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The Metaverse and its Potential for Türkiye

September 2022

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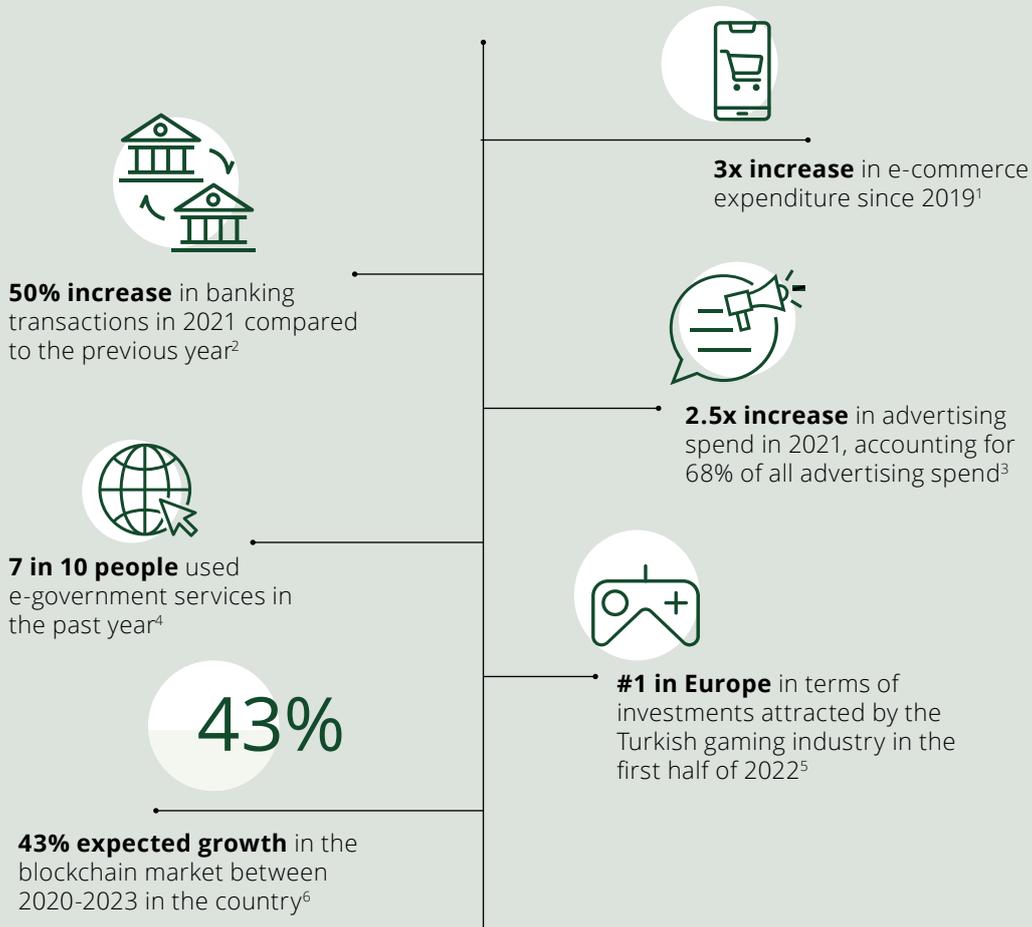
Executive Summary

The metaverse is envisioned as the next generation of the internet

The metaverse is a term that refers to the next iteration of the internet, where widespread 3D virtual spaces could transform the way we work and interact. The concept aims to connect users' experience of physical and virtual worlds through seamless and immersive user experiences. In the near-term applications are likely to include opportunities in Türkiye's thriving gaming sector, but in the longer-term businesses and consumers across economic sectors stand to benefit.

Digitalization is on the rise in Türkiye

Türkiye is characterised by widespread use of smartphones, near ubiquitous 4G connectivity and comfort with making transactions online. The pace of digitalization accelerated during the COVID-19 pandemic as businesses and consumers sought new ways to connect and transact. Key highlights of Türkiye's rising digitization are given below:



The metaverse presents an opportunity to extend digitalization in Türkiye

Recent digitalization trends are giving rise to new initiatives related to the metaverse, with potential to create new marketplaces and expand access to services. Turkish retailers such as LC Waikiki, Damat Tween and Kiğılı have opened stores in the metaverse, giving customers new ways to experience products in a virtual environment before buying. The metaverse can enable more effective ways of working remotely – for example, Toyota Türkiye has hosted an annual strategy meeting on a metaverse platform. And by generating simulations of real-world situations, the quality and accessibility of education and training could be enhanced: already there are examples of Turkish institutions using metaverse technologies for healthcare training and treatment.



The metaverse will support economic growth via:

- Expansion and creation of new marketplaces
- Higher levels of efficiency through improved ways of working
- Expanding educational and training opportunities

Successful metaverse growth relies on an ecosystem of enabling technologies, infrastructure, and regulations

While Türkiye has high levels of smartphone adoption and broadband connectivity, more sophisticated immersive experiences will require further advances in consumer hardware and ICT infrastructure. Augmented reality (AR) or virtual reality (VR) devices can enhance the user experience, and 5G or Gigabit fibre connections may be needed to support the low latency, high bandwidth requirements of virtual worlds. From a business perspective, an enabling social and regulatory environment can accelerate metaverse adoption. Türkiye has relatively robust cybersecurity frameworks, but there is scope to improve digital skills and the technological readiness of businesses; and policymakers and regulators may play a role in ensuring the development of a competitive metaverse ecosystem. From a consumer perspective, social acceptance of the metaverse will rely on individuals feeling safe when interacting in immersive virtual worlds. This in turn may require governance frameworks to protect personal privacy and appropriate safeguards against harmful online content and behaviours.



There is an opportunity to realise social and environmental benefits, as well as economic impacts

In addition to the economic impact, mass adoption of the metaverse could also have profound social and environmental implications. For example, it could contribute to Türkiye's Sustainable Development Goals by expanding access for to rural communities (that constitute almost a quarter of Türkiye's population)⁷ to resources such as educational and training programs that would otherwise only be available in urban hubs.⁸ Carbon emissions from travel and business activities could also be reduced by enabling further growth in remote working, while creating new virtual marketplaces that reduce the need for physical presence. Addressing these issues can help to ensure that the metaverse is developed in a sustainable way within an inclusive, safe and environmentally friendly ecosystem.



Successful development of the metaverse could contribute up to US \$37.5bn to the Turkish economy by 2035

Substantial investment in ICT will be required to create a metaverse that is widely available and has a substantial impact. There is potential to unlock business investment and realise benefits through the creation of an enabling environment that fosters momentum for metaverse-related initiatives.

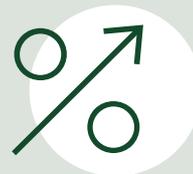
The magnitude of the required investment is currently uncertain. Estimates from existing studies suggest that global investment in the metaverse might range between \$700 billion and \$1.4 trillion over the coming years. By combining these global investment estimates with findings from the economic literature on the historical relationship between ICT capital and GDP growth, this report estimates the potential economic impact for Türkiye.

Assuming that Türkiye attracts a proportionate share of the global ICT investment and metaverse's global economic impact from this investment, our analysis indicates that the metaverse could add between \$19.9bn and \$37n to Türkiye's annual GDP by 2035.⁹ This is approximately 1.3% to 2.4% of Türkiye's projected GDP in 2035.¹⁰



By 2035, the annual economic impact of the metaverse could be between **\$19.9bn** and **\$37.5bn**

It is equivalent to **1.3% to 2.4%** of Türkiye's projected GDP in **2035**





1. Introduction

The metaverse will create new ways of working, learning and interacting online. Türkiye's government and businesses have started to invest in immersive user experiences as part of broader digitalization efforts, as interest in the metaverse gains momentum.

The metaverse is the next evolution of the internet^{11,12,13}

The internet has revolutionised the world, transforming it from a system of mainly text-based communications into the ubiquitous and versatile worldwide network of today.¹⁴ It has changed how people work, have fun, shop, find information, manage their health, search for partners and connect with friends, in ways that would have been difficult to imagine during the early stages of the technology. The internet has become an important part of Turkish people's lives. An average user in Türkiye spends about 8 hours a day using the internet¹⁵ and about 80% of Türkiye's population is active on social media.¹⁶



The metaverse is envisioned as the next generation of the internet.

The metaverse is seen as the next generation of the internet, with an emphasis on immersive and intuitive experiences in 3D virtual settings. It has the potential to enrich our digital experiences, making them more seamless, intuitive and engaging. Examples its potential impact include:

- Enriched consumer experience during online shopping and in stores,
- Expanded access to healthcare via virtual consultations and remote surgery,
- Improved remote working conditions facilitated by new technologies,
- Enhanced experience in remote education, entertainment, gaming, public services.

To achieve such impacts, the metaverse will rely on an interconnected ecosystem of digital infrastructure, devices, policies, applications, and platforms. Some key components of the metaverse already exist in some form in Türkiye, such as augmented reality (AR) and virtual reality (VR) headsets, 3D virtual spaces, cryptocurrencies, compute power and artificial intelligence (AI)/ machine learning (ML) algorithms. For example, 94% of adults in Türkiye are familiar with augmented reality¹⁷ and 24.7% of individuals own some form of cryptocurrency, the highest proportion in the world.¹⁸ However, these continuing trends will need to coalesce around the metaverse concept in order to create a cohesive ecosystem.

In general, new technologies require several years to reach maturity, although timeframes can vary greatly. A typical path for new technologies is shown by an S-curve (see Figure 1), with technology progressing through three distinct phases: infancy, expansion, and maturity.¹⁹

Figure 1: The S-curve



In the infancy phase, a new technology progresses relatively slowly, as awareness increases gradually and bottlenecks to growth are overcome. The metaverse is currently in its infancy phase in Türkiye but is likely to become better understood and more widely adopted.

With further research and investment, the technology then enters an expansion phase, where the rate of progress accelerates as dominant standards emerge, product characteristics and consumer preferences are established, and the user base grows. Finally in the maturity phase, progress slows down as the technology approaches its natural ceiling. Realising opportunities from the metaverse in Türkiye will depend on the country's technology fundamentals, macroeconomic determinants and ecosystem enablers.



The metaverse is currently in its infancy phase in Türkiye but is likely to become better understood and more widely adopted.

Interest in the metaverse is growing in Türkiye

Turkish companies are investing increasingly to create user-centric virtual experiences. For example a community-managed special metaverse project was launched in the Turkish market, allowing people to play games, engage with crypto markets, and buy virtual (metaverse) land in several Turkish cities.²⁰ As of 2021, more than 20,000 virtual land plots were sold within the borders of Türkiye on the OVR platform, with more than half those sales occurring in Istanbul and with other sales across almost all of the Turkish cities on the platform.²¹ Firms in sectors ranging from consumer products (including the leading chocolatier Sagra)²² to telecommunications (including Vodafone) have opened digital stores in the metaverse to interact with their customers. The Turkish Red Crescent has begun to use the metaverse for training in first aid and disaster preparedness.²⁴



“The Metaverse is a massively scaled and interoperable network of real-time rendered 3D virtual worlds which can be experienced synchronously and persistently by an effectively unlimited number of users with an individual sense of presence, and with continuity of data, such as identity, history, entitlements, objects, communications, and payments.”

— Ball, M., (2021) “Framework for the Metaverse. The Metaverse Primer”

Alongside developments in the private sector, the Turkish government is also exploring metaverse applications.²⁵ President Recep Tayyip Erdoğan has tasked key party members to study the metaverse and cryptocurrency, including the necessary legal infrastructure to support their development. The use of metaverse technologies in the hosting of governmental forums has also been publicly endorsed.²⁶ The government plans to use the technology in education and is currently developing a pilot training program in the metaverse for Turkish teachers.²⁷ This follows a series of initiatives to support digital transformation in Türkiye, such as the establishment of a national Digital Transformation Office (DTO), the National Cybersecurity Strategy and Action Plan and the National Artificial Intelligence Strategy for 2021-25.²⁸

Against this backdrop, this report seeks to inform the public debate

This report considers how the metaverse differs from the internet of today, what are the opportunities for Türkiye, and how Türkiye can support development and adoption of the metaverse.

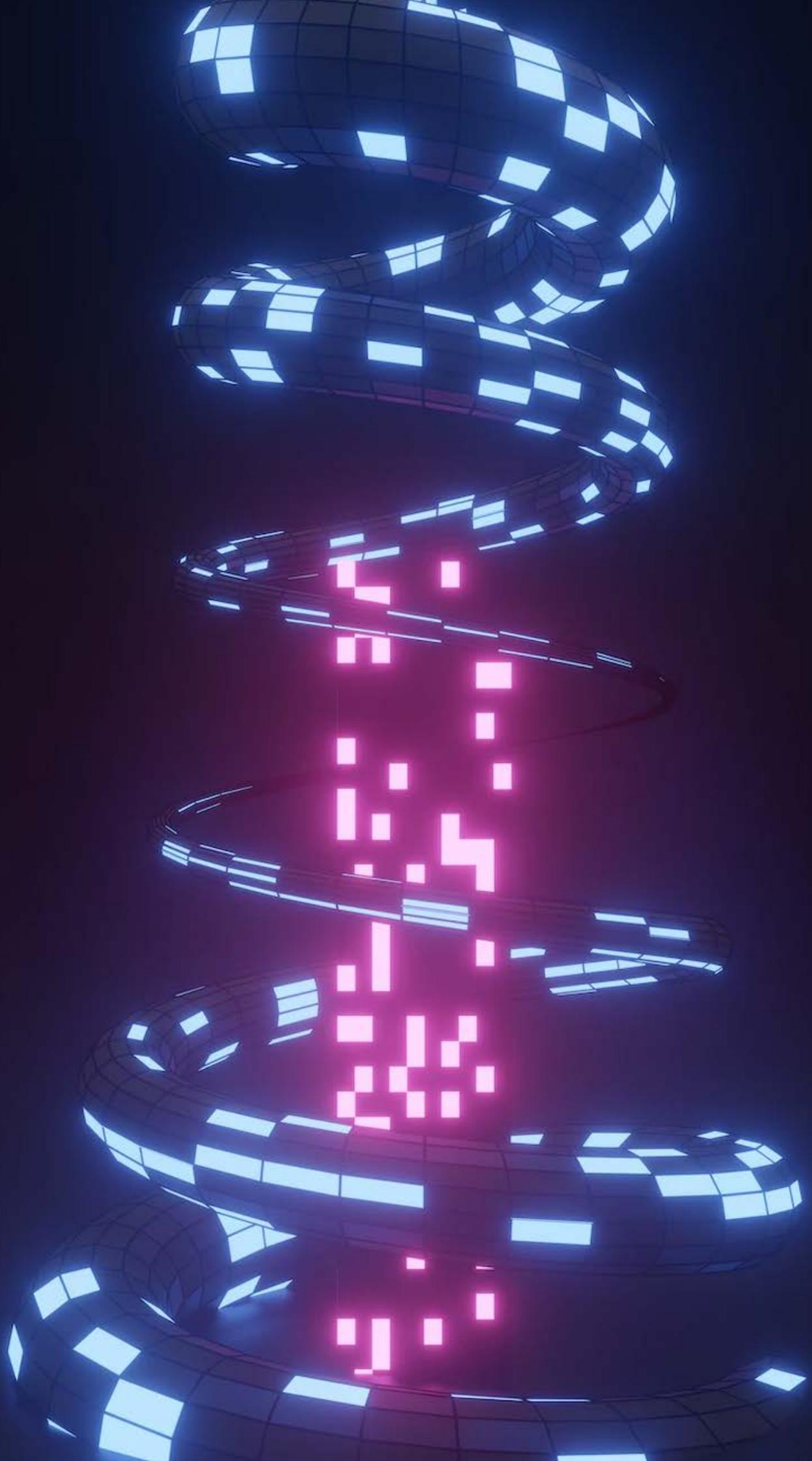
The remainder of the report is structured as follows:

- **Section 2** explains the concept of the metaverse in detail and its current state of development in Türkiye.
- **Section 3** estimates the magnitude of potential economic impact of the metaverse on Türkiye’s GDP and discusses how key sectors are likely to benefit via metaverse value drivers.
- **Section 4** discusses how the infancy stage of the metaverse presents an opportunity to consider the implications for social and environmental sustainability in Türkiye.
- **Section 5** discusses the prerequisites for an open and safe metaverse in Türkiye.
- **Section 6** concludes with a brief discussion of the report’s findings and the way ahead.

The appendix provides a detailed description of the methodology used to arrive at the estimate of the economic impact of the metaverse on Türkiye’s GDP.



As of 2021, more than 20,000 virtual land plots were sold within the borders of Türkiye on the OVR platform, with more than half those sales occurring in Istanbul and with other sales across almost all of the Turkish cities on the platform.



2. The Emergence of the Metaverse in Türkiye

The metaverse is likely to bring together technological advances in various fields to deliver an immersive experience with potentially high impact. The momentum in Türkiye is picking up, with initiatives across various business sectors.

The metaverse is expected to drive the next cycle of innovation

The metaverse seeks to combine virtual and physical worlds using AR and VR technologies, supported by improvements in computing and connectivity. Its development and adoption will be worldwide, and it will require collaboration between multiple stakeholders from various countries, including Türkiye.

However, to realise this vision for the metaverse, underlying technologies will need to evolve to support its development. Manufacturers will need to develop affordable, user-friendly devices that support AR and VR use cases, with 5G (and later 6G) connectivity for mobile use. Developers and system integrators will need to develop fit-for-purpose platforms and infrastructure. Each country will need to adapt according to the composition of its economy and competitive advantage. Manufacturing-based economies may focus their efforts on the production of user devices, whereas services-based economies may focus on platforms, apps and content.



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The metaverse is characterised by some key elements, as illustrated in Figure 2.

Interaction: While current technologies allow users to see, interact and create in digital spaces, the metaverse seeks to bridge the gap between physical and virtual experiences. It could eventually incorporate senses such as touch, taste, and smell,²⁹ making interactions feel more genuine and immersive. For example, the Turkish Textile Exporters and Employees Association (TİHCAD) is establishing a presence in the metaverse and is experimenting with replicating the tactile experience of real fabric in the virtual showroom.³⁰ Another example is the Microsoft HoloLens, which uses MR technology to allow health professionals to connect remotely with experts and consult MRI images in 3D at the point of care.³¹

Figure 2: Key elements of the metaverse

Virtual, Mixed and Augmented Reality (VR, MR and AR): Connecting the digital and physical worlds

Decentralization: Development of more autonomous platforms, where ownership is distributed

Interoperability: Allowing a seamless transition of user experiences across multiple platforms

Persistence: Metaverse will exist regardless of time and place forming a perpetual virtual space



Interaction: Creating more realistic digital interactions

Availability & Synchronicity: A living experience that is available for everyone

Source: Deloitte Analysis

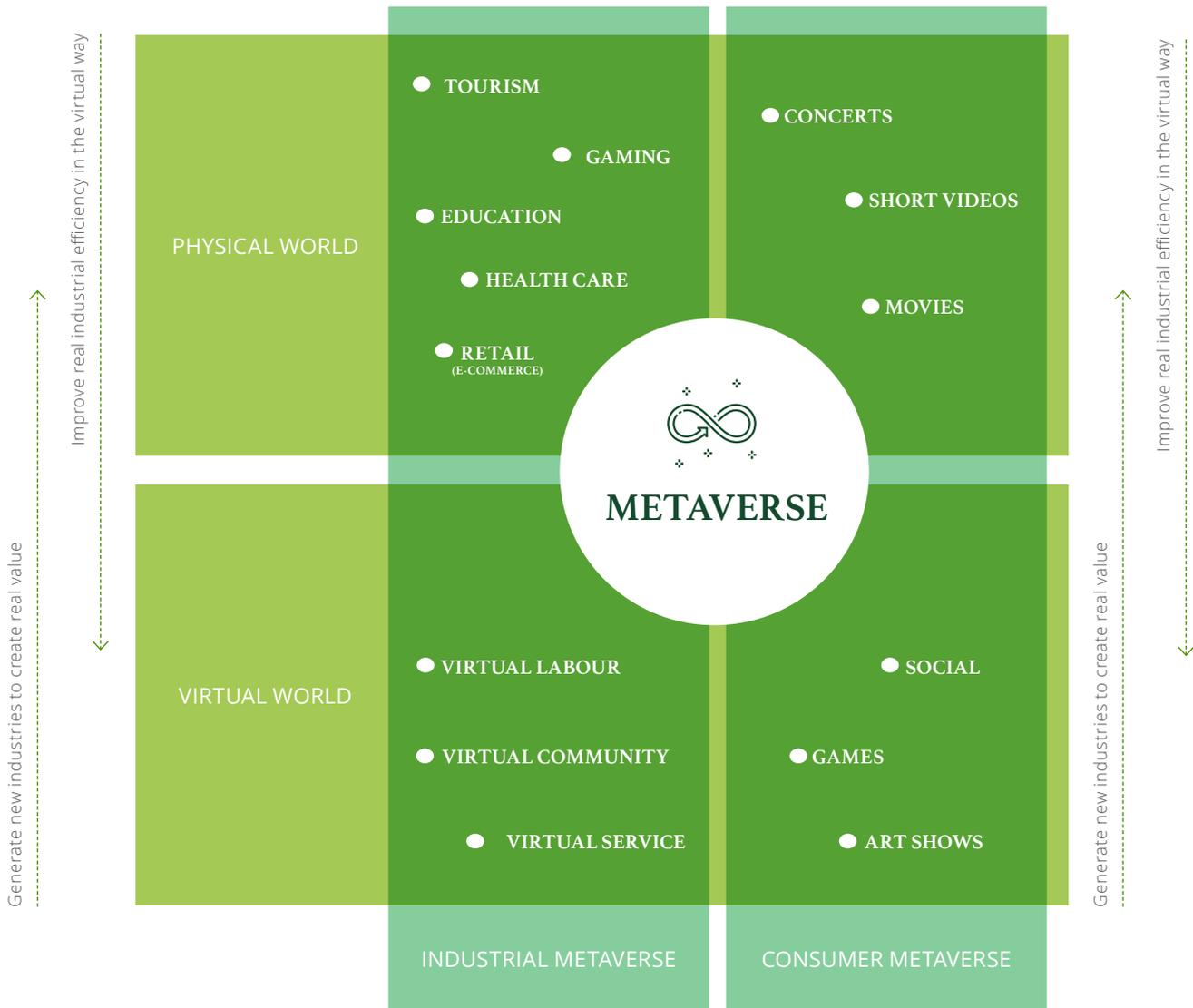
Virtual, mixed and augmented reality (VR, MR and AR): VR, MR and AR technology enables users to connect the digital world with the physical world. With VR, users are transported into a digital world. With MR, they can interact with both the digital and the physical world. With AR, virtual information is superimposed on the physical world. While these technologies are commonly associated with use of a headset or auxiliary equipment, it may be that advances in the future will reduce hardware requirements or introduce new devices for a smoother and more seamless experience.

Decentralization and Interoperability: A successful metaverse will have individuals at its core, including users, content creators and developers. It is likely that multiple alternative metaverse platforms will emerge, possibly as part of a decentralized digital ecosystem. Benefits will be maximised when different platforms and systems are interoperable and function effectively with one another, enabling users to move easily from one virtual world to another. For example, MetaAge, a metaverse platform in Türkiye, is currently in the early stages of development.³² To become part of the broader metaverse ecosystem, it will have to consider allowing users the flexibility to move seamlessly and exchange information between platforms.

Persistence, Availability and Synchronicity: The metaverse is envisioned to be accessible regardless of time and place. It will provide an experience that is available for everyone and anyone to engage in.

The metaverse will create virtual worlds that blend with the physical world and thereby enrich experiences for both consumers and industry (see Figure 3).^{33,34}

Figure 3: Industrial and consumer applications of the metaverse in Türkiye



Source: Deloitte Analysis

On the consumer side, the metaverse could make more content available to Turkish audiences and allow them to experience it in more engaging ways. Examples include virtual access to concerts, games, art shows and social gatherings. On the industry side, the metaverse could allow existing industries to become more efficient and enable new sectors and business models to prosper. For example, Turkish TV producers are among the world’s biggest exporters of TV series with international sales reaching \$27.16 billion in 2021.³⁵ The metaverse could enable an expansion of reach, improvement of audience engagement, and development of new forms of content.

Though the metaverse is in a nascent stage, momentum in Türkiye is building

In Türkiye, an IPSOS survey shows that the level of awareness of the metaverse is among the highest in the world.³⁶ Data from Google Trends shows that Türkiye ranks at number 1 for searches on the word “metaverse” in past 12 months.³⁷



In Türkiye, an IPSOS survey shows that the level of awareness of the metaverse is among the highest in the world.

Turkish institutions have recognised the potential of the metaverse and have taken initial steps to support its development. The country’s capital, Ankara, became the fourth test city of the Open AR Cloud Association (after Los Angeles, Helsinki and Bari). The Open AR Cloud Association develops standards for the metaverse, enabling and supporting development of openness and interoperability.³⁸ At the TRT International Metaverse and Broadcasting Forum in June 2022, Türkiye’s public broadcaster the Turkish Radio and Television Corporation (TRT) unveiled a project to launch the world’s first public broadcasting metaverse platform.³⁹

Trends across the private sector demonstrate the increasing momentum:

- In the first half of 2022 the Turkish gaming industry received \$20 million in investments for blockchain- and metaverse-related initiatives (6% of the total investments received by Türkiye in the period), with at least 50% of investment directed at the metaverse.⁴⁰
- Vodafone Türkiye was the first telecom operator to open a store in Decentraland,⁴¹ and Turkcell has announced plans to enter the metaverse soon.⁴² This will create new touchpoints between businesses and customers, with new ways for customers to explore products and services.
- Toyota Türkiye hosted its annual strategy meeting on a metaverse platform, demonstrating how new forms of meetings are practicable.⁴³
- Cerebrum Tech introduced the Cereverse ecosystem, which aims to create a 3D virtual smart city in which users can socialise, and at the same time contribute to sustainable development goals.⁴⁴

The metaverse will require alignment across stakeholders in Türkiye and globally

The metaverse ecosystem consists of different stakeholders, across Türkiye and globally: for its successful development and operation these stakeholders need to collaborate, and their efforts need to be in alignment with each other. As shown in Figure 4, there are key stakeholders across four domains: infrastructure; hardware, protocols, and standards; platforms; and content and experiences.

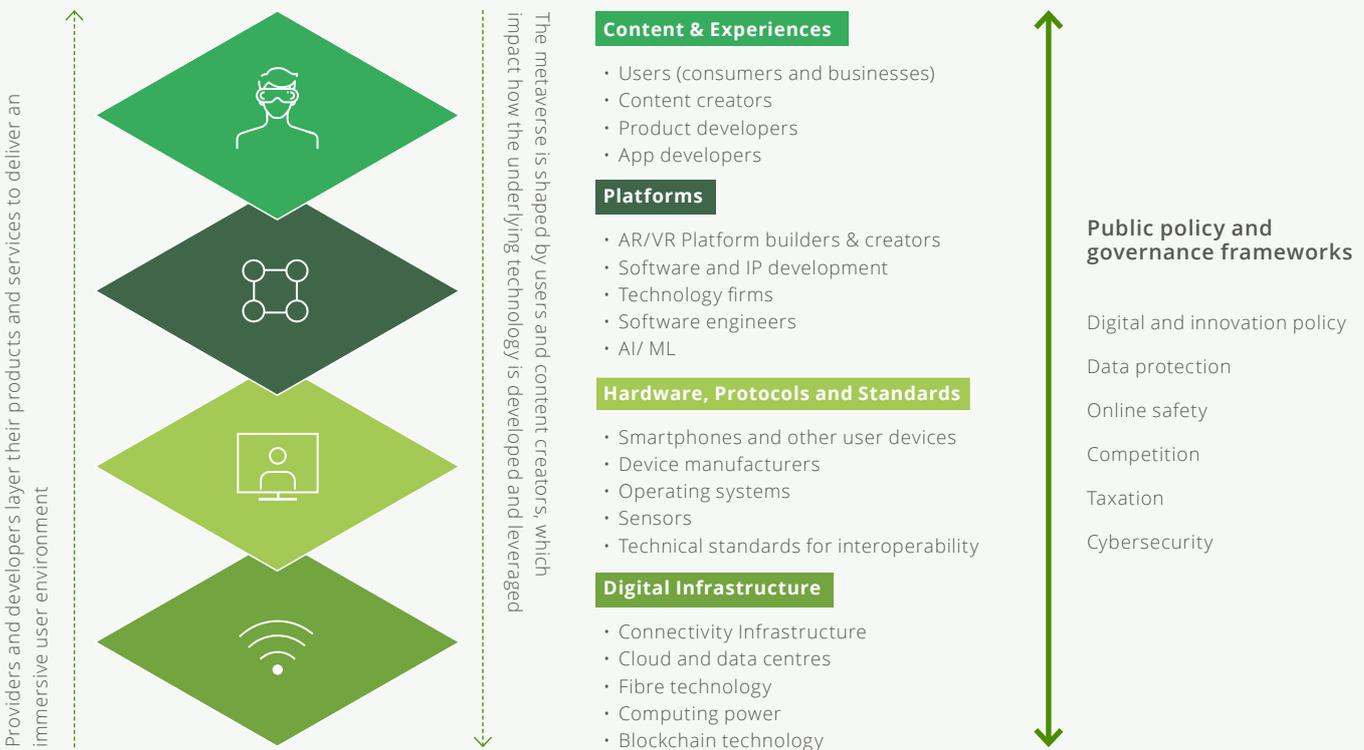


“Metaverse is a new concept in our lives, but we will hear and talk more about it from now on.”

— Mr. Ali Taha Koç, Ph. D. President of Digital Transformation Office of the Presidency of Turkey

Source: Twitter (2022). Ali Taha Koç on Twitter: “Metaverse hayatımızda yeni bir kavram ancak bundan sonra daha çok duyacak ve konuşacağız.”

Figure 4: The metaverse ecosystem



Source: Deloitte Analysis

Digital infrastructure: Digital infrastructure is the foundation of the metaverse. It includes the connectivity, cloud infrastructure, computing power and blockchain technology on which metaverse platforms can be built. Türkiye's telecom operators (Turk Telecom, Turkcell and Vodafone) and both global and local cloud service providers will be among the infrastructure providers.

Hardware, protocols and standards: These form the second layer. Innovative hardware will be needed to maximise the end-user experience. Common protocols and standards are needed in order for devices, platforms and underlying infrastructure to function seamlessly together. Türkiye's local mobile phone manufacturers such as General Mobile, Vestel, and Casper, and other manufacturers globally, can contribute to this.

Platforms: The stakeholders in platforms layer create and operate digital worlds that enable immersive experiences. Decentraland, MetaAge, and Cereverse are the current metaverse platforms in Türkiye, but others are likely to emerge.

Content and experiences: The end user experience relies on content creators, developers and regulators to enable effective and safe access to engaging content.

The success of this metaverse ecosystem will also require trust between stakeholders with regard to the handling of personal data. In 2019, Türkiye's government released guidelines to ensure that personal data remains confidential and is treated with integrity.⁴⁵ For Türkiye to leverage the full transformative potential of the metaverse, proactive dialogue between stakeholders will help to develop any further policies that can support metaverse growth and manage any risks to consumers and business participating in it.



3. The Economic Opportunity of the Metaverse in Türkiye

The potential contribution of the metaverse to the Turkish economy could be in the region of between \$19.9bn and \$37.5bn annually by 2035. This estimate is based on published global investment predictions and achieving it will require sustained investment in the metaverse.



The potential economic contribution of the metaverse could reach between \$19.9bn and \$37.5bn annually by 2035 in Türkiye.

As the metaverse is in its early stages of development, the full scale of the economic opportunities remains uncertain. Both the timing and size of its impact will depend on a wide range of socioeconomic factors and enablers.

Nevertheless, early estimates are that the potential impact of the metaverse will be substantial both regionally and globally:

- Estimates of the potential global market size of the metaverse (i.e. revenue) range from \$678.8bn (Grand View Research) up to \$13tn (Citi GPS) per year by 2030.⁴⁶
- Estimates of the potential impact of the metaverse on global GDP range from \$1.5tn per year by 2030 (PwC) and \$3tn per year by 2031 (Analysis Group).⁴⁷
- For the MENAT region specifically, Analysis Group estimates that the net contribution to GDP could reach \$360bn per year by 2031.

Using the metaverse can unlock value across diverse sectors of the economy, including retail, education, gaming, healthcare and tourism, with knock-on effects on ancillary services and related sectors.



Using the metaverse can unlock value across diverse sectors of the economy, including retail, education, gaming, healthcare and tourism, with knock-on effects on ancillary services and related sectors.

Potential benefits could accrue to small and large businesses as well as to individuals and entrepreneurs. Just as Web 2.0 generated new opportunities for creators to reach audiences and monetise their work, the emergence of virtual experiences could have a transformative effect.

To achieve this within Türkiye, significant investment, predominantly in ICT and its end-to-end supply chain, will be required. This includes metaverse-related hardware, infrastructure and enabling technologies as well as software, databases and created content.

Previous studies have estimated the global and regional economic impacts of the metaverse, but there have been no studies that look specifically at Türkiye. However existing research provides some guidance for estimating the potential impact at country level. The approach we have taken is to begin by considering the potential scale of global investment in developing the metaverse, and then drawing on economic studies that assess the relationship between ICT capital and economic growth. Estimates of economic growth for each country can then be made by allocating a share of the global total. We have used this approach to estimate the potential impact on Turkish GDP up to 2035.

Using this approach, we have estimated that under different scenarios the development and adoption of the metaverse could add between \$19.9bn and \$37.5bn to Türkiye's annual GDP by 2035 - approximately 1.3-2.4% of its projected GDP in 2035. This would represent a sizable contribution to the Turkish economy.

In comparison over the past five years, the ICT sector has contributed on average 2.6% annually to Turkish GDP, and financial services has contributed 3.2%.



Snapshot of Türkiye's Economy

Upper middle-income economy.^a

2021 nominal GDP: \$815 billion.^b

The Turkish economy is led by the services sector, which contributed 52.7% of GDP in 2021.^c

GDP per capita is \$31,252 (constant at 2017 international \$US) - higher than the \$18,195 average for upper middle-income economies.^c

In recent years, the country has faced macroeconomic challenges, with the Turkish lira depreciating by 44% against the US dollar in 2021, followed by further losses in 2022.^d

Sources: ^aWorld Bank (2021).GDP (constant 2015 US\$) - Türkiye |; ^bServices, value added (% of GDP) - Türkiye | ^cData (worldbank.org); Global Innovation Index (2021) | ^dInnovation Trends and Report 2021; Reuters (2022). Turkish lira declines to weakest since December over Ukraine concerns



METHODOLOGY: ESTIMATING THE POTENTIAL IMPACT OF THE METAVERSE ON THE ECONOMY OF TÜRKIYE

Based on existing third-party estimates, we considered two global investment scenarios for the metaverse:

- A baseline investment scenario where global investment is \$700bn over five years from 2024 to 2029, or \$140bn per year.
- An upside scenario where global investment scenario is \$1,350bn over the same five-year period, or \$270bn per year.

Economic literature on the relationship between ICT capital and economic growth was then used to determine how global investment in the metaverse can be expected to affect growth in GDP in the short-to-medium term (through to 2035). Finally, a representative economic impact for Türkiye was calculated by apportioning a share of the total growth in global GDP across countries, taking into consideration their current national GDP and economic growth rates.

These estimates are contingent on continued and sustained investment in the metaverse, including within Türkiye itself, as well as broader measures to support adoption through to 2035.

The investment scenarios described above are based on estimated investments by ICT firms. At this stage it is unclear whether some of those investments will be substitutes for other investments. For the purposes of this analysis, they are assumed to be incremental to other ICT investment that will occur. On the other hand, the estimates may be conservative as they do not necessarily capture broader metaverse-related investments, for example by firms outside the ICT sector, or by public authorities. The attribution of a share of global impacts to Türkiye specifically is uncertain, as it will be contingent on the level of investment within the country itself and the development of an enabling environment to support adoption.

For more detail on the methodology, see the Appendix.

Economic gains can benefit key sectors of the Turkish economy

The nature and magnitude of economic impacts can be expected to vary across economic sectors. Key sectors of the Turkish economy such as e-commerce and retail, tourism and culture, education, and gaming and e-sports are likely to be among the first to benefit from the metaverse.⁴⁸ These sectors have already experienced digital transformation and have a growing number of initiatives linked to the metaverse (See Figure 5).

The estimated economic impacts reflect the potential of the metaverse to support more efficient interactions and to create value by enabling entirely new business models. In broad terms, the metaverse can contribute to economic growth and development via three value drivers:

- expansion and creation of new marketplaces,
- higher levels of efficiency through improved ways of working,
- expanding educational and training opportunities for young people, developers, creators and start-ups.

The implications of these value drivers for the Turkish economy are considered in more detail below.

Figure 5: Key sectors in Türkiye likely to benefit from metaverse opportunities



Retail & e-commerce

This sector was worth over \$118bn in 2021 and had an annual nominal growth of 69%¹

17.7% of retail revenue is from e-commerce²

Two e-commerce sites, Trendyol and Hepsiburada have grown significantly in the past 2 years and are worth \$16.5bn and \$3.9bn respectively^{3,4}



Education

In 2019, Türkiye had over 59,000 ICT graduates, 100,000 high school graduates, and 30,000 PhD students specializing in digital technology⁵

More than 20% of people employed in the ICT sector are R&D personnel¹⁴

Türkiye has been developing virtual learning platforms and has allocated \$19m for metaverse applications in the sector⁶



Culture & tourism

The contribution to GDP is expected to grow to 15.5% by the end of 2022, amounting to 8.3% of all economic activity⁷

2021 revenue was \$24.5 bn, with \$18.8 bn from tourists and travellers⁸

Türkiye is home to 99 museum directorates and 151 private museums⁹



Gaming & e-sports

In 2021, there were 41m players in Türkiye, up from 36m in 2020¹⁰

Türkiye is the 18th largest in the world in terms of gaming industry revenues¹⁶

The sector attracted the most financial capital for gaming in Europe in the first half of 2022¹⁵

In 2021, there were 52 deals worth \$265m in the gaming industry¹¹

2 out of 5 business that became unicorns in the past 2 years are in the gaming industry - Peak Games and DreamGames¹²

In 2021, the gaming industry's contribution to total exports was approximately 1.3%¹³

Sources: ¹E-Commerce Info Platform (2021). 2021 Yılı E-Ticaret Verileri Açıklandı (eticaret.gov.tr); ²Department of E-Commerce (2022). Yılı E-Ticaret Verileri Açıklandı; ³Bloomberg (2021). Turkey's Trendyol Valuation Set to Hit \$16.5 Billion - Bloomberg; ⁴Bloomberg (2021) First Turkish Firm to IPO on Nasdaq Hits \$3.9 Billion Value - Bloomberg; ⁵Investment Authority (2021). "Why Invest in Turkey's ICT Sector?" PowerPoint Sunusu (invest.gov.tr); ⁶Digital Transformation Office of the Presidency of Turkey (2022). Digital Future in Turkey (cbddo.gov.tr); ⁷WTTC (2022). News Article | World Travel & Tourism Council (WTTC); ⁸TURKSTAT (2022). Veri Portalı (tuik.gov.tr); ⁹Turkish Museums (2022); ¹⁰Webteknoloji (2022). We Are at the Table in the Gaming Industry: Turkey Becomes the Country Receiving the Most Gaming Investments in Europe; ¹¹Daily Sabah (2022). Strong start to 2022 promises golden year for Turkish gaming startups; ¹²Business Wire (2022). Dream Games Raises \$255m at \$2.75bn Valuation - as Royal Match Becomes One of the World's Top Grossing Mobile Games; ¹³Milliyet (2021). Oyun ihracatı rekora koştu: 2.5 milyar \$ - Son Haberler; ¹⁴ICT Authority (2021). Invest in Türkiye; ¹⁵Webteknoloji (2022). We Are at the Table in the Gaming Industry: Turkey Becomes the Country Receiving the Most Gaming Investments in Europe; ¹⁶Size of Turkish gaming industry reaches \$1.2 bln - Latest News (hurriyetdailynews.com)

Growth of new markets and businesses can unlock economic value in key sectors

The metaverse can catalyse the development of new products and services across sectors supported by the growing pool of developers, software engineers, small and medium enterprises (SMEs), and start-ups in Türkiye. Sectors such as e-commerce, gaming and tourism stand to benefit, as discussed below.

Retail and e-commerce: Türkiye's retail and e-commerce sector has been growing at an accelerating rate.⁴⁹ According to Accenture's Türkiye Digitalization Index, Türkiye's retail sector was ranked amongst the top three sectors in the economy with a score of 77 out of 100,⁵⁰ due to



Istanbul has consequently been ranked among the top 20 of the world's 100 best emerging ecosystems for start-ups in e-commerce.

high digital maturity and supportive regulation.⁵¹ Istanbul has consequently been ranked among the top 20 of the world's 100 best emerging ecosystems for start-ups in e-commerce.⁵²

The metaverse presents an opportunity to develop the retail and e-commerce sector through use cases such as digital customer contact centres, data-enhanced shopping, and (eventually) sensory immersion shopping experiences.⁵³ Established Turkish retailers such as LC Waikiki,⁵⁴ Damat Tween,⁵⁵ and Kiğılı⁵⁶ have plans to open stores in the metaverse to give consumers new opportunities to see, experience and design before ordering a product.⁵⁷ Other companies, such as Spacerunners, are focused exclusively on retail in the metaverse, with no delivery of goods in the physical world.⁵⁸



HoloNext: AR/VR in retail

HoloNext is a full-service technology startup developing AR and Mixed Reality (MR) technologies for different sectors, especially e-commerce. The company participated in the 5th Workup Entrepreneurship program, established by Türkiye İş Bankası to support new ventures.

The company implemented an e-commerce project with Arçelik, the leading white goods manufacturer in Türkiye and the second largest white goods company in Europe. Arçelik's conversion rate increased by more than 300% due to the use of the HoloNext AR Viewer technology, which enables it to display its products to consumers in 3D and AR mode via its website.

Source: HoloNext website

The products, sometimes in the form of NFTs (non-fungible tokens), are designed to be bought and worn by avatars across different games in the metaverse. Hybrid business models are also emerging; for example, Lidyverse is creating a metaverse experience where digital counterparts will be sold alongside physical products.⁵⁹

Compared to larger businesses, SMEs have been slower to adopt digital and metaverse technologies.⁶⁰ SMEs form 36.6% of the retail sector, the full potential of the metaverse will be realised once they start adopting the technology.

Gaming and e-sports: These sectors are already relatively mature in Türkiye. Internet users are familiar with VR/AR and the metaverse globally.⁶¹ Professional gaming is also popular - Türkiye established an e-Sports Federation within the Youth and Sports Ministry in 2018 and issued licences to more than 1,000 e-sports professionals.⁶²

Building on its strong position, Türkiye plans to double its market share of the worldwide gaming industry from a little over \$1 billion to \$10 billion in five years.⁶³ On this growth trajectory, Türkiye has an opportunity to be amongst the leaders in metaverse adoption in the gaming industry.

Through adoption of VR/AR, the metaverse can offer immersive gaming experiences to users, leading to new employment, innovation and growth opportunities for developers.



On this growth trajectory, Türkiye has an opportunity to be amongst the leaders in metaverse adoption in the gaming industry.



**Teleporter:
Gaming in the metaverse**

Teleporter aims to build the world's first gamer metaverse using the power of VR, artistry, and magic. Its first digital universe, World of Gamers, brings video game enthusiasts together in a VR universe for playing games, attending virtual events, watching and purchasing gaming content, and socializing around gaming.

In the long run, Teleporter aims to become a gamer metaverse with industry partners and plans to incorporate every part of gaming, e-sports and geek culture. It raised \$1.2m in pre-seed finance, and investors include Adam Draper's Boost VC, angels from Riot Games, Microsoft, Disney, and Zynga.

Source: Sector interview, Deloitte analysis

Greenpark Sports and Yesports are examples of metaverse platforms specific to sports and e-sports, where users can access games and sports experiences using NFT passes, equivalent to tickets. This has already been gaining traction with the broadcast of the EA Sports FIFA 2022 Champions Cup in the metaverse, and the NBA announcing its partnership in metaverse projects with mobile gaming start-ups like GreenPark Sports.⁶⁴

Culture and tourism: The culture and tourism sector is crucial for the Turkish economy, contributing 8.3% of total economic activity and attracting 45 million foreign visitors in 2019, before the start of the pandemic.^{65,66} Türkiye's 11th Development Plan highlights the importance of digitalization for tourism, with an aim to study the potential for collecting Big Data and analysis tools to advance the sector.⁶⁷

While physical tourism will remain important, potential visitors may face barriers to travelling – financial, geographical or physical (e.g. disabilities). The metaverse enables new business models that could expand access to popular museums and sites to everyone via virtual experiences. For instance large festivals, such as the technology festival Teknofest in Türkiye, could be attended



The metaverse could also empower content creators to target an international audience and promote Türkiye as a tourist destination.



Where To Go Today: Culture and tourism in the metaverse

The tourism industry has started to incorporate ideas including augmented reality and the metaverse into its growth strategies. Where To Go Today (Bugün Nereye Gidelim)'s founder, İlker Kulaksız, remarks on the new opportunities for the industry, "New technologies like Metaverse create a suitable foundation for the 'try before you purchase' strategy, which has become a popular trend among consumers."

The travel agency, which is also a content producer on social media, broke new ground this year in Türkiye by promoting accommodation for rent in the metaverse. Its followers responded to this application with enthusiasm. The initiative allows both domestic and international visitors to explore bungalows in a 3D virtual setting, on a metaverse platform known as OVR.

Source: Hürriyet Gazette

by many around the world at the fraction of the physical in-person cost. Admission models could emulate the real world, ranging from entirely free-to-view entry to requiring visitors to buy NFTs to access the virtual space. There may also be interactions between physical and virtual tourism – for example, tourists being motivated to visit Türkiye physically after experiencing cultural sites or hotels in the virtual world.

The metaverse could also empower content creators to target an international audience and promote Türkiye as a tourist destination. For example a well-known Turkish artist, Tarık Tolunay, created the first Turkish NFT called “Fractal Istanbul – Pandemic,” and sold it in 2021 for \$36,000.⁶⁹ İş Sanat gathered Türkiye İş Bankası’s cultural and artistic activities under a single brand and in April 2022 brought art enthusiasts together in the metaverse. NFT tickets were sold to aesthetes on Decentraland for the preview of the virtual exhibition “Walking on the Bosphorus with Paintings.”⁷⁰

Improved ways of working can bring higher efficiency and productivity

Across the world, virtual meeting platforms such as MS Teams and Zoom were crucial to individuals and businesses during the COVID-19 pandemic. Only 3% of Turkish employees work remotely,⁷¹ but this number is projected to grow,⁷² with 60% of employees wishing to work from home or work flexibly.⁷³

In education, many Turkish schools and universities resorted to remote learning options through the country’s Educational Platform Network (EBA). These were expanded during the pandemic to deliver interactive lessons and offer learning materials through television and online.⁷⁴



METU- Education in the metaverse

Middle East Technical University (METU), one of Türkiye’s leading research universities, has been conducting studies on the metaverse. Researchers established a 3D virtual campus of the university as early as 2010. They plan to create a virtual infrastructure where students can access information without coming to the campus.

Assoc. Dr. Tuğba Tokel states that after the virtual campus initiative, a “virtual therapy” technology was developed to treat those with social phobia by confronting their fears in a virtual reality environment. Dr. Tokel noted, “We have intensified our work on the virtual clinic. With this technology, meetings with psychologists can now take place in 3D environments. In these environments, people feel much more comfortable and can express themselves much more comfortably”.

Source: Anadolu Agency (AA)

Of university students who received an online education during the COVID-19 pandemic in Türkiye, 90% stated that they benefited from online teaching materials and found them useful, while 74% stated that they preferred fully online learning or hybrid educational models compared to face-to-face teaching.⁷⁵



74% stated that they preferred fully online learning or hybrid educational models compared to face-to-face teaching.

Recognising the potential for further benefits, the government announced that the education sector will be the first to enter the metaverse in Türkiye, and a pilot program is currently being developed to educate Turkish teachers via hands-on training, with the aim of producing over 400 master apprentices.⁷⁶ The metaverse could further expand access to information and resources while providing more engaging ways of learning and training, such as immersive simulations of real-world situations, which should ultimately enhance future employment prospects for students.

In the workplace, the metaverse can transform the concept of remote working and learning through collaboration in virtual working environments. This could in turn cut costs of rent, maintenance, and transportation for businesses, and encourage cooperation and creativity.

New employment and training opportunities can drive economic growth

The metaverse has the potential to create employment and utilize resources more efficiently in sectors such as education, media and entertainment, and ICT. In 2021, the ICT sector in Türkiye accounted for 3% of total economic activity and experienced a high rate of growth (36%).⁷⁷ The government has set a strategic goal of increasing the number of developers and ICT graduates. The Turkish Ministry of Education has announced the budget of \$19 million for the creation of authentic Turkish metaverse content for the training of apprentices. Separately, Birol Güven Cinema and Television Academy, which started with the aim of bringing new actors, screenwriters, writers, directors, and artists from Bursa to the world of TV series, cinema, and television, has started providing “Metaverse in Cinema” training.⁷⁸

Recently, the global AR/VR Association, of which Türkiye is a member, has been engaging companies in soft skills training and team building activities, with post-its, blackboards, presentations and avatars to simulate non-verbal communication.⁷⁹ The experience received positive feedback for encouraging ‘powerful’ engagement and collaboration, and enabling connectivity despite physical barriers.⁸⁰



New employment opportunities may be especially important for content creators and the younger generations

New employment opportunities may be especially important for content creators and the younger generations of individuals, who are often equipped with at least basic digital skills but do not necessarily have the means to employ them in the labour market. Employment opportunities could even improve for people with disabilities, for whom participation in the labour market through virtual worlds may be more viable than in the physical world.⁸¹



Smartpro Teknoloji - Training in the metaverse

Smartpro Teknoloji, established in Türkiye, supports the labour market and youth employment in order to add to the pool of software specialists in the country.

The corporation launched the Metaverse Education Scholarship Program in July 2022. Metaverse education will be given to 100 successful young people who are studying or newly graduated in computer engineering, computer programming, and numerical-based undergraduate and associate degree departments of universities. Over 3,000 applications have already been received.

More than 700 hours of instruction will be offered across six topics: software, advanced software, animation, game development with unity, AR/VR augmented reality, blockchain, and NFT. It is anticipated that candidates will be hired by Smartpro Technology at the conclusion of their training, provided that they successfully complete the tasks that are assigned to them.

Source: Dünya Gazette

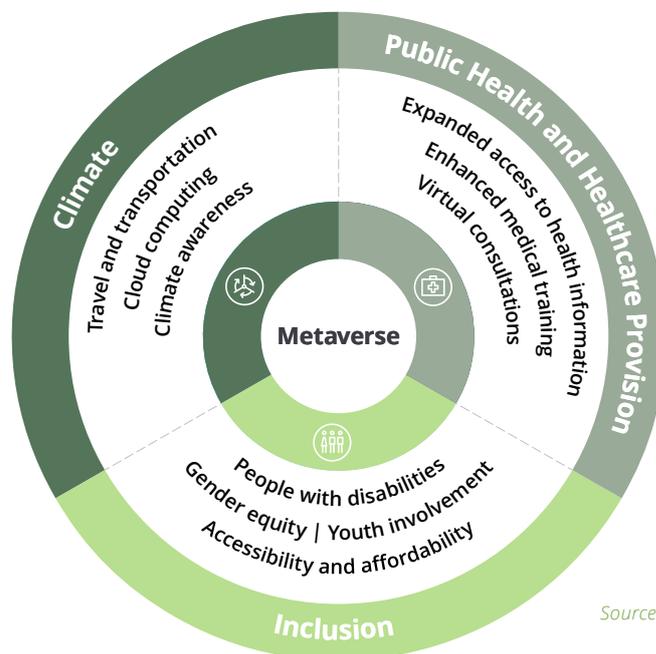
4. Social and Environmental Opportunities from the Metaverse

Beyond providing economic benefits, the metaverse could contribute to a more inclusive and sustainable Turkish society. To realise broader social opportunities, stakeholders across the metaverse ecosystem can consider how best to support its sustainable development, whilst overcoming any challenges.

Alongside providing economic benefits, the metaverse could have important wider implications for both Turkish society and the physical environment. Successful growth and adoption of the metaverse could drive social inclusion by expanding access to information and services, for example by transforming the provision of healthcare. Conducting activities and delivering services virtually has the potential to support the country's Climate Change Action Plan. However, there may also be adverse environmental effects as the metaverse, and its underlying infrastructure are developed. By considering all the issues proactively, Türkiye has an opportunity to promote significant social benefits, while taking steps to overcome potential challenges.

There are three broad areas where the metaverse is expected to have a social and environmental impact in Türkiye (see Figure 6).

Figure 6: Potential social and environmental considerations for the metaverse



Source: Deloitte Analysis

Inclusion

The UN defines inclusion as the process by which equal access to opportunities and social participation is guaranteed to all groups of people irrespective of race, gender, disability, medical need, region, or income.⁸² As part of its Sustainable Development Plan, Türkiye has been working to expand access to employment opportunities and education for all segments of society. Sustainable Development Goal (SDG) metrics in relation to education show that Türkiye has made improvements between 2005 and 2019, but further progress is required before it achieves its goals.⁸³ For example, according to a World Bank report Türkiye scored 4.3 in scores for both education and social inclusion, compared to the OECD average of 6.4 and 6.1 respectively.⁸⁴ Women’s participation in some business sectors is relatively low. For example, in 2021 women comprised approximately 27% of the ICT sector’s workforce.⁸⁵

The metaverse could contribute to achieving Türkiye’s SDGs by expanding access to information and resources for rural populations (constituting 23% of Türkiye’s population)⁸⁶, for example through educational and training programs that might otherwise only be available in urban hubs.⁸⁷ The technology could also improve young people’s participation in the workforce and reduce the gender gap by challenging stereotypes,⁸⁸ enabling new forms of remote working and encouraging women’s participation in the labour force. For disabled people, the metaverse can enhance social inclusion, for example through innovative methods that rely on interactive sensory engagement and non-verbal communication.⁸⁹ One such example is the “Dreams are Moving Digitally-From Canvas to Pixels” project, launched in 2021 by Istanbul Grand Airport (IGA) and Türkiye’s Autistic Support and Education Foundation (TODEV) to support children with Autism and Down Syndrome by transforming drawings depicting their dreams into NFTs and using the revenues from NFT sales as donations to TODEV.⁹⁰

While these impacts on inclusion could be profound, they are so far largely theoretical. For Türkiye to capitalise on the opportunity to promote inclusion through the metaverse, stakeholders will need to consider the measures required to ensure equal access to platforms and applications. Achieving this may require, among other things, adequate sufficient connectivity in rural areas, affordable devices and apps, and at least basic digital skills across segments of the population.



Istanbul Grand Airport (IGA) and Türkiye’s Autistic Support and Education Foundation (TODEV) launched an NFT project called “Dreams are Moving Digitally-From Canvas to Pixels” to support children with Autism and Down Syndrome.

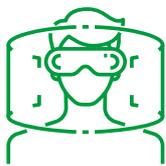
Public health and healthcare provision

Türkiye has committed to supporting the SDG of ‘good health and wellbeing’ by launching 18 countrywide initiatives in capacity building, training, research, policy studies, and direct support for the country’s healthcare system. The initiatives aim to expand immunisation, enhance community-based mental health services, establish free cancer screening facilities, and offer near-universal insurance coverage.⁹¹

Some of these initiatives involve increasing access to healthcare information and delivering online health training using digital devices.⁹² The popularity of virtual consultations grew considerably during the pandemic. For example, the Ministry of Health introduced Dr. E-nabız, a telemedicine service for remote inspection for COVID-19 patients. This service provided consultations to more than 10,000 patients in 2021.^{93,94}

The metaverse could help to expand the delivery of healthcare services and enhance their quality. Immersive and realistic simulations could deliver specialised training at a lower cost to a broader cohort of medical professionals. In addition Türkiye’s Red Crescent is already collaborating with Meta to deliver such training. Within a project carried out by the European School of Modern Technology and Hacettepe University (HU), three-dimensional human models were used in medical education, trial surgeries, and diagnosis of critical diseases. Training has been delivered in 2022 to approximately 50 urologists and medical school students from Türkiye, Belgium, Italy, North Macedonia and Bosnia and Herzegovina.⁹⁶

Notwithstanding the potential benefits for the healthcare sector, the development of use cases is still at an early stage and will require substantial further investment in Türkiye to have a widespread impact. At the same time, there can be health implications from increased used of digital devices – for example, deterioration in eyesight, back pains and social isolation.⁹⁷ Psychological or psychiatric health issues may also be exacerbated by blending physical and virtual experiences, particularly in cases of excessive or compulsive usage. By considering such issues as the metaverse develops, Türkiye has an opportunity to promote the metaverse as a tool to enhance health and wellbeing, while monitoring for any undesirable effects and putting safeguards in place where necessary.



The European School of Modern Technology and Hacettepe University have collaborated on the metaverse and 3D human models to be used in medical education and diagnosis.

Climate

Türkiye has expressed its commitment to the Paris Agreement⁹⁸ and seeks to minimise environmental damage in line with the UN's Sustainable Development Goals to "adopt sustainable management and clean practices to protect the environment."⁹⁹ The government is pursuing cleaner solutions for the delivery of e-government services as part of the Digital Türkiye project. It is also currently working on compliance with the EU Fit for 55 initiative and the Carbon Border Adjustment Mechanism (CBAM) and is building an emissions trade system (ETS).¹⁰⁰ Despite these commitments, international indices and metrics show that Türkiye, like many other countries, can go further in some areas. For example, the country still faces significant challenges from fossil fuel CO2 emissions and in the treatment of electronic waste, but it has made progress in reducing SO2 and nitrogen emissions as well as exports of plastic waste.¹⁰¹

By enabling further growth in remote working, the metaverse could contribute to reducing greenhouse gas emissions, by reducing the need for people to travel. When remote working became more prevalent during the COVID-19 pandemic, global daily emissions of greenhouse gases were temporarily reduced.¹⁰² The creation of new virtual marketplaces and experiences could also see a similar degree of substitution from physical to virtual attendance – for instance at concerts, museums and other events, and also for shopping and social gatherings. The metaverse could even act as a tool for raising environmental awareness.

From an infrastructure perspective the metaverse will rely heavily on cloud technologies, which can be between 22%-93% more energy-efficient than traditional enterprise data centres.¹⁰³ Accelerating the adoption of cloud technologies has the potential to reduce greenhouse gas emissions and e-waste, and boost energy efficiency.

However, the transition from current technology to the metaverse could have some adverse environmental implications. Widespread adoption of the metaverse is likely to require significant new infrastructure and increased computing power and may involve migration to new devices that enable more immersive experiences. These developments could contribute to greenhouse gas emissions from high levels of computing power and data processing. As the development of the metaverse gathers momentum, there is an opportunity for stakeholders and policymakers in Türkiye to promote sustainable development and mitigate any undesirable or unintended consequences. For instance, emissions and e-waste could be reduced by device recycling, and developing the industrial capabilities to re-use obsolete devices in the manufacture of new ones. Stakeholders could explore design and production strategies that reduce the use of rare earth minerals like lithium and industrial diamonds, which are mined using methods that can be environmentally damaging.¹⁰⁵



As the development of the metaverse gathers momentum, there is an opportunity for stakeholders and policymakers in Türkiye to promote sustainable development and mitigate any undesirable or unintended consequences.

5. Enabling Successful Metaverse Growth

Many things need to come together to create a successful metaverse. Although Türkiye is well positioned to benefit, it will need to consider how to create the necessary technology ecosystem utilising and whether the current regulatory frameworks will require revision.

As discussed previously, the metaverse could add between \$19.9bn and \$37.5bn per year by 2035 to Türkiye's GDP. However, to achieve this, a complex ecosystem will be needed to integrate different infrastructures, hardware, platforms and apps, both within Türkiye and across borders.

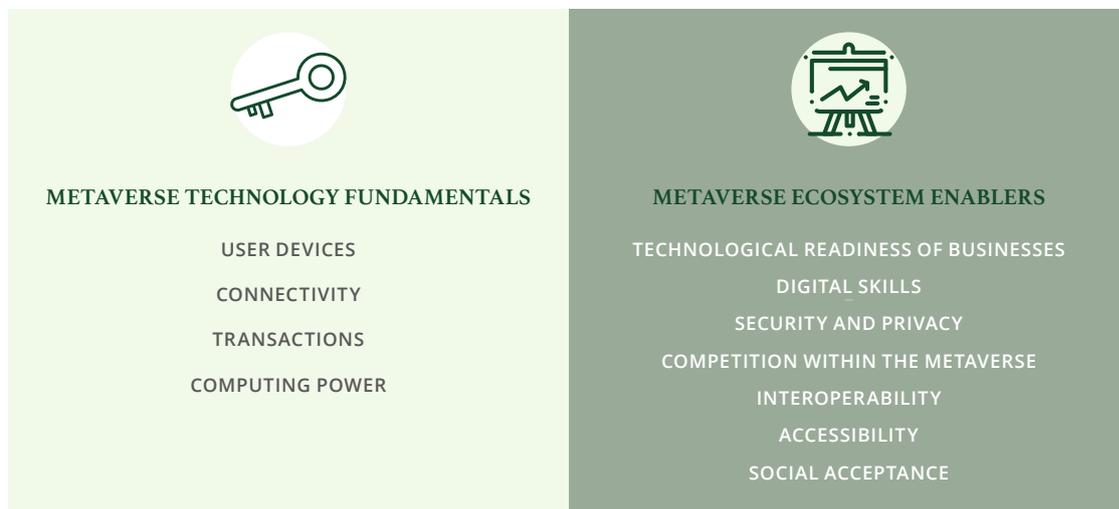
Metaverse growth is dependent on ICT infrastructure and a broader enabling environment

The metaverse is likely to rely on digital infrastructure and capabilities beyond those available in Türkiye today. As a prerequisite for mass adoption, there are several "technology fundamentals" for the availability of user devices and the underlying infrastructure for connectivity, payments and data processing. More broadly, there is a set of "ecosystem enablers" with regard to the business and regulatory environment which together can facilitate successful adoption (see Figure 8).

Metaverse technology fundamentals

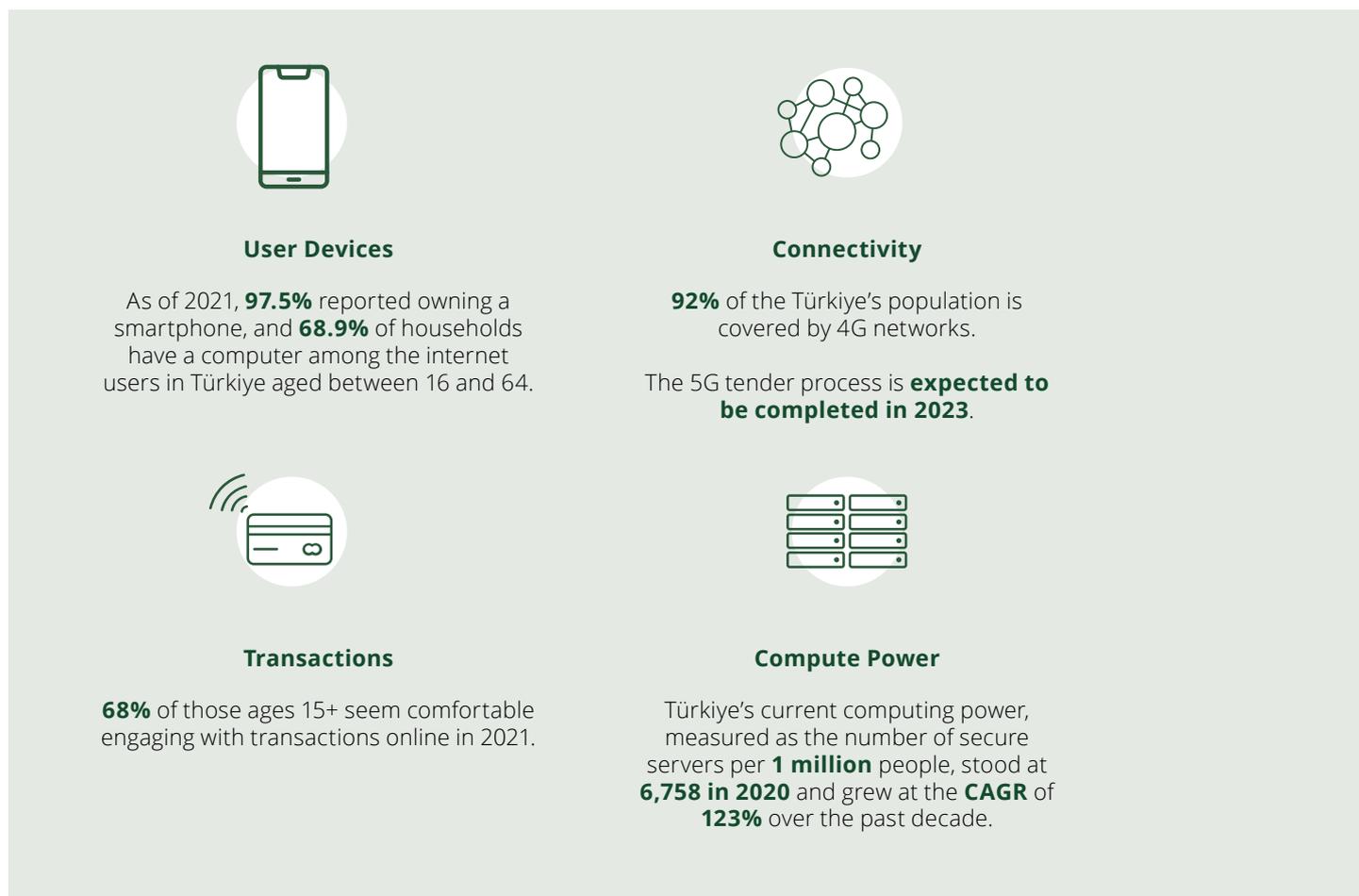
The metaverse cannot exist without the core devices, networks and systems that are required to develop and operate it. These include AR/VR devices, computing power, online transactions and fast internet connection. These will not guarantee the success of the metaverse, but are essential for its development and adoption.

Figure 8: Metaverse technology fundamentals and ecosystem enablers



Source: Deloitte Analysis

Figure 9: Current status of technology fundamentals in Türkiye



User devices: The availability of affordable user devices to support immersive experiences will be important for creating a large user base, generating investment incentives for businesses and bringing benefits to as many consumers as possible. In 2021, among the internet users in Türkiye aged between 16 and 64, 97.5% reported owning a smartphone, and 68.9% of households reported having a computer. However, AR/VR devices can be expensive, which acts as a barrier to mass adoption.¹⁰⁶ At present, the current average price of the Meta Quest headset is more than double the net monthly minimum wage in Türkiye.¹⁰⁷ This affordability barrier could create disparities in access for people to the metaverse, and could exacerbate existing digital divides across genders and age groups.¹⁰⁸ However, these devices may become more affordable over time as technologies mature.¹⁰⁹



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Connectivity: Fast fixed and mobile connectivity is essential for real-time interactions and transactions, and facilitating fast, high-volume and low-latency exchanges of data. Currently, although 92% of the Türkiye's population is covered by 4G networks,¹¹⁰ the median mobile internet speed in Türkiye is 31.93 Mbps, lower than the top ranked UAE (with 133 Mbps) and behind other major economies.¹¹¹ Leading telecom operators, Turk Telekom (TT), Turkcell, and Vodafone have been conducting tests to implement 5G technology in the country.¹¹² It is expected that many of the metaverse's mobile use cases will require mid-band spectrum in 5G¹¹³ and Türkiye expects to complete its 5G tendering process by 2023.^{114,115}

With regards to fixed connectivity, only 19% of people in Türkiye had fixed broadband subscriptions in 2020, compared to an average of 36% in the EU.¹¹⁶ This low penetration partly reflects affordability challenges.¹¹⁷ Türkiye aims by 2023 to achieve 100% mobile broadband subscriber density, 11.5% fiber broadband subscriber density, and 90% female internet usage,¹¹⁸ with the aim of reducing disparities in internet access among different income levels, regions, genders and age groups.



92% of the Türkiye's population is covered by 4G networks.

Transactions: The availability of digital payment processes, platforms, and systems is essential for supporting financial transactions in the metaverse. Cryptocurrencies might play an important role in this regard, though the extent of their use for metaverse transactions is as yet uncertain.

According to the World Bank's Global Findex Database in 2020, 68% of users in Türkiye aged 15+ were comfortable engaging with transactions online, up from 50% in 2014, but lower than the Euro area average of 97%.¹¹⁹ Deloitte's Global Marketing Trends 2022 shows that the younger generation in Türkiye is engaging with online purchase across a range of channels – 58% made a purchase through a streaming service, 49% through a social media platform, 30% through a video game, 17% through a voice assistant, and 13% through a virtual reality headset.¹²⁰

The ownership of cryptocurrencies in Türkiye is highest in the world,¹²¹ and the Central Bank of Republic of Türkiye (CBRT) has been working on regulations to establish greater control over them, potentially including taxes on certain transactions involving digital assets. In the interim, the CBRT has issued a regulation prohibiting the direct and indirect use of crypto assets for payments.¹²²



The younger generation in Türkiye is engaging with online purchase across a range of channels – 58% made a purchase through a streaming service, 49% through a social media platform, 30% through a video game, 17% through a voice assistant, and 13% through a virtual reality headset.

In other jurisdictions, the European Union (EU) has brought crypto assets, issuers of crypto assets, and providers of crypto asset services under a regulatory framework known as MiCA (markets in crypto assets).¹²³ Supranational institutions such as the OECD¹²⁴ and UNCTAD¹²⁵ are also taking an active interest. To promote an enabling environment for the metaverse, it will be desirable to put effective regulations in place that are harmonized as far as possible across jurisdictions, while taking country-specific issues into account.¹²⁶

Computer power: Given the early stage of the metaverse development, the precise computing requirements are not yet known.¹²⁷ However the notion of providing immersive and smooth experiences to multiple people and devices across geographies will necessarily entail a substantial amount of computing power. Today, virtual worlds such as Fortnite or Roblox do not allow more than 200 participants in a confined space due to computational issues.¹²⁸ Türkiye's current computing power, measured as the number of secure servers per 1 million people, stood at 6,758 in 2020, compared to 50,289 in the EU. Although computing power in Türkiye is substantially lower than in the EU, it has grown at a compound annual rate (CAGR) of 123% over the past decade.¹²⁹

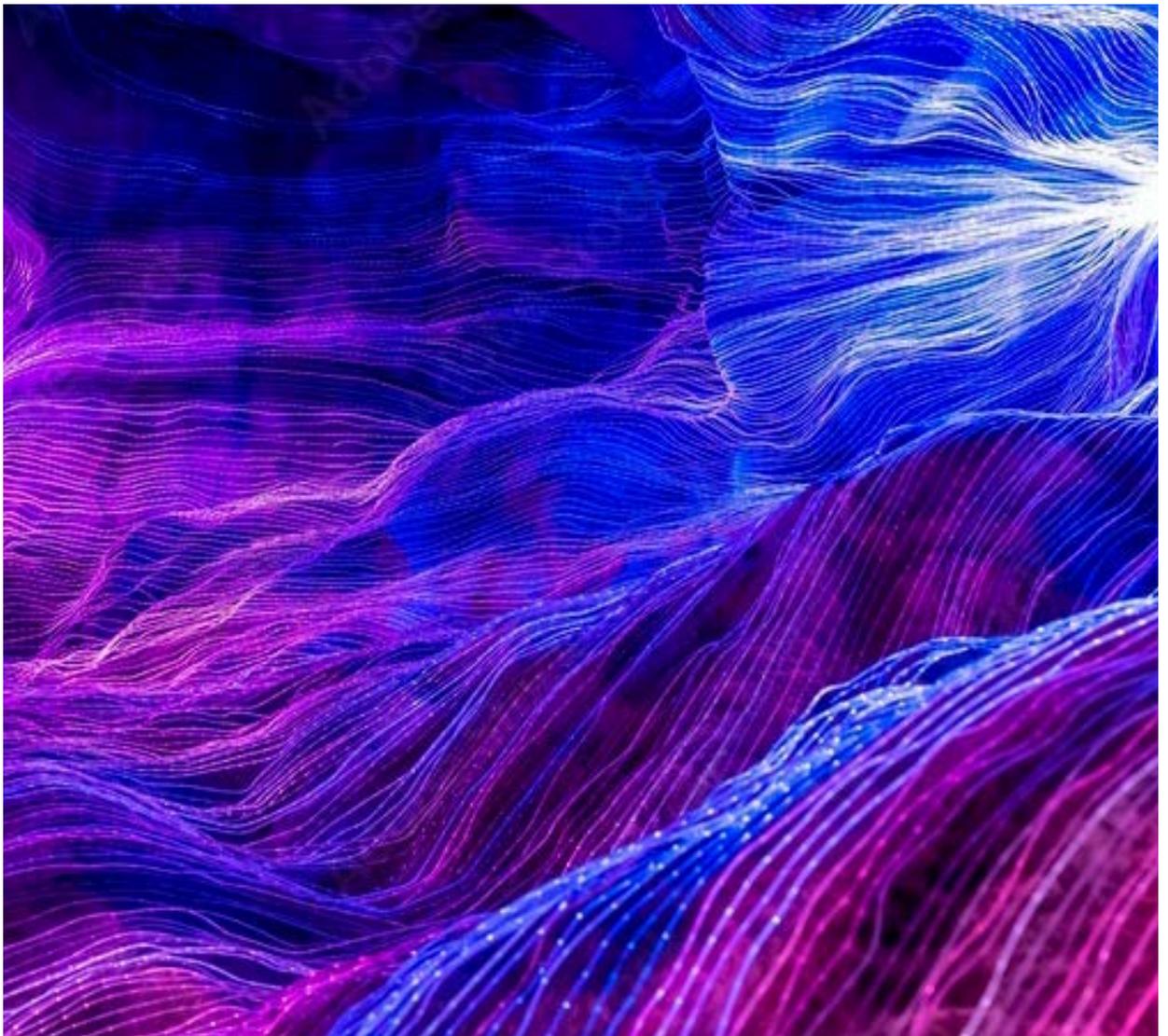


Figure 10: Current status of ecosystem enablers in Türkiye

Technological Readiness of Businesses	>	As per the 2022 inclusive internet index, Türkiye was ranked 43 rd out of 100 countries
Digital Skills	>	41% of people have basic ICT skills, 30% have standard skills and 3% have advanced skills
Safety and Security	>	In the context of the metaverse, Turkish consumers rank personal privacy concerns as their fourth most serious problem
Competition	>	Türkiye ranks 61 st out of 141 countries on the Global Competitiveness Index, and 46 th in terms of the start-up ecosystem
Interoperability	>	Proactive policies supporting the efforts of international bodies ITU could ensure that domestic standards evolve in accordance
Accessibility	>	About 50% of the individuals with no internet access said that high-cost equipment (26%) and high service cost (24%) were the main hurdles
Social Acceptance	>	The social acceptance level of immersive technologies in Türkiye is 13 percentage points higher than the global average of 50%

Source: Deloitte Analysis

Metaverse ecosystem enablers

Beyond the ICT infrastructure, there are other factors that can contribute to a faster and broader adoption of metaverse technology. These include the technological readiness of businesses, digital skills, security and privacy, competition within the metaverse, interoperability, accessibility, and social acceptance, as shown in Figure 10.

Technological readiness of businesses: The capabilities and culture of businesses typically influence the speed of uptake of new technologies. As per the 2022 inclusive internet index, that incorporates many dimensions of digital readiness, Türkiye was ranked 43rd out of 100 countries. While Türkiye scored well on its capacity to access the internet (rank 16) and existence and extent of local language content and relevant content (rank 26), the index highlighted the scope of improvement in infrastructure (rank 52), quality of internet (rank 46) and affordability (rank 46).¹³⁰

SMEs in Türkiye account for 99.8% of all businesses and 53.5% of value added. Their technological readiness for the metaverse is therefore significant.¹³¹ Compared to large businesses, they may lack resources and capabilities for technology adoption. In 2019, only 12% of businesses had employed ICT specialists in the previous 12 months and only 49% had a website.¹³² These percentages reflect the low penetration of technology among small businesses with less than 49 employees. In the absence of appropriate support measures, SMEs may therefore take longer to adopt digital technologies and reap the benefits.

Digital skills: A vibrant metaverse ecosystem will rely on advanced digital skills among the people developing the underlying systems and software, and end users will require at least basic digital skills in order to make the most of the opportunities available. In Türkiye, 41% of people have basic ICT skills, 30% have standard skills and only 3% have advanced skills.¹³³ Studies suggest that in the workplace, 66% of workers lack the necessary digital skills and that employees in the private sector have great difficulty in learning skills where advanced technology is involved.¹³⁴ Improvement in digital skills could accelerate metaverse development and adoption.

In recent years, the Human Resources Office of the Presidency of the Republic of Türkiye delivered extensive training programs, particularly for public employees, with the number of views reaching 11.8 million.¹³⁵

Social acceptance, Safety and Security: The rate of metaverse adoption will also depend on the degree of social acceptance for more immersive virtual experiences. A recent IPSOS & WEF survey suggests that 63% of the people in Türkiye feel positively about engaging with some form of extended reality (XR) technology, higher than the global average of 50%. The acceptance level is particularly high for virtual concerts and shows (72%), virtual learning (71%), virtual/enhanced gaming (70%), trading of digital assets such as cryptocurrencies and NFTs (69%), and virtual work settings (68%).¹³⁶

However, widespread social acceptance could be undermined if there is public concern regarding safety and security. The metaverse will involve the transfer of large amounts of data, including confidential and personal data (depending on the use case). In order to reach mass adoption, trust among users will be essential, and this will require appropriate privacy and security frameworks to be in place. Turkish consumers have expressed concerns in the context of the metaverse, ranking personal privacy as their fourth most serious concern.¹³⁷ This reflects current perceptions of the internet today, with 30% of internet users in Türkiye reporting concern about how companies may use their data.¹³⁸ Türkiye introduced data protection legislation in 2016 and has published a National Cybersecurity Strategy for 2021-25 to protect the cybersecurity of critical infrastructure.¹³⁹ Such measures have contributed to an improvement in the cybersecurity environment, with Türkiye ranked at 11th out of 158 countries in 2020 on ITU's global cybersecurity index, compared to 43rd in 2017. Moving forward, as the metaverse increases the level of interactivity in everyday internet use, authorities may need to consider further steps to ensure that data safety and user trust are preserved, especially with regard to harmful online content and behaviours, which could have a profound impact in an immersive setting.

Competition and Interoperability: Metaverse development is likely to be driven by a combination of individuals (e.g. content creators, entrepreneurs), established businesses across sectors, and new start-ups. A more competitive ecosystem may bring benefits in terms of accelerating metaverse development and generating a variety of applications. Türkiye ranked 61st out of 141 countries on the 2019 Global competitiveness Index and 46th globally in terms of business start-ups.¹⁴⁰

Given the likely presence of a diverse range of market players in the metaverse ecosystem, the interaction and interoperability of different systems and technologies will be crucial to enable a seamless user experience. The issue of interoperability is captured in Türkiye's 11th Development Plan from the perspective of government services,¹⁴¹ and studies in Türkiye have examined interoperability in the transportation and infrastructure sectors.¹⁴² Similar initiatives with regard to the metaverse are likely to be needed, for example via international forums and working groups, on the development of interoperable standards.

Accessibility: The affordability of devices and connectivity could affect metaverse adoption in Türkiye. According to a 2017 ITU report, about 50% of the individuals who do not have internet access pointed to the high cost of equipment (26%) and high service cost (24%) as the main barriers.¹⁴³



A recent IPSOS & WEF survey suggests that 63% of the people in Türkiye feel positively about engaging with some form of extended reality (XR) technology, higher than the global average of 50%.



6. Conclusion

The metaverse is expected to enrich digital interactions and create new virtual spaces with diverse applications. In Türkiye, where the government, private sector, and user base are already involved in the development of digital ecosystems, the metaverse can benefit the economy by creating new markets, widening access to resources, and improving ways of working together. We have estimated that investment in the metaverse could have an economic impact that adds between \$19.9bn and \$37.5bn to Türkiye's annual GDP by 2035.

However, at this early stage of metaverse development, the timing and magnitude of economic benefits is uncertain. In Türkiye, where the government, private sector, and user base are closely involved in the development of the country's technological and digital ecosystems, the metaverse can offer a multitude of benefits for the economy, through its ability to expand markets into a three-dimensional digital sphere, widen access to information, and improve learning and working dynamics.



The metaverse could have an economic impact that adds between \$19.9bn and \$37.5bn to Türkiye's annual GDP by 2035.

But Türkiye will need an adequate IT infrastructure and a broader enabling environment. With respect to enabling technologies, there is already widespread use of smartphone, 4G connectivity and online transactions.

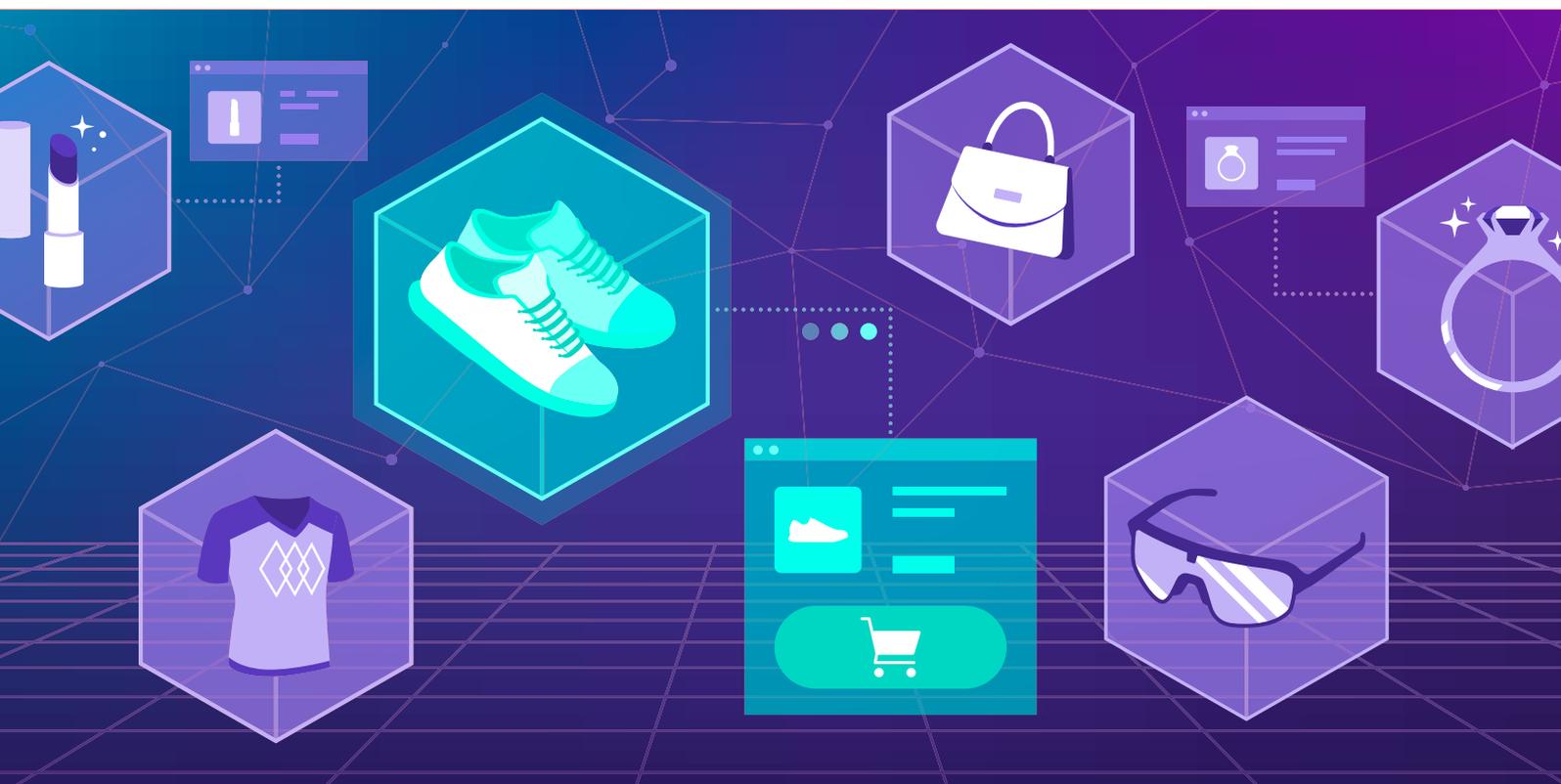
Growth of the metaverse could be supported by increased adoption of AR/VR technology and deployment of 5G connectivity. With respect to the broader environment, Türkiye has a robust cybersecurity framework in place, but there is scope to improve the technological readiness of businesses and the level of digital skills.

In order to achieve mass adoption, robust legal and regulatory frameworks will be needed to address such diverse issues as interoperability, data privacy, intellectual property rights, content licensing, competition and taxation. While these are not new issues, the creation of new marketplaces, different types of virtual content and ways of interacting can affect the suitability and interpretation of regulations. Therefore, the Turkish laws and guidelines that exist today may need to evolve in parallel with the development of metaverse technology.



Growth of the metaverse could be supported by increased adoption of AR/VR technology and deployment of 5G connectivity.

In confronting legal and regulatory challenges, there are likely to be benefits from pursuing – where appropriate – international alignment and harmonisation. Just like the internet, the metaverse is expected to be global. However, different legal and regulatory approaches across jurisdictions could prevent the emergence of a true global metaverse, meaning that economic and social benefits would not be maximised and might be distributed unevenly across jurisdictions. Cross-jurisdictional dialogue and coordination, on matters ranging from common metaverse technical standards to regulation of cross-border data transfers, can play an important role ensuring that governance frameworks in Türkiye take account of all relevant international developments.



Appendix:

Detailed Methodology

This appendix provides further detail on the quantitative method used in this report to estimate the potential impact of the metaverse on the Turkish economy.

Metaverse technology fundamentals

Existing attempts to quantify the potential impact of the metaverse.

The metaverse has the potential to be a breakthrough technology. However, given its early stage of development, the full scale of the economic opportunity and the timing of any benefits are uncertain. As noted within the S-curve literature, the impact will be felt mostly after the first phase of technological innovation. As with Web2.0, the overall cycle could take two or more decades to reach maturity,¹⁴⁴ depending on a wide range of socioeconomic factors and enablers.

Early estimates suggest that the potential impact of the metaverse could be significant both regionally and globally. Existing studies use a number of heterogeneous methods. Some studies seek to evaluate the potential size of the “metaverse opportunity” or Total Addressable Market (TAM) from an investor perspective. Such estimates do not distinguish between GDP growth and the displacement of other economic activities. For example:

- Estimates of the potential global market size of the metaverse (i.e., annual revenue) range from \$679bn (Grand View Research) up to \$13tn (Citi GPS) per year by 2030.¹⁴⁵

Other studies seek to capture the potential impact on global- and/or country-level GDP growth, aiming to evaluate how GDP may change as a consequence of metaverse adoption and estimating the net value of the new output generated. For example:

- The potential GDP impact estimates of the metaverse globally range from \$1.5tn per year by 2030 (PwC) and \$3 tn (Analysis Group) per year by 2031.¹⁴⁶

Each approach to estimation relies on different specific assumptions. The quantitative analysis in this report seeks to complement the existing literature by:

- generating an estimate specifically for Türkiye, which is not found in the existing literature, and,
- providing an alternative to existing studies, using a methodology that draws on the economic literature regarding the relationship between ICT capital and economic growth.

Context and wider literature

For the metaverse to develop and deliver meaningful economic impacts, substantial investment will be required. This is likely to include investments in various forms of ICT capital such as hardware, computing and network infrastructure, other supporting infrastructure and intangible assets such as software, databases and content. To support the analysis in this report, a literature review was undertaken with a focus on the impact of digital technologies, and more broadly ICT capital, on economic growth.

A number of studies have attempted to quantify the relationship between various ICT metrics and economic output or growth, in order to observe how changes in ICT impact economic growth. In this context a large body of literature focuses on internet access, broadband penetration and mobile connectivity, consistently finding a positive relationship with economic growth.^{147 148} For example, in a study of 21 OECD countries from 1970-1990, Roller and Waverman (2001) assessed the impact of telecommunication infrastructure on economic growth. They found elasticities ranging from 0.034-0.154%. Elasticity is defined as percentage change in economic growth for every 1% increase in investment. They therefore estimated that a 1% increase



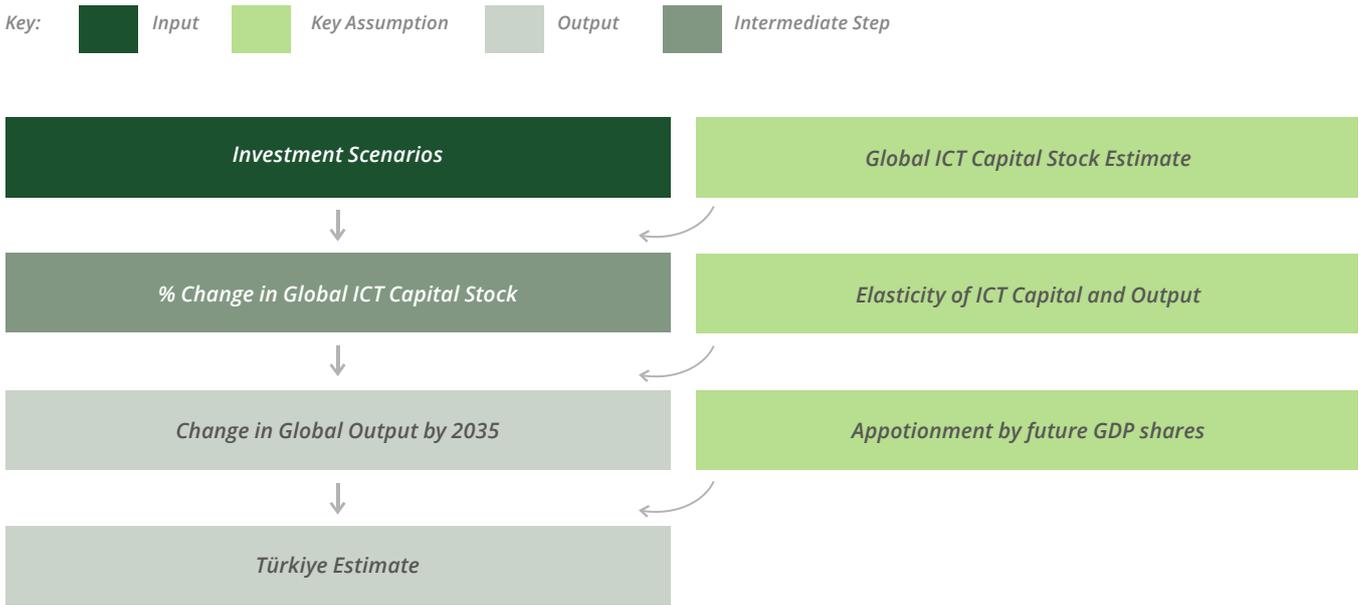
in telecommunication infrastructure was associated with a 0.034-0.154% increase in economic growth.¹⁴⁹ Similarly, in an analysis of broadband infrastructure and economic growth across 25 OECD countries in 1996-2007, Czernich et al. (2019) found that a 1% increase in broadband penetration is associated with growth in annual GDP per capita in the region of 0.09-0.15%.¹⁵⁰ Katz and Callorda (2018) assessed the link between mobile broadband penetration and changes in GDP per capita across 139 countries between 2004-2017, estimating a per capita output elasticity of 0.150%.¹⁵¹ The same study also constructed a digital index, consisting of indicators measuring connectivity, infrastructure reliability and affordability. Using this index, they found that a 1% increase in the digital ecosystem index was associated with a 0.133% growth in GDP per capita.

Other studies have looked at output elasticities of ICT capital, focussing on the role of ICT capital as a factor of production, alongside labour and non-ICT capital inputs. This is part of research literature that looks at gross capital formation and the impact of capital on the economy, both in terms of magnitude and duration. Studies focusing on ICT capital have consistently found that ICT has a positive impact on output, with excess returns compared to the income share of ICT. Those assessing the link between ICT capital stocks or services

have focused primarily on the US, EU and across OECD countries and they have estimated elasticities for ICT capital with economic output ranging from 0.03-0.14. In other words, a 1% increase in ICT capital is typically estimated to be associated with between a 0.03-0.14% increase in economic growth.

Analysing a sample of 59 countries over the period 1995-2010, Niebel (2014) estimated output elasticities of ICT capital services in the range of 0.066-0.100% employing a regression of an augmented Cobb-Douglas production function.¹⁵² Similarly, Tsachtsiris et al. (2022) estimated the elasticity of ICT investments with economic growth across 27 countries in the European Union over the period 1996-2006, producing elasticities ranging from 0.087-0.139% depending on the model employed.¹⁵³ Venturini (2009) estimated the impact of ICT capital from a long-run perspective across the US and 13 EU member states between 1980 and 2004 using a panel co-integration methodology: elasticities varied from 0.056-0.138% according to the estimation model used.¹⁵⁴ However, other studies have found more moderate estimates. Hanclova et al. (2015) assessed 14 older EU member countries and 7 newer members across two time periods 1994-2000 and 2001-2008.¹⁵⁵ They found that the impact of ICT capital services was significantly higher (0.086%) amongst newer member states compared to older ones (0.031%).

Figure A.1: Illustration of methodology



Source: Deloitte Analysis

Methodology overview

The methodology used for this report combines findings from the economic literature on ICT with existing estimates of metaverse investment.

- For economic benefits to materialise, sustained investment in developing the metaverse will be needed. Investment scenarios have been developed from Goldman Sachs estimates.
- Assuming that this investment contributes directly to the maintained net ICT capital stock the following year (i.e., metaverse-related IT hardware and equipment, software, databases etc.), the change in net ICT capital stock can be calculated, with the total net ICT capital stock estimated using evidence from the OECD that this is on average about 7.3% of GDP.^{156, 157, 158}
- Using the relationship between ICT capital and GDP from the literature, an elasticity of 0.1 is used to estimate the change in GDP associated with the increase in ICT capital stock.
- Then calculating the impact of investment on global growth for a given year, calculated GDP from the preceding year is used, allowing for the compounding of growth arising from prior year investments.

- Over the time period assessed, we assume that growth associated with metaverse investment is additional to the existing growth path of the economy. GDP growth in the absence of investment in the metaverse is based on IMF forecasts up to 2027, and a fixed growth rate is assumed thereafter based on average historical growth rates using World Bank data, shown in Table 2.¹⁵⁹
- Impacts at a global level are assessed up to and including 2035. This was done to allow for both short-run and medium-term impacts of short-term investments. A longer time horizon was not considered given potential uncertainty into the persistence of initial capital investments and whether this investment will be sustained, and at what level, over a decade from now.
- The estimate of the impact on Türkiye is made by apportioning the global impact on the basis of Türkiye’s projected share of global GDP, adjusted to account for changes in the composition of global GDP up the end of the investment period in 2029.

Table A.1: Investment Scenarios for the development of the metaverse

Scenario ¹⁶²		Cumulative investment if sustained from 2022-2029
Base Case	\$700bn spread over 5 years, which equates to an annualised investment of \$140bn.	\$1,120bn
Upside Potential	\$1,350bn spread over 5 years, which equates to an annualised investment of \$270bn	\$2,160bn

Source: Deloitte Analysis

Investment scenarios

In market research conducted by Goldman Sachs in 2021, an illustrative scenario analysis was undertaken of the likely spend on metaverse-related activities.¹⁶⁰ This research estimated that investment by public companies as well as funding within the private markets that are directly linked to developing the metaverse could range from \$135bn to 1.35tn 'in the coming years', with the likelier scenario falling between \$135bn-\$700bn.¹⁶¹ Using this information, two potential investment scenarios were selected for analysis, as shown in Table 1. Uniform investment profiles each year were assumed for the period 2022-2029.

The investment figures were based on public company investment in the metaverse and private market funding, and these investment scenarios may therefore present a narrow view of metaverse-related spending. The figures do not capture wider investment which is not metaverse-specific but may support the adoption and proliferation of the metaverse, such as public and private spending on enabling infrastructure, improvements to connectivity and wider digitalization of society and businesses. Although, such investments are likely, there is great difficulty in estimating what magnitude and proportion of future ICT investment will be reasonably attributable to the metaverse. On the other hand, it is not clear at this stage how much of this investment might replace existing ICT investment, which might lower the estimated impact on GDP.

Estimating global net ICT capital

Data pertaining to net ICT capital stocks is constrained given difficulties in measurement. However, datasets have been developed across selected country groups, such as EU and OECD countries.¹⁶³ Using the OECD ISTAN Structural Analysis database, estimates for the ICT capital stock have been made, indicating net ICT capital stocks equivalent to about 7.3% of global GDP across available OECD countries between 2005 and 2017.¹⁶⁴ Extrapolating this estimate across global GDP, an estimate of global net capital stocks can be derived, taking 7.3% of global GDP, and estimated at around \$7tn in 2021, for example.¹⁶⁵

Global GDP projections in the absence of investment in the metaverse were calculated using IMF forecasts of real GDP growth from 2022 to 2027 and then a fixed growth rate thereafter based on average historical compound annual growth rates, as shown in Table 2.¹⁶⁶ Similarly, counterfactual global net ICT capital stocks were assumed to follow a similar path, comprising 7.3% of GDP in each year of analysis. (Over this period the unweighted mean capital stock as a proportion of GDP remains relatively stable, in the range 7.0-7.5%).

Table A.2: Counterfactual real GDP growth assumptions

GDP growth assumption	2022	2023	2024	2025	2026	2027	2028-2035
Global	3.6%	3.4%	3.4%	3.3%	3.3%	3.3%	3.16%

Source: Deloitte Analysis

Calculating the impact of metaverse investment on global output

To analyse the impact of metaverse investment, an ICT capital-output elasticity is used given the broad nature of investments across different types of ICT capital. An elasticity value of 0.1 is assumed: this point estimate is the midpoint of elasticity estimates produced by Venturini (2009) looking at the long-run return on ICT capital.

Using annualized investments across the two investment scenarios, assuming spending in the metaverse would contribute directly to the productive global net ICT capital stocks in the following year, the percentage change to the global net ICT capital stock was estimated. Accordingly, the impact on global output can be derived through multiplication with the elasticity for each year of investment, assumed to take place from 2022-2029 (forming δ_t in Equation 1 and Equation 2, below).

The impact of subsequent investments was calculated using the 'new' level of net ICT capital stocks, equivalent to the sum of counterfactual capital stocks in a given year and additions to the stock of capital arising from investment in prior years less depreciation of metaverse-related capital. By viewing investments on an annualized basis, subsequent investments serve to compound changes to GDP from prior year investments. Growth arising from the additions to the capital stock are assumed to be additive to the existing growth path of the economy.

Using this methodology, the impact of metaverse investments across years can be calculated. Letting r_t equal the natural assumed growth rate of real GDP in year t , δ_t , is the additive growth arising from metaverse investment in year t (equal to the percentage change in capital stock multiplied by the elasticity of ICT capital and output).¹⁶⁷ Therefore, the share of GDP attributable to the metaverse can be expressed as:¹⁶⁸

Equation 1:
Derivation of GDP impact as a percentage of GDP¹⁶⁹

$$\text{GDP impact by the end of 2035 (\%)} = \frac{\prod_{t=1}^{14}(1 + \delta_t + r_t) - \prod_{t=1}^{14}(1 + r_t)}{\prod_{t=1}^{14}(1 + \delta_t + r_t)}$$

This could also be expressed in today's money. If GDP_{2022} represents the value of GDP in 2022, the first year of investment, the dollar contribution to GDP of the metaverse by the end of 2035 can be expressed as:

Equation 2:
Derivation of GDP impact in dollars (2021 dollars), in a given year

$$\text{GDP impact by the end of 2035 (\$)} = GDP_{2022} \prod_{t=1}^{14}(1 + \delta_t + r_t) - GDP_{2022} \prod_{t=1}^{14}(1 + r_t)$$

Note that this is equivalent to calculating the difference between the counterfactual GDP (GDP in the absence of metaverse investment) and GDP calculated with metaverse investment, at the end of 2035.

Generating the Türkiye-level estimate

A share of the global impacts is apportioned to Türkiye using a re-weighted share of Türkiye's GDP in global GDP. Re-weighting of global GDP shares was achieved by using the compound annual growth rate (CAGR) for each country's real GDP over the 2009-2019 period. This was done to allow for likely changes in the composition of global GDP by the end of the investment period under investigation (up to 2029), due to the faster growth of middle- and lower-income countries, and their likely shares of metaverse investment, over time. Under the two investment scenarios investigated, estimates suggest that by the end of 2035, the metaverse could contribute \$1.90-\$3.59 trillion to global GDP. This is estimated to be between 1.3-2.4% of global GDP in 2035.

Table A.3: Global- and country-level impact estimates

Region	Base case economic impact (2035) (\$bn, current)	Upside potential economic impact (2035) (\$bn, current)
Global	\$1,900.0	\$3,589.8
Türkiye	\$19.9	\$37.5

Source: Deloitte Analysis

Whilst an attempt has been made to estimate the impact of the metaverse for Türkiye, it is based on assumptions of the size and contribution of the country to global GDP. The full impact of the metaverse, however, will be highly dependent on various socioeconomic determinants and enablers, such as the level of investment occurring in Türkiye itself, the development of the country's enabling infrastructure, the affordability and accessibility of relevant devices and services, and the legal and regulatory frameworks.

Table A.4: Overview of key quantitative assumptions used within the economic modeling

Assumption	Value	Source
Global GDP in 2021	\$96,100bn	World Bank, World Development Indicators ¹⁷⁰
Global GDP shares	-	World Bank, World Development Indicators
Global real GDP growth rates	Shown within Table 2	IMF (2022-2027); Deloitte Calculation using World Bank, World Development data (2029-2035).
Türkiye's share of global GDP (2021)	0.85%	World Bank, World Development Indicators
Türkiye's share of global GDP (2029)	1.05%	World Bank, World Development Indicators; Deloitte Analysis
ICT investment scenarios	\$140-\$270bn per year	Deloitte analysis of investment scenarios given by Goldman Sachs ¹⁷¹
Global (and Türkiye) net ICT capital stock as a share of GDP	7.30%	Analysis of OECD countries using the OECD ISTAN Database ¹⁷²
Elasticity of ICT capital and economic output	0.1	Venturini (2009); Tsachtsiris, Magoutas & Papadogonas (2022) ¹⁷⁰
Annual depreciation rate of metaverse-related capital	28%	Weighted average of ICT hardware and software rates (0.16 and 0.32, respectively from Edquist & Henrekson (2017)). ¹⁷⁴

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- ¹⁵⁹ Real GDP growth in future years, in the absence of the Metaverse-investment, is based on [IMF](#) forecasts until 2027 and then a fixed growth rate thereafter based on average historic compound annual growth rates (CAGR) over the period from 2009-2019 using [World Bank](#) data on global GDP (measured in constant 2015 US dollars).
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- ¹⁶⁸ This follows the accounting approach followed within the Analysis Group estimates.
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