubled, while global internet traffic has expanded 25-fold (International Energy Agency, 2023). All the while, innovations, such as AI, require advanced computing solutions. To meet this market demand, the European data center hubs have expanded with increased data storage, data processing, and computing power.

Additionally, **data centers foster collaboration and innovation, driving technological advancement and economic growth.** They boost ecosystems where startups, enterprises, and research institutions come together, fueling the development of innovative solutions and creating employment opportunities, both within the tech sector and beyond.

European data centers play a pivotal role in shaping the continent's digital future. While driving innovation and economic prosperity, they must **navigate challenges such as energy consumption and sovereignty to ensure a sustainable and resilient digital ecosystem**.

The European Data Center Overview will highlight the diversity of the European data center ecosystem, taking into account the added value for our European societies, as well as how data centers operate across Europe. Additionally, exploring the types of energy data centers use and the sustainability initiatives data centers are implementing. As a first of its kind, this report aims to create a comprehensive overview of the current European data center market based on the available facts, figures, and examples. Resulting in a knowledge base on the social, environmental, and economic value of this European sector.

The European Data Center Overview was created through the fruitful collaboration of several European data center associations. We hope you enjoy reading the report and find it useful for the understanding of the European data center industry.

FIRST AND FOREMOST, WHAT IS A DATA CENTER?

The intricate network of data centers serves as the backbone of our online world, ensuring the seamless operation of digital applications. These industrial infrastructures are purpose-built to meet the increasing demands of the digital age, operating non-stop, year-round. **A disruption in a data center has far-reaching consequences**, potentially affecting critical services like health care, logistics, and electronic banking, Fortunately, such incidents are rare, thanks to the adoption of cutting-edge innovations in infrastructure, cooling, power supply, and security. These systems are not only advanced but also redundant, equipped with backup mechanisms to address any potential failures.

Data centers come in different forms, from multi-tenant to single-tenant facilities. Multi-tenant data centers, also known as colocation data centers, cater to multiple businesses, offering space rental as their primary service. In contrast, single-tenant data centers exclusively serve the needs of a single entity, like a bank or government agency, managing their IT infrastructure internally. As a result, these facilities are commonly known as corporate/enterprise data centers.

FLAP-D + TIER 2 MARKETS:

THE LANDSCAPE OF THE DATA CENTER INDUSTRY IN EUROPE

Europe's data center landscape is shaped by the prominence of FLAP-D cities (Frankfurt, London, Amsterdam, Paris, Dublin) and emerging Tier 2 markets. FLAP-D cities stand as connectivity hubs, attracting major tech players. Their strategic significance lies in their important role in Europe's digital economy, serving as digital gateways to global networks and financial centers.

However, the saturation and rising costs of FLAP-D cities have spurred interest in Tier 2 markets like Madrid and Milan. These emerging hubs offer lower operating costs and growing digital ecosystems, driving investments and decentralization efforts.

While FLAP-D cities remain vital, diversifying into Tier 2 markets offers resilience and cost efficiency. It mitigates risks associated with concentrated infrastructure and enhances regional connectivity, ensuring a robust digital ecosystem across Europe.

The different types of data centers are typically categorized as followed:

	SINGLE TENANT	COLOCATION DATA CENTER			SINGLE TENANT
Type	PRIVATE / ENTERPRISE Including server spaces	REGIONAL	NATIONAL	INTERNATIONAL	HYPERSCALE
Customers	SME Enterprise Public Semi - public	SME Public Semi - public	SME Enterprise Cloud Public Semi - public	SME Enterprise Cloud SaaS	Cloud SaaS
Space **Impact**	>10 m² Small	>200 m² Small	>2000 m² Small	>5000 m² Medium	5 ha Medium / Large
Energy **Impact**	0,01 - 10 MW Small	0,5 - 10 MW Small	1 - 10 MW Medium	>5 MW Medium	50 MW Large

DATA CENTER MARKET

Tier 1 markets (FLAPD)

Emerging Tier 2 markets

Tier 3 markets of interests

Oslo
Stockholm
Helsinki
Riga
Edinburgh
Copenhagen
Manchester
Dublin
Hamburg
Berlin
Amsterdam
Poznań
Warsaw
London
Dusseldorf
Brussels
Frankfurt
Prague
Krakau
Luxembourg
Paris
Nürnberg
Munich
Vienna
Zurich
Budapest
Lyon
Milan
Bucharest
Marseille
Sofia
Rome
Barcelona
Istanbul
Madrid
Lisbon
Athens

2 ENERGY EFFICIENCY

ENERGY EFFICIENCY

PRIORITY NUMBER ONE OF THE INDUSTRY

To keep digital services and the internet running 24/7, data centers operate at all times of the day. As a result, **the data center sector is an energy-intensive industry**; running data centers requires a substantial amount of electricity. The data center sector is fully electrified, with a high number of data centers using sustainable energy resources, and working towards the goal of using 100% carbon-free energy as described in the Climate Neutral Data Centre Pact (CNDCP).

According to the European Commission (2024), the energy consumption of data centers within the Union was 45–65 TWh in 2022. Due to the **enormous growth in data volumes and the rapidly increasing demand for digital processing options for innovations such as Generative Artificial Intelligence and Quantum Computing**, this figure is expected to rise even further. Although data center operators have succeeded in decoupling absolute electricity consumption from the growth rates of data volumes by continuously increasing efficiency: measured in terms of workloads in data centers, performance increased eightfold between 2010 and 2020 (Borderstep Institut, 2021), but the energy requirement per workload was 12 times lower in 2020 than in 2010 (Eco, 2020).

THE EU'S VISION ON DATA CENTER ENERGY USE:

"The ICT sector is another important sector which receives increasing attention. (...) The Union's Digital Strategy already highlighted the need for highly energy-efficient and sustainable data centers and calls for transparency measures for telecommunication operators on their environmental footprint." (EED, 2023)

Increasingly, the EU Member States are creating transparency by monitoring the electricity use of data centers. Take a look at an overview of the electricity use of data centers per country on the next page.

A FULLY ELECTRIC INDUSTRY

Furthermore, the data center sector is fully electrified. **The sector now runs largely on low-carbon electricity**. This makes the data center sector a leader in sustainable innovation, both in energy efficiency within data centers and renewable electricity supply.

Electricity is the largest expense for a data center operator. This electricity is used to run the servers, as well as to cool the servers. Most data centers use air-cooled solutions, which are more energy-intensive. However, increasingly data centers are looking to use immersive cooling and water-cooling techniques, as these help reduce energy consumption. These innovations will also improve the Power Usage Effectiveness (PUE) ratio. This ratio describes how efficiently a computer data center uses energy.

Besides sustainability goals, creating the most energy-efficient data center is a part of the business model for operators; **saving energy saves costs. Therefore, operators are highly motivated to implement energy-saving solutions**. As a result, for the last 10 years, outsourcing to colocation data centers and the growth of cloud applications have kept worldwide energy consumption stable, despite the exponential rise in internet traffic and data center workload, as indicated by the IEA:

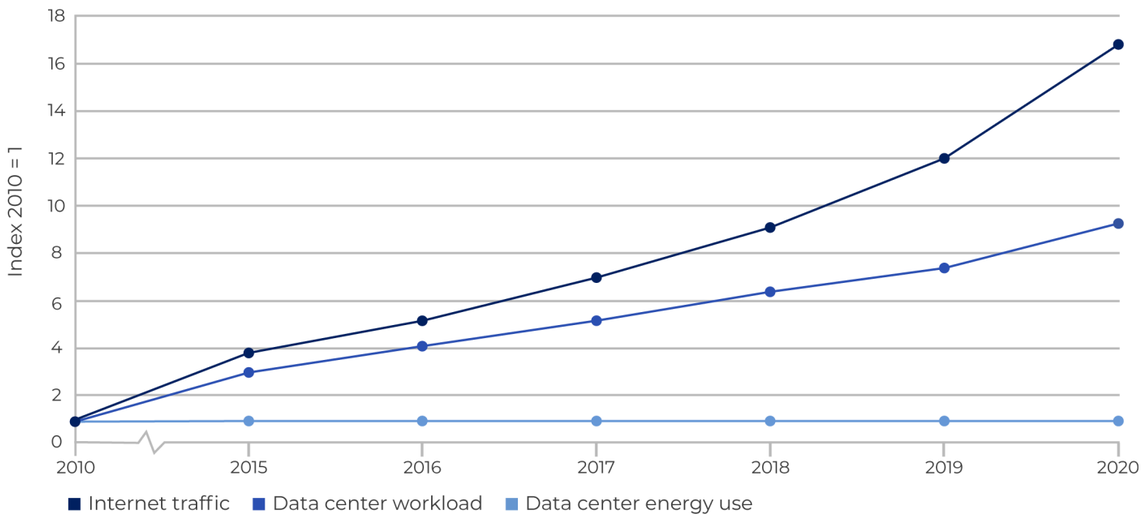
Additionally, migrating old IT infrastructure from in-house server rooms to professional data centers and public clouds saves energy. Cloud and Hyperscales have a growing share and are much more efficient than the traditional IT they are replacing. The Dutch government exhibited the benefits of consolidation by going from 64 small data centers to 5 larger data centers. Consequently, the government effectively halved its energy consumption.

Overview of the electricity use of data centers per country (European Commission, 2024*):

COUNTRY	TOTAL ELECTRICITY CONSUMPTION	% OF NATIONAL TOTAL
Belgium	± 1,5 TWh in 2021	± 2 % of national electricity consumption
Denmark	1,3 TWh in 2021	± 4,7 % of national electricity consumption
Finland	± 0,7 TWh in 2018	± 1 % of national electricity consumption
France	10 - 12 TWh in 2018	± 2,2 % of national electricity consumption
Germany (Bitkom, 2023)	18 TWh in 2022	± 3% of national electricity consumption
Ireland (CSO, 2023)	5,25 TWh in 2022	± 18 % of national electricity consumption
Italy	± 4,25 TWh	± 1,5 % of national electricity consumption
Netherlands (CBS, 2022)	3,7 TWh in 2021	± 3,3 % of national electricity consumption
Norway (Norsk Datasenterindustri, 2024)	1,5 TWh in 2023	± 1,2 % of national electricity consumption
Poland	± 2 TWh	± 1 % of national electricity consumption
Spain	± 2,9 TWh	± 1,2 % of national electricity consumption
Sweden	3 TWh in 2022	± 2,3 % of national electricity consumption
United Kingdom (TechUK, 2020)	9-10 TWh in 2020	± 3 % of national electricity supply

* The data in the table is from the European Commission unless indicated otherwise

Global trends in internet traffic, data center workloads and data center energy use, 2010-2020



EXAMPLES

ACROSS EUROPE, MANY DATA CENTER OPERATORS ARE IMPROVING ENERGY EFFICIENCY AND LOWERING THE PUE.

Evolution of the PUE

YEAR	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
PUE	1.64	1.61	1.60	1.54	1.49	1.48	1.48	1.47	1.47	1.46	1.46

Average value, as at the beginning of each period Source: Polish Market Review, 2023

EVOLUTION OF THE PUE

In 2017, for the first time, the largest providers in Poland reached an average PUE value below the 1.5 barrier. In the last few years, the PUE has remained more or less at a similar level. This is a result of the recent development of energy-efficient facilities (PMR, 2023).

The Netherlands and Germany have implemented PUE requirements for new data centers. New data centers can have a maximum PUE of 1.2 in the Dutch province of North Holland (Provincie Noord-Holland, 2023).

UTILIZING AI TO LOWER ENERGY CONSUMPTION:

The servers in data centers need to be cooled and there are different techniques to achieve this. Previously engineers needed to analyze the cooling systems and optimize them if necessary. Increasingly, data centers are utilizing AI to analyze the systems, identify inefficiencies, and implement more efficient practices; resulting in significant energy savings.

INCREASING OPERATING TEMPERATURES:

Equinix operates across Europe and is committed to reducing its overall power use by increasing operating temperature ranges within its data centers. As a part of this new efficiency initiative, Equinix expects to operate its facilities closer to 27°C (80°F) (Equinix, 2022).

USING RENEWABLE ENERGIES:

GREEN MOUNTAIN DATA CENTERS (UNDER CONSTRUCTION), GERMANY

Norwegian data center company, Green Mountain, has partnered with energy company, KMW, to establish a new 54 MW data center site in Mainz. The power supply is covered by KMW's renewable energy portfolio. The servers inside the data center will be cooled using water from the adjacent Rhine River. Resulting in a very energy-efficient data center with a PUE below 1,3 (Green Mountain Data Center, 2023).

HEAT REUSE AND BROWNFIELD APPROACH:

WINDCLOUD, GERMANY

Windcloud supplies the data center with 100% physically genuine green electricity, largely from wind energy. This energy is used for a second time when the residual heat warms an algae farm on the roof of the data center. These algae bind large amounts of CO2 in the process. As a result, the data center is not only operated CO2-free, but the algae farm also helps to absorb CO2 from the environment.

Additionally, with their Brownfield approach, Windcloud is utilizing former military buildings and bunkers in Schleswig-Holstein to house their data centers. (Windcloud, n.d.)

SUSTAINABILITY INITIATIVES

CLIMATE NEUTRAL DATA CENTRE PACT

European data center operators and trade associations have united in the Climate Neutral Data Center Pact. The pact wants to ensure that data centers are an integral part of the sustainable future of Europe. Data center operators and trade associations agreed to take the following actions to make data centers climate-neutral by 2030 (CNDCP, 2021):

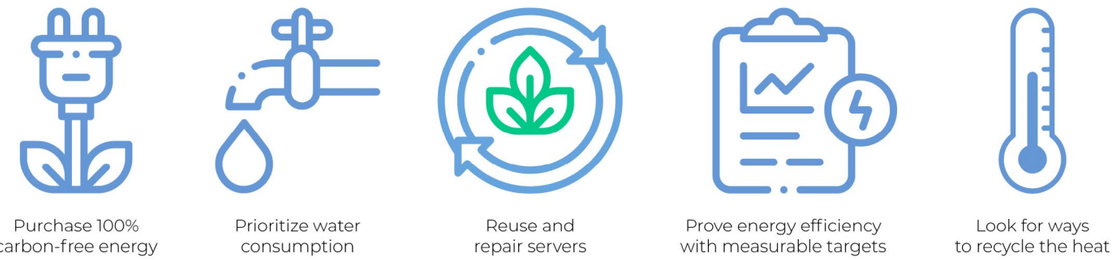
- **Energy Efficiency:** Data centers and server rooms in Europe shall meet a high standard for energy efficiency, which will be demonstrated through aggressive Power Usage Effectiveness (PUE) targets. By January 1, 2025, new data centers operating at full capacity in cool climates will meet an annual PUE target of 1.3, and 1.4.

- **Clean Energy:** Data centers will match their electricity supply through the purchase of clean energy. Data center electricity demand will be matched by 75% renewable energy or hourly carbon-free energy by December 31, 2025, and 100% by December 31, 2030.

- **Water:** Data centers at full capacity will meet a high standard for water conservation, demonstrated through the application of a location and source-sensitive water usage effectiveness (WUE) target. By January 1, 2025, new data centers at full capacity in cool climates that use potable water will be designed to meet a maximum WUE of 0.4 L/kWh in areas with water stress

- **Circular Economy:** The reuse, repair, and recycling of servers, electrical equipment, and other related electrical components is a priority for data center operators. Data centers will set a high bar for circular economy practices and will assess for reuse, repair, or recycling 100% of their used server equipment

- **Circular Energy System:** The reuse of data center heat presents an opportunity for energy conservation that can fit specific circumstances. Data center operators will explore possibilities to interconnect with district heating systems and other heat users to determine if opportunities to feed captured heat from new data centers into nearby systems are practical, environmentally sound, and cost-effective.



3 HEAT REUSE

HEAT REUSE

AN OPPORTUNITY TO RECOVER THE HEAT OF DATA CENTERS

All the green electricity needed for computing power in data centers is converted almost entirely into heat. With this residual heat, data centers can play an important role in the energy transition.

Residual heat from data centers is a valuable form of energy that can be used for deployment in heat districts and other processes that require low to medium temperatures. The residual heat is generated by the servers in data centers, this heat can be captured and used as part of the heat source strategy of a new or existing heating network. A well-designed heat reuse system can not only improve the energy efficiency of a facility, but also reduce the overall energy consumption and greenhouse gas emissions associated with traditional heating and cooling methods.

Residual heat from data centers can be seen as a sustainable low-temperature heat source of around 28 °C. The current data center residual heat temperatures are not high enough for many use cases without the addition of systems to further elevate recovered heat temperature, such as a heat pump. If we compare this with other low-temperature sources such as aqua and sewer heat, it is notable that data center residual heat has a relatively higher temperature. It is also worth noting that residual heat does not extract any heat from the environment, such as the sewage system, therefore these systems are not disturbed. All these forms of low-temperature renewable heat require a heat pump and distribution infrastructure.

However, **an important condition for the economic feasibility of any heat network is that the heat must be collected relatively close to the customer**. This is mainly due to the construction costs of district heating networks and crowding in the subsurface. Thus, to successfully deploy residual heat, customers must be located in the vicinity. The implementation of residual heat from data centers is **feasible through proper coordination of spatial planning and requires a different vision for the placement of data centers**. Either the infrastructure for the district heating system has to already be in place, or the infrastructure needs to be created by (local) governments. Important to note, **creating the district heating system is not the sole responsibility of data centers**.

EXAMPLES

ACROSS EUROPE, DATA CENTERS ARE DISTRIBUTING THEIR RESIDUAL HEAT

FRANCE

Equinix has agreed to provide the residual heat from their PA10 data center to heat the pool for the 2024 Paris Olympic Games. Additionally, Equinix agreed to provide the heat for free for the coming 15 years (Equinix, 2023).

NETHERLANDS

In Groningen, the Netherlands, QTS Data Centers and Bytesnet are collaborating with WarmteStad, the utility company for the municipality of Groningen, to provide residual heat for a large-scale sustainable district heating project (DDA, 2022).

BELGIUM

In Brussels, the Digital Realty data center sends excess generated heat to warm local households through a new sustainable district heating project in Zaventem, Belgium. (Digital Realty, n.d.)

NORWAY

In Olso, data center operator Stack Infrastructure and District heating provider Hafslund Olso Celsio, have completed a joint project. The data center is providing heat and hot water for up to 5000 Oslo homes (STACK Infrastructure, 2022).

SWEDEN

The atNorth data center in Kista is supplying the Stockholm district heating network, Exergi, with its residual heat. Eventually, the residual heat from the data center is able to heat 20.000 apartments (Tidningen Energi, 2022).

GERMANY

Data center operator in Southern Germany, JH-Computers, is feeding its residual heat into the local heating network. In cooperation with the municipality, up to 280 buildings in the town of Stödtlen are heated through a 4.5km district heating network (JH-Computer, 2023).

UNITED KINGDOM

Deep Green, a small data center in Devon is providing heat to a public swimming pool, saving the leisure center thousands of pounds in heating costs (TechUK, 2024).

ITALY

In Milan, a2a, DBA Group, and Retelit are collaborating to transform the residual heat from a data center (DC Avalon 3) into thermal energy for 1,250 families. (Data Center Dynamics, 2024).

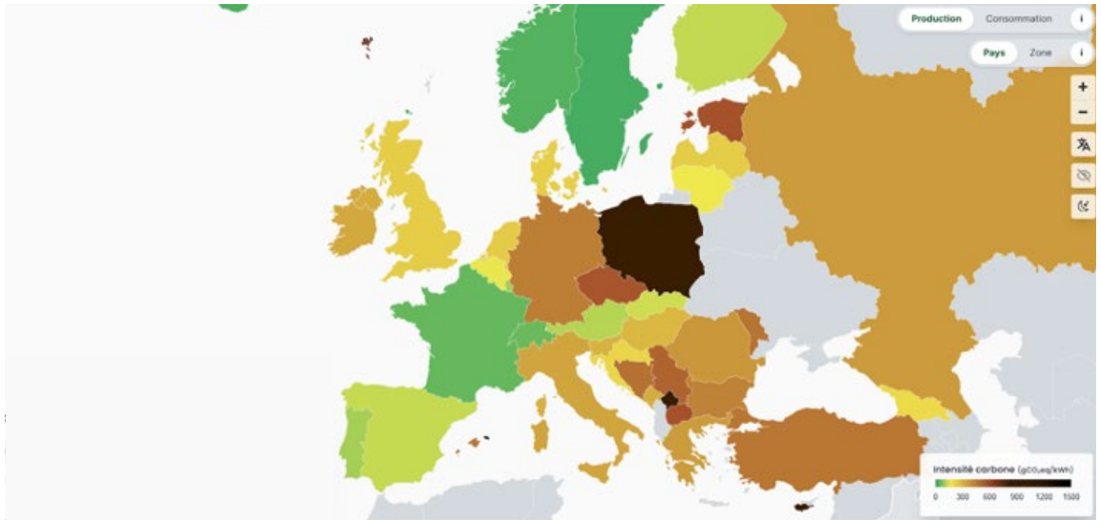
4 ENERGY MIX

ENERGY MIX

THE TRANSITION IS COMING

Currently, Europe is going through an energy transition, with the electrification of the industry and the development of renewable energies. As one of the first industries, **the data center sector is 100% electrified**. Consequently, they are taking the next steps in the energy transition.

Europe-wide, data centers are spearheading several initiatives to actively contribute to a more sustainable future. For one, **data centers are major investors in renewable electricity supply projects with the procurement of PPAs**. Thanks to these investments, government grants supporting solar and wind energy have become increasingly unnecessary. In addition to PPAs, data centers also participate in other initiatives to make their energy consumption more sustainable. For example, implementing hydrogen generators, investing in self-consumption, and consuming energy generated by hydro plants.



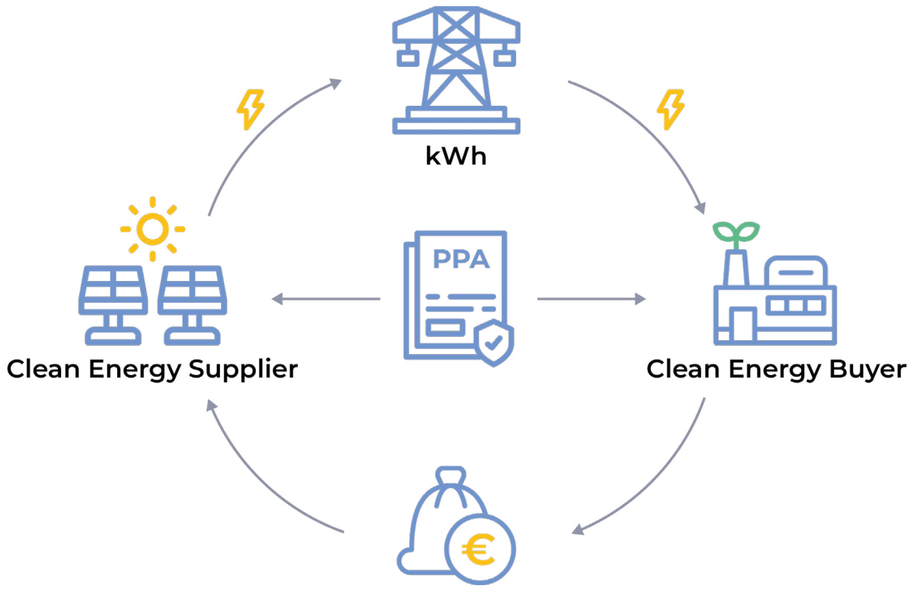
This map summarizes the carbon intensity of the various European countries' electricity mix over the last 12 months.

PPA FOCUS

A Power Purchase Agreement, or PPA for short, is a long-term agreement to purchase clean energy from a specific asset at a predetermined price between a renewable developer and a consumer — generally, a company requiring large amounts of electricity, such as data center operators. With the PPA, **data centers can ensure their energy security by participating directly in the financing of renewable energies and thus decarbonizing their consumption.**

Data centers, as a part of the IT sector, are a large driver in the PPA module. About 28% of the disclosed contracted volumes are contracted by the IT sector, making this sector an important driver in the realization of new renewable energy projects.

Scheme of an off-site Corporate PPA (the most common)



EXAMPLES

PPA & DATACENTERS ACROSS THE CONTINENT

THE IBERIAN EXAMPLE

The Iberian peninsula, with Spain and Portugal, is less dependent on fossil fuels thanks to their high production of renewable energies. These two countries have seen a huge increase in the share of renewable energies in their electricity mix in recent years. In Portugal, over the last year, 88% of electricity production came from renewable sources. In Spain, the trend is a little less strong, with 64% of electricity production from renewable sources, nuclear (18%) and gas (16%) still play a major role in electricity production. Moreover, Spain is an example of the development of renewable energy financing through PPAs. It is mandatory for companies that consume large amounts of electricity to source at least 10% of their consumption via PPAs. In Spain, the majority of data center companies sign PPA contracts ensuring renewable energy. In 2023, companies like Digital Realty or Equinix signed PPAs to develop 225MW in solar in Spain.

SPAIN

In Spain, the majority of data center companies sign PPA contracts ensuring renewable energy. In 2023, companies like Digital Realty or Equinix signed PPAs to develop 225MW in solar in Spain.

EQUINIX

Since 2021, Equinix has signed a number of Greenfield PPAs across Europe. These include 3 wind farms in Finland and 6 solar farms in Spain. In total, Equinix has signed up 490MW of capacity in Europe.

GOOGLE

Google is expanding its portfolio of Greenfield PPAs, with a contract signed in Ireland for 58MW of solar power, following previous contracts signed in Belgium (23.8MW), the Netherlands (153MW), Spain, and the UK. In Norway, Google signed a PPA for 160 MW of power from a wind farm in the southwest part of Norway once their DC project is online in 2027.

DIGITAL REALTY

Digital Realty has secured its energy supply in Europe by signing PPA contracts in Germany and Spain. These two 10-year contracts will supply its data centers with 120GWh and 65GWh of electricity per year respectively. Digital Realty's PPA in Germany will support the establishment of a new 154 MW ground-mounted photovoltaic project (Engie Deutschland, 2023).

MAINCUBES

In Germany, Maincubes and Stadtwerke Göttingen AG have signed a Power Purchase Agreement (PPA) with a capacity of 34 megawatts peak (MWp). The PPA agreement has a term of ten years and provides for the supply of pure solar power. The solar energy comes from plants south of Göttingen (Maincubes, 2024).

T-MOBILE POLAND

T-Mobile Poland has committed to purchasing 400,000 MWh of green energy in 2022-2023 which would allow it to fully meet its telco and data centers' energy demand (Swinhoe, 2022).

Top 10 countries, by disclosed contracted capacity in MW

Source: PexaQuote, PPA Tracker

NUCLEAR POWER

Countries with a low carbon intensity, such as France, Sweden, and Switzerland, can all attribute this to the use of civil nuclear power. Over the past 12 months, France, Sweden, and Switzerland have all had at least 30% nuclear power in their electricity mix (and over 60% in the case of France). Nuclear power produces a low-carbon form of electricity, therefore becoming an important part of the electricity mix for these countries.

HYDRAULIC POWER GENERATION

Due to their geography and watersheds, countries like Norway, are able to generate large amounts of hydroelectric power. For example, Norway produces almost 90% of its electricity from its hydraulic network. 98% of this power comes from renewable sources, mainly from hydropower (source: Norwegian Data Center industry). Additionally, Austria and Sweden also produce half their electricity from hydroelectric plants. Portugal is also a major producer of hydroelectricity (30% of its output). As a renewable energy source, hydropower is more "controllable" than other renewable energies, as it can be called upon as needed.

SELF-CONSUMPTION

In the future, self-consumption may be a solution for data centers to ensure their power consumption. For a data center to generate its own electricity, data centers will need a lot of space. The roofs of data centers are often filled with HVAC installations, therefore space needs to be created elsewhere on the property. Today, self-consumption represents only a small percentage of a data center's total consumption. Several data center operators in Europe already self-consume their energy production:

FRANCE

In France, CIV (now Etix Everywhere in Lille) is investing in renewable energy and consuming directly from the energy source. In this case, installing a 250-kWp photovoltaic farm allows 3% of the overall consumption to be self-produced.

BELGIUM

Google is another example, with its data center in Saint-Ghislain, Belgium. The site includes a solar farm that meets part of the company's energy needs. This initiative helps to reduce local demand for electricity on the grid and to reduce tension on the grid. The solar farm generates enough electricity annually to power the data center's water treatment facility.

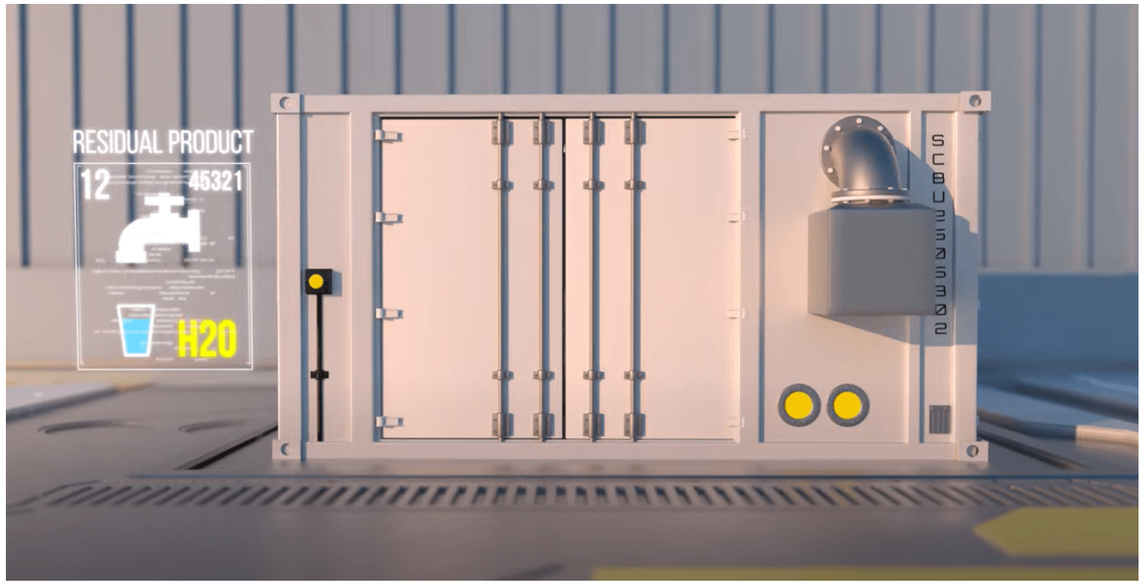
The solar farm generates enough electricity annually to power the data center's water treatment facility.

ATTENTION TO HYDROGEN

As part of the drive towards carbon neutrality, data centers are turning their attention to hydrogen. Hydrogen provides a green fuel (produced by green electricity) and replaces backup power generators running on fuel oil.

An example can be found in Groningen in the Netherlands, where NorthC data centers have replaced backup generators with green hydrogen-powered generators, a first in Europe (NorthC, n.d.).

Hydrogen powered generators



Source: NorthC Datacenters

5 DIGITAL ECONOMY

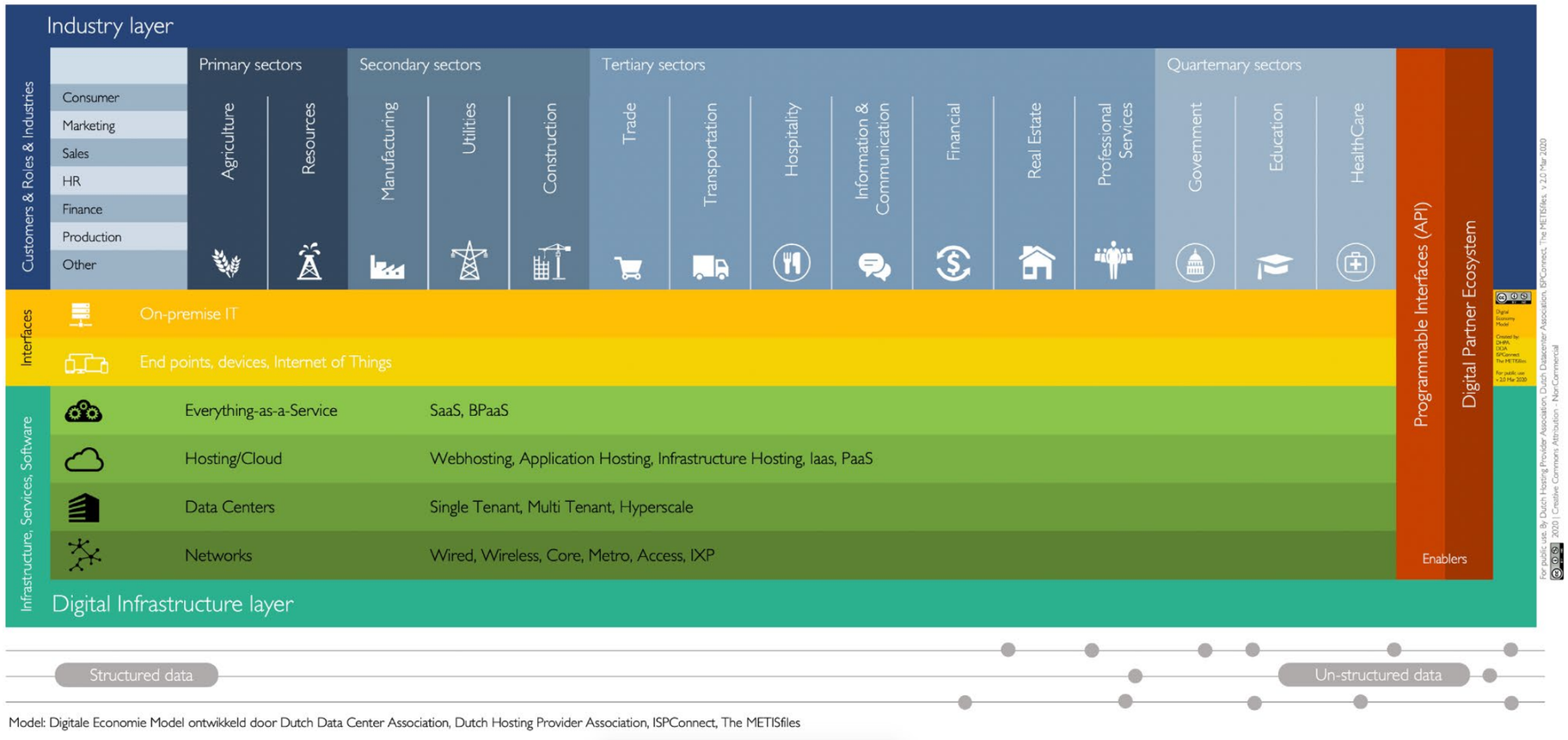
DIGITAL ECONOMY

WITHOUT DATA CENTERS, NO (DIGITAL) ECONOMY

Over the past 20 years, digitization has become the main driver of progress and growth. The digital economy is no longer separated from the economy as a whole. Digital services are prevalent in all sectors and industry layers. With the implementation of digitalization, industries, including agriculture, construction, and healthcare, are able to operate more efficiently and sustainably.

During a time when data is at the center of many processes, a strong digital infrastructure is the basis for further innovation, security, and sovereignty. **In the digital age, this infrastructure is an absolute precondition for a robust and future-proof society.** This is certainly true for European businesses: a strong digital infrastructure is essential for the continued competitiveness, innovation, and growth of our combined economies.

Here are some examples of attempts to evaluate the impacts of data centers on the economy and examples of political support for data centers in Europe.

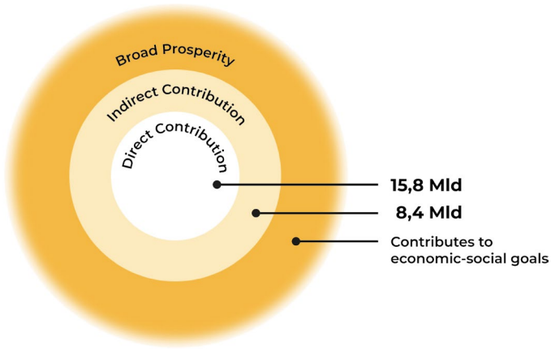


Model: Digitale Economie Model ontwikkeld door Dutch Data Center Association, Dutch Hosting Provider Association, ISPConnect, The METISfiles

EXAMPLES

IMPACT IN THE NETHERLANDS

Since the data center industry and the digital infrastructure are intertwined into all layers of our economy, it is difficult to calculate the sector's economic impact. The Dutch government researched how far-reaching the impact is. Their research shows that **digital infrastructure has a direct contribution of 15,8 billion euros to the Dutch economy. Additionally, there is an indirect contribution of about 8,4 billion euros from the ecosystem surrounding the Digital Infrastructure**. Lastly, the Dutch government concludes that the digital infrastructure is of great importance to the broad prosperity of the Netherlands. This broader prosperity also includes the contribution of digital infrastructure to societal interests that are less easily expressed in monetary terms, but no less important (Ministerie van Economische Zaken, 2024).



IMPACT IN NORWAY

According to Menon Economics, **data centers contribute twice as much to value creation compared to traditional power-intensive industries measured against energy consumption** (Norwegian Datacenter Industry, 2024). Data centers deliver NOK 1.8 million in value creation effect per annual GWh, compared to NOK 0.9 million per annual GWh in the traditional power-intensive industry (5).

The Ministry of Local Government and Regional Development (n.d.) said "Data centers in Norway are important to ensure a robust national infrastructure with fast, secure, and flexible digital services throughout the country"

IMPACT IN THE UNITED KINGDOM

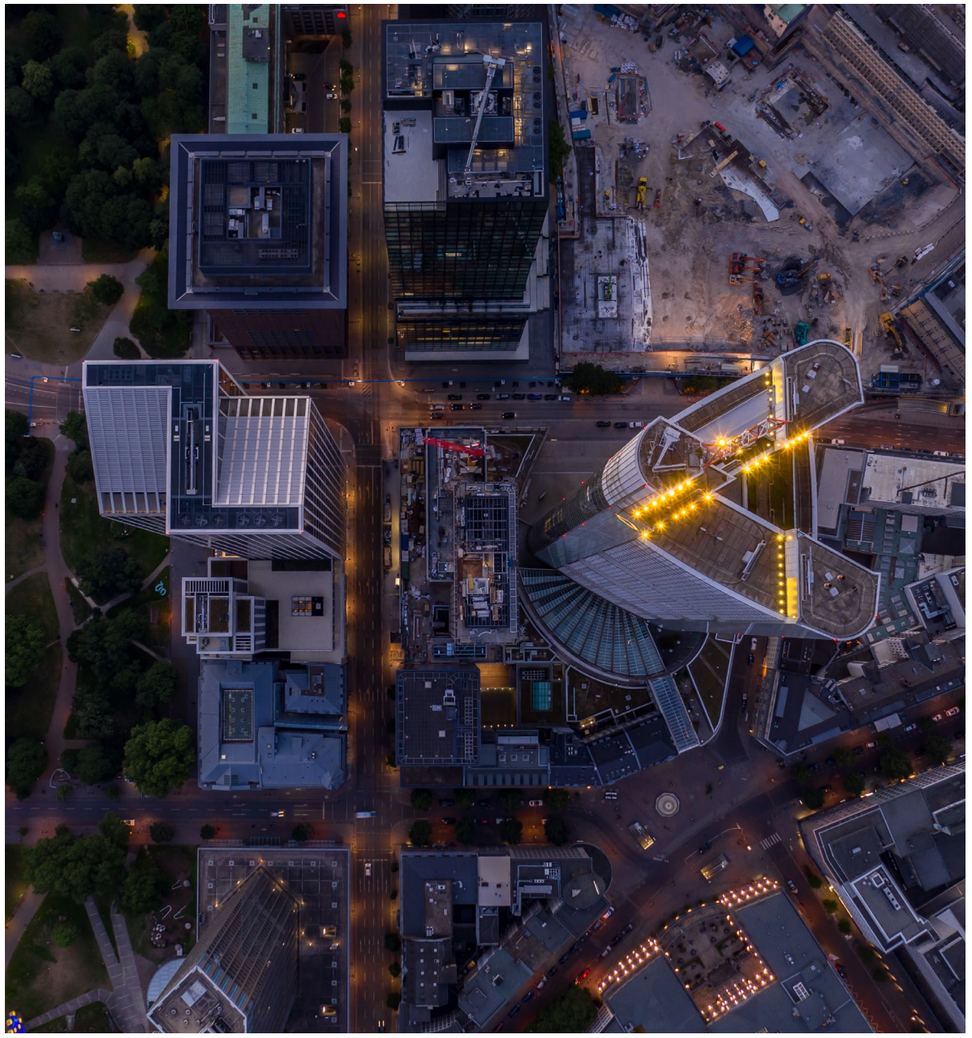
Data centers underpin an internet economy that contributes over 16% of domestic output. Each new data center contributes between £397 million and £436 million Gross Value Added (GVA) per year to the UK economy while that of each existing data center is estimated to lie between £291 million and £320 million per annum. Data centers are where industrial strategy meets digital strategy (TechUK, 2020).

IMPACT IN SPAIN

The Spanish Government has stated, in its 2025 Digital Strategy, that data centers represent one key element in 7 out of the 10 pillars of the program (Ministerio de Economia y Empresa, 2021). Data centers active in Spain have estimated that their customers represent 5% of Spanish GVA (gross value add). Examples include major insurance companies, a regional airline, access to the cloud (including on-ramps to AWS, Azure, Google and IBM Cloud), the interconnection hub of major banks, the network equipment to connect public R&D facilities, and termination equipment of subsea systems.

'TO SUCCEED IN THE BATTLE OF ARTIFICIAL INTELLIGENCE, WE MUST HAVE COMPUTING CAPABILITIES (...). BUT IF WE LOSE BASIC CONTROL, WE'RE IN **TROUBLE. BASIC CONTROL IS HAVING DATA CENTERS HERE** (...) REDOUBLED EFFORTS, FRANCE 2030 MUST ENABLE US TO SECURE THIS CHAIN. **ADDITIONALLY, WE MUST REDOUBLE OUR EFFORTS TO HAVE MUCH STRONGER, MUCH MORE MASSIVE COMPUTING DATA CENTER CAPACITIES HERE. '**

- PRESIDENT EMMANUEL MACRON



“WE NEED AI BECAUSE WE WON'T BE COMPETITIVE IN THE FUTURE WITHOUT IT.

And the fact that such data centers are being built in Germany is an important sign. ”

- VOLKER WISSING

FEDERAL MINISTER FOR DIGITAL AFFAIRS AND TRANSPORT OF THE FEDERAL REPUBLIC OF GERMANY

“EUROPE'S DIGITAL TRANSITION MUST PROTECT AND EMPOWER CITIZENS, BUSINESSES, AND SOCIETY AS A WHOLE.

IT HAS TO BE DELIVERED TO PEOPLE SO THAT THEY FEEL THE BENEFITS OF TECHNOLOGY IN THEIR LIVES. TO MAKE THIS HAPPEN,

EUROPE NEEDS TO HAVE ITS OWN DIGITAL CAPACITIES – BE IT QUANTUM COMPUTING, 5G, CYBERSECURITY, OR ARTIFICIAL INTELLIGENCE (AI).

THESE ARE SOME OF THE TECHNOLOGIES WE HAVE IDENTIFIED AS AREAS FOR STRATEGIC INVESTMENT, FOR WHICH EU FUNDING CAN DRAW IN NATIONAL AND PRIVATE SECTOR FUNDS.”

- URSULA VON DER LEYEN, *2020*

6 EMPLOYMENT & EDUCATION

EMPLOYMENT & EDUCATION

YES, DATA CENTERS DO CREATE JOBS

DIVERSITY OF JOBS OFFERED BY THE INDUSTRY

Data centers are not only the driver of many occupations in the tech sector, but in order to run 24/7 data centers need highly skilled staff. **Around 80 types of jobs have been identified in a data center**, here are some of them (French Ministry of Labor, n.d.):

DESIGNING:

- HVAC engineer (design of cooling infrastructure)
- Digital simulation engineer / BIM (simulation of air flows, new job)
- Energy Manager (improvement of energy performance)
- Systems & networks engineer

BUILDING (CONSTRUCTION OF THE SITE):

- Site Manager
- Project manager electricity (facilities)
- Electrician (facilities)
- HVAC Technician (Facilities)

NETWORK (DEPLOYMENT AND OPERATION COMPUTER ROOMS):

- Data center planner (organize rooms computer)
- Network technician (connecting servers between them and at the heart of the network)
- Data center technician (install, implement service, and configure the servers)
- IT maintenance engineer (interventions on the servers in the bays)
- Cybersecurity manager (new job)

MANAGEMENT/SALES:

- Site manager (infrastructure management and operation/ maintenance management)
- Account Manager / Sales Representative

SUPPORT:

- Security agent (surveillance & access control)
- Maintenance agent (routine cleaning of the building)

Data centers secure and support the whole digital industry, which represents around 2 million new jobs in the EU (IDC, 2015). In the Netherlands, the information and communication sector represents 330,000 jobs (CBS, 2023). In France, the digital industry grew by 8% in 2022, which shows interesting outlooks for an industry looking for new talents. The number of employees in the digital sector represented a total of 572,126 people in 2021 (BIPE sources, Numeum, and ACOSS data), and an additional 34,000 net jobs were created in 2021 (Numeum, 2022). Many jobs rely on digital infrastructure.

Data centers also help in the creation of a digital ecosystem when they're settled: they help the implementation of other companies in the areas, such as Silicon Valley. A job in a data center can create 3 other jobs. Large cloud providers attract other companies.

NUMBER OF JOBS IN THE INDUSTRY

COUNTRY	DIRECT (FULL - TIME EMPLOYEES)	INDIRECT/INDUCED
France	28.000	17.000
Netherlands	5.500	7.300
Italy	8.000	20.200
Norway	650	1.700
Sweden	±2.000	-
Germany	25.000	25.000
Spain	1.500	40.000
Poland	± 1.500	-

TRAINING AND INSERTION:

A SHARED AND BIG CHALLENGE

The European economy is changing rapidly due to digitalization. Every day, billions of people use online services in their work and private lives. This is not possible without a strong digital infrastructure. Within this ecosystem data centers, cloud service providers and fiber carriers, among others, ensure that everyone can utilize the internet 24/7 and be connected to the world. However, to run the European digital infrastructure, qualified personnel is required and it is increasingly difficult to obtain them.

The shortage of skilled workers in data centers is a shared concern around the EU, but due to 24×7 operations and growing internet traffic, it's essential for data centers to have access to qualified personnel to secure our digital economy and prosperity.

There is a shortage of many profiles, including those of data center project managers who must combine experience and knowledge of electrical, connectivity, and refrigeration subjects. In an effort to combat the shortage of skilled workers, **the sector is working hard to improve education and create a larger influx of new employees**.

EXAMPLES

One European project that is being developed is CEDCE. The European Commission has awarded a grant of four million euros to the Colleges for European Datacenter Education (CEDCE) project (CEDCE, n.d.). The goal is to create a standardized European Datacenter Education, in collaboration with educational institutions, trade organizations, and industry players. The Dutch Data Center Association (DDA), has been involved in the education project and grant application alongside different partners, such as Alfa-college, Google, and NorthC Datacenters, as well as German and Finnish stakeholders. Vocational tools will be developed in the Netherlands, and certification will be provided by the association after an exam to get the qualification.

CEDCE

FRANCE

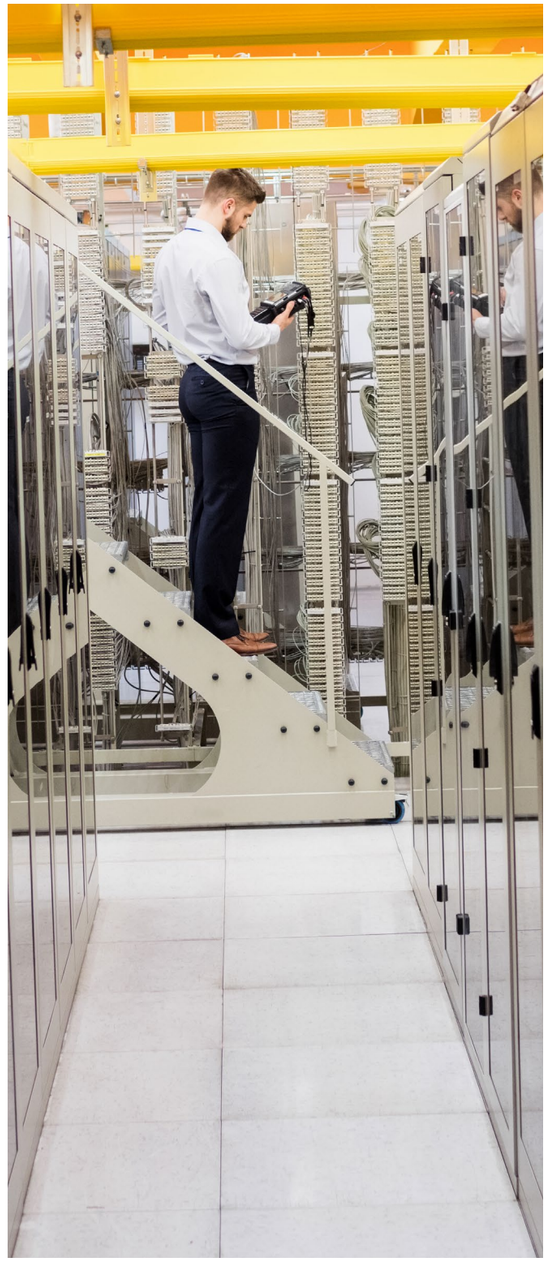
In France, there is a focus on professional reintegration, with the initiative 'Digital plumbers'. France Datacenter is a partner of a not-for-profit organization to provide training sessions for NEETs[1] with the goal of allowing young professionals to work in the data center industry in a short period of time.

SWEDEN

In Sweden, regarding data center educational programs, the Technical College offers vocational education programs in IT, engineering, energy, and urban development, ensuring alignment with industry needs. The education for data center technicians has been developed in collaboration with industry partners such as Amazon Web Services, Coromatic, Stack, EQUINIX, atNorth, and EcoDataCenter. Many of these companies are also involved in the education management group, which works on quality assurance and development (Teknikhögskolan, n.d.)

GERMANY

Data centers play an active role by offering internal training programs. There are approximately 250 trainees out of a total workforce of 5,000 employees, plus 40 students in the dual study program. Additionally, there are also dedicated educational programs, such as Training as Data Center Specialist™. The training is aimed at professionals who are already in the data center industry or want to enter it (DCE Academy, n.d.).



[1] Not in Education, Employment or Training

REFERENCES

Bitkom. (2023). Rechenzentren in Deutschland. Bitkom.
Retrieved from https://www.bitkom.org/sites/main/files/2023-05/BitkomStudieRechenzentreninDeutschland2023.pdf

Borderstep Institut. (2021). Energiebedarf der Rechenzentren steigt trotz Corona weiter an. Borderstep Institut.
Retrieved from https://www.borderstep.de/wp-content/uploads/2021/03/Borderstep_Rechenzentren2020_20210301_final.pdf

CBS. (2022). Elektriciteit geleverd aan datacenters, 2017-2021 | CBS. Centraal Bureau voor de Statistiek.
Retrieved from https://www.cbs.nl/nl-nl/maatwerk/2022/49/elektriciteit-geleverd-aan-datacenters-2017-2021

CBS. (2023). Bedrijfsleven; arbeids- en financiële gegevens, per branche, SBI 2008. StatLine.
Retrieved from https://opendata.cbs.nl/#/CBS/nl/dataset/81156ned/table?ts=1659519960367

CEDCE. (n.d.). Education. CEDCE – Colleges for European Data Center Education.
Retrieved from https://cedce.net/education/

CSO. (2023). Key Findings Data Centres Metered Electricity Consumption 2022 - Central Statistics Office. CSO.
Retrieved from https://www.cso.ie/en/releasesandpublications/ep/p-dcmec/datacentresmeteredelectricityconsumption2022/keyfindings/

CNDCP. (2021). ENGAGEMENTS OF CNDCP. Climate Neutral Data Centre Pact – The Green Deal need Green Infrastructure.
Retrieved from https://www.climateneutraldatacentre.net/

DCE Academy. (n.d.). Ausbildungsweg zum Data Center Specialist™. DCE academy.
Retrieved from https://www.dce-academy.com/ausbildungswege/data-center-specialist

Data Center Dynamics. (2024). Retelit to use waste heat from Milan data center to warm 1,250 homes. Data Center Dynamics.
Retrieved from https://www.datacenterdynamics.com/en/news/retelit-to-use-waste-heat-from-milan-data-center-to-warm-1250-homes/

DDA. (2022). QTS Groningen gaat restwarmte aan woningen in Groningen leveren. Dutch Data Center Association.
Retrieved from https://www.dutchdatacenters.nl/nieuws/qts-groningen-restwarmte/

Digital Realty. (n.d.). Environmental, Social and Governance Report 2021. Digital Realty.
https://www.google.com/url?q=https://go2.digitalrealty.com/rs/087-YZJ-646/images/Report_Digital_Realty_2206__ESG_Report.pdf&sa=D&source=docs&ust=1723633158368085&usg=AOvVaw1ZQax6jgNpNm6m7uCpliRz

Eco. (2020). eco-Studie: Rechenzentren sind Garant für nachhaltige Digitalisierung in Europa. Eco.
https://www.eco.de/presse/eco-studie-rechenzentren-sind-garant-fuer-nachhaltige-digitalisierung-in-europa/

Engie Deutschland. (2023). Digital Realty schließt Power Purchase Agreement mit ENGIE und investiert in Photovoltaik-Projekt. ENGIE Deutschland.
Retrieved from https://www.engie-deutschland.de/de/presse/digital-realty-schliesst-power-purchase-agreement-mit-engie-und-investiert-photovoltaik-0

Equinix. (2022). Equinix to "Adjust the Thermostat" to Optimize Data Center Energy Use. Equinix.
Retrieved from https://www.equinix.com/newsroom/press-releases/2022/12/equinix-to-adjust-the-thermostat-to-optimize-data-center-energy-use

Equinix. (2023). Repurposing Heat for Community Use—Heat Export Project Powered by Equinix Sets Stage for Further Cooperation.
Retrieved from https://www.equinix.co.uk/newsroom/press-releases/2023/07/repurposing-heat-for-community-use-heat-export-project-powered-by-equinix-sets-stage-for-further-cooperation

European Commission. (2024). Energy Consumption in Data Centres and Broadband Communication Networks in the EU. JRC Publications Repository.
Retrieved from https://publications.jrc.ec.europa.eu/repository/handle/JRC135926

Federal Energy Efficiency Center (BfEE). (2024). Implementing the EED: Data centers and the German Energy Efficiency Act. ca eed.
Retrieved from https://www.ca-eed.eu/ia-document/implementing-the-eed-data-centers-and-the-german-energy-efficiency-act-germany/

France Datacenter. (2024). Resources & Publications. France Datacenter.
Retrieved from https://www.francedatacenter.com/ressources/

French Ministry of Labor. (n.d.). ÉTUDE PROSPECTIVE DES BESOINS EN EMPLOIS ET COMPÉTENCES DE LA FILIÈRE DES INFRASTRUCTURES NUMÉRIQUES À L'HORIZON 2030.
https://travail-emploi.gouv.fr/IMG/pdf/etude_prospective_emploisetformations_rapportcomplet.pdf.

German Datacenter Association. (2024). Data Center Impact Report Deutschland 2024.
Retrieved from https://www.germandatacenters.com/en/data-center-impact-report-germany-2024/

Green Mountain Data Center. (2023). New KMW and Green Mountain Data Center in Germany. Green Mountain Data Centers.
Retrieved from https://greenmountain.no/green-mountain-and-kmw-partners-to-build-new-sustainable-data-center-site-in-germany/

IDC. (2015). Energy-efficient Cloud Computing Technologies and Policies for an Eco-friendly Cloud Market. Shaping Europe's digital future.
Retrieved from https://digital-strategy.ec.europa.eu/en/library/energy-efficient-cloud-computing-technologies-and-policies-eco-friendly-cloud-market

International Energy Agency. (2023). Data centres & networks - IEA. International Energy Agency.
Retrieved from https://www.iea.org/energy-system/buildings/data-centres-and-data-transmission-networks

JH-Computer. (2023). Nachhaltigkeitskonzept. JH-Computers.
https://jh-computers.de/wp-content/uploads/2023/10/20231023_Nachhaltigkeitskonzept.pdf

Maincubes. (2024). Solarstrom für Rechenzentrum-Anbieter. maincubes.
Retrieved from https://www.maincubes.com/solarstrom-fuer-rechenzentrums-anbieter-maincubes/

Ministerie van Economische Zaken. (2024). Staat van de Digitale Infrastructuur - De ruggengraat van onze digitale economie. Rijksoverheid.
Retrieved from https://www.rijksoverheid.nl/documenten/rapporten/2024/01/22/staat-van-de-digitale-infrastructuur

Ministerio de Economia y Empresa. (2021). DIGITAL SPAIN 2025. DIGITAL SPAIN 2025.
Retrieved from https://portal.mineco.gob.es/RecursosArticulo/mineco/ministerio/ficheros/210204_Digital_Spain_2025.pdf

Ministry of Local Government and Regional Development. (n.d.). Norwegian data centres - sustainable, digital powerhouses - regjeringen.no. Regjeringen.
Retrieved from https://www.regjeringen.no/en/dokumenter/norwegian-data-centres-sustainable-digital-powerhouses/id2867155/?ch=2

NorthC. (n.d.). NorthC Data Center Groningen. NorthC Datacenters.
Retrieved from https://www.northcdatacenters.com/en/northc-datacenters/groningen/

NorthC Datacenters. (n.d.). Datacenter Eindhoven | High Tech Campus. NorthC Datacenters.
Retrieved from https://www.northcdatacenters.com/northc-datacenters/eindhoven/

Norsk Datasenterindustrien. (2024). The Data Center Industry in Norway 2023-2024. datasenterindustrien.
Retrieved from https://www.datasenterindustrien.no/s/The-Norwegian-Datacenter-Industry-2023-2024.pdf

Numeum. (2022). Bilan 2022 et perspectives 2023 du secteur numérique. Numeum.
Retrieved from https://numeum.fr/actu-informatique/bilan-2022-et-perspectives-2023-du-secteur-numerique-75-de-croissance-attendue-en

PMR. (2023). Data centre market in Poland 2023. PMR.
Retrieved from https://mypmr.pro/products/data-centre-market-in-poland

Provincie Noord-Holland. (2023). Datacenterstrategie. Provincie Noord-Holland.
Retrieved from https://www.noord-holland.nl/Onderwerpen/Economie_Werk/Projecten/Datacenters/Datacenterstrategie

STACK Infrastructure. (2022). Pioneering Heat Reuse For Sustainable Data Centers | STACK. STACK Infrastructure.
Retrieved from https://www.stackinfra.com/about/news-events/press-releases/stack-infrastructure-connects-data-center-to-hafslund-oslo-celsio-system-for-city-wide-heat-reuse/

Swinhoe, D. (2022). T-Mobile Poland signs 98MW PPA - DCD. Data Center Dynamics.
Retrieved from https://www.datacenterdynamics.com/en/news/t-mobile-poland-signs-98mw-ppa/

TechUK. (2020). UK Data Centre Sector Overview 2020 - London. techUK.
Retrieved from https://www.techuk.org/resource/uk-data-centre-sector-overview-2020.html

TechUK. (2024). Warming Up to Efficiency: Understanding the Potential Benefits and Pitfalls of Data Centre Heat Export in the UK.
Retrieved from https://www.techuk.org/resource/warming-up-to-efficiency-understanding-the-potential-benefits-and-pitfalls-of-data-centre-heat-export-in-the-uk.html

Teknikhögskolan. (n.d.). Data Center Technician | YH-utbildning hos Teknikhögskolan. Teknikhögskolan | Studera på en auktoriserad yrkeshögskola.
Retrieved from https://teknikhogskolan.se/

Tidningen Energi. (2022). Nytt datacenter med inbyggd värmeåtervinning. Tidningen Energi.
Retrieved from https://www.energi.se/artiklar/2022/mars-2022/nytt-datacenter-med-inbyggd-varmeatervinning/

von der Leyen, U. (2020). Op-ed by Commission President von der Leyen. European Commission.
Retrieved from https://ec.europa.eu/commission/presscorner/detail/en/ac_20_260

Windcloud. (n.d.). Windcloud 4.0 GmbH | Ökosystem. Windcloud.
Retrieved from https://www.windcloud.de/unternehmen/oekosystem

EUROPEAN DATA CENTER ASSOCIATIONS

AUSTRIAN DATACENTER ASSOCIATION

BELGIAN DIGITAL INFRASTRUCTURE ASSOCIATION

DANISH DATA CENTER INDUSTRY

DUTCH DATA CENTER ASSOCIATION

FDCA

FRANCE datacenter

GERMAN DATACENTER ASSOCIATION

Host In Ireland

iDA. ITALIAN DATACENTER ASSOCIATION

NORWEGIAN DATACENTER INDUSTRY

Polish Data Center Association©

zit SITIP

HOST IN SPAIN

SWEDISH DATACENTER INDUSTRY

SWISS DATACENTER ASSOCIATION

EUROPEAN DATA CENTRE ASSOCIATION