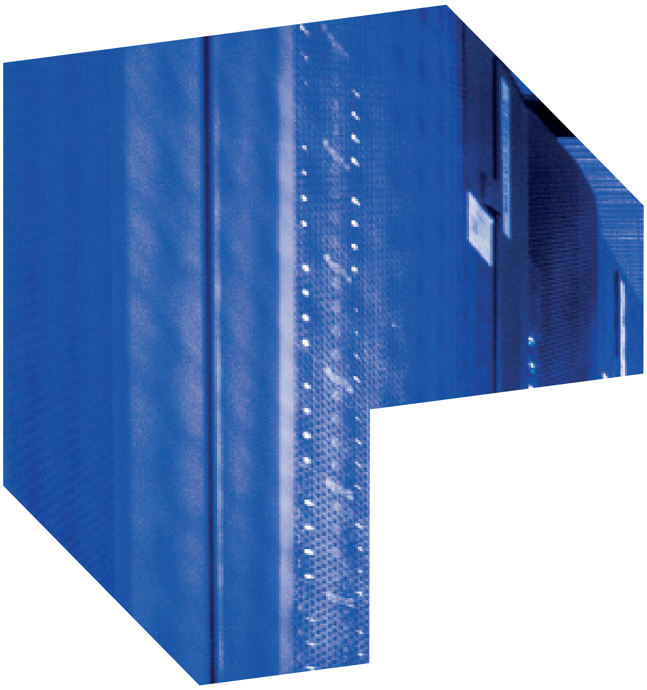
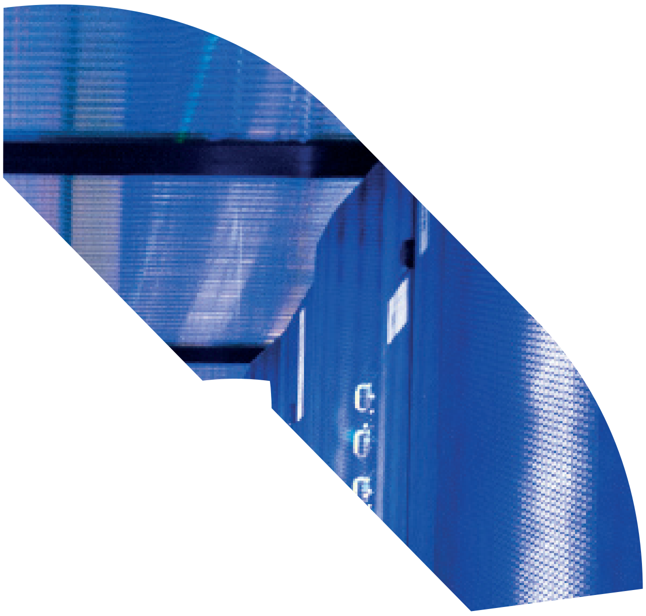
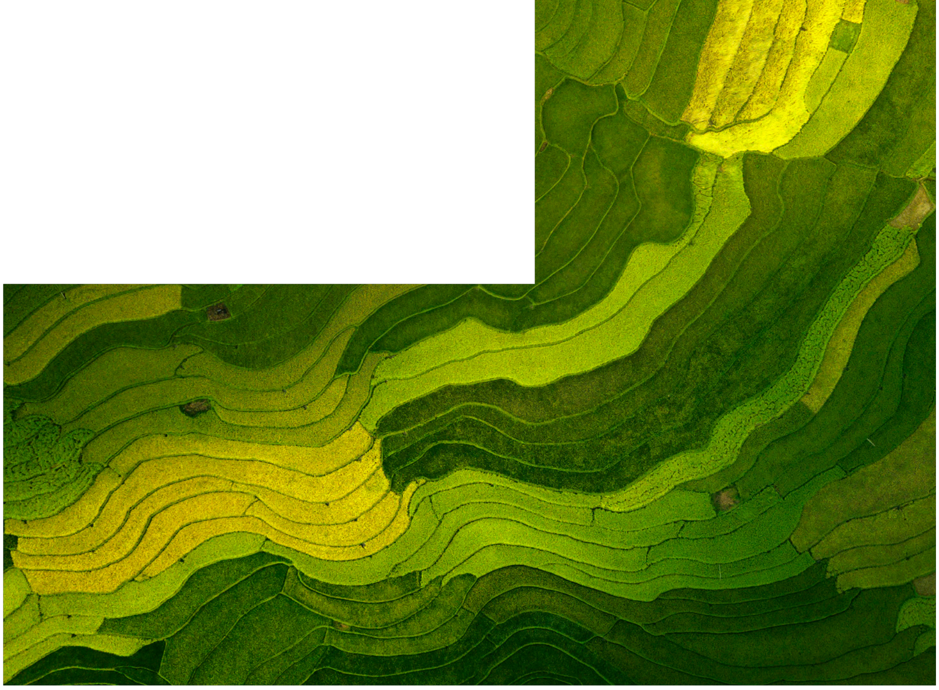




# Digitalization, sustainability and data centers

Report prepared by International Financial Analysts for ADigital and Digital Realty



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**Report prepared by International Financial Analysts for ADigital and Digital Realty**

# Executive Summary

**Digitalization is already a major determining factor of growth for the more developed economies.** The Fourth Industrial Revolution (or Industry 4.0) is already underway, and the relationship between economic growth and the influence of digitalization is becoming more and more tangible. In Spain, the contribution of the digital economy to GDP increased by 3.3 percentage points in 2020 to 22% of total gross domestic product.

**The connection between digitalization-sustainability duo is clear.** Digitalization is now a necessary condition to achieve environmental sustainability because of its unparalleled contribution to the decarbonization of the economy, or in other words, reducing $CO_2$ emissions into the atmosphere. In fact, digitalization[1] has been found to exhibit an inverted U-shaped relationship with $CO_2$ emissions per capita. This means that the world's economies demonstrate a systematic pattern of increasing emissions when digitalization is low, but after reaching a digitalization threshold, the trend reverses and emissions begin to decrease.

This study confirms this threshold or turning point, at which increasing digitalization reduces annual per capita emissions. **In absolute terms, a one-point increase in DESI would decrease $CO_2$ emissions by approximately 142,000 tons, equivalent to the annual emissions of the financial sector.**

**The digitalization–sustainability duo is present in all areas of our lives.** Digitalization makes possible activities that just a few decades ago were inconceivable and unattainable, or allows them to be carried out without physical travel or the consumption of ancillary goods and services with a high environmental footprint in terms of energy consumption, $CO_2$ emissions and with a high opportunity cost, for example, in terms of the time spent implementing them in their analog mode, if possible.

**Teleworking, the digitalization of financial services or the ability to hold virtual or hybrid meetings** are **a few day-to-day examples** of activities of daily life that have proven to be **more environmentally sustainable** versions of their traditional analog counterparts, in addition to increasing productivity and efficiency. Adding an additional day of **teleworking** per week in relation to the days of teleworking before the pandemic **would save 406 tons of $CO_2$ per day in Madrid or 612 tons per day in Barcelona.** A debit card transaction saves 0.8 grams of $CO_2$ emissions. Together, and **if all cash payments were made by debit card, it would save more than 9,000 tons of $CO_2$ emissions per year.** Changing over from in-person **meetings** and conferences to virtual events can reduce the carbon footprint by 94 percent and energy use by 90 percent, with transport being the most critical aspect in environmental terms.

**Data centers are an essential infrastructure for the deployment of the digital economy**; they are the physical part of this economy.

For economies to be digitized, it is necessary to generate digital services (streaming, gaming, cloud, e-learning, e-banking, industry 4.0, etc.) that are developed in the physical world, in the data center, the place where companies and citizens interconnect to provide or receive digital services.

**Digitalization is transforming entire economic sectors and its deployment depends on**

[1] Measured using the ICT index of the International Telecommunication Union.

**the installed capacity of large data centers**, a complex, indispensable and specialized infrastructure to enable digital innovations, services and technologies that rely on cloud processing and the interaction and communication between multiple data sources in real time.

**The rapid growth of the services that make up the digital economy, the scale that the platforms that support them have acquired, and the geographical expansion have changed the infrastructure that supports the economy.** Digital service providers—because they in turn must offer them to their SME customers, large companies, integrators, outsourcers and also individuals— are demanding more sophisticated services, capacity, availability and latency. Not surprisingly, the space and power needs of these global providers, along with those of predictability and future availability, are driving a boom in third-party data center contracts (colocation).

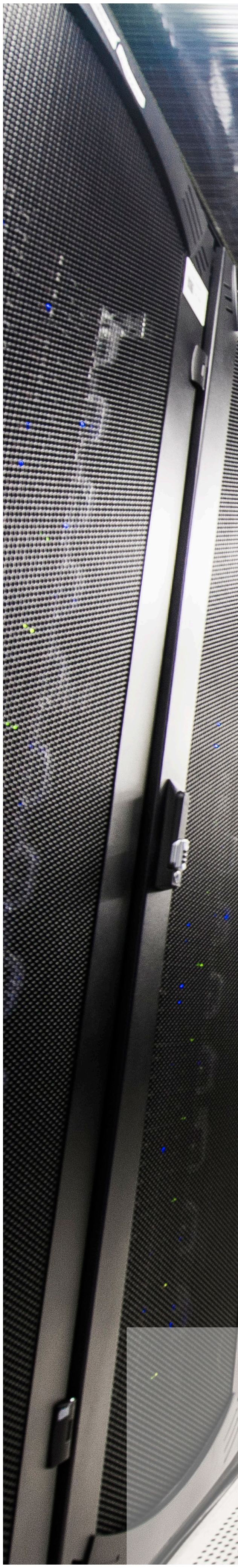
**The development of the data economy will boost the digitalization of the other economic sectors**, also helping to reduce their energy demand and environmental impact, and to optimize the resources they need in their production processes. Improvements in the efficient use of resources that the ICT sector generates in other sectors make it one of the activities with the greatest capacity for reducing $CO_2$ emissions in the economy as a whole. According to the International Energy Agency, the sectors with the most room for improvement in terms of energy consumption and emissions include road transport, which, if it were digitized, would see a decrease is its energy demand by almost 50%, and its greenhouse gas emissions by 75% by 2050. Other important sectors are manufacturing, agriculture, and construction.

**In Spain, the digitalization of the main production sectors would reduce their annual $CO_2$ emissions by 4.8 million tons.** Nationwide, the efficiency gains made possible by the ICT sector would decrease the annual $CO_2$ emissions recorded by the energy sector, the transport sector and manufacturing industry by 784, 1,662 and 2,061 thousand tons, respectively.

The digitalization–sustainability duo is present in all areas of our lives.

# Data centers are an essential infrastructure for the deployment of the digital economy

# 01 Data centers



## Essential activity in the 21st century

Data centers are **infrastructure dedicated** to the centralized hosting, interconnection and operation of networked information technology and telecommunications equipment. They provide data storage, processing and transport services, and have facilities for energy distribution and environmental control, with the necessary levels of resilience and security to ensure the uninterrupted availability of services.

**In them, cloud, telco and IT suppliers and companies connect users with digital services.** Today, data centers are an essential infrastructure for developing digital services. Despite their essential nature, this sector of activity is unknown to citizens and public administrations.

Data centers, as the physical place where digital services are developed, are **technology-centered real estate assets** that support the accelerated **cloud migration of IT services** promoted by Cloud Service Providers[2], and accessible to content generated in every corner of the world. In short, the cloud is a real place in the form of a huge server (data centers) capable of managing and interconnecting millions and millions of terabytes of information from users around the world in real time.

Cloud Service Providers build their own data centers (hyperscale) or use data centers built and managed by third parties (colocation) to better serve their customers in terms of the variety and **sophistication of services, availability, and latency**. Connectivity (from Internet exchanges, subsea cables or communications networks) is a key attribute as it ensures minimal latency for cloud services.

The rapid growth of digital services, many of which are essential today—online services, platforms, communications, streaming, gaming, APIs, etc.—, the scale that the platforms that support these services have acquired and the geographical expansion of the deployment of hubs, have led to the emergence of a **new segment of colocation customers: global cloud service providers.**

[2] The main global cloud service providers are AWS, Azure, Google, IBM, Oracle and Alibaba.

The geographical expansion of data centers is now a necessity for two main reasons: to comply with **data protection regulations** of the countries where the users who receive the digital services reside; and to **bring the platforms closer to customers with applications that require low latency.**

The widespread deployment of fiber optic networks in Spain, together with its location and the fact that it is a peninsula are competitive advantages in terms of intercontinental connectivity (subsea cables) to become southern Europe's digital hub. These attributes result in lower latency. The penetration of renewable energies is another important competitive attribute of Spain, but there are also obstacles to investment in data centers.

# Processes that take place inside data centers

There are countless processes taking place within the data centers, which enable innovations that are now part of all dimensions of our daily lives, and which have become essential innovations in the value chains of all economic activities.

## New Businesses: more digital economy

### E-commerce

There are many computer applications and digital platforms (marketplaces) in the retail sector that have appeared and have covered needs not addressed by more traditional commercial distribution.

Spain has seen its e-commerce turnover increase sevenfold since 2010 (CNMC figures). In 2020, 1.038 billion e-commerce transactions were recorded (20% more than 2019), representing a turnover of close to 52 billion euros, a 6% increase compared with 2019.

The breakdown of transactions by origin and destination shows the predominance of transactions from Spain to other countries (57%), associated with the importing of goods and services purchased online, which has grown enormously in the last year. Transactions in the domestic market have remained relatively unchanged (32% of the total). In 2020, there was a drop in transactions from other countries with Spain, in other words, e-commerce exports (12%), which interrupted the gradual growth recorded since 2010, when exports accounted for 20% of the total. This means that there is a lot of room for improvement and growth for e-commerce exports in Spain.

### Culture and Entertainment

TV, streaming videos and social media via smart devices account for 25% of all data loads globally, and more than half of the traffic.

All of these have grown exponentially as a result of the COVID-19 pandemic: by December 2021, 82.8% of Spaniards (32.2 million) had access to paid content, 60% had access to Netflix and 53.7% to Amazon Prime Video[3]; since 2020, views on platforms like Twitch have increased by 45% year-over-year (from 3.114 billion hours in the first quarter of 2020 to 6.129 billion hours two years later), according to data from the consulting firm Streamlabs [4].

Other new innovations, such as gaming (video games and e-sports), virtual reality or open community platforms that create personalized ecosystems are part of the new entertainment industries.

### *Gaming*

This consists of running specialized applications (video games) on dedicated consoles, computers, smartphones or other electronic devices, and includes related activities such as competition (e-sports). Video games are positioned as one of the most preferred audiovisual and cultural leisure options in Spain, with the player base increasing by 20% since the start of the pandemic according to data from the Spanish Video Game Association (AEVI).

[3] https://www.barloventocomunicacion.es/wp-content/uploads/2021/12/BAROMETRO-TV-OTT-Avance-4-ola-2021.pdf
[4] https://streamlabs.com/content-hub/post/streamlabs-and-stream-hatchet-q1-2022-live-streaming-industry-report

The sector has evolved over time: from video games that were played independently on consoles to online multiplayer games that require a strong server infrastructure to provide good service in terms of latency and availability. To cover the increasing power required to run them, the most demanding video games draw on cloud computing to allow players to invest little in computer resources by shifting the real weight of the processing to dedicated servers.

## New ways of producing

### Industry 4.0 and the Industrial Internet of Things

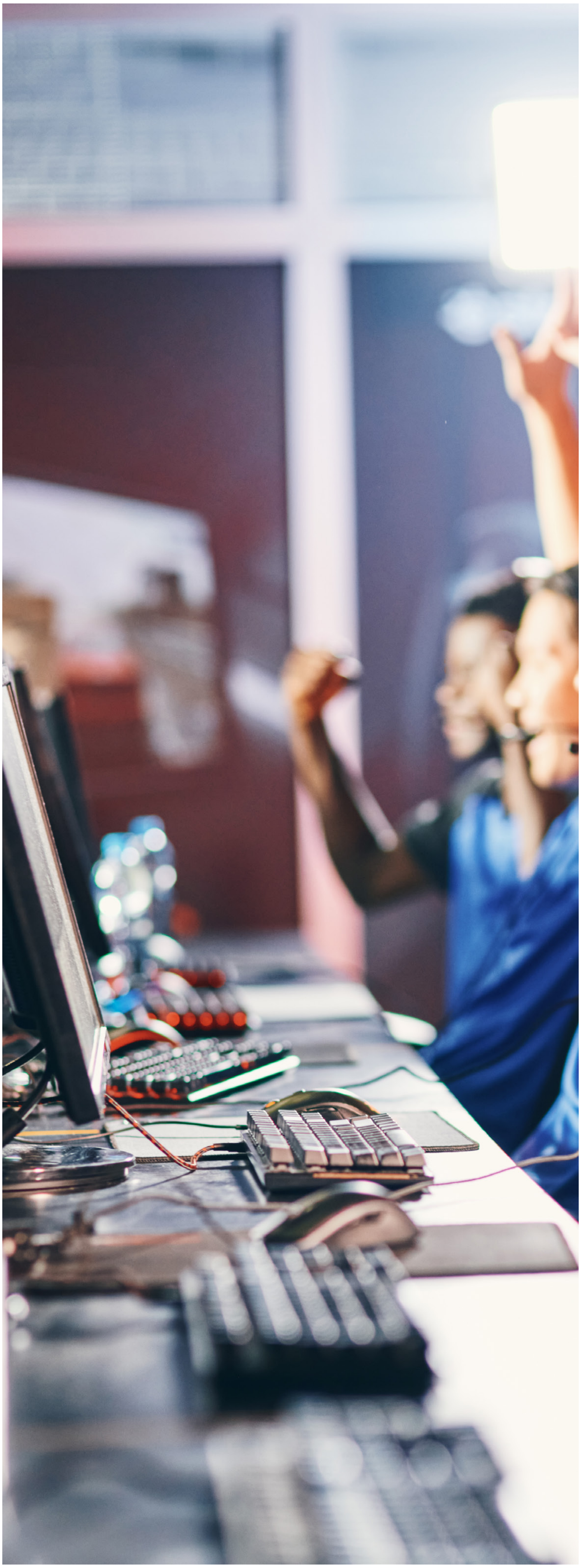
The Industrial Internet of Things (IIoT) is the term first coined by the German government to describe an organization of production processes based on technology and devices that communicate with each other autonomously along the value chain (Smit et. al. 2016).

While still in its infancy, the IIoT's development is based on the intensive use of digital technologies based on smart sensors, interconnected devices (IoT), and machine-to-machine communication, to develop innovations such as virtual manufacturing, customer-centric production, or 3D printer, in addition to process optimization.

### Smart Buildings

These are residential, administrative or commercial buildings whose installations and systems (air conditioning, lighting, electricity, security, telecommunications, multimedia, IT, access control, etc.) allow integrated and automated management and control to increase:

- efficient energy and water use and waste generation
- functional, comfortable and healthy usability for inhabitants in terms of acoustics, temperature and atmosphere
- accessibility



- sustainability with healthy and environmentally friendly materials
- centrally automated security to optimize integrated and/or electronic operation and management—O&M

Domotic systems use technologies to improve smart home automation systems. They collect information from sensors (pressure, optical or acoustic) or other sources that transmit information to a computer that makes decisions according to the programming for each situation, processing data and executing actions through actuators (devices capable of driving electromagnetic systems) and inmotics (integral high-tech automation of properties).

## New capabilities

### Communications: the C in ICT

More than a century has passed since the first phone call. Our society is now much more connected thanks to the evolution of telecommunications, especially in the last decade.

Today we have multiple communication channels (messaging, email, video calls, social networks, etc.) available in the palm of our hand (smartphone), to cover all of the preferences and needs of the moment (communication by voice, text, image, sending documents, and even signatures).

We use this wide variety of different communication channels and formats on a daily basis, and they have already changed many of our habits and above all, have given us new communication skills and along with it, the gift of ubiquity (being in more than one place at the same time).

### Teleworking

According to the Labor Force Survey, in 2019 the percentage of employed people working from home (on a daily basis, or more than half of the days) was 4.8%, and occasionally, 3.5%, for a total of 8.3%.

2020 was the year that every employed person who could work from home did so. In 2021, according to the Survey of ICT Use and Equipment of Spanish households, 17.6% of the employed population worked remotely, double the pandemic figure.

Implementing telework in companies is an opportunity that entails risks and challenges that the companies need to minimize through digital technology: online and offline tools to improve and enhance the security of equipment and connections, to monitor jobs, for communication between work teams and with customers and other stakeholders; to hold meetings; remote access to files and programs; remote project management; to store information and send files, anti-malware tools; time control, and a long etcetera.

### Online education

This is education in which teachers and students participate in a digital environment through new technologies and computer networks, making intensive use of the functions provided by the Internet and digital technologies.

In 1995, there was only one online university (UOC) and one remote university (UNED) in Spain. In 2021, all of Spain's universities (83) were using e-learning in one way or another. The COVID-19 pandemic has undoubtedly accelerated this revolution in the education sector, spreading to primary, secondary and ultimately to all educational and training environments. According to Forbes, the market for online educational platforms has the potential to grow to $325 billion by 2025.

## New service channels

### Public Administrations

Spain's Recovery, Transformation and Resilience Plan includes measures to ensure citizen-oriented administration and improved interoperability and digital public services provided to citizens and businesses; smart operations and data management (e.g.

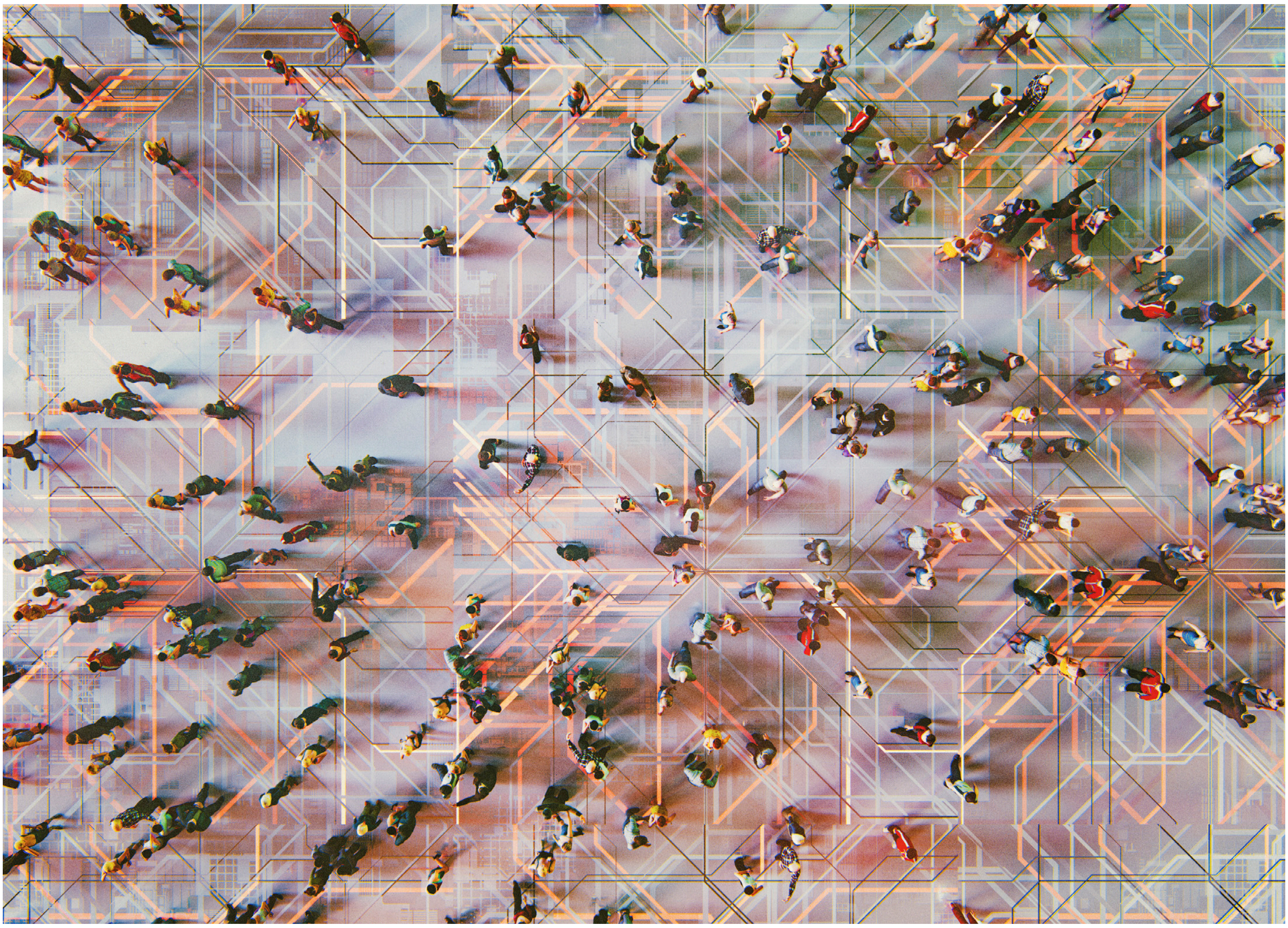
procurement); and digital infrastructure and cybersecurity. It also includes specific measures to prioritize the digitization of the national administration in the health system, the judiciary and public employment services; inclusion, social security and immigration.

All levels of the public administrations are encouraged to base their strategies on digitalization. For example, at the municipal level, cities and their local administrations are already applying digitalization to a wide variety of functions, from traffic and mobility management to urban waste management.

### Financial services

One of the sectors where the digital transformation was initially most evident was in financial services. Electronic channels (ATMs) have historically been used to serve customers. More recently, online banking and mobile banking have been gaining ground on in-person service. Retail financial services have been exponents of this digital transformation, and it is an ecosystem with increasing involvement of agents from other financial services industries, such as global technology suppliers (bigtech) and start-ups from the fintech and insurtech environments.

Data generation in the financial sector is expected to exceed 10 zettabytes by 2025 (9 ZB will have to be encrypted for security and 3.5 ZB will be managed in real time), according to IDC 2018b. For this reason, the financial sector requires significant installed digital capabilities to enable financial transactions over the Internet effectively, immediately, privately and securely.



Today, data centers are an essential infrastructure for developing digital services.

# New intelligence: real-time monitoring and decision making

### Healthcare

In healthcare, smart devices (watches and mobiles) monitor health-related parameters so that patients can track, store, transmit and process their health data.

Big data can be used to predict the likelihood of developing a disease, monitor the functioning of medical devices, provide faster diagnoses (through the use of portable devices), offer personalized health solutions and improve the effectiveness of treatments. Healthcare professionals will be able to use data analysis techniques for faster and more accurate diagnoses. Augmented reality, for example, offers applications for assistance during surgery (tele-surgery) and can help during medical practices (remote diagnosis).

### Mobility and transport

Smart transport systems are being used to improve the operating system, safety, efficiency and urban and interurban mobility service thanks to digital innovations (some of which have already been deployed, with others in initial stages before widespread roll-out) such as:

- Traffic control and optimization through smart sensors, GPS geolocated applications and smart infrastructure.
- Car-sharing and car-pooling platforms.
- Intelligent logistics that connect vehicles, products and load units
- Autonomous driving.

All of these innovations that enable sustainable mobility - less pollution and lower greenhouse gas emissions - require the capabilities installed in data centers to interconnect data from different sources, digital service providers, transactions, etc. to function.

## New geostrategic balance: security and sovereignty

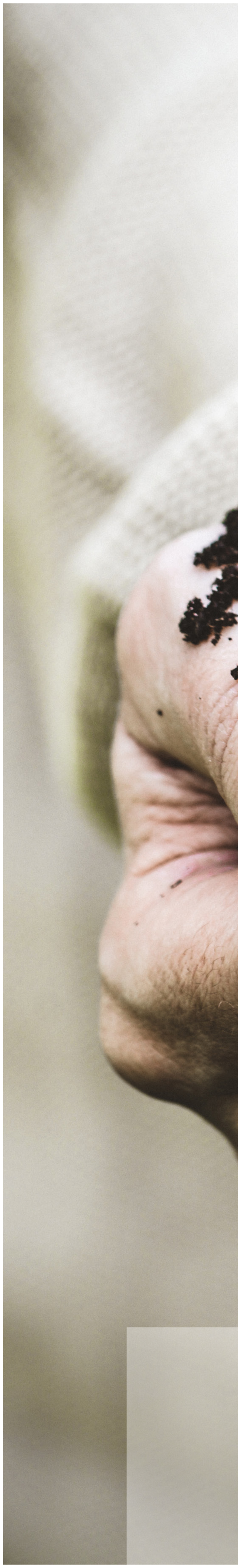
The definition of data sovereignty is based on the concept that information that is created or stored digitally is subject to the laws and regulations of the country in which such information is located. The governance of the data and its assignment to the jurisdictions where it is generated (or where the natural, legal or active persons that produce it are located) is a critical aspect.

The main topics of discussion in this area are compliance with national regulations (confidentiality, availability, retention, auditing), the jurisdiction claimed by third countries; data leaks and privacy risks, liability, redress, guarantees, insurance, and legal consistency between jurisdictions. In practical terms, these issues determine the decision on where to locate data centers.

Sovereignty in terms of industrial policy and dependence on critical suppliers across borders has forced sectors as important (and drawing parallels with data centers) as microchips and semiconductors to reorient themselves strategically.

The 'Chips Act' is the European directive that is aimed at positioning Europe as a power in semiconductor production, 80% of which is currently controlled by Asian countries. The goal is to reach 20% of the world's chip production by 2030, doubling the current level of 10%. It allocates 43 billion euros to finance investment plans (public and private) in semiconductors. China's largest semiconductor manufacturer, SMIC, has announced an investment of $8.9 billion in a plant in Shanghai. The Biden Administration has a $50 billion plan to promote chip production, and Intel will invest $20 billion in a factory in Ohio, which will become the largest in the world.

# 02 What data centers contribute to a sustainable economy



## A contribution to well-being

Data centers are an essential activity for the digital economy and their contribution to well-being can be analyzed from several different perspectives. This study examines its status as a factor to enable and guarantee the growth of the digital economy, which in and of itself demonstrates its contribution to well-being and sustainability; and lastly, along with the previous perspectives, it also enables an environmentally sustainable economy.

# Digitalization and environmental sustainability: an essential duo

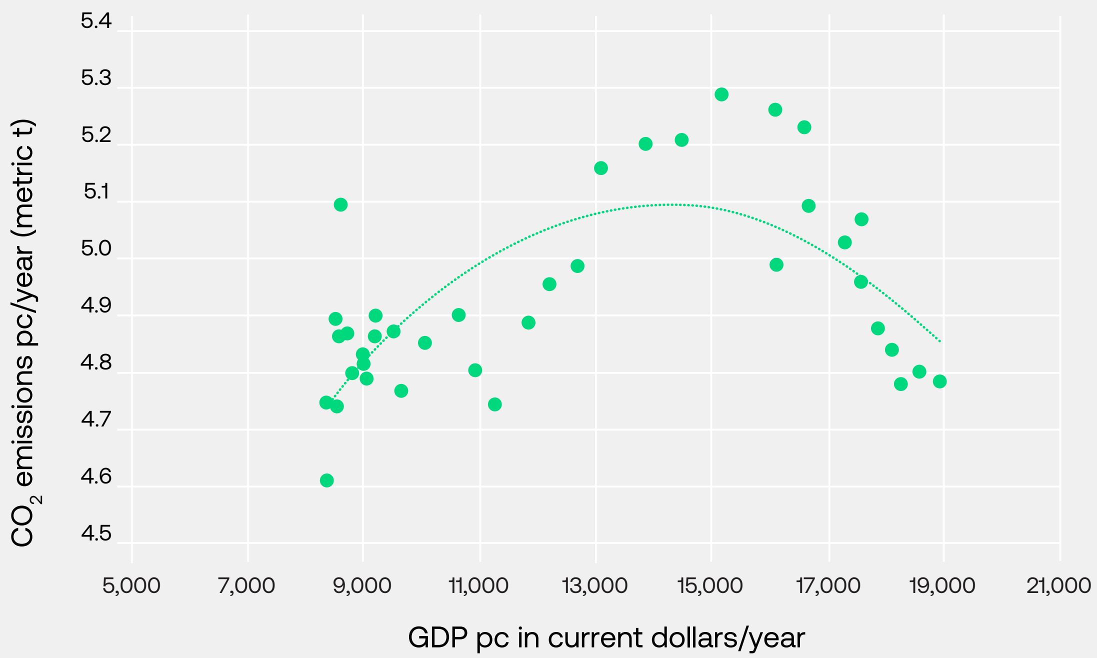
The contribution of digitalization to sustainability is perhaps one of the most important issues on the political and social agenda today. There are those who would argue that digitalization is an additional source of pollution in the world, and that any improvement in the digital environment comes at the expense of higher greenhouse gas emissions, more inefficient energy use and distribution, and the worsening of the climate crisis.

However, there is little theoretical and empirical support for these arguments because they often ignore the increased efficiency as a result of digitalization (through network economies, for example), along with the results of several studies published in academic journals that analyzed this relationship using multiple methodologies, for very heterogeneous groups of countries or regions, in different decades, and always with the empirical robustness that can only be achieved under peer review.

Figure 1 shows the **relationship between GDP per capita and $CO_2$ emissions** (measured in metric tons per year) between 1980 and 2020. The trend line suggests a clear parabolic relationship between the two variables. This curve, known as the environmental Kuznets curve, suggests a positive relationship between emissions and GDP per capita when the latter variable is less than $14,000 per person. However, this relationship becomes negative when GDP per capita exceeds this limit, which means that **above this income level, the higher the income per capita, the lower the emissions.**

## Figure 1

**Environmental Kuznets curve: GDP and $CO_2$ emissions (1980-2020)**




Source: Our World in Data, World Bank, Afi.

Grossmann & Krueger[5] (1995) for the first time proposed an inverted-U shaped relationship between income and environmental developments when analyzing the impact of NAFTA agreements on pollution. This relationship had already been noted in other studies, including those by Shafik & Bandyopadhyay[6] (1992) and Panayotou[7] (1993). Likewise, of the theoretical explanations for this phenomenon, there is one that gives an increasing level of attention to the environment above a particular level of income, which implies a social awareness of this problem, and a reaction in this sense.

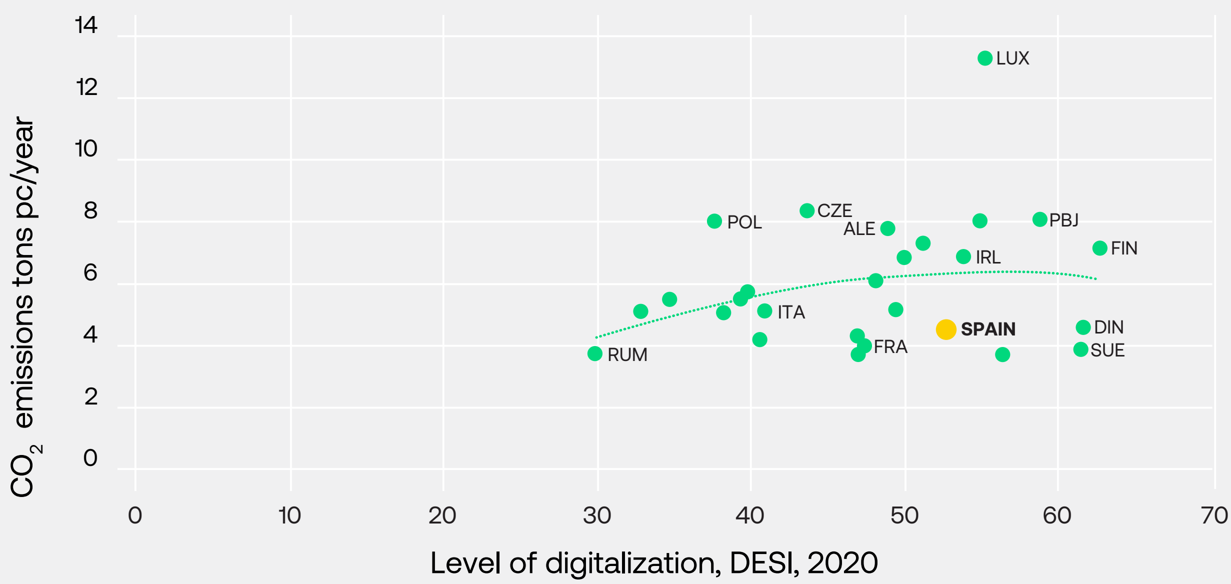
In addition to the relationship between economic development and sustainability, an important part of the academic literature has tried to integrate digitalization into the equation. Gouvea et al.[8] (2018) and Matei & Savulescu[9] (2012) found a positive and statistically significant relationship between the development of the ICT sector and environmental sustainability levels: **the larger the ICT sector or the better the telecommunications infrastructure, the better the results in sustainability variables.**

Although perhaps the most complete study of this aspect is the one published by Añón Higón et al.[10] (2017), which makes an estimate with panel data for 142 countries (116 developing, and 26 developed) for the period 1995–2010. According to this estimate, digitalization (measured using the ICT index of the International Telecommunication Union, ITU) also exhibits an inverted-U shaped relationship with $CO_2$ emissions per capita, even when control variables such as GDP per capita, the weight of industry in total GDP (in percent), the level of education of the population, population density, oil reserves, and the number of vehicles registered in circulation, among others, are included.

There is therefore also a **quadratic (or parabolic) relationship between the degree of digitalization and $CO_2$ emissions per capita**. A priori, before applying an econometric method to derive causality, the trend curve in Figure 2 shows the shape that this relationship could take for the countries of the European Union.

## Figure 2

**Level of digitalization and global $CO_2$ emissions. European Union, 2020**




Source: Our World in Data, World Bank, Afi.

[5] Grossman G, Krueger A. 'Economic growth and the environment'. Quarterly Journal of Economics; 1995, 110 (2) pp. 353–377.
[6] Shafik N, Bandyopadhyay S. 'Economic growth and environmental quality: Time series and cross-country evidence' Background Paper for the World Development Report. The World Bank, Washington, DC; 1992.
[7] Panayotou T. 'Empirical tests and policy analysis of environmental degradation at different stages of economic development'. ILO, Technology and Employment Programme, Geneva; 1993.
[8] Gouvea, R., Kapelianis, D., & Kassicieh, S. (2018). Assessing the Nexus of sustainability and information & communications technology. Technological Forecasting and Social Change, 130, 39–44.
[9] Matei, A., & Savulescu, C. (2012). Towards sustainable economy through information and communication technologies development: Case of the EU. Journal of Security and Sustainability Issues, 2 (2), 5–17.
[10] Higón, A., Dolores, R. G., & Shirazi, F. (2017). ICT and environmental sustainability: A global perspective. Telematics and Informatics, 34(4), 85–95.

As shown in Figure 2, on the left, countries with less digitalization also show low levels of per capita emissions (e.g. Romania). However, as digitalization increases, so do emissions, until a turning point is reached where high levels of digitalization also lead to lower $CO_2$ emissions per capita (in 2020, these countries are mostly Scandinavian).

**In order to calculate the point of inflection of the parabola** (when the relationship between digitalization and $CO_2$ emissions per capita becomes negative), to position Spain within this relationship (if it has already reached this turning point), **an econometric estimate** similar to that defined by Añón et al. (2017) was made.

The relationship between $CO_2$ emissions per capita, GDP per capita, degree of digitalization (DESI), and the weight of industry in total GDP was estimated using panel data. The estimate includes data for all of the countries of the European Union, and covers the time period between 2016–2020. Table 1 summarizes the variables included, along with a definition and the statistical source used in the download.

## Table 1. Variables used and data sources

| Variable | Description | Data source |
|---|---|---|
| **$CO_2$ emissions per capita** | $CO_2$ emissions per capita in metric tons | Ritchie, H., Roser, M. & Rosado, P. (2020). “$CO_2$ and Greenhouse Gas Emissions” |
| **DESI Index** | Digital Economy and Society Index prepared annually by the European Commission that reflects the digital performance for each country with a score between 0 and 100%. | European Commission (Digital Agenda) |
| **GDP per capita** | Real GDP per capita at current prices, in euros | Eurostat (2022) |
| **Weight of Industry (% GDP)** | Value added of the industrial sector (including construction) as a percentage of GDP | WDI (World Bank, 2022) |

Source: Afi

The following **econometric model** was used:

$$CO_2 \text{ emissions } pc_{it} =$$

$$\beta_1 \text{ Desi Index}_{it} + \beta_2 \text{ Desi Index}_{it}^2 + \beta_3 \text{GDP } pc_{it} + \beta_4 \text{ Weight of industry}_{it}$$

Factor i: concerning the individuals from the 27 Member States of the European Union who form the database.
Factor t: reflects the year of the variable, from 2016 to 2020.
Data panel consisting of a total of 135 observations.

It should be noted that the inclusion of the DESI in linear and quadratic terms is due to the fact that at low levels of digitalization, emissions increase when the investment in improving it increases. This is partly due to the accompanying growth of the economy as a whole. However, after reaching a peak, emissions begin to fall as levels of digital implementation increase. After this turning point in the curve, emissions continue to increase but at slower and slower rates until they become negative; in other words, **at high levels of digitalization, $CO_2$ emissions are reduced with small increases in investment.** This means that this pattern of evolution shows the importance of broad investment in digital development for countries that want to reduce their emissions, confirming digitalization-sustainability duo as a solution to many environmental problems.

## Table 2. Results of the model estimation

| **Increase in the model's variables** | **$CO_2$ emissions (metric t)** |
|---|---|
| +1 p.p. DESI | +0.1416 |
| +1 p.p. $DESI^2$ | −0.03 |
| +1 p.p. GDP per capita | +0.0001 |
| +1 p.p. Weight of industry (%GDP) | +0.1640 |

p.p. = percentage point

*Observations 135* *$R^2$ 0.3565* *$R^2$ adjusted 0.3418* *F statistics 227.8577*

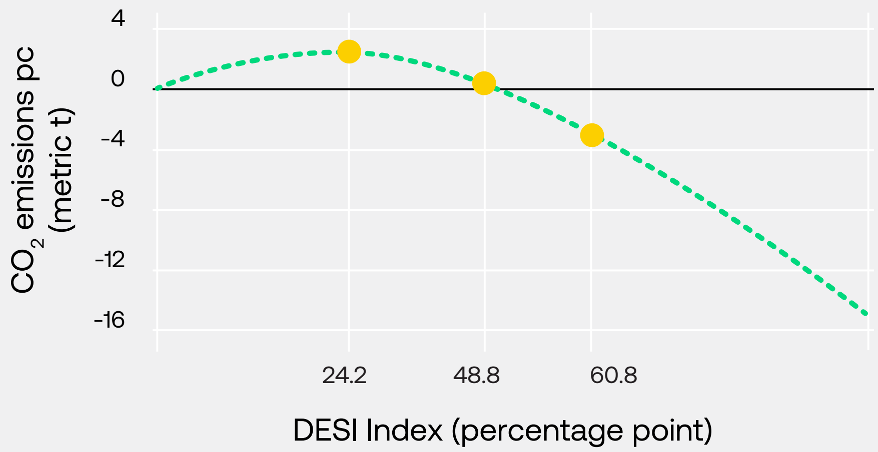
Source: Afi, prepared in house

From the results of the estimate done for this study, it can be concluded that digitalization does indeed have an increasing and linear initial effect on $CO_2$ emissions per capita, increasing $CO_2$ emissions by 0.14 for each additional percentage point in the DESI.

When this “digitalization effect” reaches a maximum point, it begins to be negative on the level of emissions, although slower for each percentage point of increase in the DESI: One point of growth in the DESI reduces per capita emissions by 0.003 metric tons.

## Figure 3

**Relationship between $CO_2$ emissions per capita and the DESI index**




Source: Afi, prepared in house

Emissions growth as digitalization progresses peaks when the DESI is 24.2; from that point on, emissions continue to increase, but at lower rates. Starting at a DESI Index of 48.8, emissions growth reverses its trend and begins to decline. In other words, once this digital development threshold has been exceeded, $CO_2$ emissions pollution drops continuously as digital deployment increases.

In 2022, in the last published DESI indices, Spain had a score of 60.8 and had passed this barrier for emissions reduction in 2019. Countries that are still far from this turning point are Bulgaria, Greece and Romania, with indices below 40. On the flip side, Denmark and Finland exceeded this score in 2016 and their trajectory has only continued to improve, with scores around 70 points.

From these results, the DESI Index has been broken down into its four components. By analyzing these dimensions, future scenarios have been designed for the case of Spain, which suggest a roadmap that would maximize the benefits of digitalization on sustainability in the country. The index is made up of four main dimensions that are weighted equally:

- 1. Human Capital
- 2. Connectivity
- 3. Integration of digital technology
- 4. Digital public services

Each of these dimensions is divided into a different number of sub-dimensions, which are weighted differently in the 25% of each block and which, in turn, contain a different number of indicators, which also contribute different values to the overall index (Table 3).

## Table 3. DESI indicators according to the dimension and sub-dimension to which they belong

| Dimension | Sub-dimension | Indicator |
|---|---|---|
| 1. Human Capital | 1a. Internet usage skills | 1a1. Digital skills, at least at the basic level<br>1a2. Digital skills, above the basic level<br>1a3. Content creation knowledge, basic level |
| | 1b. Advanced skills and development | 1b1. ICT Specialists<br>1b2. Women ICT specialists<br>1b3. Companies that provide ICT training<br>1b4. Holders of ICT degrees |
| 2. Connectivity | 2a. Fixed broadband deployment | 2a1. Total fixed broadband deployment<br>2a2. Fixed broadband deployment at least 100 Mbps<br>2a3. Deployment of at least 1 Gbps |
| | 2b. Fixed broadband coverage | 2b1. Next Generation Broadband Coverage (NGA)<br>2b2. Very high capacity fixed network coverage<br>2b3. Fiber optic coverage to the premises (FTTP) |
| | 2c. Mobile broadband | 2c1. 5G spectrum<br>2c2. 5G Coverage<br>2c3. Mobile broadband deployment |
| | 2d. Broadband pricing | 2d1. Broadband price index |
| 3. Integration of digital technology | 3a. Digital intensity | 3a1. SMEs with a basic level of digital intensity |
| | 3b. Digital technologies for business | 3b1. Electronic exchange of information<br>3b2. Social networks<br>3b3. Big Data<br>3b4. Cloud<br>3b5. Artificial Intelligence<br>3b6. ICT for environmental sustainability<br>3b7. Electronic billing |
| | 3c. E-Commerce | 3c1. SMEs selling online<br>3c2. Turnover from e-commerce<br>3c3. Cross-border online sales |
| 4. Digital public services | 4a. E-government | 4a1. Users of e-government<br>4a2. Pre-filled forms<br>4a3. Digital public services for citizens<br>4a4. Digital public services for businesses<br>4a5. Open data |

Source: Afi, from DESI Index 2022 (EC).

From the calculation of the specific weight that each of the indicators contributes to the total, it can be deduced that the three most important are:

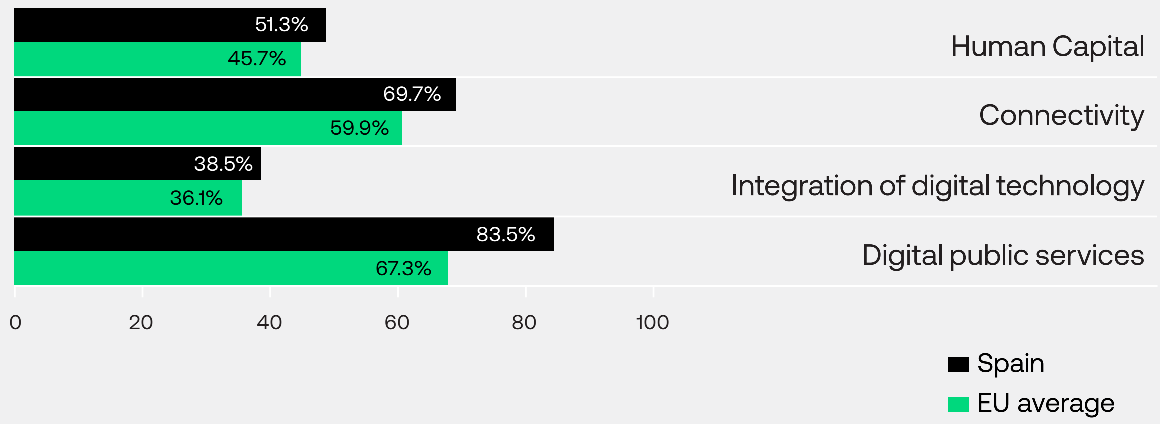
**1a1** Digital skills, at least at the basic level
**4a3** Digital public services for citizens
**4a4** Digital public services for businesses

This means that the DESI is constructed as an indicator that is more focused on the social and educational scope of the development of digital skills, than on the provisioning and guarantee of infrastructure that facilitates the digitalization process for the entire population.

Based on the analysis of the breakdown of Spain's score in 2022, it can be concluded that Spain's level of development is higher than the European average. Spain's score is far above the European average in dimensions 2 (connectivity) and 4 (digital public services), specifically 9.8 and 16.2 p.p. higher. In dimension 1 (human capital and digital skills), Spain outperforms the EU by 5.6 p.p. Regarding dimension 3 (integration of digital technology), the scores are more in line with the European average (difference of 2.4 p.p.). Similarly, there is still a lot of room for improvement, especially in dimensions 2 and 4.

## Figure 4

**Spain's score compared with the European average by indicators in the DESI Index (in percent, 2022)**




Source: Afi, from DESI Index 2022 (EC).

It is important to note that **none of the indicators in this extensive list focuses on measuring the presence or development of data centers**, infrastructure that is essential for the advancement of digitalization. For this reason, it would be advisable to integrate indicators that make it possible to determine and evaluate their scope. In the absence of these more precise indicators, to continue the analysis, **three indicators were selected as proxies because they also form part of the concept of deployed or available digital infrastructure**:

**2c1** 5G spectrum
As the percentage of the assigned spectrum relative to the total harmonized 5G spectrum.
**2c2** 5G coverage
Percentage of populated areas with 5G coverage.
**3b4** Cloud
Measured as the percentage of companies that purchase intermediate or sophisticated services in the cloud.

As mentioned above, Spain has already exceeded the DESI threshold at which higher digitalization levels reduce $CO_2$ emissions (48.8). This means that **increasing this index by one point would reduce $CO_2$ emissions per capita by 0.003 metric tons**, with the rest of the variables remaining constant.

Spain's DESI score could be increased by one point by independently implementing the following initiatives related to indicators 2c2 and 3b4. In particular:

- An increase of 20 percentage points in populated areas with 5G coverage, an investment that would increase the indicator of populated areas covered by 5G from the current value of 59%, to 79%.
- An increase of just over 28 percentage points (28.6%) in the percentage of Spanish companies that use a cloud service. This would increase cloud use at the enterprise level from 27% to use by more than half of businesses (55.6%). It should be noted that this is an “after” indicator, that is, cloud use by companies requires an initial global investment in the infrastructure required to be able to optimally cover this use. While the other two selected indicators do refer to the provision of infrastructure and services for consumption.

For each additional point in the DESI Index, Spain would reduce its $CO_2$ emissions by 0.003 t per inhabitant.

The situation is different for the indicator that evaluates the assignment of the 5G spectrum (2c1). In this particular case, to achieve a one-point increase in the DESI, taking into account its weight in the overall indicator, it would need to be increased by 40 percentage points. But Spain already has 65% of the assigned 5G spectrum, so the room for improvement is limited to 35 percentage points. This means that even if the maximum allocation of the harmonized 5G spectrum were achieved, it would only add 0.9 points in the DESI, reducing $CO_2$ emissions per capita by 0.0027 metric tons (2.7 kg less per capita per year).

Another possible scenario would be to **implement all three initiatives at the same time**. In this case, **the DESI would increase by 2.9 percentage points**, bringing Spain to almost 64 points, which is equivalent to Sweden's score, which is the fourth highest in the European ranking. Similarly, applying the coefficient derived from the estimate (0.003 metric tons of $CO_2$ per capita), these advances in digitalization would result in a **reduction of per capita emissions by 0.0087 metric tons per year** (8.7 kg of $CO_2$ per capita per year = 412,690 t of $CO_2$).

In conclusion, **digitalization is clearly a real solution for building a more sustainable economy**. Spain is at a very good point in this process, having reached significant levels of digital development that since 2019 have guaranteed a positive relationship between increased digital intensity and the reduction of $CO_2$ emissions.

## Annual reduction of $CO_2$ emissions

**+1**

DESI Point

**–142,000**

t $CO_2$ year

**+2.9**

DESI Points

**–412,700**

t $CO_2$ year

Source: Afi

## There is a positive relationship between digital intensity and the reduction of $CO_2$ emissions

Digitalization is a real solution for building a more sustainable economy.

# Digitalization of the economy

The fourth industrial revolution that is currently underway is based on data as well as all of the innovations, technologies, channels, business models and hardware and software developments that are aimed at solving problems, enabling new immediate and ubiquitous analytical, robotic, communication, marketing, educational, etc. capabilities.

Digitalization makes it possible to carry out activities that were previously inconceivable:

- without physical travel (meetings and business trips),
- without going to a specific place to carry out activities (education, work, entertainment, shopping, financial transactions, signing of documentation, etc.),
- without requiring the movement of goods and merchandise (sending documentation by email vs postal mail);

As well as previously unthinkable daily actions such as:

- saving, editing, comparing and consulting all types of information, in all types of formats (texts, images, sounds, etc.),
- official communication with public administrations, service providers, etc.

And these activities and actions that can now be carried out digitally, as opposed to their exclusively analog versions, reduce:

- overall energy consumption
- $CO_2$ emissions
- pollution
- the time spent on execution
- the cost associated with moving people and goods.

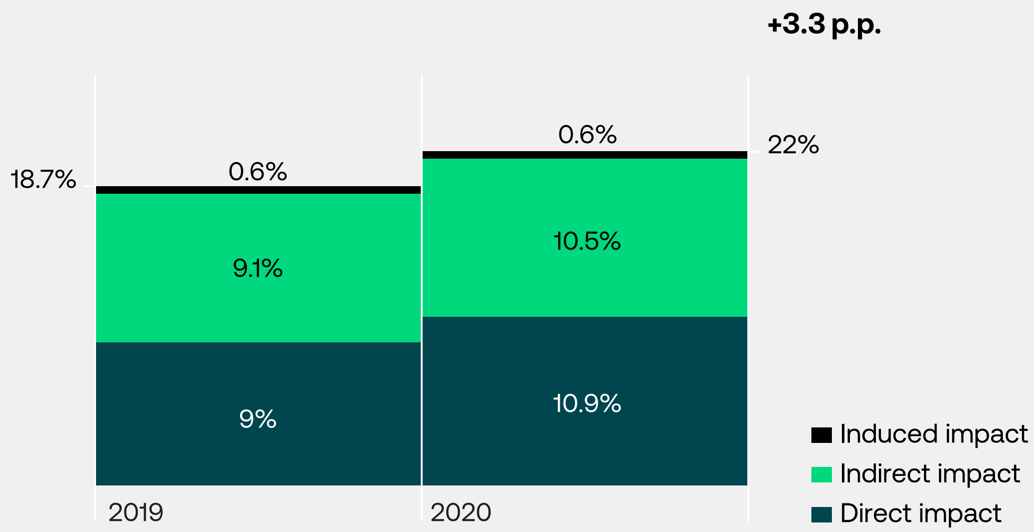
But digitalization not only means an improvement in certain activities or a reduction in the resources it uses; it also has a direct impact on the GDP of countries.

In 2019, the ICT sector in the European Union accounted for 4.89% of GDP, with countries such as Sweden (6.48%) standing out, according to Eurostat figures[12]. In 2020, according to estimates by the United States Bureau of Economic Analysis [13], the weight of the digital economy reached 10.2% of the country's GDP. In Spain, the direct contribution of the digitized economy in 2020 accounted for 10.9% of GDP, according to a study by ADigital[14] (Figure 5).

[12] https://ec.europa.eu/eurostat/databrowser/view/tin00074/default/table?lang=en
[13] https://www.bea.gov/system/files/2022-05/New%20and%20Revised%20Statistics%20of%20the%20U.S.%20Digital%20Economy%202005-2020.pdf
[14] https://www.adigital.org/doc/202202_informe-economia-digital.pdf

## Figure 5

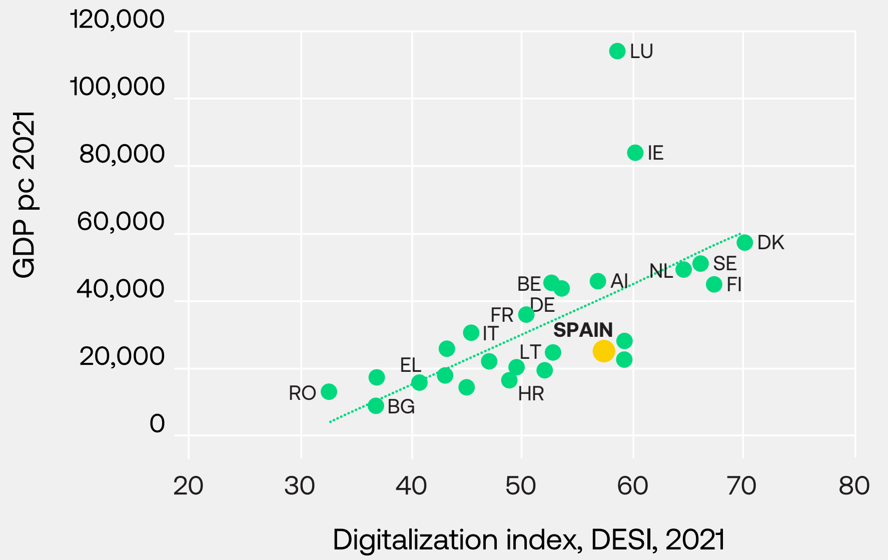
**Contribution of the digital economy to GDP in Spain, 2019 and 2020 (%)**




Source: ADigital.

## Figure 6

**GDP pc and level of digitalization of countries belonging to the European Union, 2021**




Source: European Commission, Eurostat, Afi.

Likewise, the degree of economic development of countries is linked to their level of digitalization, so the higher the GDP per capita, the more digital development increases, in this case (Figure 6) measured through the DESI (Digital Economy and Society Index).

No single causal relationship between the two variables can be affirmed because the digital deployment process depends on multiple factors, but there is no doubt that there is a strong positive and mutually beneficial relationship between them.

# Sector innovations enabled by digital processes in data centers

There are countless examples of digital innovations applied to the production sector, and both personal and professional daily life, and digitalization is a real solution to contribute to making our economy and our actions more sustainable. Some of these examples of sector digitalization are shown in Table 5.

## Table 5. Examples of sector innovations enabled by digital processes in data centers

| **Sector** | **Digital innovation** |
|---|---|
| Commerce | E-commerce |
| Culture | Streaming, Gaming |
| Manufacturing | Industry 4.0 and IoT |
| Real estate | Smart buildings, collaborative environments for construction |
| ICT | New forms of communication |
| Education | Online learning and online universities |
| Public Administrations | Remote attention to the citizen |
| Finance | Bigtech, Fintech and Insurtech |
| Healthcare | Tele-surgery, remote diagnosis |
| Transportation | Real-time fleet planning, Smart cities, shared mobility |
| General | Teleworking |

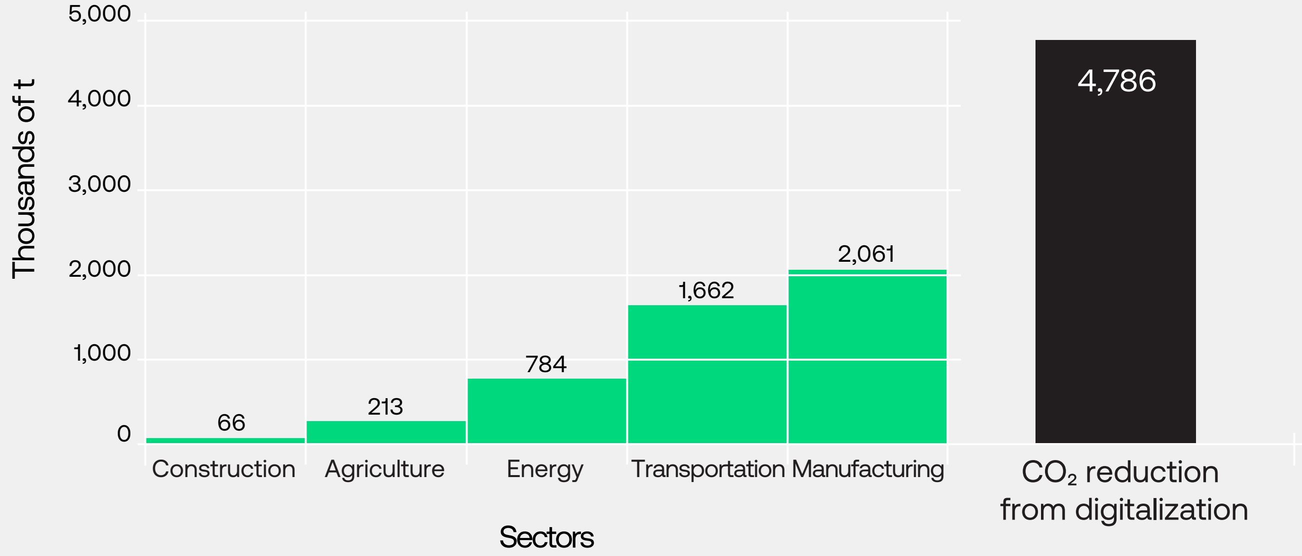
Source: Afi

The different economic activities of our productive fabric are benefiting from digital advances.

As shown in Figure 7, at the national level, the efficiency gains that digitalization enables would lead to a decrease in annual $CO_2$ emissions.

Figure 7

**Potential reduction of $CO_2$ emissions by sector in Spain, according to emissions figures recorded in 2019, (thousands of t)**




Source: Afi, GeSI & Accenture Strategy (2015), #SMARTer2030, Atmospheric Emissions Accounts (INE).

Three examples from everyday life have been selected because they are activities or actions that are so present in our daily lives that it is easy to understand the benefits of the digitalization-sustainability duo:

| | |
|---|---|
| 1 | Cash vs. digital payments |
| 2 | In-person versus virtual or hybrid meetings |
| 3 | In-person work versus telework |

1

## Cash vs. digital payments

In October 2018, the Dutch National Bank (DNB) published its working paper 610, "Assessment of the cash-payment life cycle" to identify the environmental impact of the use of coins and banknotes in an economy, one of the first to compare the environmental impact of cash to that of debit card payments. Their analysis used the ReCiPe endpoint (H) impact method, one of the most recent and up-to-date impact assessment methods available to Life-Cycle-Analysis (LCA) practitioners, which is normally used for this type of estimates.

Although the results are based on the situation in the Netherlands, they are also important for other countries inside and outside the euro area, such as Spain.

Previous studies only considered the environmental impact of banknotes (not including coins, like the one referred to in this example): Wettstein et al. (2000) carried out an LCA on Swiss banknotes and the ECB (2005) on euro banknotes, and found that the operating phase is the one that concentrates the greatest environmental impact generated by the transport of banknotes and the energy use of ATMs.

To put the environmental impact and global warming potential (GWP) of an average cash transaction in the Netherlands in 2015 into perspective, the impacts are compared to those of their closest substitute, that is, a debit card payment transaction.

The results show that the environmental impact of an average cash transaction in the Netherlands in 2015 was 36% higher and its GWP 21% higher (4.6 g $CO_2$e) than that of an average debit card transaction (3.8 g $CO_2$e). The relatively greater impact of cash on the environment is due largely to the impact of the use of metals for coin production, and their transport, one of the critical points in the cash payment system.

One interesting similarity between cash and debit cards is that for both types of transactions, the use of energy during stand-by (ATMs for cash and POS terminals for debit cards) is unavoidable because they are always available (they are never turned off).

The study also compares the environmental and climate impacts of the cash payment system as a whole with those of the debit card system. In this case, in terms of GWP, the difference between the cash and the debit card payment systems is 42%.

The differences in impacts at the system level are greater than at the transaction level, because there are still more transactions (including p2p transactions) in the cash payment system than in the debit card payment system, a trend that is changing across Europe. In Spain the differences would be even greater because the use of cash is much higher than the European average, as indicated in the "Study on the payment attitudes of consumers in the euro area (SPACE)" prepared by the European Central Bank in 2020.

In short, and in the light of the results of the research, the gradual replacement of cash payments by debit card payments could improve the sustainability of the retail payment system as a whole.

GWP cash payment

4.6

g $CO_2$ e

GWP card payment

3.8

g $CO_2$ e

$CO_2$ emissions savings

–21%

-0.8 g/transaction

Global GWP cash payment (2015)

17,000

t $CO_2$ e

Global GWP card payment (2015)

12,000

t $CO_2$ e

$CO_2$ emissions savings

–42%

-5,000 t 2n 2015

Source: Afi, from "Life cycle assessment of cash payments"

## In-person versus virtual or hybrid meetings

Since 2020, the COVID-19 pandemic has encouraged organizers of meetings, conferences and events to hold them online.

A recent study ("Trend towards virtual and hybrid conferences may be an effective climate change mitigation strategy") published in the journal Nature Communications and prepared by researchers at Cornell University, The American Center for Life Cycle Assessment and the Sustainable Process Integration Laboratory of the Czech Republic in 2021, highlights the potential of these types of conferences to reduce carbon emissions, the main greenhouse gas due to its acceleration of climate change.

At this point in 2022, based on common sense and personal experience, we can all agree that virtual and hybrid conferences are greener alternatives to in-person conferences. However, the environmental sustainability of these types of conferences had not been fully assessed as of the date of this study. In it, the research team reports the comparative results from an LCA perspective, taking into account not only the impact of transport, but also accommodation, food or catering, preparation, execution, ICT media involving one type (in-person) and the other types (virtual and hybrid) of conferences, also considering the trade-offs in terms of carbon footprint between in-person and hybrid meetings.

They indicate that **changing from in-person conferences and meetings to virtual meetings can reduce the carbon footprint by 94% and energy use by 90%.** And even ensuring a target of maintaining approximately 50% of in-person participation, they also showed that **hybrid conferences have the potential to reduce carbon footprint and energy use by two-thirds**. This means that a further reduction of the carbon footprint of virtual conferences and meetings almost exclusively involves improving the energy efficiency of the ICT sector, and considering catering options that include more vegetables and local products.

Previous LCA studies focused on quantifying the carbon footprint of in-person conferences. About half of them focused exclusively on transport (travel to and from the conferences).

Due to differences in scenarios associated with in-person conferences (e.g. duration, audience size and conference locations, geographical distribution of participants, mode of transport, etc.), the carbon footprint ranges from 92 to 3,540 kg $CO_2$ equivalent per capita. **All of these studies identified transport as the critical point in terms of the environment.** The location of the conference and the geographical distribution of the participants determine the distance traveled and the mode of transport used by the participants, so the location of the conference is also important to determine the mode of transport, given the differences in the availability of sustainable options, such as rail.

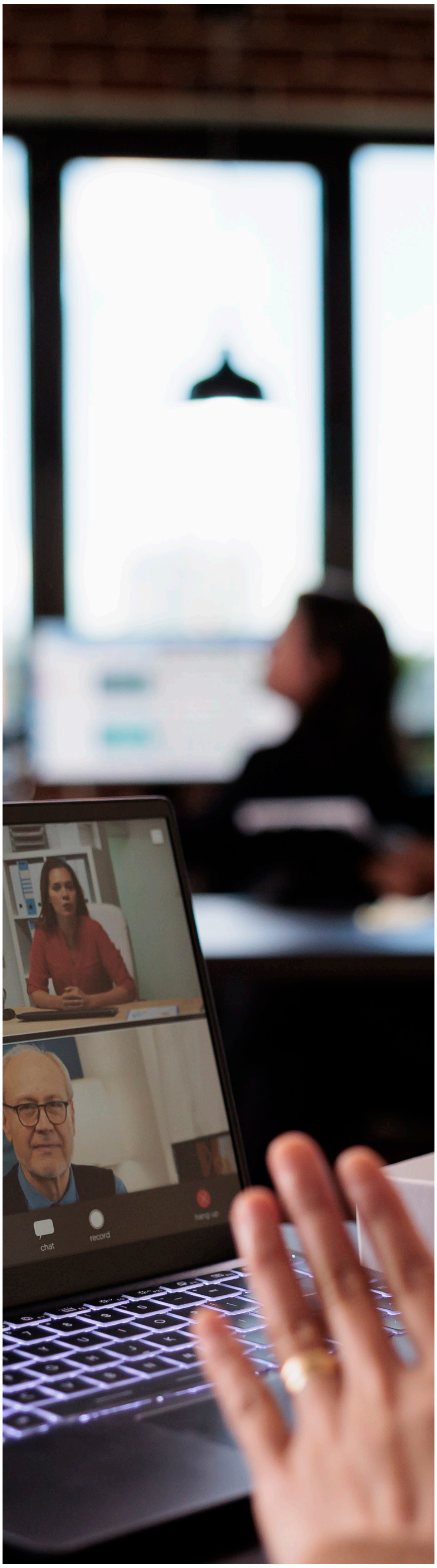
Recent studies that compare the carbon footprint of in-person and virtual conferences, in some cases assume carbon neutrality for virtual conferences; others calculate the carbon footprint based on the electricity needed for devices and servers; others consider emissions related to the network, laptops and videoconferencing servers (Zoom or others).

$CO_2$ emissions
**–94%**
in a virtual meeting

Energy usage
**–90%**
in a virtual meeting to

$CO_2$ emissions
**–60** to **–70%**
in a hybrid meeting

Energy usage
**–60** to **–70%**
in a hybrid meeting



# In-person work versus telework

Since 2020, the COVID-19 pandemic has encouraged the adoption of teleworking.

A recent study by Greenpeace Spain (March 2021) (“A year of teleworking: its impact on mobility and $CO_2$ emissions”) estimates the quantity of emissions that could be saved by implementing teleworking in Spain, recognizing that mass implementation is not feasible considering that only some jobs can be carried out remotely, from home. For this reason, Greenpeace Spain assumes two teleworking scenarios in the post-covid era for occupations that could potentially be performed remotely, focusing its analysis on Madrid and Barcelona.

In order to estimate the potential emission savings of teleworking, they calculate the total emissions of work travel, which is determined by the total passenger-kilometers used in this mode of mobility, based on the data of the transport authorities of Madrid (CRTM) and Barcelona (ATM), and multiply it by the specific emission factor for each mode of transport.

Under the “moderate” hypothesis, which consists of **adding one additional day of teleworking** per week in relation to the days of teleworking before the pandemic, **it could save 412 tons of $CO_2$ daily in Madrid or 605 tons daily in Barcelona.** This means that the routine of teleworking **could reduce the daily emissions generated by travel to the workplace by 7–8%** and the emissions associated with passenger transport in general by 3%.

Under the “advanced” hypothesis, that is, **adding two more days of teleworking per week**, **790 tons of $CO_2$ would be saved daily in Madrid and 1,153 tons in Barcelona**, equivalent to 14–15% of the savings in emissions from commuting, or 5–6% of the emissions produced by the mobility of people in these cities.

**Potential emissions savings due to the extension of teleworking in Madrid and Barcelona**

| | MADRID | | BARCELONA | |
|---|---|---|---|---|
| | +1 extra day | +2 extra days | +1 extra day | +2 extra days |
| Emissions in private vehicle | 339 | 649 | 547 | 1042 |
| Emissions in public transportation | 74 | 141 | 58 | 111 |
| Total $CO_2$ emissions avoided | 412 | 790 | 605 | 1153 |
| % of emissions from transportation | -2.8% | -5.4% | -3.1% | -5.8% |
| % of emissions from commuting | -7.8% | -15% | -7.2% | -13.8% |

Source: Un año de teletrabajo: su impacto en la movilidad y en las emisiones de $CO_2$. Greenpeace Spain, March 2021.

t $CO_2$ in Madrid

**–412**

for 1 additional day of teleworking

t $CO_2$ in Barcelona

**–605**

for 1 additional day of teleworking

t $CO_2$ in Madrid

**–790**

for 2 additional days of teleworking

t $CO_2$ in Barcelona

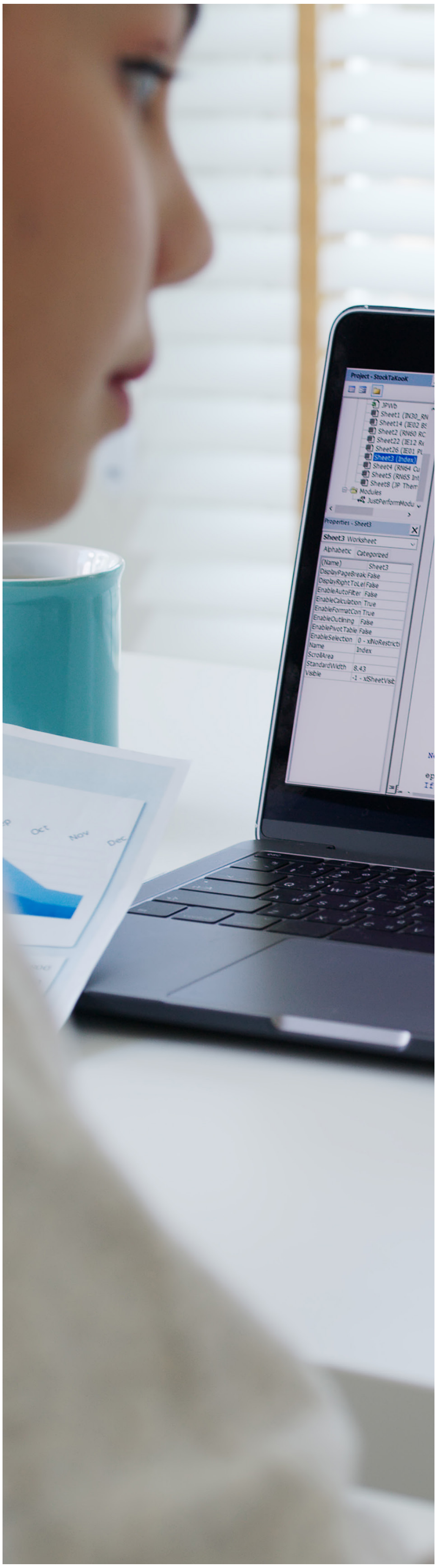
**–1,153**

for 2 additional days of teleworking

Reduction in

**7–15%**

$CO_2$ emissions



# 03 Data centers contribute to the overall reduction of energy demand

## Energy efficiency to reduce demand

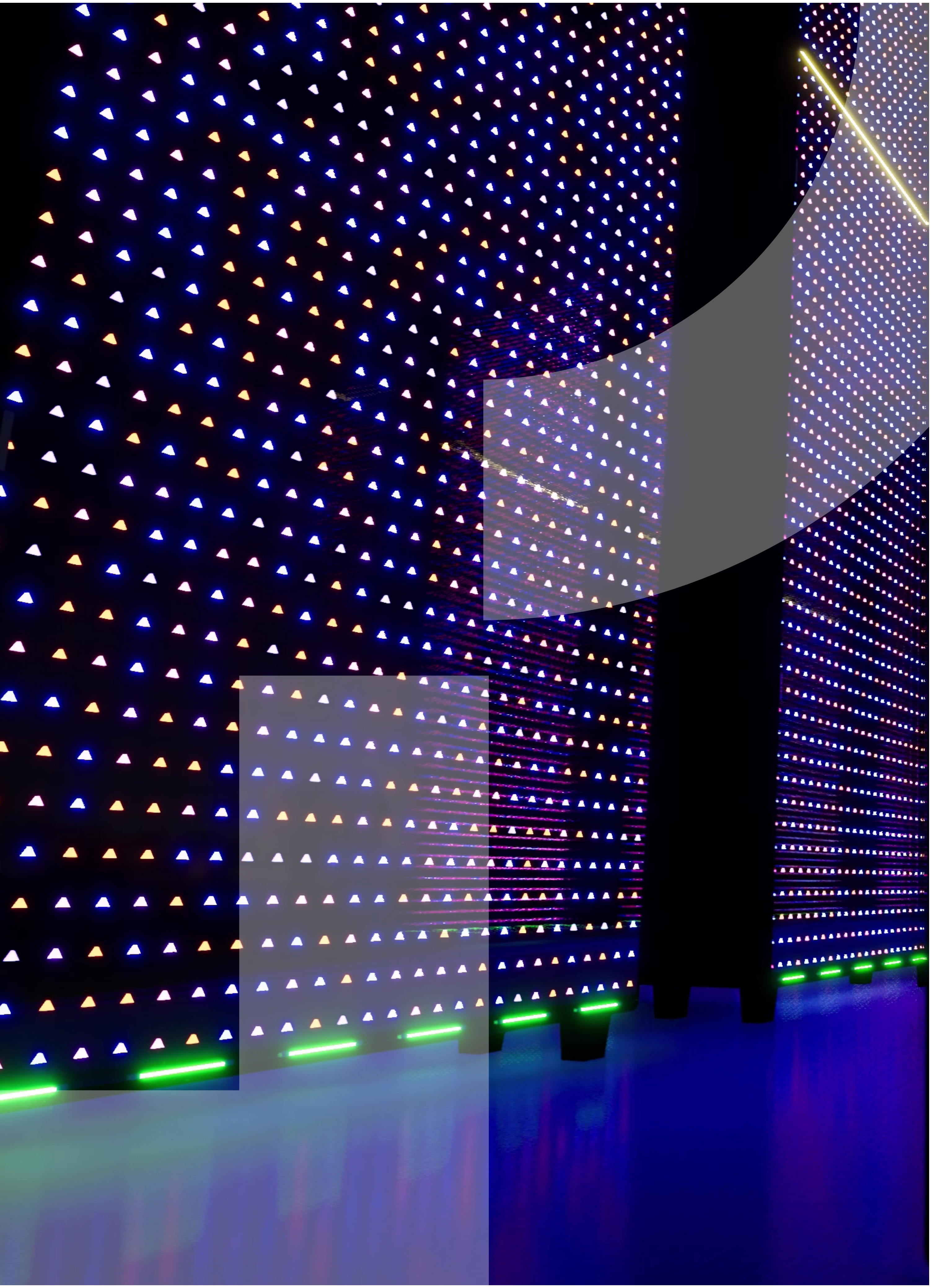
The energy efficiency gains that the processes that take place in data centers contribute to and which would in turn lead to a significant decrease in the annual $CO_2$ emissions recorded by the most energy-intensive sectors of activity today (energy sector, transport and manufacturing industry) have been determined.

Specifically, and according to the International Energy Agency (IEA), among the sectors with the greatest room for improvement in terms of energy consumption and emissions is road transport, whose digitalization would contribute to reducing its energy demand by almost 50% and greenhouse gas emissions by 75% by 2050. Similarly, the use of real-time data in buildings (offices or homes) could reduce energy consumption by 10% through 2040, with a total saving of 65 PWh, equivalent to the energy consumed by the OECD countries in 2015.

In addition to this positive contribution of digitalization, there is the demonstrated fact of the **energy efficiency of professional data centers** (colocation or cloud) that significantly reduce energy demand.

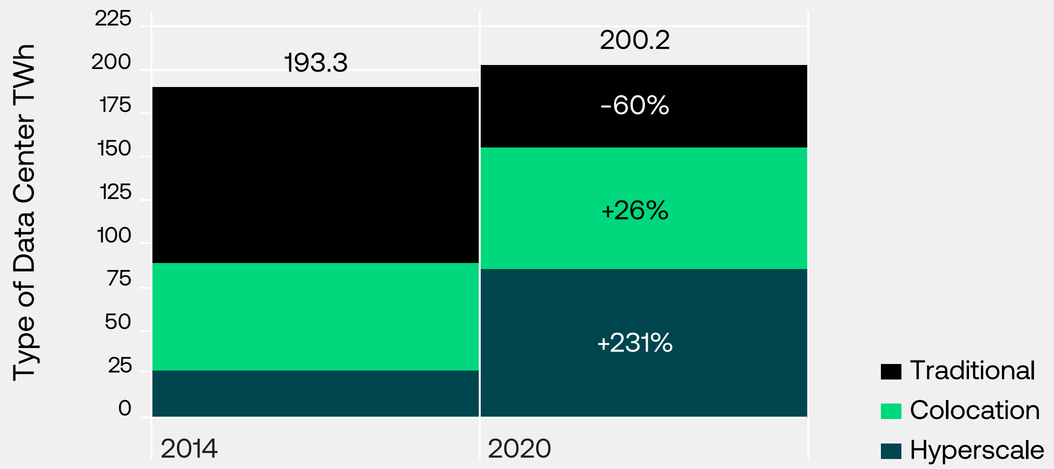
These data centers and their operating model generate powerful economies of scale and thus contribute to the efficient use of resources. The variable that measures the efficiency of energy use, Power Usage Effectiveness (PUE), notes that while a corporate data center has a PUE of between 2 and 3, colocation and cloud data centers are designed and operated with efficiency variables of 1.2–1.5, reducing energy demand by 60%.

Although corporate data centers are still the most common type of data center in the EU, as the demand for digital processes and real-time data processing grows (according to IEA data, Figure 8) a movement of IT loads has been observed from these traditional or corporate centers to colocation data centers (which have increased by 26%) or to hyperscale or cloud data centers (which have increased by 231%).



## Figure 8

**Evolution of the type of data centers (2014-2020)**



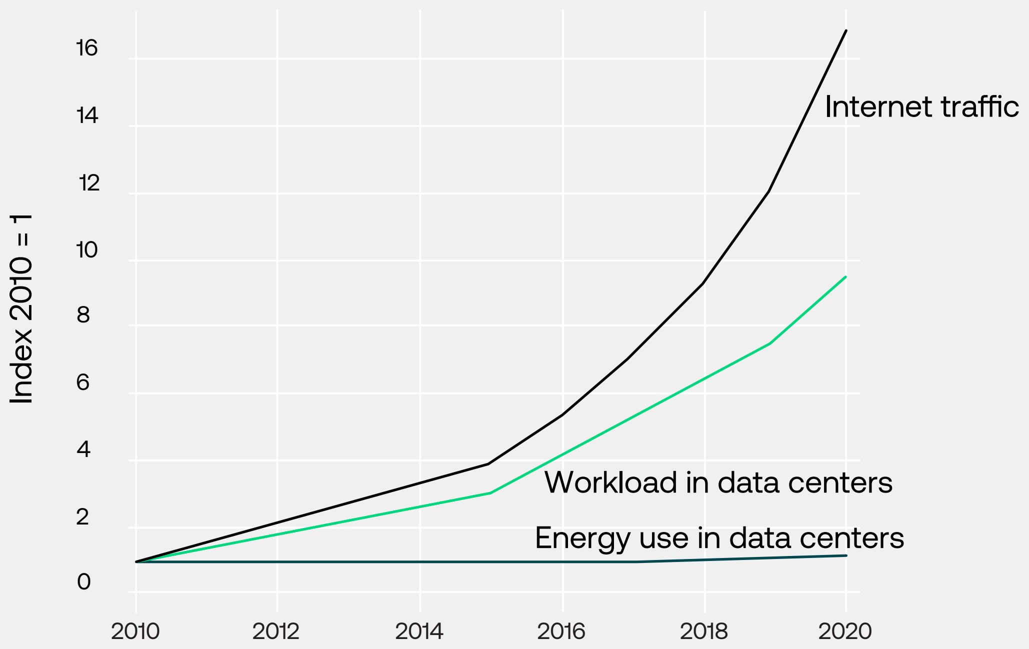

Source: https://www.iea.org/reports/digitalisation-and-energy

This migration of digital processes to colocation data centers has led to a reduction in energy use between 2016 and 2020, as confirmed by the IEA (Figure 9).

The energy consumption of data centers has remained stable despite the explosion in data generation and Internet traffic, which has doubled, and the load they receive, store and process, which has tripled. This means that the increase in data generation and processing has been much greater than the increase in energy consumption in relative terms, due to the higher energy efficiency of colocation and hyperscale data centers over traditional data centers.

## Figure 9

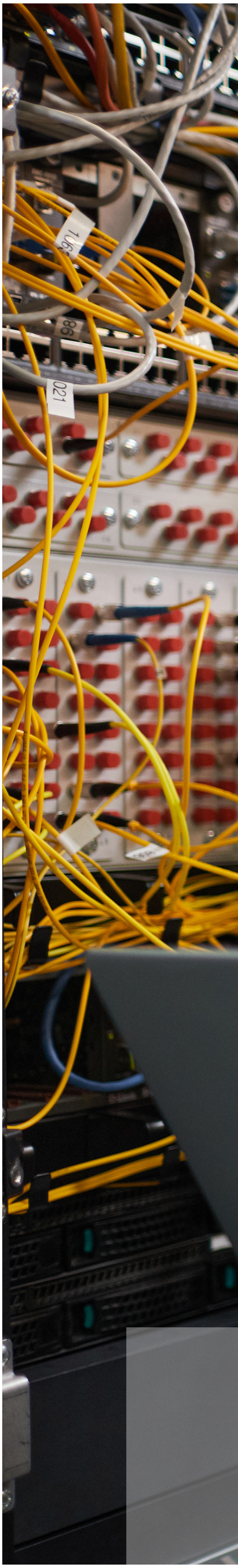
**Evolution of energy usage and load of data centers associated with the growth of Internet traffic, 2010-2020**




Source: https://www.iea.org/reports/data-centres-and-data-transmission-networks

The efficiency of professional (colocation or cloud) data centers reduces energy demand by 60%.

# 04 Digital infrastructure in Spain



## Spain as part of the data economy

**"If Spain wants to be competitive in the data economy, it needs the cloud, infrastructure services to store and process data, a data-sharing architecture between the different agents and high-capacity, secure, resilient and reliable connectivity and needs to boost the deployment of 5G and edge computing, privacy processing technologies and future generations of cloud infrastructures and services."** This statement, taken up in a recent expression of interest issued by the Ministry of Economic Affairs and Digital Transformation of the Government of Spain[15], provides an explicit and detailed recognition of a strategic aspiration, and a tacit acknowledgment that achieving that aspiration depends on a significant deployment of colocation data centers.

## Spain, a digital hub? A question of capabilities and opportunities.

The fourth industrial revolution that is currently underway is based on data and all of the innovations, technologies, channels, business models and hardware and software developments that use the collection, storage, analysis, processing and exchange of data to enable new capabilities, new channels and new ways of producing and consuming data in real time, from anywhere.

Making Spain one of the host countries of the data-center industry is a strategic opportunity. In 2021, there were 8,000 data centers worldwide[16]; 77% of the total were located in OECD countries, 64% in NATO member countries and more than half in the US, UK, Germany, China and the Netherlands.

There are several factors that enter into the decision of where to locate data centers. According to the Data Center Location Index (Arcadis, 2021), some of the more important factors are the size of the domestic market and GDP per capita, the ease of obtaining construction permits, the price of electricity and security of energy supply; cybersecurity; the average download speed and mobile broadband subscriptions per 100 inhabitants. In addition, the need for

[15] Expression of interest for the constitution of the Spanish GAIA-X HUB and the establishment of a specific data hub in the tourism sector: https://portal.mineco.gob.es/ca-es/ministerio/participacionpublica/consultapublica/Pagines/mdi-gaia-x.aspx
[16] Based on CloudScene data from 110 countries with available information

digital service providers to bring their service platforms closer to their low-latency customers, and to comply with the data protection regulations of the countries where their customers reside, are conditioning factors in today's market.

**Some of the factors highlighted by the Data Center Location Index to aspire to a planned and large-scale deployment of data centers in the medium and long term in Spain decrease the appetite for investment.** In particular, the factors that refer to the security of energy supply, because it is not recognized as an electricity-intensive sector and a driver of renewable energy generation; and the ease of obtaining industrial land and construction permits suitable for this type of installation.

**Being one of the protagonists of the digital economy is a one-time opportunity for Spain, in addition to being a plausible one, because the country brings together the four essential attributes to become the digital hub for southern Europe**, in the central core of infrastructure, innovation and digital businesses:

- **It is an economy with a high level of digitalization at all levels**, as reflected in the DESI, with the data economy permeating all areas. And in those areas where there is room for improvement (e.g. digital skills of the population and digital human capital), public authorities have designed policies and plans for addressing the shortcomings.
- **It is a country with high capillarity in fixed and mobile bandwidth and 5G network deployment**, placing it at the top of the rankings thanks to very successful investment decisions of the past.
- **It is a strategically privileged location as a point for data connection and distribution between Europe, Africa and America over subsea cables.** The exponential increase in traffic and the generation of data by large technology companies are no longer carried exclusively over the telecommunications networks of traditional carriers. Technology companies create and operate their own networks, which are mainly subsea cables connecting continents, as intercontinental Internet highways.
- **It is the target of investment for the main providers of essential infrastructure for the interconnection and the free exchange of data traffic.** With the design and development of the existing infrastructure, the interconnection neutrality of data centers ensures the free exchange of traffic without favoring the use of a particular network.

**Making Spain a digital hub will also help achieve climate goals.** The European Commission's support for the Climate Neutral Data Centre Pact, in which industry agents commit to climate neutrality by 2030, is a guarantee that the industry will contribute positively to Spain's climate goals.

All of this makes data centers an essential part of the infrastructure that supports the digital and sustainable economy, and vital for the deployment of the capabilities of the other economic sectors in the 21st century.

Data centers are an essential part of the infrastructure that supports the digital and sustainable economy of the 21st century.

**About Digital Realty:**

Digital Realty brings together companies and data through the widest range of data center, colocation and interconnection solutions. PlatformDIGITAL®, the company's global data center platform, provides customers with a secure meeting place for their data, as well as a proven solution methodology for extended data center architecture (PDx™), to drive innovation and efficiently manage the challenges of the data gravity effect. Digital Realty gives its customers access to connected communities in more than 300 data centers located in 50 metros in 27 countries and on 6 continents.

For more information, visit **www.digitalrealty.com** or follow us on **LinkedIn** and **Twitter**.