



DATACENTER INVESTMENT DESTINATION GERMANY

THRIVING INVESTMENT LOCATION
FOR DATA CENTERS

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CONTENTS

03	EDITORIAL
	• GERMAN DATACENTER ASSOCIATION (GDA)
04	GDA
	• Mission
	• Profile & Member Benefits
08	2030 AMBITIONS FOR GERMANY
10	KEY FACTS GERMANY
12	LOCATION GERMANY
	• Economy
14	• Domestic Demand
16	• Investment Location Germany
18	• Full-fledged Security
20	GERMANY AS A DATA CENTER HUB
	• Locations in Germany
	• Trends: Space, Output, Employment, Yield
	• Backbone Connections in Germany/Europe
	• Location Frankfurt am Main
30	DIGITAL INFRASTRUCTURE
	• Quality Seal Made in Germany
32	AMBITIONS 2030
	• Pioneer in Renewable Energies
	• Sustainable Data Centers
36	CONCLUSION
38	GDA OVERVIEW
	• Management Board and Advisory Board Members
38	BIBLIOGRAPHY
39	IMPRINT

EDITORIAL

GERMAN DATACENTER ASSOCIATION

The rapid rise in the importance of data centers as “critical infrastructure” is increasingly attracting public attention. Our everyday lives are determined by the topics of digitalization, sustainability and energy security.

The GERMAN DATACENTER ASSOCIATION (GDA) has set itself the task of facilitating dialog between all stakeholders and of joining forces to find the best response to the urgent issues we face. We work on these issues in the six dedicated think tanks of Energy Efficiency & Sustainability, Politics & Public Relations, Real Estate, Talents, Image and Edge Computing.

As the industry’s voice, we not only enable protagonists in our industry to network with one another, but also communicate their endeavours and the progress made in charting the course toward sustainability. We support our members and partners in these activities and – in tandem with our neighboring European Associations – in achieving the overarching goal of 2030 climate neutrality. At the same time, we are committed to educating the public and the political decision-makers to the best of our ability about the opportunities, possibilities and limits of allocating data centers. Our activities extend beyond the hotspot of Frankfurt.



I invite you to support the GERMAN DATACENTER ASSOCIATION on its journey toward assuming a pioneering role and to enrich our association by contributing your valuable experience. Reap the benefit of the synergy effects with our interdisciplinary members and partners. I look forward to welcoming you.

KIND REGARDS
ANNA KLAFT



SHAPING THE DIGITAL FUTURE TOGETHER

The GERMAN DATACENTER ASSOCIATION e.V. (GDA) unites operators and owners of data centers in all dimensions. The GDA is supported by leading research institutes, municipalities and a network of partners.

Founded in Frankfurt am Main in 2018, the association offers data center operators in Germany a platform in their work together on promoting the industry's growth and enhancing its perception by the business community, society and the policymakers. Furthermore, the GDA represents its members on the respective committees in terms of the law, rules and regulations, standards, norms and political issues. Its declared goal is to sustainably improve environmental conditions for data center operation in Germany, the public's perception of the data center industry, and to enhance the appeal of German locations in the eyes of investors.

Events in the industry, organized by the GDA, allow members and stakeholders to

exchange expert ideas on technology and market trends and to develop their own networks. Together with its members and partners, the Association develops standards and norms for designing data centers. In addition, the GDA initiates and realises research projects encompassing data centers.

THINK TANKS WERE SET UP WITHIN THE GDA AT THE END OF 2021

Members concentrate their know-how in six competence groups with a view to working together on the Association's key issues. The development of a strategy for sustainable digitization and intensive dialog with representatives from politics, local authorities and the real estate industry are just as much a focus of the working groups as the promotion of young IT talent and transparent communication of, for example, sustainability goals already achieved and aspired to by the data center industry.

In cooperation with European sister associations in the Netherlands, Denmark and France, the GDA articulates German interests in Europe as well. Coordination with our European partners facilitates the achieving of shared solutions and serves to reinforce Europe's digital sovereignty.

As part of the Climate Neutral Data Center Pact, the GDA actively supports meeting the challenges presented by the European Green Deal in the digital sector. Together with the Sustainable Digital Infrastructure Alliance e.v., the GDA focuses on making the German data center market more transparent and sustainable in joint work groups, initiatives and research projects – "sustainability" within the meaning of achieving a balance between ecological, economic and social aspects.

GDA PROFILE

MEMBER BENEFITS

The GERMAN DATACENTER ASSOCIATION unites all players in the digital infrastructure value chain. Our members include operators and owners of data centers of all sizes: global players and nationwide operators – hyperscalers or colocation – as well as small and medium-sized enterprises that operate data centers. With our network of partners, we promote synergies and cooperation across traditional industry boundaries: consulting firms, energy suppliers, technical equipment suppliers and service providers are represented, as are research institutes and municipalities.

TOGETHER WE ARE SHAPING IMPROVED FRAMEWORK CONDITIONS FOR DATA CENTER OPERATION IN GERMANY – JOIN US AND BECOME PART OF THIS INITIATIVE.

“

**JOIN US IN SHAPING GERMANY'S
DIGITAL INFRASTRUCTURE OF THE
FUTURE!**



AMBASSADOR ROLE

- Take part in dialog with political decision-makers and contribute to shaping legal and regulatory requirements.
- Bring your concerns to the debate.
- Attend national and international events focused on the data center industry.
- Contribute to organizing events as well and send delegates to represent your company on site.
- Demonstrate your expert status at industry event platforms on a pan-European scale.



PROMOTING EVOLUTION

- Network with protagonists from politics, research and industry.
- Gain access to industry-relevant reference documents on regulatory, technical and commercial aspects of operating data centers.
- Join with us in playing an active part in defining standards and norms relating to data center design.
- Drawing on a strong network, launch innovative research projects on data centers and, in particular, on climate neutrality through to 2030.



INFORMATION DISSEMINATION

- Become part of an effective communication campaign to raise awareness in the public domain that digitalization and climate protection can go hand in hand.
- Help to ensure that policymakers decisions translate back into economic reality
- Together, let us inform citizens and political representatives of the positive socio-economic impact of building data centers if all stakeholders are pulling on the same rope.

AMBITION 2030 GERMANY

WELCOME TO THE HUB OF THE INTERNET!

Germany's image as a business location is still strongly projected by the producing industry and the engineering it is built on. But there is more: a digital industry that is experiencing rapid growth in generally unassuming, windowless boxes on the fringes of the metropolises. Data centers form the backbone of the digital infrastructure and are paving the way for new horizons in our networked world.

Germany is a particularly desirable location for new data centers for several reasons. In the pages that follow, we aim to give you a holistic view of advantages of digital investment while presupposing likely the most important reason for establishing operations in the Federal Republic of Germany: its central location in the European and global data network.

Some of the Internet's most important backbone lines run across the country, and the connecting data nodes regularly generate record breaking volumes of data to be processed. The continent's densely populated urban centers are swiftly accessible from any data center in Germany. Proximity to millions of users and customers, and ultimately to us all, enables a rapid exchange

of data with low latency. Short routes are indispensable – also with data transmitted virtually at the speed of light – in allowing software applications to be used live in the cloud or for enabling connected and autonomous driving. Despite the speed at which IT hardware is developing, this geographic advantage is not showing any signs of obsolescence for now.

Rapid evolution, with many new data centers being built in Germany in recent years, has resulted in a new asset class gaining a strong foothold. The mature and professional market is a fixed parameter for real estate investors and developers, with Germany offering a fusion of locational advantages for data centers against the backdrop of a generally very secure investment environment.

International consultants such as CBRE help to bridge the gap between the world of data centers and that of conventional real estate investment, offering a broad portfolio of services covering all stages of the life cycle, from acquiring land, construction, through to organization and operation and on to disinvestment. In our daily work, experience has repeatedly shown where we be of most



“
**DATA CENTERS
ARE ALREADY
AN ESTABLISHED
PLAYER IN THE
REAL ESTATE
WORLD**”

assistance, namely by explaining practices in the German market and the procedures involved in securing building rights to international data center operators.

That said, we can assuredly be of help to “traditional” real estate investors and developers in understanding the “data center” product. In our view, there can be no doubt that comprehensive consultancy services will continue to be needed in the coming years.

We are delighted by your interest in the German market and hope you will enjoy reading the pages that follow and find them informative.

MICHAEL DADA
DIRECTOR DATA CENTRE SOLUTIONS
ADVISORY & TRANSACTION
CBRE GMBH

KEY FACTS

DATA CENTERS AND GERMANY

1

Largest economy in the EU and fourth largest in the world, characterized by a polycentric structure¹

2

High density of data centers in Germany:

- Approximately 50,000 data centers, server rooms and individual server cabinets in Germany
- 3,000 data centers of a minimum of 40 kW
- 90 data centers with more than 5 MW²

3

One of the largest exchange points: DE-CIX in Frankfurt am Main (highest rate of transmitted data in the world of recently 11 Terabits per second)³

4

Five international Internet exchange points (Frankfurt am Main, Hamburg, Berlin, Munich, Ruhr district with growing relevance) & highest density backbone network



5

Germany is one of the world's largest employers in the field of data centers, offering a dual vocational training system and great potential for skilled professionals

6

Germany is a pioneer in renewable energies (41% share of renewable energies in gross electricity consumption)⁴

7

Very high data protection standards

8

Made in Germany – German Engineering Art/Work

9

Very good weather conditions and low threat levels from external influences (natural catastrophes, terror, power failures)

10

Highest standards applied to the construction and operation of data centers (fire protection, data security)

LOCATION GERMANY

ECONOMY

GERMANY IS THE MOST POPULOUS COUNTRY IN EUROPE WITH THE SECOND MOST PATENT APPLICATIONS WORLDWIDE AND THE THIRD LARGEST EXPORTING COUNTRY GLOBALLY WITH THE FOURTH LARGEST ECONOMY IN THE WORLD.



As a global hub, with one of the world's largest exchange points (DE-CIX), one of Europe's largest airports, and 16 international airports, along with position at the end of the Silk Route, with several international seaports, Germany, with its highway network of 13,000 km, offers an extensive and reliable infrastructure at all levels.



Polycentral and diversified economic structure, bolstered by a strong mid cap companies and a large number of global leaders. Strong economy with 27 companies listed in Fortune Global 500 (2021).⁵



With its central geographical location in Europe and an economy that is widely diversified and highly technological, Germany is evolving into a global player that is drawing increasingly on the services of data centers.

FORTUNE GLOBAL 500 (2021)

RANKING	COMPANY	RANKING	COMPANY
7	Volkswagen	248	Thyssenkrupp
20	Mercedes-Benz	255	E.ON
46	Allianz	271	Talanx
56	BMW	291	Deutsche Bank
74	Siemens	294	Metro
86	Deutsche Telekom	302	ZF Friedrichshafen
95	Bosch	304	Lufthansa Group
131	Uniper	312	Edeka Zentrale
135	Munich Re Group	313	Fresenius
142	Deutsche Post DHL Group	321	DZ Bank
143	BASF	404	SAP
214	Bayer	410	Phoenix Pharma
230	Continental	480	Adidas
232	Deutsche Bahn		



LOCATION GERMANY

DOMESTIC DEMAND

In terms of the demand for office space, German cities are virtually unparalleled compared with other European countries. Measured by office space take-up (including owner-occupations), no other country in Europe can match the demand in Germany for office space, with four cities in the first ten and six in the first 15.

This presents a picture confirmed by international investors as well. The "Investor Intentions Survey 2021" shows that Germany occupies first place in the ranking of the most attractive markets for cross-border real estate transactions.

Cities such as Berlin, Munich, Frankfurt and Hamburg with their international connections the serve as locations chosen by numerous global players that rely on having a stable, cutting-edge information and communication infrastructure.

Accordingly, the number of Internet connections is on the rise, as is access to cloud applications, cross-locational Intranet, along with increased mobile phone usage.



76 billion GB data volume in stationary broadband Internet traffic⁶



419 minutes of daily Internet usage by users aged between 14 - 29 years⁸



97% of the working population used Internet access in 2021⁷

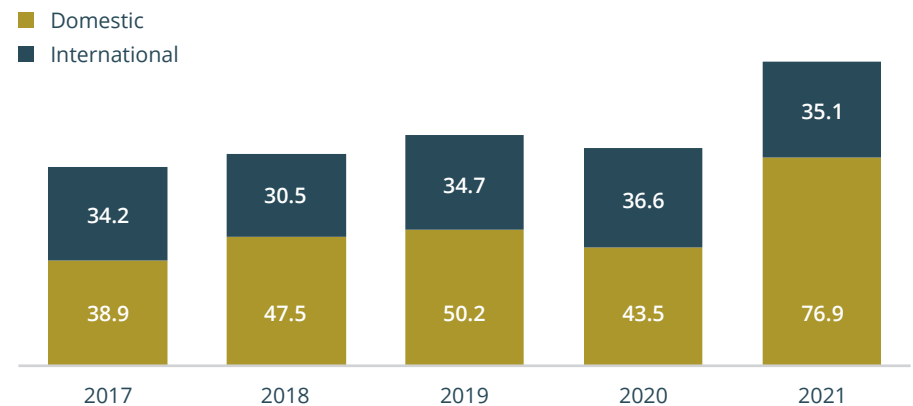


100% of people below the age of 50 use the Internet⁸

COMPARISON OF OFFICE MARKETS⁹

COUNTRY	CITY	TAKE-UP IN M ² MIO. 2021
France	Paris Ile-de-France	1.85
Great Britain	London - Central	0.85
GERMANY	BERLIN	0.82
Norway	Oslo	0.73
GERMANY	MUNICH	0.64
Belgium	Brussels	0.49
GERMANY	FRANKFURT AM MAIN	0.44
GERMANY	HAMBURG	0.43
Spain	Madrid	0.41
Luxembourg	Luxembourg City	0.37
Poland	Warsaw	0.37
Italy	Milan	0.36
GERMANY	DÜSSELDORF	0.30
GERMANY	COLOGNE	0.30
Spain	Barcelona	0.29

TRANSACTION VOLUME BY BUYER NATIONALITY DOMESTIC/INTERNATIONAL IN THE REAL ESTATE MARKET (IN € BILLION)⁹



LOCATION GERMANY

GERMANY AS AN INVESTMENT LOCATION

Germany remains an attractive investment location despite the pandemic. Contrary to the declines anticipated in investment caused by stringent restrictions on public life and on business over the course of the COVID-19 pandemic, the German start-up scene recorded a record year in 2021. Germany therefore ranks second in Europe, after Great Britain and ahead of France by a wide margin. The limelight was on digital application start-ups in particular.

The proportion of foreign direct investment (FDI) also performed better in comparison with other European countries where the pandemic had a greater impact, which suggests that ADI, which has been rising steadily for nine years, has been merely dented. In 2019, ADI reached a record level of €556 billion.¹⁰

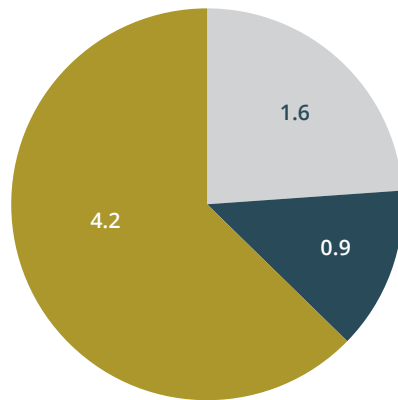


2021 marks a record year for the start-up scene in Germany

756 financing rounds add up to €17.1 billion

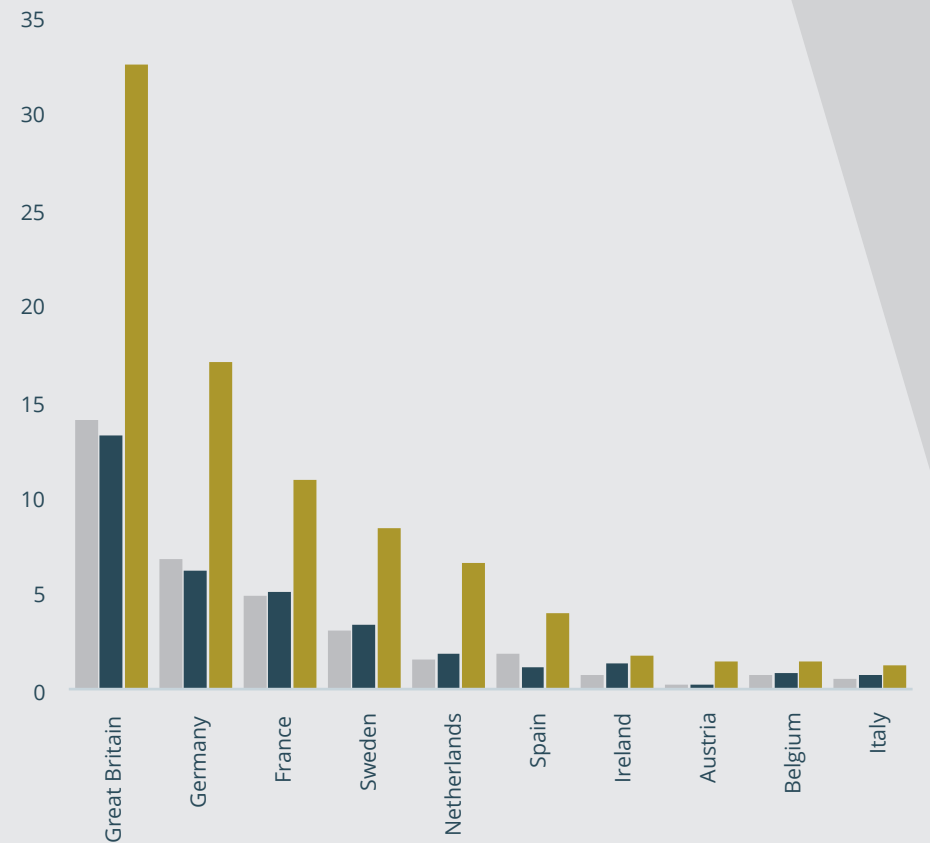
Strong focus on start-ups for digital applications

START-UP INVESTMENT VOLUME FOR FINTECHS (IN € BILLION)⁹



2019 2020 2021

START-UP INVESTMENT VOLUMES (IN € BILLION)⁹



2019 2020 2021

LOCATION GERMANY

FULL-FLEDGED SECURITY

RANKS NINTH OF 163 COUNTRIES IN THE "POSITIVE PEACE INDEX"

This index defines the attitudes, institutions and structures that create and sustain peaceful societies.¹¹

HIGH DATA PROTECTION STANDARDS[‡]

Second in Europe's data protection ranking. Stringent implementation of GDPR.¹⁴

COVID-19 RESCUE PACKAGE OF €130 BILLION

An amount of €50 billion earmarked for future growth areas, with a focus on digitalization and climate protection.¹²

Building security, fail-safe power supply and air conditioning are ensured in Germany based on strict **FIRE SAFETY RULES** and regulations. The risk of fire in data centers is therefore very low.

Power supply is becoming more sustainable, environmentally compatible, and is second to none in terms of reliability in European countries. Number 2 worldwide with an **AVERAGE OF 10.73 MIN* WITHOUT POWER IN 2020**.¹³

SAFETY RULES AND REGULATIONS on construction:

- Data center standard EN 50600
- ISO/IEC 22237
- TÜV specifications
- BSI criteria
- Tier classification

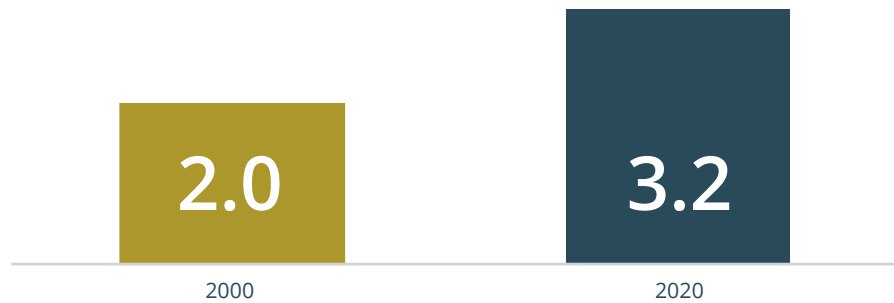
*Length of interruption per connected end user.

[‡]The right to informational self-determination is set out as part of the general right to personality under Art. 1 (1) in conjunction with Art. 2 (1) of the Basic Law (Grundgesetz).

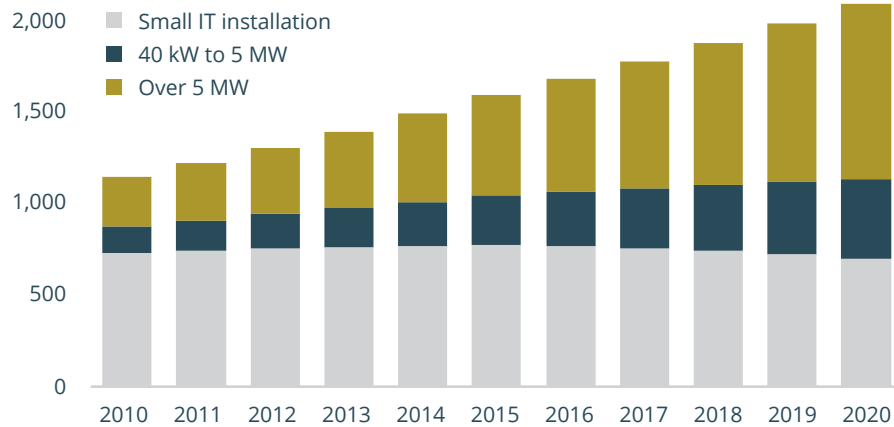
GERMANY AS A DATA CENTER HUB

LOCATIONS IN GERMANY

EXISTING SPACE OF DATA CENTERS
(IN M² MILLION)¹⁵





INSTALLED DATA CENTERS - CAPACITY (IN MW)²



Despite a steady increase in efficiency in the ICT area, over 25% more space has been needed for IT infrastructure since 2010.²

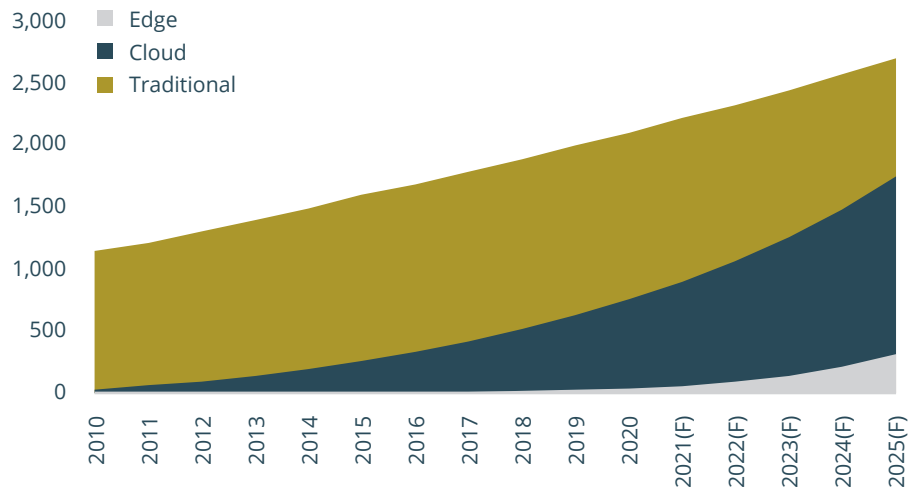


-  **TOP DATA CENTERS**
Locations with international Internet nodes
-  **UP-AND-COMING**
Data center locations

GERMANY AS A DATA CENTER HUB

TRENDS: SPACE, OUTPUT, EMPLOYMENT, YIELD

CAPACITIES OF DATA CENTERS AND SMALLER IT INSTALLATIONS* (IN MW)²



Every third real estate investor is considering investing in data centers in the future. Of the real estate investors surveyed, 41% have plans to invest in data center property in the next two years. One quarter of these investors plan to earmark funds of between €50-250 million, 60% of which for direct investment.

The rising demand for data centers is increasingly garnering the attention of real estate investors. Along with attractive yields, 10 of the top 15 cities in the DACH region are located in Germany. Frankfurt am Main, Munich and Berlin occupy the top three positions.¹⁵

*Cloud capacities in Germany have increased considerably – growing by 150% over the period from 2016 to 2021. In 2021, they accounted for 33% data center capacities (2016: 20%).

At present, an estimated €2.5 billion is invested per year in data center infrastructure (buildings and technical fit-out).²

EARLY ADOPTER

Germany features among the most advanced countries in the introduction of cloud applications (hyperscale data centers).



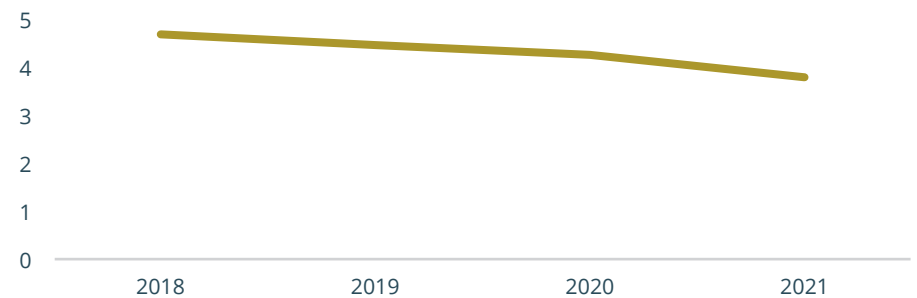
- Fourth largest employer in the world in the field of data centers.¹⁵
- 130,000 full-time employees in data centers (600,000 in Europe and 2.2 million WW)
- 80,000 more employed in the industry.
- Increase of 14% in the demand for workers in Europe by 2025.²



- Annual demand for engineers in Germany set to rise from 44,000 to 48,300 by 2027.
- Also trained at numerous universities of excellence in Germany with international relations and a sphere of influence stretching into space (ESA)

(Karlsruher Institut für Technologie, RWTH Aachen, TU Darmstadt, TU Dresden, TU Munich)

PRIME YIELDS FOR DATA CENTERS (IN %)⁹



GERMANY AS A DATA CENTER HUB

BACKBONE CONNECTIONS IN GERMANY¹⁶

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

- International exchange points
- Data exchange points
- Backbone network, higher density
- Backbone network, highest density



GERMANY AS A DATA CENTER HUB

BACKBONE CONNECTIONS IN EUROPE

FRANKFURT AM MAIN

Name	DE-CIX ³
All-time peak	11,140 Gbit/s
Annual average	7,176 Gbit/s

AMSTERDAM

Name	AMS-IX ¹⁹
All-time peak	10,969 Gbit/s
Annual average	6,900 Gbit/s

PARIS

Name	France-IX ¹⁷
All-time peak	1,850 Gbit/s
Annual average	1,330 Gbit/s

STOCKHOLM

Name	Netnod ²⁰
All-time peak	2,720 Gbit/s
Annual average	2,017 Gbit/s

DUBLIN

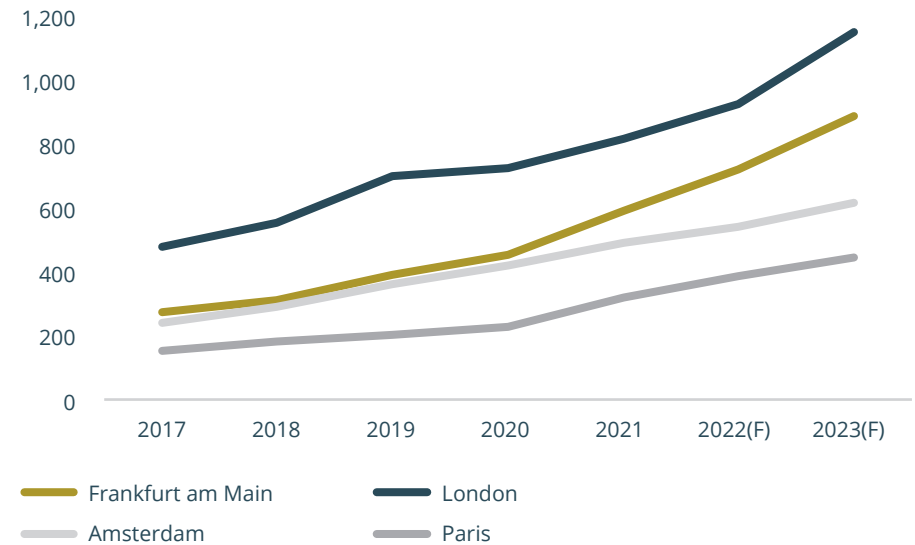
Name	INEX ¹⁸
All-time peak	754 Gbit/s
Annual average	395 Gbit/s

LONDON

Name	LINX LON 1 ²¹
All-time peak	5,759 Gbit/s
Annual average	4,131 Gbit/s

The traffic data indicated are examples of individual nodes and are not indicative of the importance of the respective location.

PROJECTION FOR FLAP MARKET SUPPLY, 2017-2023 (CAPACITY IN MW)⁹



GERMANY AS A DATA CENTER HUB

LOCATION FRANKFURT AM MAIN

HOW DOES MAINOVA AS FRANKFURT'S ENERGY SUPPLIER ENSURE THAT SUFFICIENT CAPACITY IS AVAILABLE FOR DATA CENTER DEVELOPERS?

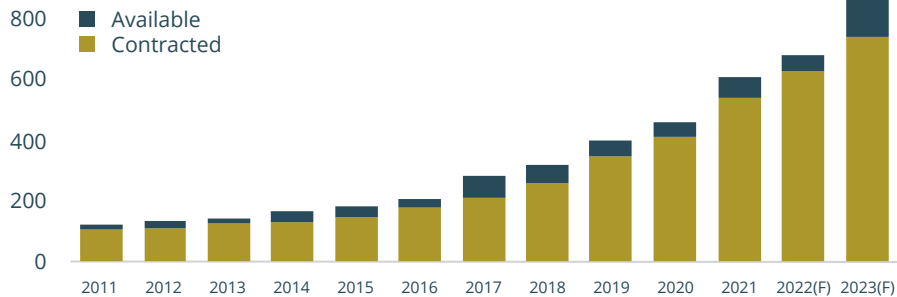


Data centers are vital to digital infrastructures. They have long become established as a key foundation for the development of a business location and its prosperity and are a precondition for the digitalization of the economy and of society. Along with its connection to high-speed data lines, Frankfurt am Main as an Internet capital boasts excellent power supply reliability. Against the backdrop of the industry's rapid growth, achieving compatibility between supply reliability and climate protection presents a challenge. With this in mind, Mainova has raised the capacity of Frankfurt's power grid by 50% within a time frame of seven years.

Together with upstream grid operators, we will be bringing an additional 500 MVA output and more to the city by 2027, which would cover the requirements of a major city with 500,000 inhabitants.

DR. CONSTANTIN H. ALSHEIMER
CHAIRMAN OF THE MANAGEMENT BOARD OF MAINOVA AG

FRANKFURT COLOCATION MARKET (IN MW)⁹



FACTS

Frankfurt am Main has Europe's highest data center density; capacity rose by 398% over the period from 2011 to 2021, and therefore by 40% p.a. Current capacity is expected to grow by another 50%, from 120 MW to 597 MW, by the end of 2023.⁹



In 2022, 73 MW are expected to go live in Frankfurt am Main, more than in any other European market.

Along with one of the world's largest Internet exchange points (DE-CIX), Frankfurt am Main is also home to other international nodes, including EQIX-FR, KleyReX and ECIX-Fr, to name a few.

DIGITAL INFRASTRUCTURE

QUALITY SEAL MADE IN GERMANY

COMPREHENSIVE GLASS FIBRE ROLL-OUT BY 2030

The German government is promoting the comprehensive glass fibre roll-out with a €12 billion package.²²

DIGITAL ECONOMY AND SOCIETY INDEX (DESI) PUTS GERMANY IN SIXTH PLACE MEASURED BY CONNECTIVITY.

In terms of the "5G readiness" indicator, Germany figures among Europe's top performers, achieving 100% (transmitter mast readiness for 5G). Germany takes second place in the EU league table of general landline broadband usage.²³



94% over the age of 13 use the Internet⁷



227 min. daily Internet usage by generation Z⁸



99% of school-children / students used an Internet access in 2021⁷



74% regularly use on-demand content via the Internet (TV, Netflix, Amazon etc.)⁸

4G

96%

Network coverage



MOBILE NETWORK

5G

53%

Network coverage

FIXED-LINE CONNECTION

Broadband availability of at least 100 Mbit/s in

>75%

of households

- >95-100%
- >75-95%

2030 AMBITIONS

PIONEER IN RENEWABLE ENERGIES

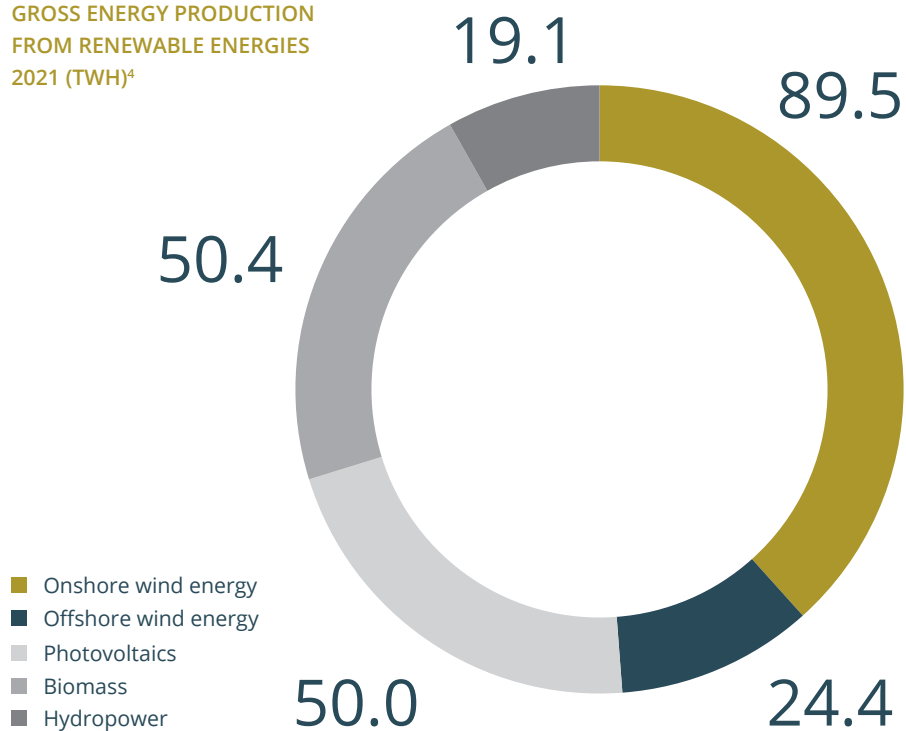
2021

Investments in facilities for harnessing renewable energies stood at €13.4 billion.

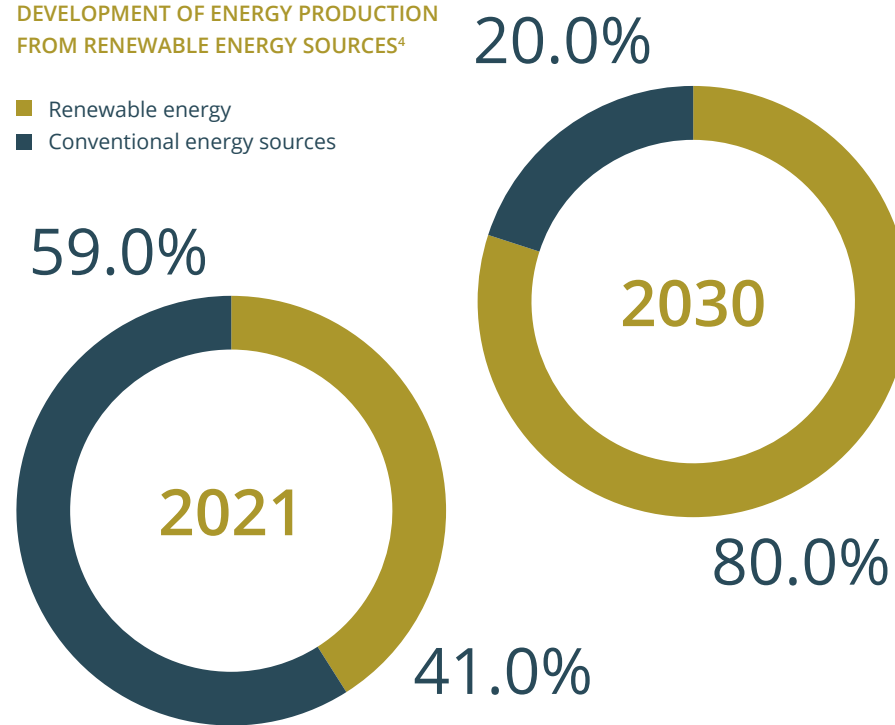
Avoidance of 221 million tons of CO2 equivalents.

In 2021, 19.7 % of Germany's final energy consumption across all sectors covered by renewable energies. EU target of 18% exceeded.

GROSS ENERGY PRODUCTION FROM RENEWABLE ENERGIES 2021 (TWH)⁴



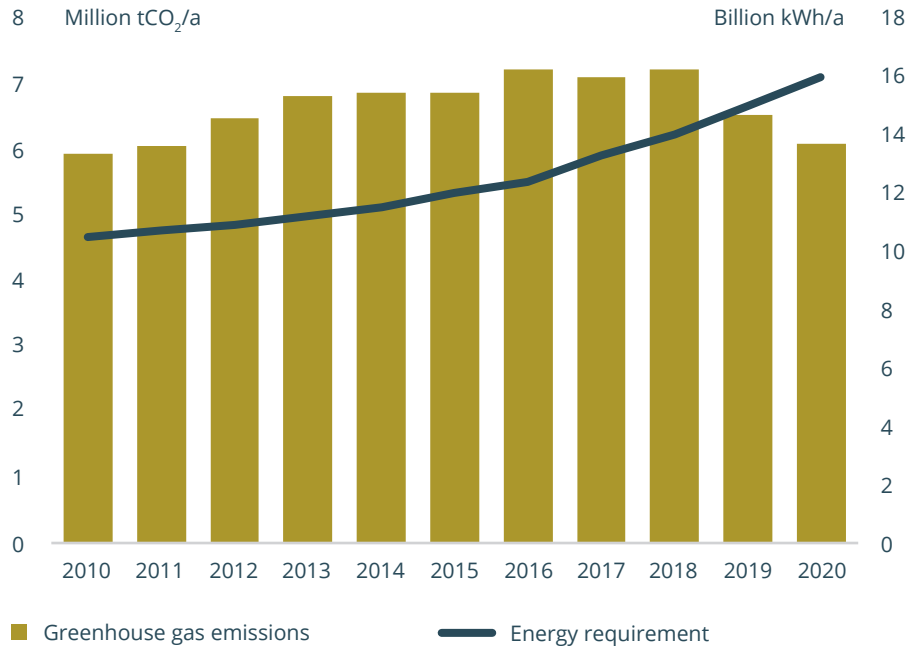
DEVELOPMENT OF ENERGY PRODUCTION FROM RENEWABLE ENERGY SOURCES⁴



2030 AMBITIONS

SUSTAINABLE DATA CENTERS

DEVELOPMENT OF GREENHOUSE GAS EMISSIONS AND ENERGY REQUIREMENTS OF GERMAN DATA CENTERS^{2, 24}



Raising data center infrastructure efficiency by 21%

PUE-FIGURE* ²³

1.98



1.63

*The PUE (power usage effectiveness) figure is the ratio of total amount of energy used by the entire data center measured against the energy delivered to the IT equipment of the data center.



GERMAN DATA CENTERS ARE CONSIDERED SOME OF THE MOST ENERGY EFFICIENT IN THE WORLD AND WILL ACHIEVE EVEN GREATER EFFICIENCY IN THE FUTURE.

With the new coalition government, German data centers must function even more sustainably in the long term. Under the coalition agreement, data centers are to be operated on a climate-neutral basis by 2027. Targets are also to be achieved by using 100% green electricity, downstream usage of waste heat, – with subsidies provided for this by the German Federal Ministry for Economic Affairs and Climate Action (BMWi) – along with efficient and conditioning and cooling, as well as through energy-efficient IT hardware. These are requirements that Germany is already largely qualified to meet.

The rapid increase in the demand for data centers in Germany is clearly reflected by greater energy requirements and accounts for 0.6% of Germany's entire energy needs. Although the greenhouse gas emissions generated are 80% attributable to electricity requirements, these are at the level of 2010 (See chart on the left.)

Measured by the work load, data center performance has increased eightfold over the years from 2010 to 2020, signifying that data center energy efficiency, expressed in workloads per energy used, has risen by a factor of six.

WHY CHOOSE GERMANY AS A LOCATION

CENTRAL LOCATION
IN EUROPE

STABLE REAL
ESTATE MARKET

LEGAL AND CONTRACTUAL
CERTAINTY

LARGE SUPPLY
OF SKILLED
WORKERS

COOPERATIVE DATA
CENTER COMMUNITY



GDA

OVERVIEW

Our Management Board and our Advisory Board are elected by the members. The term of office is three years and can be extended.

GDA – EXECUTIVE BOARD MEMBERS

CHAIRWOMAN

Anna Klafth (CBRE)
klafth@germandatacenters.com

DEPUTY CHAIRMAN

Peter Pohlschröder (NDC-GARBE)
pohlschroeder@germandatacenters.com

MANAGEMENT BOARD

Bernhard Benz (Colt)
Jens Peter Müller (Iron Mountain)
Prof. Dr. Peter Radgen (Universität Stuttgart)
Oliver Schiebel (Mainova Webhouse)
Klaus Schindling (Stadt Hattersheim)

GDA – ADVISORY BOARD MEMBERS

ADVISORY BOARD

Jens-Peter Feidner (Equinix Germany)
Peter Knapp (CloudHQ)
Volker Ludwig (Interxion Germany)
Wibke Reincke (Amazon Web Services)
Holger Zultner (ICT Facilities)

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