

The metaverse and the opportunity for the European Union

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Foreword

The metaverse is more than just headsets in a virtualised reality. It is a seamless integration of the internet and the physical world, where human perception is digitised.

If today's team meetings are two-dimensional (experienced on flat devices), then the metaverse will bring three dimensions in even higher resolutions, with holograms and human-grade sensory feedback that enable full immersion. It is an 'internet of senses,' where the internet's digital sensory experiences are more similar to the ones we experience in the physical world.

Combining new sensory technologies and augmented reality also unleashes new productivity gains through industrial use cases like digital twins, where new designs, workflows or treatments can be tested virtually. Just like the web and the mobile ecosystem before it, the metaverse adds another dimension to the internet to create new commercial opportunities. Over the course of twenty years, the user experience in ecommerce has evolved from a static low-resolution image of a garment to virtual fitting booths.

This report—authored by Meta—offers a grounded interpretation of this economic potential in the EU. It conceptualises the defining elements that will determine the nature and adoption of this nascent technology with national case studies. At first glance, these calculations by Meta may seem unconventional. While forecasts on internet technologies tend to prompt wild speculation, Meta's report works from conservative assumptions based on growth generated from current ICT investments.

However, EU network equipment industries are investing in an internet infrastructure capable of handling sensory and 3D data. Moreover, a recent survey by the European Investment Bank shows that augmented and virtual reality is one of the few technologies where the adoption rates of the EU industry are on par with—and even marginally ahead—of the US competition.

In addition, Meta's report distinguishes between different Member States for the first time. Questions will undoubtedly arise on adapting policies for skills, privacy and global interoperability—but these first attempts should encourage such discussion in Europe. By placing a strong focus on tangible developments and EU policy priorities, Meta's contribution is well-placed to begin emerging debates relating to the next iteration of the internet.

— Hosuk Lee-Makiyama, ECIPE Director

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Executive summary

The metaverse may create a significant economic opportunity for the European Union (EU) and support its objectives of sustainable economic transformation. The wide range of potential applications for the metaverse can benefit the EU's diverse member states, with use cases already being explored in key industries such as services, manufacturing and agriculture.

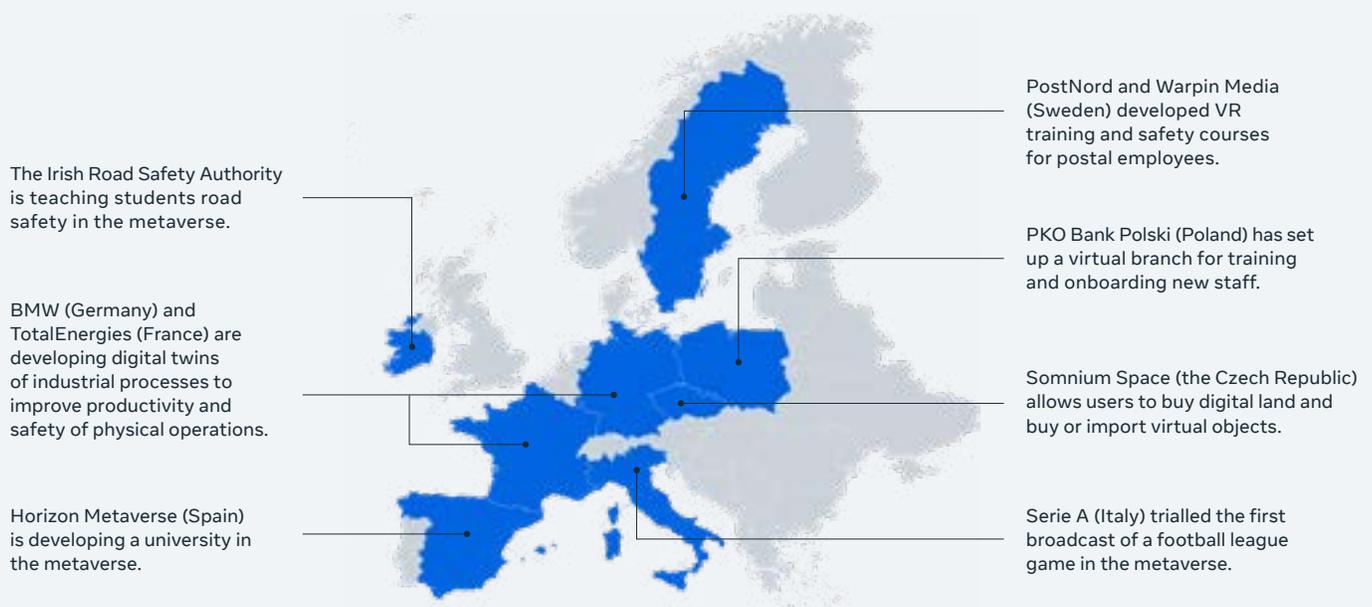
Although its exact shape and form are not yet known, the metaverse—understood as a set of interconnected digital spaces and immersive, three-dimensional experiences—promises to be the next evolution of the internet. The defining quality of the metaverse for people who use it will be a feeling of presence achieved through the convergence of several technologies, including virtual and augmented reality (VR and AR), blockchain and artificial intelligence (AI).

The metaverse and its component technologies are already spurring investment and innovation across the EU. Business adoption of VR and AR is higher in the EU (10%) than in the US (9%) and is highest in Belgium, the Czech Republic and Finland.^{1,2}

The EU market for VR and AR reached an estimated €7 billion in 2021 and is projected to grow by 37% annually to €34 billion by 2026.³

Metaverse applications are already being built across member states, creating value in a diverse range of sectors. For example, large **EU retail brands**, such as Gucci and Adidas, are exploring how they can connect with consumers via the metaverse.^{4,5} **EU farmers** are trialling how metaverse technology can **improve efficiency**.⁶ With respect to workplace training, businesses can train employees **up to 4 times faster** in the metaverse than through other methods.⁷ Figure 1 provides additional illustrative examples.

FIGURE 1: Examples of metaverse-related innovation across EU countries



The size and timing of impact and value creation in the metaverse are not yet fully known, as these new use cases are still gaining traction across the EU. However, if investments to develop metaverse devices and software continue to grow, the EU may see an increased economic opportunity of as much as **€259–€489 billion in annual gross domestic product (GDP) by 2035**—equivalent to **1.3%–2.4% of the total GDP**. Within this timeframe, the corresponding potential impact could reach €5–€9 billion in the Czech Republic, €55–€105 billion in France, €35–€66 billion in Germany, €28–€52 billion in Italy, €23–€43 billion in the Netherlands, €5–€10 billion in Poland, €28–€53 billion in Spain and €20–€38 billion in Sweden.

The coming decade calls for realising this economic opportunity in accordance with ambitions to achieve the EU's wider economic, social and environmental objectives.

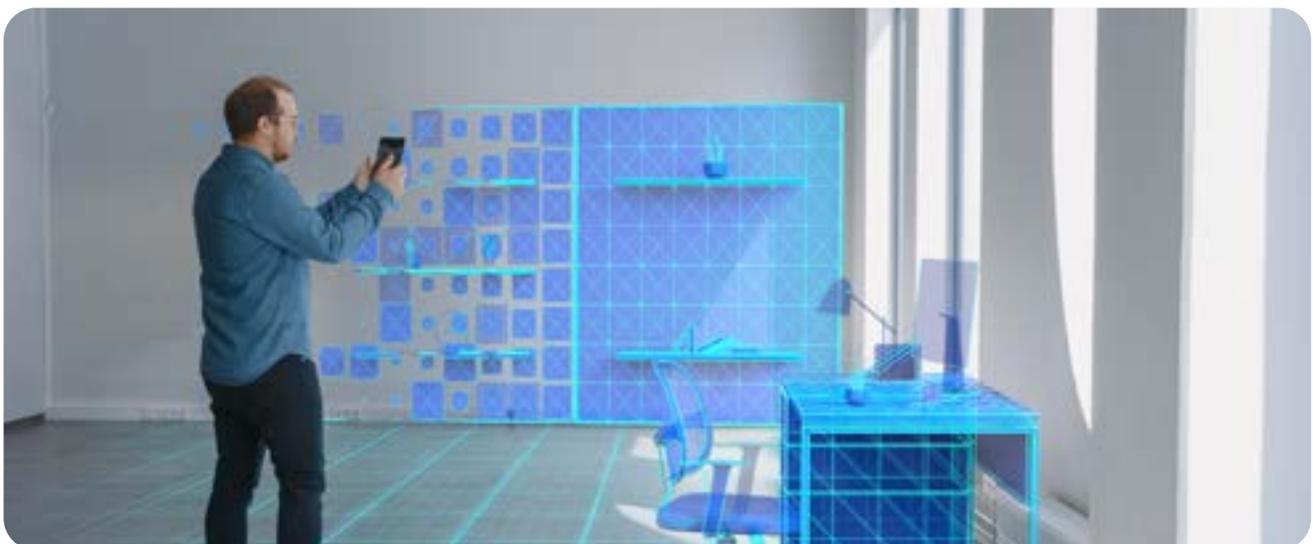
The European Commission (EC) already recognises the importance of digital transformation in achieving climate neutrality by 2050.⁸ **Meta is committed not only to supporting the realisation of the metaverse but also to achieving net zero emissions across our value chain in 2030.** Further, Meta is building tools that make virtual connections easier than ever. This means that for every flight or business trip that can be replaced in the metaverse, people will be able to choose options that have less impact on

the environment. Considering the ways in which the metaverse might support these sustainability goals will be crucial.

Facilitating and enabling greater competition and innovation in the EU and ensuring that the economic benefits of the metaverse are spread evenly across the region will require sound, consistent support from businesses and governments alike. Efforts to reduce disparities in digital infrastructure and skills across the EU are already underway, and will help ensure that all member states can fully realise the benefits of a digitally connected ecosystem, and digitally skilled workforce. From a governance perspective, maximising benefits will depend on maintaining effective openness throughout the metaverse ecosystem while ensuring appropriate safeguards for users as they engage with immersive experiences.

Meta remains committed to partnering with organisations and policymakers in the EU and its member states to support digitalisation, investment and collaboration in the metaverse so that these benefits materialise.

The EU may see an increased economic opportunity of as much as €259–€489 billion in GDP by 2035.



SECTION 01

Introduction

The metaverse is only just emerging, but it has a vast range of potential applications. The EU has an opportunity to benefit from its adoption as it pursues its aim to become better connected, equitable and sustainable.

The metaverse is the next evolution of the internet

In recent decades, the internet has facilitated the exchange of information, ideas and content. For the purpose of this report, we consider the metaverse to be **the next step forward, with a new wave of technological innovation enabling users to engage in more immersive and intuitive experiences.**

The metaverse is still at the early stages of adoption, with its eventual form and full potential uncertain. This will become clearer as the component technologies, use cases and protocols governing the metaverse are developed. Nevertheless, the metaverse is expected to consist of 3 defining elements that will influence its form and adoption (see Figure 2).

The metaverse is being built as the EU pursues a green and digital transformation

The EU is focused on a green and digital transition, targeting transformation through a series of initiatives that support its overall agenda for economic prosperity and resilience.

The EC has outlined a vision for the EU's digital transformation by 2030. **The EU Digital Decade targets** include equipping at least 80% of the population with basic digital skills; digitalising 100% of key government services; and promoting the digital transformation of businesses, so that more than 90% of small and medium-sized enterprises (SMEs) reach at least a basic level of digital intensity.⁹

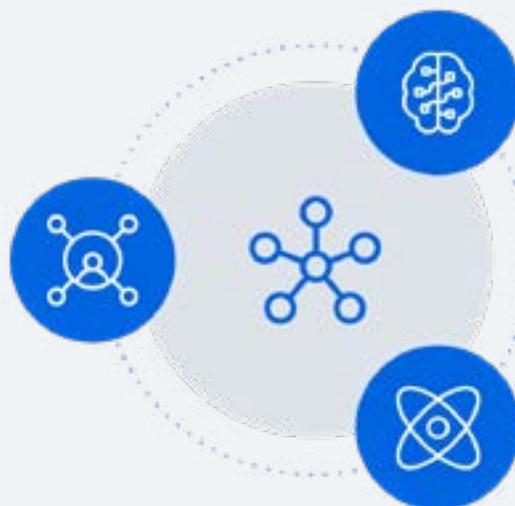
The European Green Deal includes targets to set an ambitious and cost-effective path to achieving climate neutrality by 2050; stimulate the creation of green jobs and cut greenhouse gas emissions while growing the economy; and encourage international partners to pursue an ambition to limit the rise in global temperatures to 1.5C°, in accordance with the Paris Agreement.¹⁰

Supporting digital development and the Green Deal are key features of the EU's COVID-19 recovery initiative, NextGenerationEU. As part of the initiative, the **Recovery and Resilience Facility (RRF)** has made over **€720 billion** available to support sustainability, resilience and preparing for the green and digital transitions. Current RRF spending plans allocate 26% to support digital transformation and 40% towards achieving climate objectives.¹¹

FIGURE 2: Elements of the metaverse

Immersion:

In the metaverse, people will communicate in ways that make them feel as if they are in a specific space with other people—shared environments where social interaction feels natural, like conversations at home or in a coffee shop.



Ecosystem openness:

The metaverse will allow for the seamless transition of user experience across many platforms, spaces and worlds.

Availability and synchronicity:

The metaverse will provide a living experience that is available for everyone in real time.

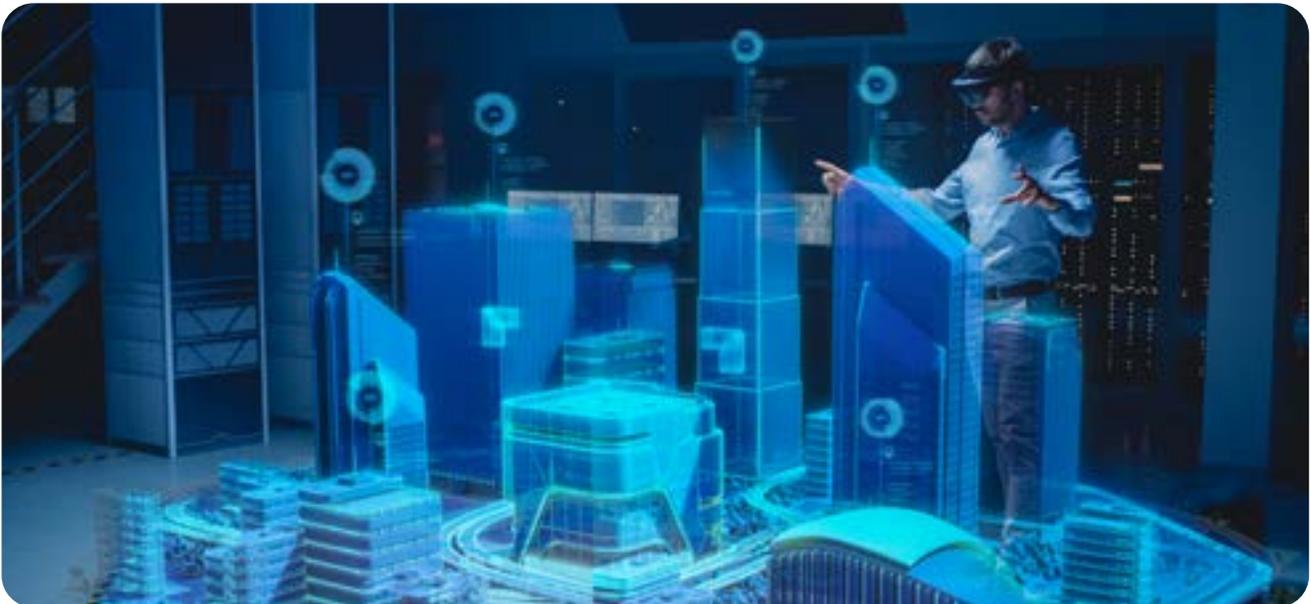
The EC has set a long-term vision to create stronger, more connected and resilient rural areas by 2040.¹² In order for rural areas to prosper, it will be important to address existing digital divides and reduce current socioeconomic disparities between urban and rural areas.

This report explores how the metaverse aligns with EU goals

The EU's continued focus on digital initiatives can contribute to an enabling environment for the metaverse, fostering digital capabilities and laying strong foundations for the adoption of new technologies. At the same time, a sustainable mindset as the metaverse is adopted will be important to achieve EU goals—for example, by accelerating the digital transformation of EU businesses and the proliferation of digital skills, by creating more sustainable ways of working and by expanding access and inclusion for rural communities.

Against this backdrop, this report explores the potential benefits of the metaverse for the EU. It considers the interaction with important EU policy objectives and the enabling factors that can contribute to realising this value and potential.

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SECTION 02

The emergence of the metaverse in the EU

The metaverse will be more immersive and interactive than the internet as we know it. To maximise the economic opportunity, an ecosystem of technologies and providers will be needed at both the EU and global level.

The unique characteristics of the metaverse will require the participation of diverse stakeholders across various geographies

For the metaverse to be realised, there must be a supporting ecosystem, with a complex network of diverse players across geographies and sectors supported by a digitally skilled workforce.

This ecosystem may comprise 3 layers:

- **Hardware, protocols and standards:** Existing information and communications technology (ICT) infrastructure will enable connectivity and data hosting and transfer. This layer also includes the user devices required to access the metaverse, such as laptops and smartphones, initially, but as immersion increases, AR and VR devices may be necessary.
- **Platforms and networks:** The intermediary level is where the products that make up the metaverse will be created. It will include blockchain-enabled platforms, with a focus on applicability to transactions.
- **Experiences:** The end user layer is where the metaverse content and experiences will be accessed. Users have a crucial role in shaping the growth of the metaverse, as providers and developers will need to cater to their requirements and needs.

The benefits from this ecosystem will be maximised if citizens possess the digital skills necessary to build, support and participate in this ecosystem, and if common protocols and standards are established to ensure different technologies, hardware and software are compatible and can interact.¹³

Momentum is building in the EU, with investments and innovation in supporting technologies

The EU tech sector has been actively developing innovations related to the metaverse and its constituent technologies (i.e., software, hardware and content creation). **European venture capital investment for emerging tech, such as blockchain and agriculture technology, rose from less than €5 billion in 2011 to more than €25 billion in 2021.**¹⁴

Innovations in the EU at the transaction platform layer of the metaverse could support its development. The EU is home to blockchain startups, with various companies building the infrastructure to simplify the design of blockchain applications. For example, companies are applying blockchain to education and providing the technology for anyone conducting public offerings of securities.¹⁵ In addition, the EU has taken steps to introduce blockchain to the public sector. The European Blockchain Services Infrastructure (EBSI) is a public blockchain being piloted throughout the EU to provide more efficient and accessible cross-border government services.^{16, 17}

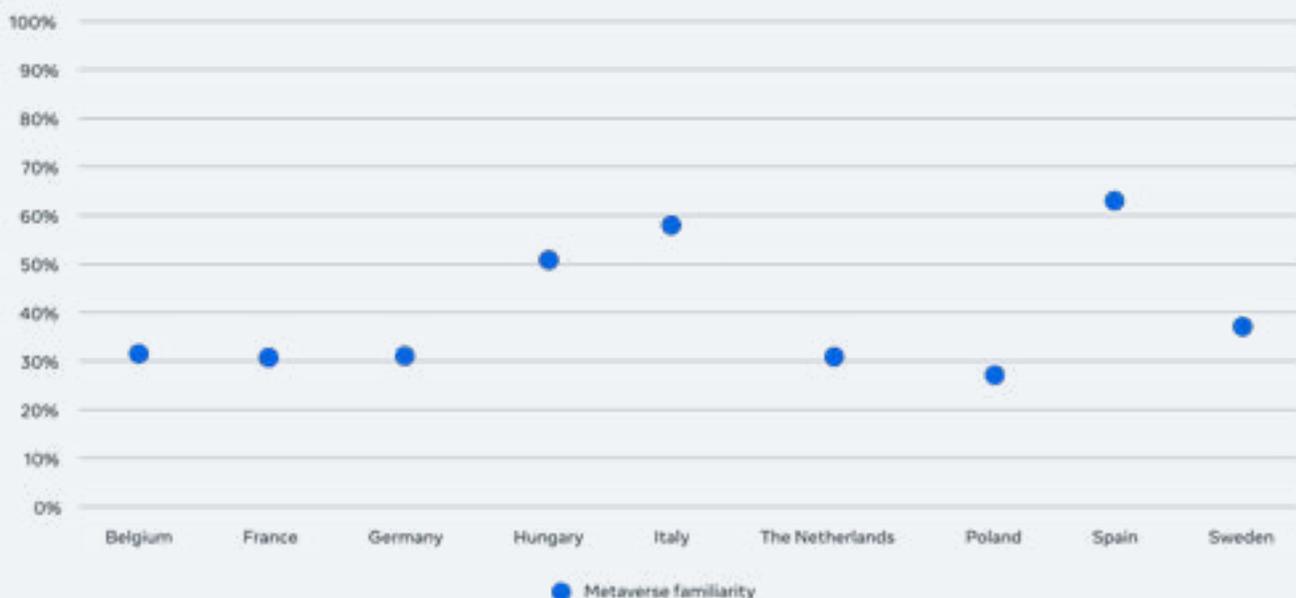


EU companies are also developing the hardware to support the metaverse. **Spending in Europe on VR and AR is expected to grow annually by 37%, reaching a total value of €34 billion by 2026.**¹⁸ For example, the European Investment Bank (EIB) recently invested in Varjo, a Finnish-based developer of VR software and hardware. And in March 2022, Meta announced that it had selected Spain to spearhead its metaverse ambitions and enhance its existing VR and AR platforms, including Horizon Worlds, Workroom and Venues.¹⁹

To support all these investments, policy stakeholders are beginning to have structured dialogues about the opportunities and challenges presented by the metaverse. For example, **the Virtual and Augmented Reality Industrial Coalition brings together key stakeholders from various sectors to support the competitiveness and unique value proposition of the EU VR/AR ecosystem.** This initiative aims to inform policymaking, encourage investment, facilitate dialogue between stakeholders and identify key challenges and opportunities for the EU VR/AR market.²⁰

An assessment of the opportunities for the metaverse in the EU requires an understanding of digital skills and current levels of investment in human capital across populations. Currently, familiarity with the concept of the metaverse varies across ‘connected’ segments of the population in the EU (see Figure 3). **In Italy, Poland, Spain and Sweden, familiarity is at a high level among the population, while in France and Germany, it is around 46–47% of the adult population.** Further investment in technological skills and education will be important for increasing familiarity with the metaverse across the EU. As understanding increases and investments in these technologies grow, additional use cases may emerge, which will be crucial for the technology to achieve scale. Although user familiarity is important, in addition to digital upskilling, compelling use cases and experiences must also be developed for the technology to become widely adopted.

FIGURE 3: Familiarity with the concept of the metaverse across the EU (2022)²¹



SECTION 03

The economic opportunity of the metaverse in the EU

It is uncertain when the metaverse will reach full maturity, but it is expected to create opportunities for development and growth in several areas. There are already examples where metaverse technologies can have a significant impact across sectors such as services, tourism, automotive, energy and agriculture. The estimated potential annual economic contribution of the metaverse to the EU is estimated to be **€259–€489 billion in additional GDP by 2035.**

The potential economic opportunity for the EU is significant

Although the metaverse is in the early stages of development, research suggests that a significant economic opportunity may exist. Most of this research focuses on the potential size of the market globally (i.e., annual revenue), and estimates range from €570 billion (Grand View Research) up to €11 trillion (Citi GPS) per year by 2030.²² However, market size estimates may not accurately capture the overall impact on the entire economy since there may be displacement of economic activity from other parts of the economy.

Other studies seek to estimate the potential impact on the global economy (i.e., on GDP). These estimates include €1.3 trillion per year by 2030 (PwC: VR and AR only), €2.6 trillion per year by 2031 (produced for Meta by Analysis Group) and €1.6–€3 trillion per year by 2035 (produced for Meta by Deloitte).^{23, 24, 25} For Europe (including EU and non-EU countries), Analysis Group estimates that the annual contribution to GDP could be €370 billion per year by 2031.²⁶

To produce an estimate for the EU, we have leveraged a methodology previously used by Deloitte for estimating the economic opportunity at a regional and country level. We estimate that the **annual benefits for the EU economy could reach up to €259–€489 billion in additional GDP by 2035**, equivalent to 1.3%–2.4% of GDP in that year.²⁸

Within this timeframe, the corresponding potential impact could reach €5–€9 billion in the Czech Republic, €55–€105 billion in France, €35–€66 billion in Germany, €28–€52 billion in Italy, €23–€43 billion in the Netherlands, €5–€10 billion in Poland, €28–€53 billion in Spain and €20–€38 billion in Sweden.²⁹ Greater discussion of the opportunities for select EU member states are included in the profiles at the end of this report.

As these estimates rely on the general relationship between ICT capital and economic growth, they may not capture all wider productivity benefits that will be specific to the metaverse. Equally, the estimates do not attempt to account for any investment in the metaverse that might be a substitute for other ICT investment that would otherwise occur.

For a summary of the methodology we have used, see the box below. Further details can be found in the Appendix.

FIGURE 4: The potential metaverse opportunity²⁷

Estimates of the potential metaverse opportunity vary



€0.6tn–€11tn

Global market size by 2030



€1.6tn–€3tn

Global GDP impact by 2035



€259bn–€489bn

EU GDP impact by 2035

We estimate that the annual benefits for the EU economy could reach up to €259–€489 billion in additional GDP by 2035, equivalent to 1.3%–2.4% of GDP in that year.



Estimating the potential economic benefits from the metaverse for the EU

Existing estimates produced by Deloitte, which are derived based on assumptions about plausible levels of metaverse-related investment, are in the range of €1.6–€3 trillion per year globally by 2035. To assess the potential benefits for the EU, we leveraged Deloitte’s methodology in combination with the International Monetary Fund (IMF) and World Bank GDP forecasts to calculate the share of global GDP attributable to the EU member states in 2035. This share is then used to allocate a share of the estimated global benefits of the metaverse to the EU.

As per Deloitte’s 2022 study, the methodology also assumes a rate of relatively consistent real economic growth between 2029–2035 of 3%–4% compound annual growth rate (CAGR) per year. While global GDP growth may fluctuate at various points in the business cycle, it is anticipated that growth will average out in the 3% range per year. Additionally, should investments in the metaverse be higher or lower than projected, metaverse-related GDP growth would also be affected (see methodology appendix for additional details).

Using this approach, **we estimate that by 2035, the potential impact on the EU’s GDP could reach up to €259–€489 billion annually.** To estimate benefits for individual member states, we apportion the EU-wide impact based on each member state’s current levels of ICT capital stock, which may serve as a proxy for each country’s ability to realise metaverse investment and benefits.

While our estimates are largely consistent with other research cited above, there are some factors that are difficult to quantify at this stage due to the uncertainty surrounding the metaverse, which may influence the total economic benefits derived in the future. Such factors include (but are not limited to):

- Variations in the factors that may enable or inhibit the metaverse across member states (as discussed in the next section of the report), except insofar as the current ICT capital stock levels of each member state may act as a proxy for this
- Productivity benefits specific to the metaverse, which may be higher than those captured by the general relationship between ICT investment and economic growth
- Substitution between metaverse investment and other ICT investment
- Metaverse investments that were made prior to 2022
- Complementary investments needed to support the metaverse (such as improving digital skills or facilitating digital transformation of businesses)
- Any ‘leakage’ effects that may affect the allocation of benefits to individual member states, (e.g., due to intra-EU trade related to the metaverse)
- Any other spillover effects from investment

Economic value may be driven by new markets, business models, training and employment and ways of working that the metaverse supports

As businesses and governments invest in the metaverse and its use becomes more widespread, economic value may be realised in several ways. These are described below, followed by examples in specific EU sectors. Further details can be found in the member state profiles of this report, which contain state-specific information and case studies.

New markets and business models

The metaverse will open up new markets and business models while helping to expand existing markets by offering new ways for consumers to interact with products and even create or develop their own applications. The value created may be comparable to how broadband internet and smartphones supported the development of the **app economy, which generated €187 billion in revenue throughout the EU economy in 2019 and contributed 0.4% to GDP.**³⁰

Virtual marketplaces are already emerging in the EU, where digital assets and content can be created, bought and sold. The Sandbox VR and Decentraland include in-game marketplaces, where players can interact with in-game environments and use virtual currencies for transactions.³¹ As the adoption of the

metaverse develops, these marketplaces are likely to become more sophisticated and compatible. For example, the potential of non-fungible tokens (NFTs) to establish authenticity and ownership of digital assets may allow users to create and acquire digital assets that can be owned, used and transferred across different platforms.

Greater access to information, digital content and digital infrastructure

The metaverse will enable users and businesses to engage with the digital world and produce and consume content in novel ways, providing users with greater access to digital tools (e.g., AI machines) and hardware (e.g., VR headsets). For example, the metaverse can broaden access to events by conducting them virtually. Virtual events are growing in popularity, partly due to the COVID-19 pandemic, as they enable users to participate in significant cultural, entertainment and sporting moments from their own homes.³² There were over 327 million online streams of concerts in 2020, with 9% of viewers regularly attending virtual live events.³³ In 2021, Solar Sound, a virtual music festival based in Finland, was attended by more than 4 million concertgoers.³⁴ **And Leinster Rugby in Ireland used metaverse technology to provide fans with a virtual pitch-side experience and presentation in a VR-built stadium.**³⁵



Better ways of working

The metaverse is expected to transform work for employees and businesses. By simulating working environments virtually, the metaverse could facilitate more productive remote working, more effective training and greater collaboration across different locations. It could also increase work flexibility and lower employment costs (e.g., commuting). Recruiting events in the metaverse can help reinforce the trend since the pandemic began for workplace technology to adapt to the needs of workers. For example, the French retailer Carrefour organised a virtual recruitment process in the metaverse after acquiring land on the Sandbox.³⁶ The metaverse could also empower virtual teams, enabling remote workers to be more productive and creating a more social and collaborative virtual work environment.

Skills development

The metaverse is also expected to transform training and skills development, leading to an increase in productivity and the development of high-value skills in the EU. Metaverse technologies could also improve the learning experience—using VR, learning retention rates are close to 75%, compared to just 5% for lectures.³⁷

Metaverse technologies such as VR could also help employees practise key skills safely, such as complex maintenance projects. For example, the German manufacturing giant Bosch has pioneered a VR training

tool for technicians on electric vehicle maintenance to provide more efficient and effective training.³⁸ Similarly, automotive manufacturers, such as BMW and Audi, have developed VR-based training systems to improve employees' everyday work and safety controls.³⁹ Furthermore, the Road Safety Authority in Ireland launched a programme for educating primary and secondary school students about road safety through an interactive experience in the metaverse.⁴⁰

The metaverse has the potential to drive value creation across the EU economy

Illustrative examples of the potential value creation across the EU's business sectors are discussed below regarding the service, industrial (manufacturing and energy) and agriculture sectors.⁴¹

Service sector

Services comprise the largest segment of the EU economy, covering 73% of GDP and 90% of employment.^{42, 43} Sub-sectors include retail, hospitality, financial services and public administration. In addition, 40% of the value of EU-manufactured products comes from services inputs, such as research and design, advisory services, information services, marketing and after-sale services.⁴⁴



The entertainment and gaming sectors may be the first to develop new products and markets that customers can reach through the metaverse. **Already, gaming has captured a large share (30%) of the VR/AR market and the media and entertainment sector (20%) in Europe.**⁴⁵ In the Czech Republic, Beat Games has risen to prominence as a developer of globally popular VR games and was acquired by Meta in late 2019.⁴⁶

In addition, retailers may make use of immersive experiences to showcase products to a broader audience. Adidas, the German sportswear brand, has made several forays into the metaverse. It has established **NFT collaborations, allowing Adidas NFT buyers to purchase exclusive physical merchandise.**⁴⁷ **Gucci, which created a business unit to house and scale its metaverse and gaming strategies,** is one of fashion's most prominent brands to experiment with Web 3.0 and the metaverse.⁴⁸

Deep dive on services: tourism

The EU is among the world's leading tourist destinations and accounted for 67% of all international tourist visits and 50% of international tourism receipts in 2021. The tourism industry in the EU is skewed towards the Mediterranean economies, which represented 32% of all global tourism in 2021, and over 50% of the total for Europe.⁴⁹

Metaverse technology will enable tourists to visit landmarks and other destinations virtually at a lower cost and mitigate challenges such as overcrowding and carbon emissions from travel. Some tourist destinations are already innovating in this regard—the **Alte Nationalgalerie in Berlin, in partnership with Meta, has developed a VR experience for its exhibitions, enabling virtual visitors to experience exhibitions remotely and interact with pieces of art in new ways.**⁵⁰

Industrial sector

The industrial sector accounts for just under 25% of the EU economy and 35 million jobs, covering areas such as manufacturing, mining and energy. These are key elements of many national economies in Europe. France, Germany and Italy contribute the most to industrial production in the EU.⁵¹

The metaverse is expected to transform the EU's industrial sectors, such as automotive manufacturing and energy, through enhanced access to digital information. Factories of the future are expected to have a digital twin hosted in the metaverse, an online replica that blends reality and VR. In addition, VR and AR technology can be used to upskill technical staff, such as maintenance engineers, and provide virtual space for them to practise, as well as delivering real-time guidance on the job. Extended reality (XR) enabled simulations will allow manufacturers to plan and optimise assembly and processing, while real-time data collection will create new opportunities for monitoring and performance analysis.⁵²

The metaverse is expected to transform the EU's industrial sectors, such as automotive manufacturing and energy, through enhanced access to digital information.

Deep dive on industry: automotive manufacturing

EU countries, in particular the Czech Republic, France, Germany and Spain are among the world's biggest producers of motor vehicles. Automotive industry turnover represents 7% of the EU's GDP and exports from the sector generate an annual trade surplus of more than €79 billion.⁵³

Metaverse technologies could increase the productivity of automotive manufacturers by enabling more immersive design processes, with teams working collaboratively in virtual spaces to design vehicles more efficiently and at a lower cost. In addition, digital twin technology could improve manufacturing processes.

German automaker BMW is developing a digital twin of its manufacturing process to design and reconfigure its factories. BMW teams will be able to collaborate in real-time to design and plan a factory, and changes to production processes can be tested virtually before implementation, **resulting in planning processes that are 30% more efficient** and potentially cost-saving.⁵⁴ Volvo, a Swedish automotive manufacturer, announced its intention to create a virtual twin plant to shorten lead times to market.⁵⁵

Deep dive on industry: energy

The energy sector in the EU—including energy generation, transmission and distribution—is undergoing rapid change. The contribution of renewable energy sources continues to grow, although oil and natural gas remain the largest sources for the EU.^{56, 57} The EU is taking steps towards climate neutrality by 2050, and its dependence on non-renewables declined 6% from 2019 to 2021.⁵⁸

The EC is working towards creating a digital twin of the electricity grid by 2023.⁵⁹ Capturing data and using it in immersive environments can help management improve performance in the energy sector. In particular, the metaverse may help reduce grid maintenance costs by enabling technicians to assess the cause of faults faster and more effectively, thereby reducing downtime.

Digital twins are already helping energy companies make operations safer and more efficient. TotalEnergies, a French energy company, uses a digital twin of one of its European offshore developments to model and trial any changes before sending personnel offshore, making the work safer and more efficient.⁶⁰

Agriculture sector

Agriculture in the EU accounts for 1% of GDP and provides employment for 20 million people. The EU is a world leader in the production and export of agricultural products.^{61, 62} Development of the sector is a key priority for supporting global food security and rural prosperity.

The digitalisation of the agriculture sector, including leveraging the metaverse, may support the development of the industry. Access to digital information, in particular, digital twin technology, could improve farms' operating efficiency. Digital twin trials are already taking place in Greece (for growing peaches) and in Spain (for pork production) to model the entire production chain. The potential benefits being investigated are increased resource efficiency, reduced waste and more resilient production methods.⁶³

The metaverse has the potential to drive value creation across the aforementioned sectors. Moreover, similar metaverse applications exist in other sectors of the economy that could enhance the economic opportunity for the EU that are not explored in this report.



SECTION 04

Enabling successful growth of the metaverse

The metaverse is expected to connect people around the world. However, the extent to which the benefits of the metaverse are experienced by people in EU member states will depend on enabling factors supporting the adoption of the metaverse. EU countries vary in their levels of digital development and socioeconomic characteristics. As long as these differences persist, the benefits from the metaverse may be shared unevenly across the EU.

The metaverse enabler framework

The success of the metaverse will depend on key enabling factors that will determine how it will be built and adopted across countries and regions in the EU. These factors can be grouped into 2 broad categories that make up what we call the metaverse-enabler framework:

- **Digital foundations:** The success of the metaverse will depend on building technology foundations that will form its backbone.
- **Support for ecosystem development:** The success of the metaverse will also rely on supporting factors that influence its operation and encourage widespread adoption. These factors include digital skills, ecosystem openness, data security and privacy, competition within the metaverse and the technical readiness of businesses.

This framework is intended to provide a provisional view of the enabling environment in the EU, and it will be refined and adjusted as adoption of the metaverse progresses.

Digital foundations in the EU

The digital foundations for the metaverse in the EU include:

- **Computing power:** Greater demand in the metaverse for complex processes and functions, such as data reconciliation and synchronisation, will require a high level of computing power.

The EU currently scores below the US in terms of the number of secure internet servers—50,000 in the EU versus 140,000 in the US per million people in 2020—which may serve as a proxy for computing power.⁶⁴ Some EU countries, such as **Germany (100,000 per million people)** and **the Netherlands (140,000 per million people)** have very high numbers of secure internet servers relative to their population size, and they are well-positioned to meet the demand for greater computing power that will be needed to support the metaverse in the region.⁶⁵

- **Connectivity:** Targets for the European Digital Decade include universal provision of wireless connectivity at least equivalent to 5G and fixed-gigabit connectivity.⁶⁶ Connectivity will facilitate the exchange of data across different metaverse platforms and support platform synchronisation.



As we have written elsewhere, metaverse adoption for the foreseeable future will continue to be driven predominantly through VR.⁶⁷ Almost all VR content is currently consumed over fixed networks through Wi-Fi. These fixed networks are already established across the majority of Europe and carry almost 20 times the traffic of mobile networks.⁶⁸ Further, the EU has opened up part of the 6 GHz band for licence-exempt use for Wi-Fi.

Europe should be lauded for its progress in installing Fibre to the Home/Building (FTTH/B), which, given its lifespan of over 30 years, is a cornerstone of access technology and a 'once in a generation' investment. Over 60% of Europeans now enjoy FTTH/B coverage. Deployments are well on their way to reach the EU Commission's goal of full coverage of homes with a gigabit network by 2030, and large markets such as Spain (89%) and France (63%) have invested early to build capacity.^{69,70} Europe is assessing the future use of the upper part of the 6 GHz band. A decision to make it available for Wi-Fi use would unlock further metaverse use cases.

- **User devices:** Physical devices, such as VR headsets and batteries used to access the metaverse must be available at affordable prices.

Demand for user devices will increase substantially as the metaverse is adopted, especially as the availability of compelling user experiences and content increases.

The European XR market (which encompasses VR and AR) has matured over the past few years and **is expected to more than double in size in the next 3 years with growth in the number of people equipped with hardware.**⁷¹

Within XR, **EU adoption of VR/AR devices exceeded the US in 2019 for the service sector.** However, there is currently very little hardware production in Europe, which suggests that the EU may need to rely on imports for the time being to meet the demand, unless an EU-based supply chain is developed.^{72,73} Varying levels of affordability across the EU will also likely affect the demand for such devices.

- **Transactions:** There won't be a single way to pay in the metaverse. Financial transactions in the metaverse will be enabled by different types of digital payment, including methods familiar today, central bank digital

currencies as they develop, and potentially, forms of cryptoassets. The opportunity to own digital assets in the metaverse will replicate the real economy, such as NFTs or assets based on other technologies.

The proportion of digital financial transactions in the EU (transactions that take place without the use of paper) **is comparable to economies such as the US and Japan.** In Sweden, 81% of people (over age 15) received digital payments in 2021, and in France, Italy and Spain, those figures were 52%, 55% and 55%, respectively.⁷⁴ EU member states should seek to encourage the adoption of digital payments and help make people comfortable with digital transactions, which are expected to be a major feature of the metaverse.

In summary, **the presence of important digital foundations in the EU indicates that there is a strong base from which the metaverse can grow.** However, some countries are more developed in those respects than others, and it is important to consider how to level the playing field and close these gaps.

Support for ecosystem development in the EU

Support for ecosystem development refers to factors influencing the operation and widespread adoption of the metaverse: digital skills, ecosystem openness, security and privacy, competition within the metaverse and the technical readiness of businesses.

- **Digital skills:** People engaging in the metaverse will need the digital skills to both contribute to its creation and use its applications to interact virtually with their surroundings and each other. People who do not have these skills may be excluded from the metaverse and unable to experience its benefits as either builders or users.

The presence of important digital foundations in the EU indicates that there is a strong base from which the metaverse can grow.

There has been an increase in digital skills among the population in the EU in the past few years, but there is variation across countries. **Digital skills are higher in Germany, the Netherlands and Spain** than in other EU countries, highlighting the need for wider EU efforts to accelerate upskilling.⁷⁵

- **Ecosystem openness:** What differentiates the metaverse from existing platforms is the ability to transfer ownership across platforms. Interoperable features in an open ecosystem will be important for the successful operation of the metaverse.⁷⁶

An open metaverse will enable the seamless transition of user experiences between multiple platforms.⁷⁷ **Metaverse developers must adopt common standards and protocols to avoid fragmentation and enable the seamless transfer of data between their platforms.**

Openness may be achieved through a combination of initiatives. For example, **Khronos Group has joined forces with groups such as the World Wide Web Consortium and the XR Association (XRA) to launch the Metaverse Standards Forum**, which promotes the development of interoperability and other standards for an open and inclusive metaverse.^{78,79} Similarly, the World Economic Forum (WEF) has announced a Defining and Building the Metaverse initiative that brings together key stakeholders to develop an interoperable and inclusive metaverse.

- **Security and privacy:** The operation of the metaverse will involve the transfer of data, including confidential and personal data that comes within the scope of the General Data Protection Regulation (GDPR).

A range of other challenges may arise concerning illegal content and user behaviour. Effective, principles-based governance frameworks will be needed to both facilitate the development of metaverse technologies and to provide an enabling ecosystem for the metaverse to be a safe and secure environment for consumers and enterprises to use and invest in.

- **Competition and collaboration within the metaverse:** As the metaverse is built collaboratively, competition will be driven by increasing numbers of players developing services, products and experiences in an open ecosystem. This will increase choices and ensure that quality is maintained by shaping the rules collaboratively.



As the metaverse takes shape, competition and collaboration in the ecosystem will be important for maximising its value and potential.

- **Technological readiness of businesses:** Businesses that are open to technological change and have the capacity to absorb new technologies could accelerate the adoption of metaverse-enabling technologies and improve the efficiency of the metaverse.⁸⁰

The EU is an innovation powerhouse. Many EU companies are investing in digital technologies, such as cloud computing, the Internet of Things (IoT) and AI. Around 90% of organisations expect their budgets for innovation to increase over the next 2 years.⁸¹ In this vein, the **Spanish government has announced a budget of €3.8 million to fund projects by SMEs and freelancers that will boost the metaverse and Web 3.0.**⁸²

As the metaverse takes shape, competition and collaboration in the ecosystem will be important for maximising its value and potential.



SECTION 05

A sustainable metaverse

The implications of the metaverse go beyond economic benefits. Success will depend on whether a sustainable metaverse is achieved.

Achieving sustainable growth is a key objective for the EU

Alongside the EU's digital transformation, another key priority is its green transition to support sustainable growth and achieve climate neutrality, otherwise known as 'net zero'.

EU economies have suffered **€487 billion of economic losses over the past 3 decades from climate-related extremes**.⁸³ The European Green Deal aims to transform the EU into a modern, resource-efficient and competitive economy that tackles climate change. The EC has adopted proposals for the EU's climate, energy, transport and taxation policies with the aim of reducing net greenhouse gas emissions by at least 55% by 2030 (compared to 1990 levels).⁸⁴

As the metaverse and its related technologies are built, it is important to also consider how reducing greenhouse gas emissions, improving energy efficiency and leveraging new data to improve decision-making about the climate, agriculture and waste reduction may support these efforts.

The metaverse has the potential to support these goals

Air travel accounted for 2.5% of global emissions prior to the start of the COVID-19 pandemic.⁸⁵ The metaverse will offer real personal presence and the ability to collaborate and share in ways that would otherwise not be possible in live gatherings without the time and expense of such physical travel. Offering options to replace travel by moving to the metaverse for work and play will make it easier for people to choose to reduce their impact on the environment.

Digital twins will help decision-makers combine the analytical benefits of AI with the immersiveness of VR. This may also enable the use of predictive technologies to improve understanding of supply chain management and how to reduce waste in industries such as agriculture. For example, 15% of food is lost due to poor resource management before leaving the farm, and using digital twins in the metaverse could help reduce the amount of this waste.⁸⁶

Meta is committed to achieving net zero emissions

The use of devices and services relies on a backbone of ICT infrastructure (e.g., telecoms networks and data centres). In 2019, the ICT sector produced approximately 1.6% of global greenhouse gas emissions.⁸⁷ Some elements of the metaverse already in place are also energy intensive. For example, the average bitcoin transaction consumes 14 times more energy than 100,000 credit card transactions.⁸⁸ The underlying source of energy is a key factor in the environmental impact of digital services and networks. Recent developments such as the Merge should help dramatically reduce the energy needed to complete transactions in certain cryptocurrencies, such as Ethereum.⁸⁹ Various efforts underway by governments and regulators are already exploring these issues.⁹⁰

Hyperscale data centres are inherently more energy efficient. Research in 2021 showed that hyperscale data centre capacity has already doubled in under 4 years.⁹¹ The energy efficiency of hyperscale data centres is illustrated by the fact that over the previous decade, data centre workloads increased by 9.4 times while energy consumption only grew by 1.1 times.⁹²

Technological advances and a shift to renewable energy sources will improve the economic sustainability of the metaverse as well as its environmental impact. In addition to building tools that make virtual connections easier than ever, in support of these objectives, Meta is transitioning segments of our logistics network to lower carbon-emitting modes of transport and evaluating opportunities to incorporate plastics and metals with recycled content into our products. This is part of **our commitment to achieving net zero emissions across our value chain in 2030**.⁹³

Technological advances and a shift to renewable energy sources will improve the economic sustainability of the metaverse as well as its environmental impact.

SECTION 06

Aligning metaverse success with EU policy objectives

Investments and collaboration between policymakers and industry can support digital development and shape the metaverse so that the benefits materialise.

The promise of the metaverse is potentially vast, but it is in the early stages of growth

Across the globe, organisations and governments are laying the groundwork for a significant digital transformation. Over the coming years, we can expect to see greater convergence of technologies and wider implementation of the metaverse. Therefore, it will be essential to consider how to attribute responsibility in adopting the metaverse and align in areas where progress can be made to create an environment of equal opportunity.

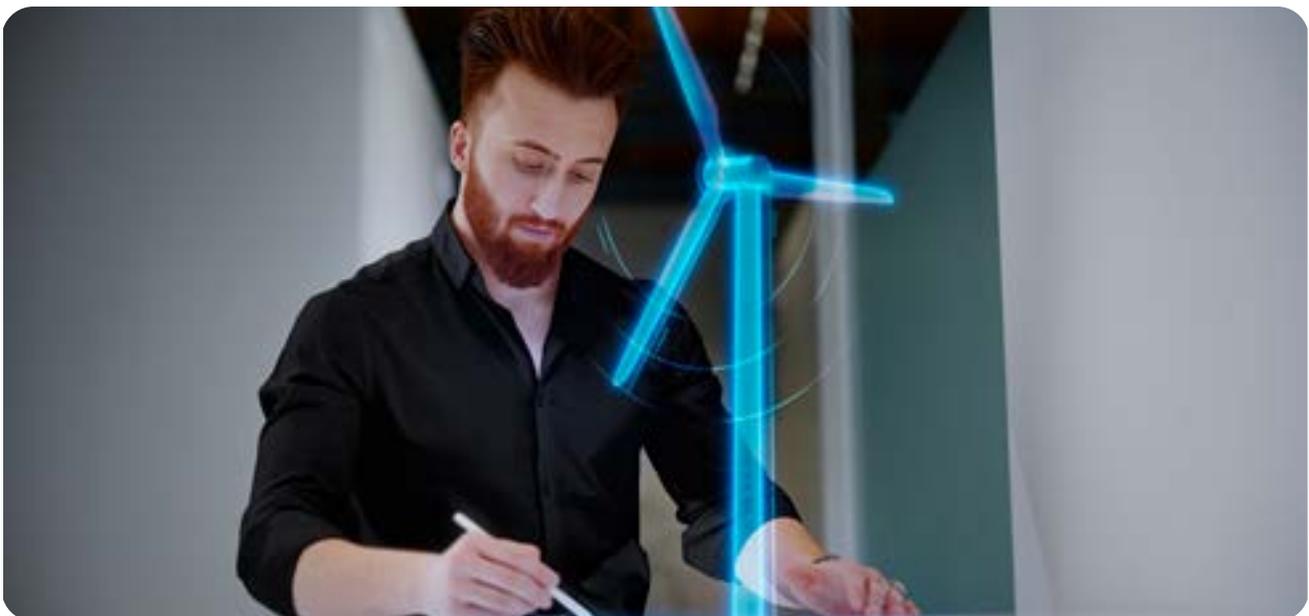
The EU has already taken steps to support the operation and adoption of the metaverse through the key enablers discussed here—digital foundations and ecosystem development. The Digital Decade targets increased levels of digital skills and improved digital readiness of EU businesses. There has already been marked progress towards some of these targets, particularly digitalisation of businesses.⁹⁴

While progress is being achieved, **key enablers vary between member states**. This is reflected in the variations in digitalisation measured by the Digital Economy and Society Index (DESI). To help address

this, the EC has required all member states to allocate at least 20% of their RRF expenditure to support digitalisation.⁹⁵ However, to realise the opportunity of the metaverse in all member states, additional support may be important.

Other enablers of the metaverse, such as ecosystem openness and competition, are also policy priorities for EU institutions. **Achieving shared standards and protocols that provide a common basis** on which to develop metaverse propositions will require EU stakeholders, including industry and governments, to work together.

Stakeholders must also consider how the metaverse can promote economic and environmental sustainability. The metaverse has the potential to enable more remote interactions. Companies, including Meta, have **committed to company-wide carbon neutrality by 2030**. Through our work with the Carbon Trust, we are developing the industry's first specifications for measuring, accounting for and decarbonising emissions associated with connected devices.⁹⁶ In addition, the EU aims to make digital transformation work for people and businesses but with the aim of reaching its climate-neutral goal by 2050.⁹⁷



SECTION 07

Member state profiles

The EU is a significant contributor to the global economy. In 2021, it comprised 5.7% of the world's population yet contributed approximately 18% to nominal global GDP.^{1, 2} The metaverse is expected to substantially impact the EU economy, with estimates indicating that it could increase annual GDP within the EU by **€259–€489 billion** by 2035.

The remainder of this section explores the country-specific impacts for the Czech Republic, France, Germany, Italy, the Netherlands, Poland, Spain and Sweden based on the methodology described in Section 3 and the Appendix. Accompanying this are selected indicators demonstrating performance in some of the areas described above. The member states in this section have been selected based on the overall size of their economy and are representative of the diversity across the EU.

¹ Eurostat. 'Population and Demography.' 2022.

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The Czech Republic

Estimates suggest that the potential economic impact of the metaverse could reach **€5–€9 billion** in the Czech Republic by 2035. For this impact to be realised, further investment in the expansion of digital skills will be important. The government is preparing the country for wider digitalisation and has introduced policies to address current challenges. If implemented, this will contribute to the adoption of the metaverse across society, bolstering the country’s already vibrant VR ecosystem and, in the longer term, presenting potential economic opportunities within sectors such as manufacturing.

The Czech Republic scores slightly below the EU average in the 2022 edition of DESI and ranks 19th of 27 member states.¹ However, yearly growth in the DESI score is above the expected rate for the nation.

The development of the Czech Very High Capacity Network (VHCN) is below the EU average.² Across other digital foundations, the Czech Republic scores at or above the EU average.

Measures of support for ecosystem development, such as digital skills and enterprise digitalisation, are at or marginally below the EU average.

The government has allocated €1.6 billion of its recovery and resilience plan towards digital priorities, including digital skills, connectivity and development of AI and Industry 4.0.³ The adoption of the metaverse will depend on the success of these policies.

The government is also increasing its public policy emphasis on digitalisation, with sizeable updates in 2018 and 2020 and another planned for 2022.

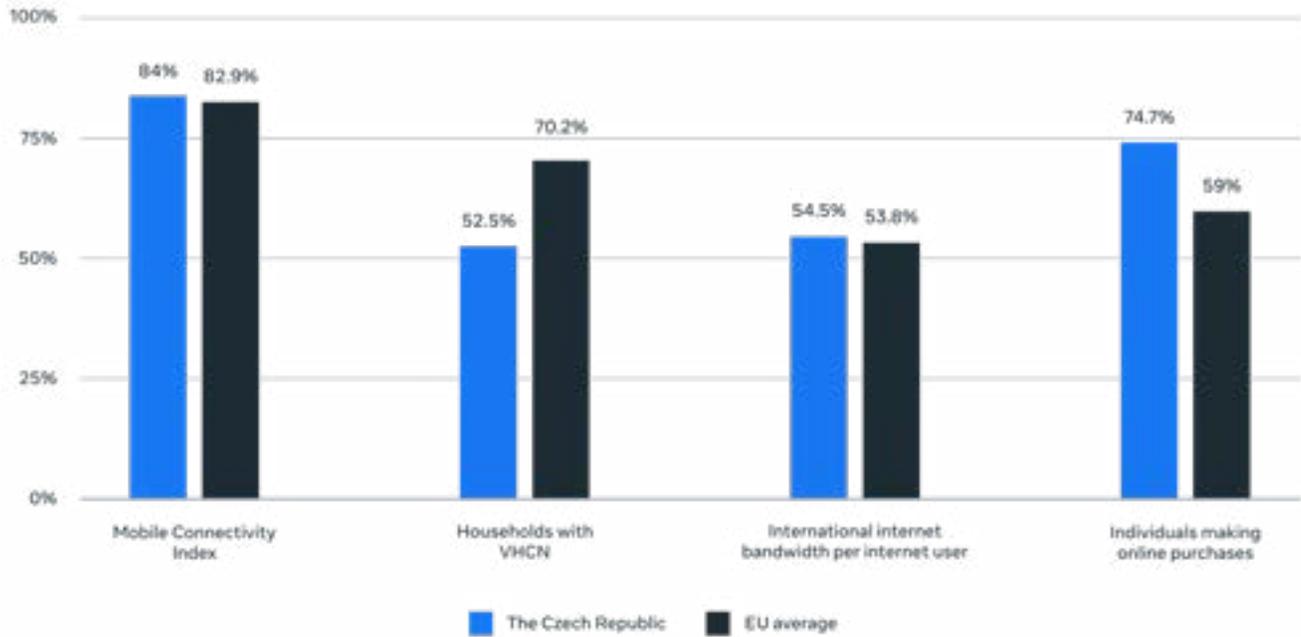
Background	
The Czech Republic	
GDP (€ billion)	€238.2
Population (million)	10.5
GDP per capita (PPP, thousand)	€29.6
ICT value added (% GDP)*	4.7%
ICT personnel (% emp)*	3.3%
* ICT manufacturing and services, based on NACE Rev. 2 classifications, which may differ from the Information and Communications sector within national accounts	

Secure internet servers



* Secure internet servers per one million

Digital foundations



Support for ecosystem development				
	Cisco Digital Readiness Index	EIU Business Environment Index	Enterprises with high digital intensity	Individuals with 'above basic' digital skills
The Czech Republic	15.8	7.4	17%	24%
EU average	16.1	7.4	19%	26%



The Czech Republic is developing a promising metaverse technology startup ecosystem. A higher percentage of Czech firms use the IoT and VR than in the EU, the latter of which is an area where multiple Czech firms specialise.⁴ The firms working in the VR industry include:

- Enterprises such as Beat Games, publisher of Beat Saber, one of the most downloaded VR games to date⁵
- A number of startups, such as Czech-based persistent VR spaces (Somnium Space)⁶
- VR live-streaming (LIV)⁷
- Video processing technology (Comprimato)⁸
- VR hardware (Vrgineers)⁹
- VR applications (Sense Arena in collaboration with Charles University of Prague)¹⁰

Large businesses in other sectors of the Czech economy are also beginning to employ metaverse technology. DHL Czech Republic is exploring the use cases of AR and VR in industry.¹¹ Furthermore, metaverse technology is beginning to make its way into the public sphere, with presidential candidate Karel Janeček using a metaverse platform for his campaign.¹²

Based on a burgeoning startup technology scene and government support in developing infrastructure, skills and digital capabilities, the Czech Republic has many sectors that may benefit from the metaverse in the medium to long-term. Sectors such as manufacturing (comprising 23% of total gross value add (GVA) in 2021) could be key beneficiaries.¹³ The metaverse could deliver sizeable benefits by using real-time data to optimise supply chains, minimise waste and generate cost efficiencies. Efficiencies such as these could hold great potential for export-oriented economies such as the Czech Republic, where international trade flows were equivalent to around 135% of GDP in 2020 and international competitiveness in industry is key to growth.¹⁴

Somnium Space—metaverse developer

Somnium Space, a Czech VR company founded in 2017, is developing an open virtual world where people can interact, socialise, engage in transactions and buy land. The company has sold \$200,000 USD worth of virtual land where people can build, buy or import properties.¹⁵

The company has partnerships with several other players in the VR industry, such as Sony, to improve the embodiment of avatars through 3D model creation and the Blockchain Gaming Alliance (BGA) to help build a decentralised metaverse.¹⁶

The CEO of the company, Artur Sychov, has recently announced the ‘live forever’ function inside the virtual world that would preserve human personalities after death. The function would allow users to create avatars that reproduce the characteristics, movements and voice of individuals so that they can live in the metaverse forever. The avatars could then be controlled by users to interact with other avatars in the virtual space.¹⁷

The company has stated it will try to keep a low price for this function, and individuals who wish to participate can already register.¹⁸



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- 8 Comprimato. '[Comprimato.](#)' 2023.
- 9 VRG. '[Vrgineers.](#)' 2023.
- 10 Sense Arena. '[Work on Your Mental Skills Every Day.](#)' 2023.
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France

Estimates suggest that the potential economic impact of the metaverse could reach **€55–€105 billion** in France by 2035, thanks to an innovative economy and broadly strong fundamentals, though further development may be helpful to maximise impact. The appetite for the metaverse is strong among French leadership, and President Emmanuel Macron is a prominent supporter of the technology. France could significantly contribute to Europe’s adoption of the metaverse, notably in showcasing arts and culture through it.

France has committed to a sustained effort in support of digitalisation, progressing significantly in recent years but remaining 12th of 27 EU member states in the 2022 DESI.

Mobile coverage is almost universal (99%), there is increased VHCN coverage (63%) and 1Gbps fixed coverage (27% versus EU average of 8%).¹

France has low high-speed broadband uptake (35%), though digital skills in France (31% of individuals hold above basic and 62% basic skills) are well above the EU average (26% and 54%).

Further digitalisation of the French economy is already supported by several public initiatives, such as the rollout of AI education centres.² Broader frameworks include the Plan de Relance, the RRF and the France 2030 strategic plan.³

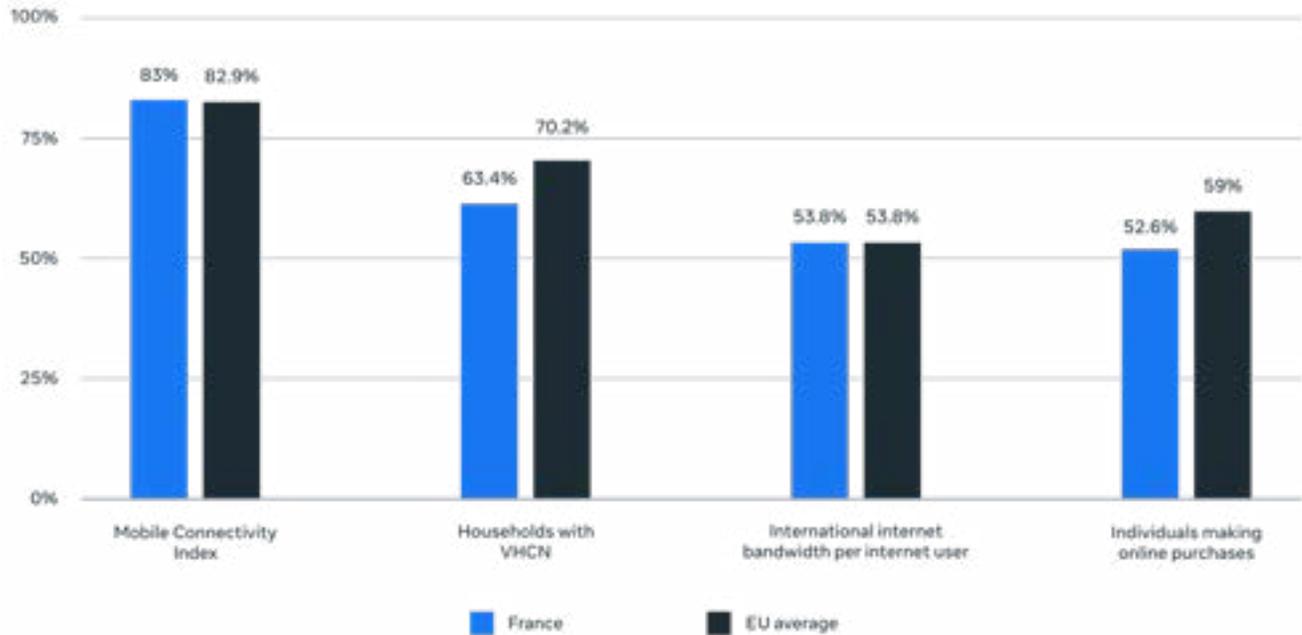
Background	
France	
GDP (€ billion)	€2,500.9
Population (million)	67.8
GDP per capita (PPP, thousand)	€33.8
ICT value added (% GDP)*	4.4%
ICT personnel (% emp)*	3.1%
* ICT manufacturing and services, based on NACE Rev. 2 classifications, which may differ from the Information and Communications sector within national accounts	

Secure internet servers



* Secure internet servers per one million

Digital foundations



Support for ecosystem development				
	Cisco Digital Readiness Index	EIU Business Environment Index	Enterprises with high digital intensity	Individuals with 'above basic' digital skills
France	16.2	7.8	13%	31%
EU average	16.1	7.4	19%	26%

At present, survey evidence suggests that French firms have lower levels of adoption for IoT and VR compared to the rest of the EU, although France specialises in several sectors that could benefit from these technologies.⁴ France has made notable progress to this effect in recent years.⁵ Investment has been allocated to research, industrial implementation, adoption in education and the digitalisation of public services, as well as wider investment in communications infrastructure generally (i.e., not metaverse-specific).

Private commercial interest in metaverse technologies is complemented by a proliferation of public applications—for instance, the creation of adaptable education programmes for special needs children and the broad My Health 2022 reform programme.^{6,7} The latter

establishes a framework for the deployment of telehealth and mandates the creation of an interoperable data platform. Public investment in infrastructure and digital skills is ongoing, and some elements of the metaverse ecosystem are already well-supported.

Such enterprises will continue to be in focus, as indicated by the objectives laid out in the France 2030 investment plan. This plan seeks to support private enterprise in developing new technologies for immersive content and experiences (video games, VR and AR).⁸ Additionally, the French chapter of the VR/AR Association provided an ecosystem report in 2020, featuring over 60 French-based VR and AR enterprises corresponding to a number of elements of the metaverse ecosystem.⁹

Advanced deep tech enterprises will be launched each year from 2025 that seek to disrupt the research ecosystem and at the same time leverage many of the elements that comprise the metaverse ecosystem such as AI, big data and broader digitalisation.¹⁰ An example of these enterprises is Dassault Systèmes, a French software corporation specialising in 3D product design, simulation and manufacturing. The company is developing 3D digital twin technology to create a virtual representation of physical or conceptual designs, allowing for product design and development strategies to be tested before implementation. Digital twins can collect and analyse real-time data from physical manufacturing and suggest improvements from this data.¹¹ Such applications can be used across industries, such as the urban planning, manufacturing and aeronautic and aerospace fields.

Some of France's most heavily weighted industries have strong potential metaverse use cases, including:

- Digital real estate markets
- Virtual wellness and social work applications
- Fintech technologies

In the longer term, the metaverse is also expected to present a significant opportunity for the arts, entertainment and leisure sector. The share of employment in this sector in France is higher than the EU average, and the sector contributes 0.3 percentage points more to GVA than the EU average.^{12,13} Furthermore, President Macron has emphasised the importance of France taking a lead in the production, promotion and mastery of cultural and creative content in the metaverse given its applications across the arts.

Meta x Simplon—metaverse academy

To boost the digital readiness of the French workforce, Meta has partnered with Simplon, a French digital training firm that operates a large network of 130 schools in France and abroad, to launch a metaverse academy that seeks to provide free high-skilled training focused on the metaverse and associated immersive technology.^{14,15}

The training programmes offered in the metaverse academy are geared towards the future of work. It is likely that employment opportunities in the future will include novel roles unrecognisable in industry today, and thus the initiative is dedicated towards 2 new professions that are expected to manifest as the metaverse develops:

- **Specialist immersive technology developers:** Listed by France Compétences, this role centres on the design of virtual, augmented and mixed reality platform and environments.
- **Support or assistive technicians:** This role aims to provide skills essential to the implementation and maintenance of equipment and the deployment of various metaverse use cases across the market.

Since the beginning of the 2022 academic year, Meta and Simplon have begun to offer targeted training courses that respond to these needs. The metaverse academy currently provides tuition to students in Lyon, Marseille, Nice and Paris but plans to expand over time.



End notes for France

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Germany

As the EU’s largest economy, Germany could comprise a significant proportion of the metaverse’s impact across the EU, potentially **€35–€66 billion** in the country by 2035. The metaverse could provide several benefits to Germany’s economy in the long-term, for example, within manufacturing, IT and the sciences. While Germany currently leads the way in metaverse-adjacent technologies such as XR, addressing skills gaps will facilitate uptake of technologies by enterprises for widespread adoption to be achieved across society.

Germany ranks 13th out of 27 EU states in the 2022 DESI and has progressed well since 2017, with growth of digital foundations higher than the European average each year.¹

Germany’s connectivity is rated fourth in the EU. Its VHCN network has increased by 20% since 2020, though rural VHCN coverage is still low.²

Germany’s digital skills are significantly below the EU average, but it has a slightly greater proportion of ICT specialists than the EU.

The government has committed to improving core digital infrastructure, with over 140 digital policy projects. It has also pledged €12 billion in subsidies for fibre connections. Coverage is 15.4% and is currently the lowest of all EU member states.³

Adoption of advanced technologies is above its EU peers, at 10.6% versus the EU average of 8.1%. The German government has provided funding to facilitate advanced technology development, such as €2 billion to support quantum computing. The 2019 Blockchain Strategy is one of several strategies to increase adoption of advanced technologies.⁴

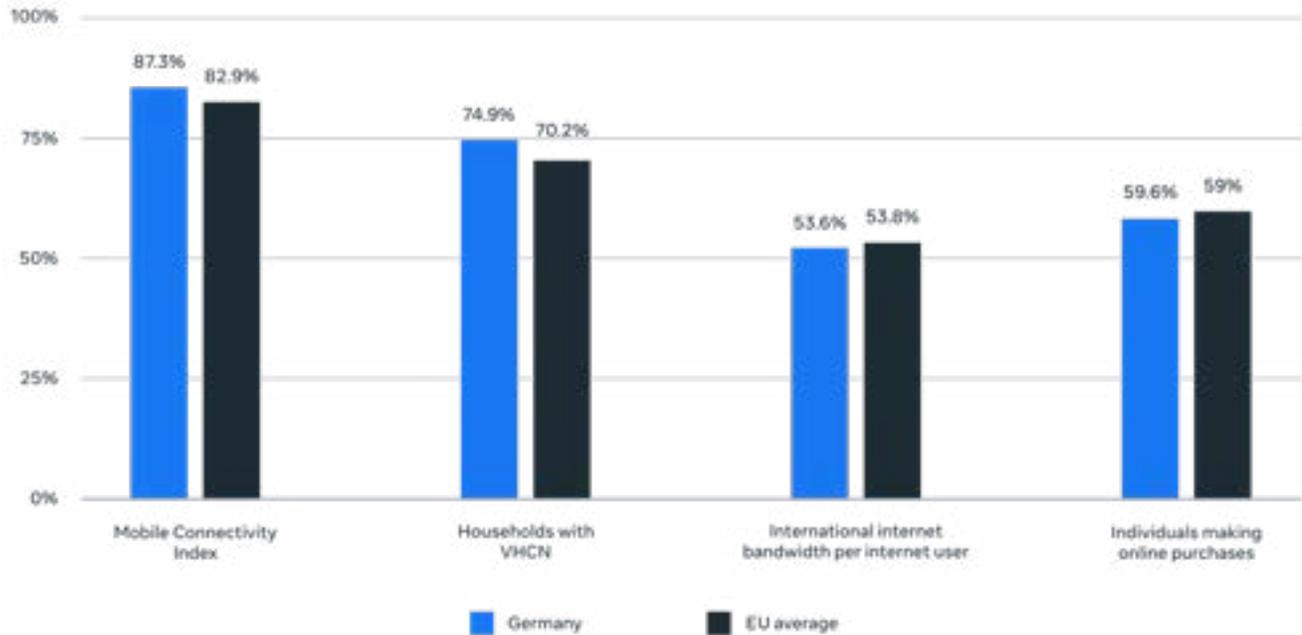
Background	
Germany	
GDP (€ billion)	€3,601.8
Population (million)	83.2
GDP per capita (PPP, thousand)	€38.6
ICT value added (% GDP)*	4.4%
ICT personnel (% emp)*	3.1%
* ICT manufacturing and services, based on NACE Rev. 2 classifications, which may differ from the Information and Communications sector within national accounts	

Secure internet servers



* Secure internet servers per one million

Digital foundations



Support for ecosystem development				
	Cisco Digital Readiness Index	EIU Business Environment Index	Enterprises with high digital intensity	Individuals with 'above basic' digital skills
Germany	17.8	8.2	21%	19%
EU average	16.1	7.4	19%	26%

Across enterprises, German firms have not adopted IoT at the same rate as the wider EU. However, adoption rates of VR appear much higher than the EU average.⁵ Furthermore, Germany possesses the second largest ecosystem for VR and AR in Europe, comprised of both large and small enterprises developing XR technology.⁶ The German public sector has taken interest in VR/AR health care, with the Healthy Reality project exploring how XR technologies can be used to develop and administer new treatments, therapies and teaching methods. This initiative is developed in partnership with the University of Applied Sciences in Bochum.⁷

Many multinational corporations are also interested in supporting the metaverse in Germany:

- SK Telecom and Deutsche Telekom launched a South Korean metaverse platform in Germany as part of a broader initiative from cybersecurity to virtual markets.⁸
- Meta has partnered with Alte Nationalgalerie to create the Magical Reflections XR experience, a 3D cinematographic gallery exhibiting the works of iconic artist Johann Erdmann Hummel, with immersive virtual photography tools enabling interactivity with artwork and integrating with shareable social media platforms.⁹

- VR and AR are particularly promising for Germany's automotive industry, with both Audi and Volkswagen each announcing initiatives to incorporate VR and AR into drivers' user experience.^{10,11}

Germany is actively developing its human capital and has recently published an implementation report on its 2019 National Skills Strategy.¹² Over €2 billion of investment has been allocated to the digitalisation of education in 2021, with €5 billion of federal funding allocated to the Digital Pact for Schools by 2024. Furthermore, Germany enhanced its STEAM-connected agency to improve digital specialism among women.

Germany's economy is weighted towards sectors that may benefit from emerging metaverse use cases—for instance, through virtual service provision, product design and manufacturing. Employment in manufacturing is about 20 percentage points higher in Germany than the EU at large, and the metaverse can be used to upskill workers in the sector via virtual training.¹³ This allows workers to gain experience effectively. Manufacturing companies can take advantage of this and digital twin technology to boost productivity, and German companies are especially likely to benefit, thanks to their use of VR.

Adidas—metaverse advertising

Adidas is an iconic German sportswear brand founded in Herzogenaurach, Germany, in 1929, where it is still headquartered. Since its foundation, the company has grown to operate in over 160 countries, employing around 62,000 employees, and the corporation reported €21 billion in sales in 2021, second only to Nike on the global sportswear stage.^{14,15,16}

Similar to other leading brands such as Nike, Adidas has already made several forays into the metaverse. At the end of 2021, Adidas Originals partnered with Coinbase and bought virtual land in The Sandbox, a gaming platform based on the Ethereum blockchain.¹⁷ This purchase was worth 400 ETH, approximately €1.7 million at the time. Adidas's purchase of land coincided with a 25% increase in the value of the SAND token, showing the benefit to the metaverse that can be provided by companies such as Adidas. This land can be used for virtual marketing campaigns, opening up Adidas to a new audience. The picture on this land can also be easily and regularly changed, which could be useful when advertising different products for various time zones, without having to purchase multiple billboards like in the physical world.

Adidas has also set up a website titled 'Into the Metaverse,' detailing its NFT collaborations, some of which are linked to exclusive physical merchandise for the buyers of Adidas NFTs.¹⁸ By tying physical merchandise to NFTs, Adidas was able to attract the attention of a new audience to its products, many of whom may not have previously considered buying Adidas clothing and footwear. As part of this project, Adidas also collaborated with Prada to feature user-generated and creator-owned art and raise money for charity, improving the public perception of both companies.^{19,20}



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Italy

Estimates suggest that the potential economic impact of the metaverse could reach **€28–€52 billion** in Italy by 2035, which could be realised through growth in Italy’s digital skills, unlocking its potential to adopt and benefit from the metaverse. Public policy is focused on easing constraints on adoption of advanced technologies, though significant metaverse use cases are already observed, including adoption in the Serie A football league, Italy’s world-leading fashion industry and in educational public-private partnerships.

Though it is the third largest EU economy, Italy’s level of digitalisation is low among EU members, ranking 18th of 27 in the 2022 DESI.¹

Italy’s connectivity has significantly improved in recent years, and VHCN adoption is rising.²

Italy ranks 25th among EU member states with regard to individuals’ digital skills. Under half of the Italian population possess basic skills, while the percentage of ICT majors among university graduates is the lowest in the EU at 1.4%.³

The Italian government announced a National Strategy for Digital Skills, with ambitious milestones for education, specialist skills and e-government, aiming to meet EU Digital Decade targets.⁴

Further measures support these aims, including the Repubblica Digitale initiative that provided upskilling to approximately 4 million people in 2021 alone.⁵ Further support of €350 million is planned in 2022 via the Fondo per la Repubblica Digitale.⁶

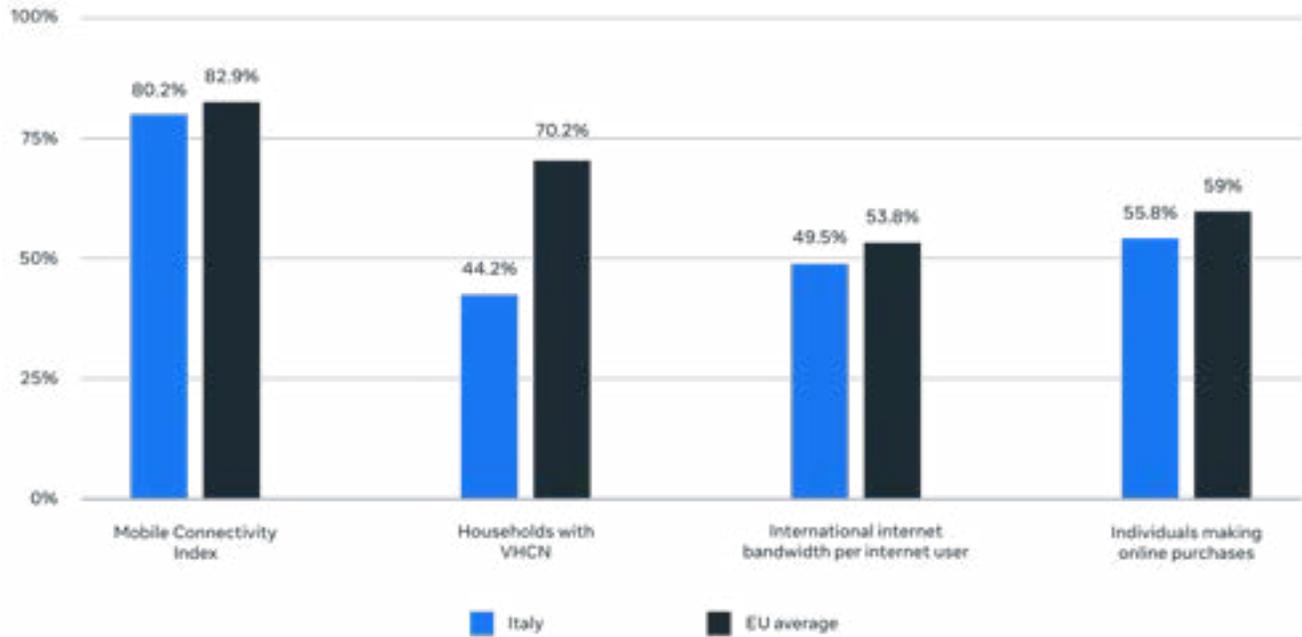
Background	
Italy	
GDP (€ billion)	€1,775.4
Population (million)	59
GDP per capita (PPP, thousand)	€30.6
ICT value added (% GDP)*	3.4%
ICT personnel (% emp)*	2.5%
* ICT manufacturing and services, based on NACE Rev. 2 classifications, which may differ from the Information and Communications sector within national accounts	

Secure internet servers



* Secure internet servers per one million

Digital foundations



Support for ecosystem development				
	Cisco Digital Readiness Index	EIU Business Environment Index	Enterprises with high digital intensity	Individuals with 'above basic' digital skills
Italy	14.8	6.7	18%	25%
EU average	16.1	7.4	19%	26%

Italian firms have adopted IoT at a higher level than the EU at large, and VR has seen similar adoption levels in both Italy and the EU.⁷ This is despite Italy’s rating for its digital readiness and business environment being below the EU average, and the nation’s ecosystem support is still developing.

Among Italy’s educational institutions, engagement with component technologies for the metaverse has been observed. In 2019, the University of Bologna partnered with leading VR and AR firm EON Reality to establish the world’s first fully-accredited master’s degree in Innovation Studies and Extended Realities (MIXR).⁸ This follows an earlier EON Reality initiative setting the foundation of a local XR ecosystem through

an interactive digital centre that develops content and applications for academic and industrial purposes.

The Italian Ministry of Education has recognised potential use cases for the metaverse, formally collaborating with the Immersive Education Initiative to organise the IMMERSIVE ITALY conference series. The series addresses the personal, cultural and educational impact of technologies including VR, AR and fully immersive environments.⁹ The initiative (IED) also included the first international use of the Knowken digital tokens, an intellectual currency awarded for intellectual achievements that can be transacted to purchase VR hardware, graphic processing units (GPUs) and educational programmes.¹⁰

Italy shows multiple signs of adopting metaverse technologies amid this development in its foundations and ecosystem.

- In the arts, Vanity Fair has launched numerous metaverse initiatives, including an NFT magazine cover and hosting an interactive VR fashion shoot. In 2022, Vanity Fair Italia will launch a metaverse artwork exhibition inspired by Rome's Pantheon.¹¹
- In financial services, Italian banking group Sella has introduced a targeted acceleration programme focused on supporting finance startups with the most promising metaverse solutions.¹² Italy's blockchain community is also investing in the metaverse, with the leading Italian crypto fund Iconium investing in OVER, an Italian decentralised metaverse platform.¹³

Public administration is digitalising via Italy's recovery and resilience plan, with €6.1 billion allocated.¹⁴ This is leading to changes that will be potentially critical to the success of metaverse in Italy—introducing a cloud environment for public administration, enhanced data interoperability standards and stronger cyber threat monitoring and management in the national digital ecosystem.¹⁵

Serie A—metaverse broadcasting

Serie A is the top division of Italian football. The football league is one of the world's biggest and most prestigious, attracting a global audience and hosting footballing giants such as Juventus, AC Milan and Inter Milan.

In May 2022, the league took its first steps into the metaverse, broadcasting AC Milan playing Fiorentina.¹⁶ While the game was physically played inside the iconic San Siro stadium in Milan in front of over 70,000 spectators, over 7,000 fans were able to experience the event virtually in the metaverse, the first trial of streaming a match on a metaverse platform.¹⁷ League sponsor TIM technology and blockchain technology specialists ConsenSys made the event possible, which was held in the gaming metaverse The Nemesis, which allows for the creation of virtual villages to host events.

Due to broadcasting rights agreements, the game could only be trialled in the Middle East and North Africa (MENA) region. Free NFTs were made available to the first 10,000 fans invited to watch the game. Users could access the event by using their NFTs, and upon entering, all the fans were placed into a virtual room. During the event, the game was broadcast onto a TV within the virtual room, and fans could interact with one another, chat, play games and access match statistics.

This will not be the league's only foray into the metaverse and associated technologies. The league has also partnered with Socios to create fan tokens and a fantasy NFT platform.¹⁸ Further, Crypto.com has also launched an NFT collection in partnership with the league.¹⁹



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The Netherlands

Estimates suggest that the potential economic impact of the metaverse could reach **€23–€43 billion** in the Netherlands by 2035. Currently, the country is well placed to realise this opportunity, possessing one of the strongest digital foundations and ecosystem developments in the EU. Substantial public funding support and a vibrant startup climate are driving significant inroads into the development of highly advanced technology applications, including XR hardware, metaverse content layer infrastructure, AI and data enablers. The Netherlands is also at the forefront of European metaverse social experiences, hosting the first European metaverse festival.

The Netherlands ranks third of all EU members in the 2022 DESI.¹ The country’s advanced digital foundations may facilitate adoption of metaverse technologies.

The country is second among EU member states in connectivity, with high VHCN coverage, and 1Gbps capacity was expected to be made widely available in 2022.²

Indicators of ecosystem foundations consistently outperform the EU, with high reported digital readiness and a highly rated business environment complementing high rates of adoption of advanced technologies.³ Among the populace, digital skills are also highly developed, with 79% reporting at least

basic skills and 52% reporting ‘above basic’ skills—the highest in the EU.⁴

The Dutch government has announced a series of initiatives to progress digitalisation. The Dutch Digitalisation Strategy is currently being implemented, which seeks to accelerate digitalisation in targeted industries.⁵ The 2019 Strategic Action Plan for AI, the NL AI Coalition, Count on Skills 2020-2024 programme, the Human Capital Agenda ICT programme and the Dutch Smart Industry programme are all initiatives aiming to further digitalisation across industries and the wider population.^{6, 7, 8, 9}

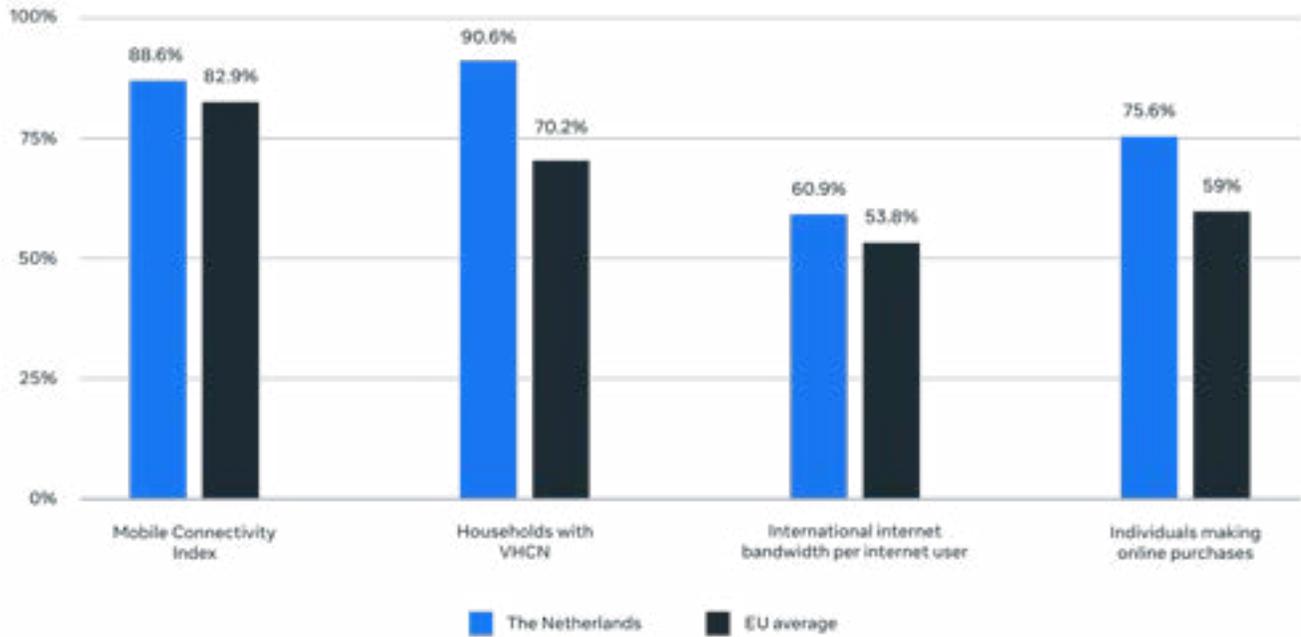
Background	
The Netherlands	
GDP (€ billion)	€856.4
Population (million)	17.6
GDP per capita (PPP, thousand)	€52.6

Secure internet servers



* Secure internet servers per one million

Digital foundations



Support for ecosystem development				
	Cisco Digital Readiness Index	EIU Business Environment Index	Enterprises with high digital intensity	Individuals with 'above basic' digital skills
The Netherlands	18.7	8.2	34%	52%
EU average	16.1	7.4	19%	26%



Both private and public applications of metaverse component technologies have been observed in the Netherlands recently. Survey evidence suggests that the adoption of VR and other advanced technologies is significantly greater among enterprises in the Netherlands compared to the rest of the EU.¹⁰ Notable businesses include:

- XR startup SenseGlove aims to advance haptics technology in VR and AR, with over 100 corporations, including Volkswagen, P&G and Airbus, using its hardware.¹¹
- Arize has aimed to enhance the experiences layer of the metaverse by developing a blockchain-native marketplace for interoperable created content.¹²

Approximately €1.3 billion is being allocated from the Netherlands' National Growth Fund to projects related to boosting research and innovation in ecosystem technologies.¹³ Most pertinent to the metaverse are projects including Quantum Delta's cybersecure quantum internet technologies, Health-RI's unified health care data infrastructure platform and AiNed's public-private partnership with the Dutch AI Coalition

on an AI implementation programme targeting high-tech industry, transport, logistics, energy, health and health care.

In June 2022, Amsterdam hosted MET AMS, Europe's first metaverse festival focusing on culture and arts applications, with over 100 thought leaders, artists and brands providing keynote presentations, talks and immersive experiences. Also from November–December 2022, Immersive Tech Week, held in Rotterdam, was the first European metaverse conference to bring together startups, scale-ups, academics and policymakers from all around the world to promote the development of immersive technology.¹⁴

The Netherlands' economic composition may also support the development of the metaverse in the longer-term, with high GDP per capita (€42,600) and levels of innovation. The economy is highly geared in employment terms towards industries with potentially strong metaverse use cases, including virtual applications in scientific and technical production, social work and the arts.

Symphony Solutions—technology applications

Symphony Solutions is one of many Dutch enterprises operating at the forefront of metaverse technology applications. A self-proclaimed Cloud Transformation Company, Symphony Solutions champions adoption of metaverse technology in generating meaningful change for businesses.¹⁵

Through embracing the latest in cloud, AI and software design technology and leveraging agile project management approaches, Symphony Solutions provides a range of digital services, including cloud solutions, educational services, omnichannel orchestration, custom software development, agile transformation, iGaming solutions and service design.

Symphony Solutions is a strong example of the kinds of enterprises that will be crucial in facilitating widespread adoption of metaverse-enabling technologies. By integrating these technologies into business operations and driving material improvements in clients' outcomes, the potential of these technologies becomes measurable and their potential impact better understood.



End notes for the Netherlands

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Poland

Estimates suggest that the potential economic impact of the metaverse could reach **€5–€10 billion** in Poland by 2035. Poland, however, may benefit from further development of its digital foundations and ecosystem support to facilitate metaverse adoption. Poland is receiving EU support to develop its digital infrastructure generally, with significant efforts underway to attain universal connectivity and incubate advanced technologies. Foundational technologies such as digital-physical hybridisation, XR and AI are already being developed and adopted by large consumer-facing enterprises and startups in Poland.

Digital development in Poland, per the 2022 DESI, is growing faster than the EU average, but remains 24th of 27 EU member states.¹ Further, Poland’s connectivity is growing, with improved VHCN coverage.²

The prevalence of digital skills in Poland is relatively low—43% of individuals possess at least basic digital skills versus 54% for the EU. A similar case is observed in ICT, with only 3.7% of Poles graduating in ICT degrees and a low proportion of businesses offering training.³

To continue to improve digital infrastructure and skills generally, Poland has made these the focus of its National Broadband Plan, its Digital Transformation Strategy for 2025 and the Operational Programme Digital Poland.^{4,5} The country is also spending 21% of its €35 billion recovery and resilience plan on digital initiatives.

Projects like the Academy of Innovative Applications of Digital Technologies (AI Tech) are being implemented and launched, with the aim of further enhancing advanced skills.⁶

Background	
Poland	
GDP (€ billion)	€574.4
Population (million)	37.7
GDP per capita (PPP, thousand)	€25
ICT value added (% GDP)*	3.6%
ICT personnel (% emp)*	2.7%

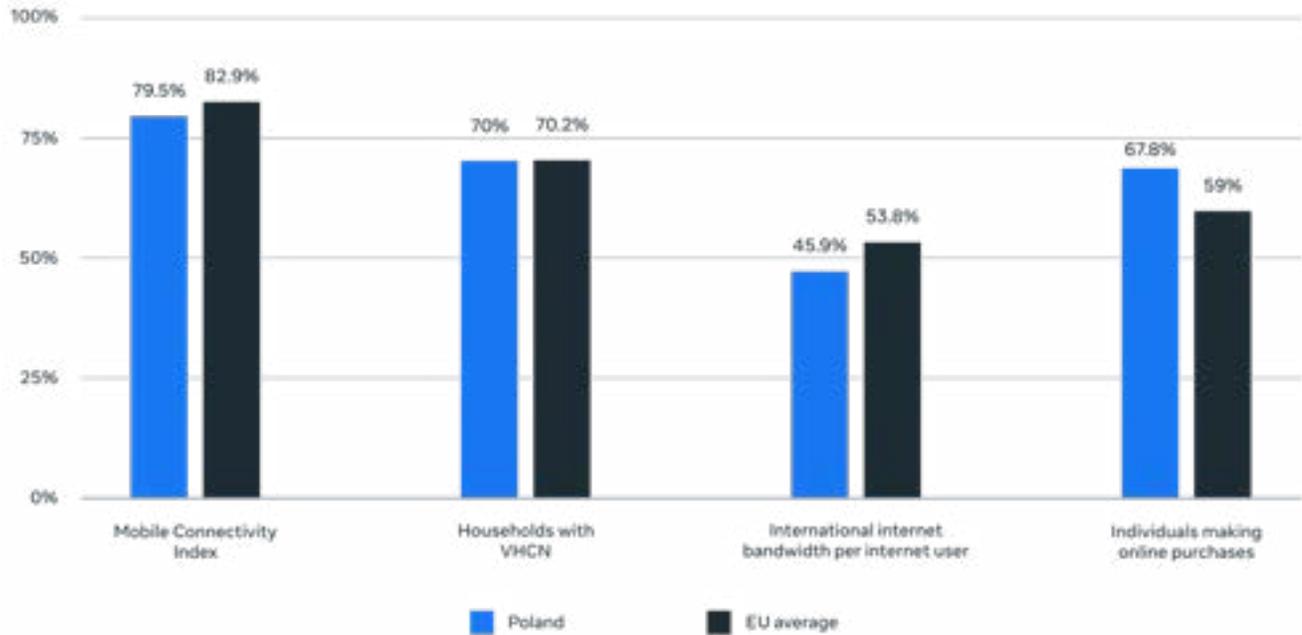
* ICT manufacturing and services, based on NACE Rev. 2 classifications, which may differ from the Information and Communications sector within national accounts

Secure internet servers



* Secure internet servers per one million

Digital foundations



Support for ecosystem development				
	Cisco Digital Readiness Index	EIU Business Environment Index	Enterprises with high digital intensity	Individuals with 'above basic' digital skills
Poland	14.9	7.3	12%	21%
EU average	16.1	7.4	19%	26%

The metaverse ecosystem is nascent within Poland, though the government is supporting efforts to implement component technologies. A number of large Polish banks have begun providing interoperable authentication services to customers, enabling a range of devices to be used to access online public services and have widely adopted blockchain authentication technology.^{7, 8, 9}

Solutions providers are also entering the metaverse, including:

- European metaverse building company Immersion¹⁰
- IoT and edge computing hardware producer BIVROST¹¹
- XR analytics firm VadR¹²

Startups are also expanding, such as EpicVR, which received \$1.2 million in funding from the Polish National Center for Research and Development to develop tools for the metaverse with respect to VR gaming as well as educational and business-oriented applications.¹³

In education, metaverse technologies have been adopted since their infancy, with the Institute of Cardiology in Warsaw using VR for its clinical practice and the Warsaw University of Technology partnering with global program VR First to establish a research lab that develops and implements VR solutions in education and practical applications in health care.^{14, 15}

Poland is leveraging EU-coordinated programmes on implementation of advanced technologies, which include:

- The EuroHPC Joint Undertaking
- The Partnership for Advanced Computing in Europe¹⁶
- The PIONIER-LAB National Platform for Integration of Research Infrastructures¹⁷

Poland also participates in European Digital Innovation Hubs (EDIHs), which provide access to technical expertise and implementation advice for enterprises. The European Regional Development Fund (ERDF) provides Poland with funding to improve digital skills. Notable ERDF initiatives include the Remote School project and the Zdalna Szkoła scheme that provide funding for remote learning equipment.¹⁸ The related Lekcja:Enter scheme is directly co-financed by the ERDF, providing training to educators in facilitating remote education.¹⁹



PKO Bank Polski—metaverse banking

PKO Bank Polski, the largest bank in Central and Eastern Europe, has recently moved one of the most recognisable buildings in Warsaw into MetaWorld, where it set up its virtual branch.²⁰

PKO Bank Polski unveiled its ambition to become a prominent player in the area of banking in the metaverse and wishes to explore the opportunities offered to banks in the virtual world.²¹

The bank expects to use the virtual branch to develop its capabilities and knowledge in the space that can be used to expand its business in the future. Initially, the bank aims to use the virtual branch for training and onboarding new employees. This would allow the bank to improve the onboarding process for remote workers who would be able to participate in activities and interact with their surroundings in a way similar to the physical world.²²

In the future, the bank aims to use the virtual branch to offer banking products and services and benefit from solutions related to clients' identity verification.²³



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Spain

Backed by large digital corporations and the public sector, Spain continues to make progress towards realising its potential in the metaverse. The economic impact of the metaverse could reach **€28–€53 billion** in Spain by 2035. Spain excels in household connectivity and online sales penetration and is also emerging as a country that contributes to the development of metaverse platforms.

Spain has good digital foundations, ranking seventh of all EU members in the 2022 DESI. Spain’s level of connectivity is third in the EU, with high household VHCN coverage.¹

Basic and above basic digital skills in Spain’s workforce are well above the EU average, though ICT specialists and graduates are less prevalent.² Spain is prioritising the reduction of the urban-rural connectivity gap.

Spain’s ecosystem support is more advanced in terms of individuals than enterprises, with the former greatly outperforming the EU average.

Spain dedicates 28.2% (€19.6 billion) of its recovery and resilience plan to digitalisation—larger than most other EU members. Spain’s focus is on digitalising businesses and public services, digital skills development and connectivity.

Several public policies are in place to support firm adoption of advanced technology, including the Spain Entrepreneurial Nation Strategy and the Digital Rights Charter, which are seeking to accelerate and govern digital entrepreneurship. Governance will be further enhanced with the new startups law in development.^{3, 4, 5}

Background	
Spain	
GDP (€ billion)	€1,205.1
Population (million)	47.4
GDP per capita (PPP, thousand)	€27.2
ICT value added (% GDP)*	3.3%
ICT personnel (% emp)*	2.5%

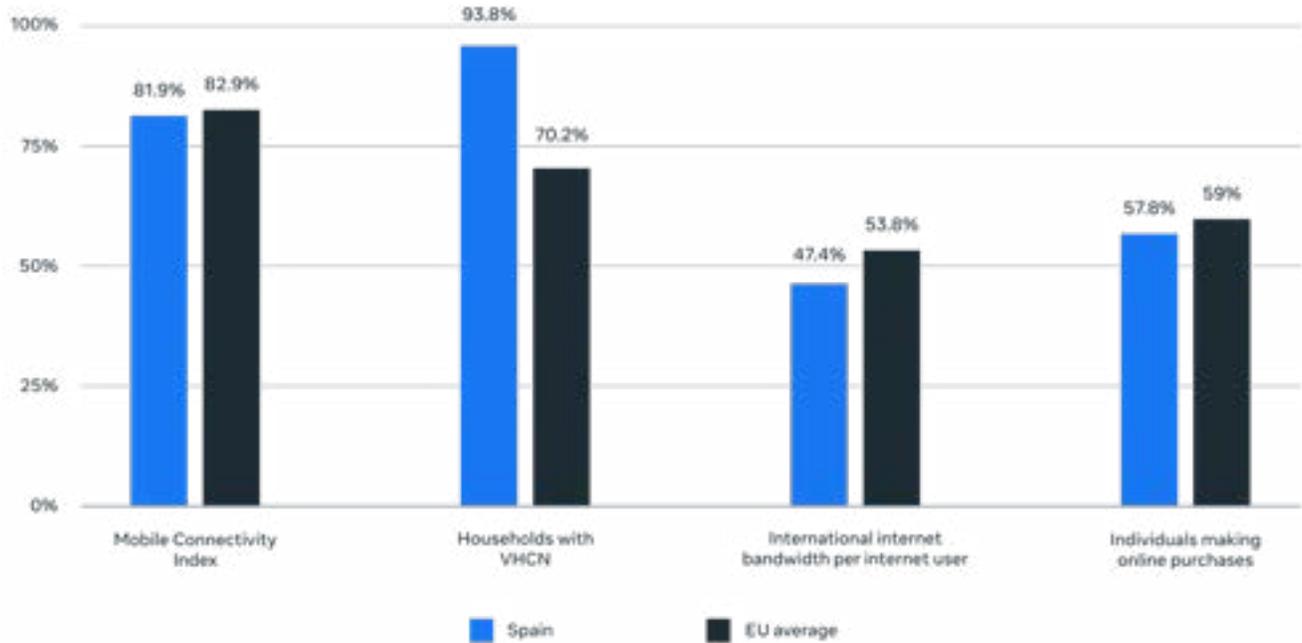
* ICT manufacturing and services, based on NACE Rev. 2 classifications, which may differ from the Information and Communications sector within national accounts

Secure internet servers



* Secure internet servers per one million

Digital foundations



Support for ecosystem development				
	Cisco Digital Readiness Index	EIU Business Environment Index	Enterprises with high digital intensity	Individuals with 'above basic' digital skills
Spain	15.7	7.4	22%	38%
EU average	16.1	7.4	19%	26%

A number of metaverse use cases have already been demonstrated in enterprise, education and the public sector in Spain. Large enterprises have also entered into the market, for instance:

- Orange Spain has opened a metaverse-based store.⁶
- Zara is launching 2 clothing collections that hybridise physical and virtual garment segments.⁷
- Spain is one of the first European countries to be covered by Meta’s Horizon Worlds metaverse platform.

Spanish universities are beginning to leverage the potential of the metaverse. In the CEU Group of

universities, metaverse environments have already been created that enable virtual student interaction, participation in educational activities and access to information on facilities and procedures.⁸ Furthermore, metaversity institutions such as the Metaverse University in Barcelona have been established with metaverse technology at their core.⁹

In the public sector, digital applications are increasingly used to support democratic discourse. Madrid’s City Council has pioneered CONSUL, a software that supports e-government and participation in public processes.¹⁰ Via the Decide Madrid platform, citizens can propose legislation, vote on budgetary decisions and participate in debates and consultations.

Spain's government is mitigating its current lack of digitally-trained workers, particularly among SMEs and micro-enterprises, with the recent publication of the SME Digitalisation Plan 2021-2025 for boosting innovation and entrepreneurship in digital fields.¹¹ The government is also allocating €186 million of its RRF funds to boost digital tool usage to create immersive VR and mixed reality (MR) experiences in the tourism sector.¹² A further €95 million of this funding is allocated towards supporting projects to develop VR and AR applications in industry.¹³

The Spanish economy is weighted towards accommodation and food services industries, which are less exposed to metaverse applications than IT-intensive industries. However, the arts, entertainment and recreation industries could benefit greatly from the more consumer-focused aspects of the metaverse.

Orange Spain—metaverse store

Orange Spain is championing virtual commerce by following the lead of Orange Group in launching a virtual store in the metaverse and expanding its product lineup to include metaverse-enabled hardware, including VR headsets and other products from a range of suppliers.¹⁴

Orange Spain's metaverse store is cognisant of differences in technological readiness among society and accommodates for this. Customers can access the metaverse store using VR headsets or via standard home PCs. Additionally, Orange Spain has provided accessible VR setups in physical stores to showcase and raise awareness for more advanced metaverse technology in practice.

The metaverse store is designed as a persistent, immersive virtual world. Hosted on a metaverse platform managed by Orange Spain staff presenting as virtual avatars, the store showcases the flexibility of metaverse spaces, containing areas for Orange Spain commercial activity, a leisure area for games and audio-visual consumer content and an amphitheatre space for events. The objective of the store is to reproduce physical world activity in a virtual space.¹⁵

The platform demonstrates the potential utility of a highly digitalised enterprise on the consumer experience. The platform seeks to be reliable and scalable, running on an XGSPON Infinity fibre data superhighway, which enables the management of a high volume of data traffic.¹⁶

Orange Spain has complemented the virtual store initiative with associated software applications, such as the 360° Immersive Now events platform accessible via mobile or VR headsets. The Immersive Now platform offers over 100 immersive audio-visual experiences introducing consumers to VR technology and applications.



End notes for Spain

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Sweden

Estimates suggest that the potential economic impact of the metaverse could reach **€20–€38 billion** in Sweden by 2035. At present, Sweden is among the EU front-runners with respect to digitalisation. Relatively high levels of digital skills and adoption of advanced technologies indicate relative advancement in preparation for the metaverse relative to many of its EU peers. With a large IT sector and a catalogue of innovative technology firms, Sweden may be well-positioned to capitalise on metaverse opportunities as they emerge.

Sweden is a digital front-runner, ranking fourth in the 2022 DESI, trailing only Denmark, Finland and the Netherlands.¹

Sweden ranks highly in connectivity overall, with 100Mbps fixed broadband and VHCN significantly higher than the EU on average.²

Sweden is one of the best performing countries with respect to human capital, digital literacy and the digital competitiveness of businesses.

Sweden continues to improve both its digital infrastructure and skills through ongoing public programmes. Sweden’s 2016 Broadband Plan has mandated universal high-speed broadband by 2025 and 98% of households to have access to capacity of 1Gbps or above.^{3,4}

The country continues to leverage the Swedish Digitisation Strategy, the National Approach to AI and the Data Strategy to further support digital skills, aiming to establish Sweden as a world leader in digitalisation through a blend of infrastructure, skills, security, innovation and management.^{5,6,7}

Background	
Sweden	
GDP (€ billion)	€537.8
Population (million)	10.5
GDP per capita (PPP, thousand)	€40.1
ICT value added (% GDP)*	6.5%
ICT personnel (% emp)*	4.9%

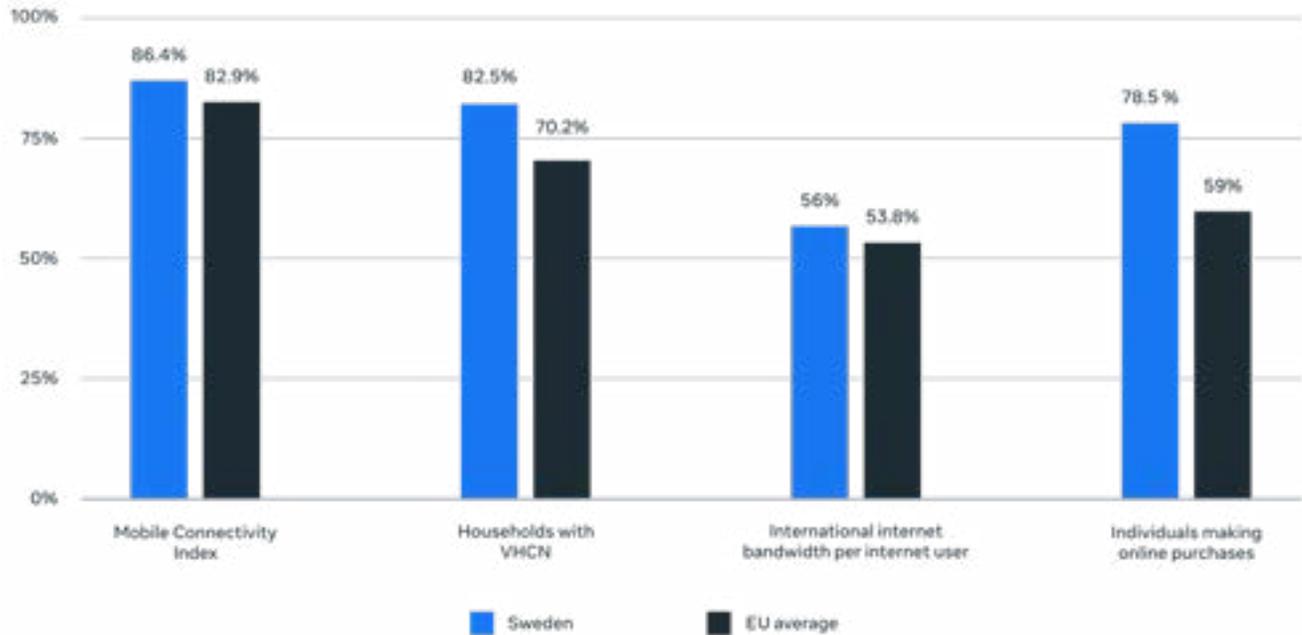
* ICT manufacturing and services, based on NACE Rev. 2 classifications, which may differ from the Information and Communications sector within national accounts

Secure internet servers



* Secure internet servers per one million

Digital foundations



Support for ecosystem development				
	Cisco Digital Readiness Index	EIU Business Environment Index	Enterprises with high digital intensity	Individuals with 'above basic' digital skills
Sweden	18.4	8.2	38%	36%
EU average	16.1	7.4	19%	26%

A number of technology firms and startups are making use of Sweden’s strong foundations and ecosystem, growing the country’s reputation for digital innovation. Survey evidence suggests enterprises in Sweden use VR and AR technologies and advanced technologies at a higher rate than most firms in the EU.⁸ For instance:

- Companies such as Warpin Media have successfully collaborated with a number of brands seeking to generate value through immersive technologies (see case study).
- Startups such as Gleechi are pioneering technologies in VR, creating the ability to conduct VR training through learning-by-doing within virtual environments.⁹

- Alloverse is developing an open-source platform for the development and sale of collaborative productivity apps in VR.¹⁰
- Enterprises such as Hiber, Moralis and Fast Travel Games are developing platforms for game development and VR gaming.^{11, 12, 13}

Partnerships with large multinational corporations are increasing Sweden’s presence on the international scene. For example, digital signage firm Visual Art partnered with McDonald’s to provide AI-enabled digital menu boards.¹⁴ Sweden’s public sector has also recognised the potential of metaverse technologies with significant deployment already charted.

For instance, VR tools are being used among local councils for boosting mental health among the elderly and disabled, while Visit Sweden has leveraged VR content to inspire potential tourists.^{15, 16}

Sweden's economy is wealthy and highly innovative relative to the rest of the EU, with price-adjusted per capita income 24% above the EU average and a global ranking of second within the Global Innovation Index. Sweden's economic outputs are also geared towards industries with strong potential metaverse use cases, such as virtual land ownership in the real estate industry, virtual scientific and technical workflows in knowledge industries and a range of technologies

applicable in ICT-oriented industries. The ICT sector is prominent, representing 8.5% of GVA, 3 percentage points higher than the EU average.¹⁷ The large Swedish public sector, which employs just under a third of the workforce in the country and comprises a fifth of output, may benefit from innovation brought about by advanced technologies.¹⁸ Sectors such as health care and education, which contribute 5.6% and 5.3% to GVA, approximately 0.7 and 0.3 percentage points greater than the EU average, respectively, could also drive growth and living standards.^{19, 20}

Warpin Media—immersive experiences

Warpin Media is a Swedish strategic technology company based in Stockholm, offering services to companies wanting to generate value through immersive technologies and the development of VR, AR and mixed reality (MR). Since their inception in 2016, Warpin Media has successfully collaborated with a number of partners across industries, developing prospective use cases and solutions with these technologies. Notable applications include²¹:

PostNord x Warpin—Swedish postal service PostNord has adopted the use of immersive technologies in order to train its workforce with Warpin.^{22, 23} VR was used to enable training across key activities such as the sorting and scanning of parcels, safely using and operating vehicles, including forklifts, and the minimisation of injury risks through lifting techniques.

KRY x Warpin—KRY, a Swedish platform, initiated a pilot project to develop VR exposure therapy to treat fears of public speaking.²⁴ Using Warpin's VR platform, patients were able to access treatment remotely from the environment of their own choice, and psychiatrists were able to speak to patients while simultaneously controlling the content shown within VR headsets.

Wellness in VR x Warpin—Together with psychologist Christina Andersson, Warpin developed a VR experience to offer users an opportunity to experience wellness treatments in VR.²⁵ Using headsets, users are virtually transported to the High Coast, a picturesque coastal landscape in the northeast of Sweden, which is accompanied by well-being exercises directed by Andersson. These include guided meditation, stress management and breathing exercises to try to offer users an opportunity to experience stress relief.

Other notable collaborations include developing applications for H&M for the first MR clothing launch event (H&Moschino), with the Swedish Migration Agency, Migrationsverket, to demonstrate potential use of AR in meetings with asylum seekers and with Swedish housing operator Stångåstaden to create digital models of kitchens and bathrooms prior to their refurbishment.



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Data points	Description	Year	Minimum	Maximum	Source
Background					
Gross domestic product (GDP)	GDP measures the monetary value of a country's annual output. Data is presented in current Euros.	2021	€14,685M (Malta)	€3,601,750M (Germany)	Eurostat
Population	Defines the 'usually resident population' and represents the number of inhabitants on January 1 of the given year.	2021	520,971 (Malta)	83,237,124 (Germany)	Eurostat
GDP per capita (PPP)	GDP per capita based on purchasing power parity (PPP). PPP GDP is gross domestic product converted to Euros using purchasing power parity rates to adjust for the price level, which determines the spending ability within a given country. Data is provided in current Euros.	2021	€6,690 (Bulgaria)	€86,550 (Luxembourg)	Eurostat
ICT value added (% GDP)	The value added of the information and communications technology (ICT) sector as a proportion of GDP, including both ICT manufacturing and ICT services defined by NACE Rev. 2 classifications: ICT Total (261 + 262 + 263 + 264 + 268 + 951 + 465 + 582 + 61 + 62 + 631). Note the definition of the ICT sector differs from other classifications, which may pertain to the information and communications sector (as denoted within standard ISIC 4. classifications). Further, data is not available for the Netherlands, and 2018 is the latest available data for Spain.	2019	2.27% (Greece)	7.7% (Malta)	Eurostat
ICT personnel (% employment)	Employment within the ICT sector as a proportion of total employment, including both ICT manufacturing and ICT services defined by NACE Rev. 2 classifications: ICT Total (261 + 262 + 263 + 264 + 268 + 951 + 465 + 582 + 61 + 62 + 631). Note the definition of the ICT sector differs from other classifications, which may pertain to the information and communications sector (as denoted within standard ISIC 4. classifications). Further, data is not available for the Netherlands, and 2018 is the latest available data for Spain.	2019	1.5% (Greece)	4.9% (Sweden)	Eurostat
Digital Economy and Society Index (DESI) score	<p>DESI is a metric published by the European Commission (EC) to primarily track member states' progress in achieving digitalisation across society. DESI currently stands as the main monitoring tool of the EU's Digital Decade, which sets the targets for the digital transformation of Europe by 2030.</p> <p>The DESI is formed of 33 indicators across 4 core pillars: connectivity, human capital, integration of digital technologies and digital public services (each given an equal weighting to derive a final aggregate score). The index has been produced since 2014, with subsequent adjustments to align more closely to the Digital Decade targets set out by the EU.</p>	2022	30.6 (Romania)	69.6 (Finland)	EC

Data points	Description	Year	Minimum	Maximum	Source
Digital foundations in the EU					
Mobile Connectivity Index	The Mobile Connectivity Index measures the performance of 150 countries, accounting for 98% of the world's population, against the 4 key enablers of mobile internet connectivity: infrastructure, affordability, consumer readiness and content. The index has a maximum of 100.	2021	73.8 (Bulgaria)	89.1 (Finland)	GSMA
Households with VHCN	Proportion of households covered by a Very High Capacity Network (VHCN).	2022	19.8% (Greece)	100% (Malta)	Eurostat
International bandwidth per internet user	The maximum rate of data transmission from a country to the rest of the world per internet user. Data is derived from GSMA intelligence and originally sourced from the International Telecommunications Union (ITU). Data is normalised to have value between 0 and 100.	2021	45.9 (Poland)	99.4 (Luxembourg)	GSMA/ITU
Individuals making an online purchase	This is the number of individuals surveyed who used a mobile phone or the internet to buy something online (% aged 15+). Data is derived from the World Bank Global Findex, one of the leading sources of data on global access to financial services, payments and savings.	2021	37.2% (Romania)	86.6% (Estonia)	The World Bank Global Findex
Secure internet servers	The number of distinct, publicly-trusted TLS/SSL certificates found in the Netcraft Secure Server Survey.	2020	8.9K (Greece)	277.1K (Denmark)	The World Bank

Data points	Description	Year	Minimum	Maximum	Source
Ecosystem support					
Cisco Digital Readiness Index	The Cisco Digital Readiness Index explores the level of digital readiness across 141 countries and 7 holistic components: basic needs, business and government investment, ease of doing business, human capital, startup environment, technology adoption and technology infrastructure. The Index is out of 25, with each component contributing a maximum score of 5 to the total, with countries closer to 25 performing better.	2019	13.3 (Romania)	19.5 (Luxembourg)	Cisco
EIU Business Environment Index	The business environment rankings are produced by the Economic Intelligence Unit (EIU) and rate the business environment of countries taking into account factors surrounding the political environment, the macroeconomic environment, market opportunities, policy towards free enterprise and competition, policy towards foreign investment, foreign trade and exchange controls, taxes, financing, the labour market and infrastructure. Note data for Croatia, Cyprus, Latvia, Luxembourg and Malta was unavailable. An EU average was calculated using the mean weighted by population over the remaining EU countries. The index has a maximum of 10, with 10 referring to the best performing economies.	2021	6.4 (Bulgaria)	8.3 (Denmark)	EIU
Enterprises with high digital intensity	Describes the proportion of enterprises denoted as having a 'high' or 'very high' digital intensity based upon a composite indicator, the digital intensity index (DII), derived from a survey on ICT usage and ecommerce in enterprises. The DII is formed based upon survey evidence of enterprises denoting how many technologies are used out of 12 selected technologies: having 30Mb/s minimum download speeds; a website; the majority of employees using a computer device with access to the internet; employment of ICT specialists; ecommerce sales account for >1% of turnover and use of 3D printing, industrial or service robots and big data analysis.	2021	6% (Romania)	38% (Sweden)	Eurostat
Individuals with 'above basic' digital skills	Individuals surveyed with 'above basic' digital skills in each of the following 5 dimensions: information, communication, problem solving, software for content creation and safety.	2021	7.8% (Bulgaria)	51.8% (Netherlands)	Eurostat

Appendix: methodology for estimating the EU economic opportunity

This appendix describes the methods used to produce estimates of the potential economic benefits from the metaverse for the EU.

Estimating the global economic opportunity of the metaverse⁹⁸

Previous studies have used various methods to estimate the potential benefits of the metaverse for the global economy. Broadly, these methods include basing estimates on potential market size, use case-driven impact, adoption-driven impact and investment-driven impact.

- **Potential market size:** This method estimates the total addressable market of the metaverse measured by global revenue potential. Estimates using this method have been developed by Grand View Research, which estimates a potential market size of €570 billion by 2030;⁹⁹ Goldman Sachs, which estimates a potential market size of €2.2–€10.6 trillion;¹⁰⁰ and Citi GPS, which estimates a potential market size of €11 trillion by 2030.¹⁰¹
- **Use case-driven impact:** This method looks at the estimated impact of use cases of metaverse technologies. PricewaterhouseCoopers (PwC) research based on potential use cases of VR and AR has estimated that the annual impact of these technologies could be €1.3 trillion by 2030.¹⁰²
- **Adoption-driven impact:** This method considers the potential impact associated with the adoption of the metaverse. Analysis Group has estimated the impact of mobile broadband adoption on economic growth and assumes that metaverse adoption will have the same marginal impact as mobile adoption. This results in an estimated economic impact of €2.5 trillion by 2031.¹⁰³

- **Investment-driven impact:** This method considers the impact of investment in the metaverse, using estimates of metaverse investment and the ratio of investment in ICT capital to GDP (i.e., the rate of increase in GDP as a proportion of the increase in ICT capital). Deloitte estimates that the global impact of metaverse investment could be €1.6–€3.0 trillion by 2035.¹⁰⁴

While these estimates vary in size and by time period, they are broadly consistent, except for the lower and upper estimates of potential market size.

Estimating the EU economic opportunity of the metaverse

Adopting a similar approach to Deloitte's 2022 study referenced above, this study takes Deloitte's estimates of the potential contribution of the metaverse to the global GDP and allocates the benefits to the EU according to member states' combined share of the global GDP. Within the EU, benefits are apportioned to individual member states in proportion to the distribution of ICT capital stocks amongst EU member states (as found within the EU Klems database). The current ICT capital stocks are used as a proxy for each member state's relative potential level of metaverse investment and of the benefits that ultimately accrue.

In line with the above, this report estimates the EU's share of the global GDP in 2035 (real GDP with a 2021 base) based on historical growth rates and forecasts from the IMF and the World Bank. On this basis, it is estimated that the EU's share of the global GDP in 2035 may be 16% (available data suggests it was 18% in 2021)

and that by 2035, the potential economic impact on the EU’s GDP could reach up to €259–€489 billion annually, expressed in 2021 EUR.

While our estimates are consistent with other research, some factors are difficult to quantify at this stage due to the uncertainty surrounding the metaverse and the nature of the macroeconomy, which may influence the total economic benefits derived in the future. Such factors include but are not limited to:

- Variations in the factors that may enable or inhibit the metaverse across member states, except insofar as the current ICT capital stock levels of each member state may act as a proxy for this
- Productivity benefits specific to the metaverse, which may be higher than those captured by the general relationship between ICT investment and economic growth
- Metaverse investments that were made prior to 2022

As per Deloitte’s 2022 study, the methodology also assumes a rate of relatively consistent real economic growth between 2029–2035 of 3%–4% CAGR per year. While global GDP growth may fluctuate at various points in the business cycle, it is anticipated that growth will average out in the 3% range per year

as it has for the past century. Additionally, should investments in the metaverse be higher or lower than projected, metaverse-related GDP growth would also be affected.

Region	Base case (€billion, 2021 EUR)	Upside potential (€billion, 2021 EUR)
Global impact		
Global	€1,600	€3,000
Regional impact		
EU	€259	€489

These estimates further assume that there will be sustained investment in the metaverse that is not a substitute for other investments that would otherwise be undertaken. Investment scenarios also do not consider wider complementary investments that may be needed to support the metaverse. Further, it is uncertain how the global impacts of the metaverse may be distributed across countries and regions, such as the EU, as this could be affected by various factors and enablers.



Investment and elasticity assumptions

This study adopts the investment-driven impact approach used in Deloitte's 2022 study and relies on its assumptions regarding metaverse investment scenarios and ICT capital-output elasticity.

Metaverse investment scenarios

Investment scenarios are based on market research conducted by Goldman Sachs.¹⁰⁵ Its report presents illustrative scenario analysis based on public company investment in the metaverse and private market funding. This research estimated that investment in the metaverse could range from €135 billion to €1.35 trillion in the coming years. From this, Deloitte assumed a base case of a €700 billion investment over 5 years and an upside potential of €1.35 trillion over 5 years, with the annualised level of investment in each case assumed to persist to 2029. We consider this assumption as reasonable and note that Goldman Sachs' original estimates, on which Deloitte's assumption is based, do not include investment from businesses that will become active in the metaverse after the first wave of investments from core technology firms.

ICT capital-output elasticity

An ICT capital-output elasticity is used to convert estimates of investment into impacts on GDP. This is applied given the broad nature of potential metaverse investments across different types of ICT capital. The literature has provided a wide range of elasticity values for various geographies and time periods.^{106, 107, 108} An elasticity value of 0.1 is assumed, which reflects the midpoint of elasticity estimates by looking at the long-run return on ICT capital in the US and EU countries and is well within the wider range in the literature.¹⁰⁹



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