

Driving development

The impact of ICT investments
on the digital economy

About this report

Driving development: the impact of ICT investments on the digital economy is a white paper supported by GSMA Intelligence and Huawei, and produced by EI Studios, a custom division of Economist Impact, which operates separately from the editorial and research staff of The Economist and Economist Impact.

This paper explores the impact of information communication technology (ICT) investments on the global digital economy.

For well over two decades, studies have been produced that highlight the linkages between ICT investments and a number of key indicators, such as economic growth, employment, productivity, and even social indicators such as income levels. An illustrative example is the *Mobile technology: two decades driving economic growth* report by GSMA Intelligence, which shows that the adoption of mobile technology—and its advances—directly result in GDP growth.¹



Post-covid, the global economy is experiencing a moment of transition as companies, governments and whole societies reorganise around the growing importance of digital technologies to everyday life. As such, a new reassessment of the importance of ICT investments to the global digital economy is not just relevant, but necessary.

The report draws on a global survey of 500 individuals, conducted in December 2022, of which 400 are company executives, 50 are policymakers and another 50 are institutional investors. Also included are insights gleaned from in-depth interviews and desk research. EI Studios wishes to thank the following experts for their participation in the programme:

Kushe Bahl, partner at McKinsey & Company

Enrique Blanco, global chief technology officer, Telefonica

Pau Castells, head of economic analysis at GSMA Intelligence

Blair Chalmers, managing director of infrastructure innovations at Marsh McLennan

Julian Gorman, head of Asia Pacific for the GSMA

Mohammad Azmal Huda, chief product and technology officer at bKash

Peter Jarich, head of GSMA Intelligence at the GSMA

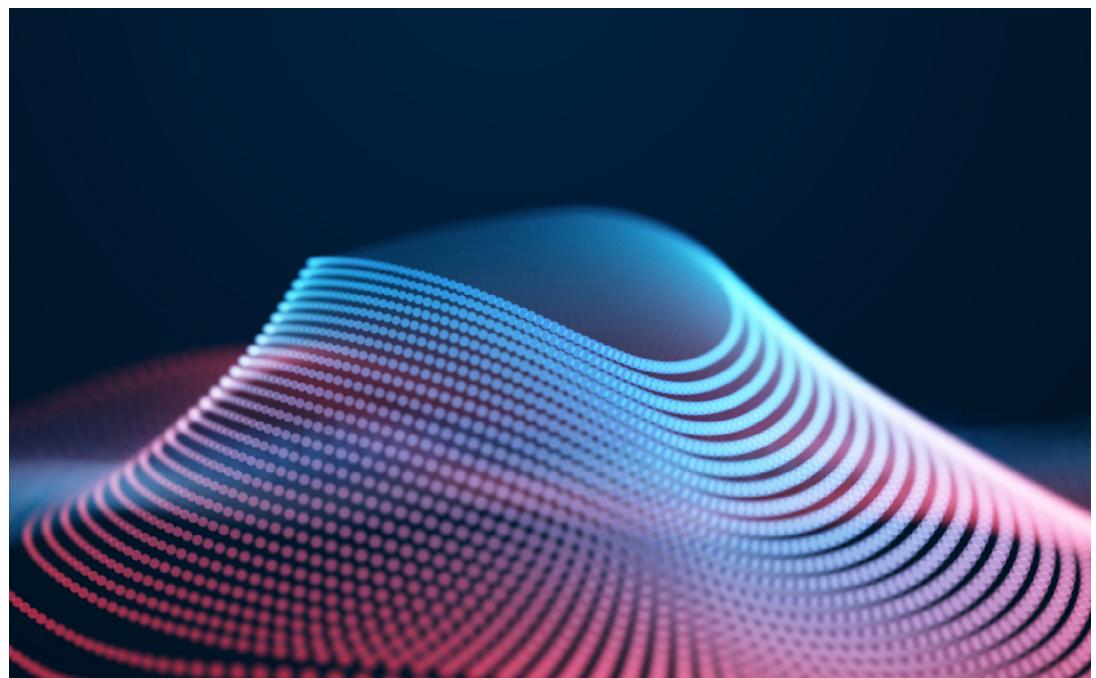
Tay Yeow Lian, managing director, Networks, Consumer Singapore at Singtel

Atsuko Okuda, regional director of the International Telecommunication Union (ITU) Regional Office for Asia and the Pacific

Ceyhun Özata, chief corporate sales officer, Turkcell

Audrey Plonk, head of the Digital Economy Policy Division at the Organisation for Economic Co-operation and Development (OECD)

Anna Yip, chief executive officer, Consumer Singapore at Singtel





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Table of contents

Introduction: The digital economy is more relevant than ever	5
Unlocking growth in the digital economy	15
GSMA Intelligence Perspective: Growth in ICT investments and penetration over time	22
Identifying what ICT infrastructures matter most	31
GSMA Intelligence Perspective: Connectivity at the core of digitisation	35
Barriers to ICT investment in the public and private sectors	41
GSMA Intelligence Perspective: The link between 5G ICT investments and economic growth	44
Driving ICT investment	49
GSMA Intelligence Perspective: Next-generation ICT infrastructure	53
The importance of telcos	56
What should telcos focus on to support the digital economy?	59
Conclusion	66

Introduction: The digital economy is more relevant than ever

The history of the digital economy is a story of constant evolution, shifting and changing as the internet has grown from a niche technology into a fundamental aspect of daily life.

A broad sweep of the history of the internet reveals a number of pivot points, from the release of wireless internet, cable broadband to the invention of mobile connections. With each technological upgrade, the global economy has seen improved economic outcomes, resulting in a virtuous cycle of value creation to value distribution.

Digital technologies have unlocked innovation opportunities for both private and public organisations, and bolstered access to goods and services across every tier of society.

Digitalisation is reshaping industries, creating new opportunities and changing the way we live and work. Today, two-thirds of the world's population—or about 4.3 billion people—have come online, with more joining every day.²

Digital has evolved into a foundational aspect that has applications “across all sectors of the economy.”

Peter Jarich, head of GSMA Intelligence



Digital drives economic growth

While prior definitions of the digital economy tended to refer to technology and the tech industry as separate from other sectors, this is no longer the case. Today's digital economy spans an ecosystem of “digitally-transformed enterprises” that are not only major consumers of technology but also producers of digital-first products and services. With time, these firms will increasingly move their operations out of traditional on-premises data centres into cloud and edge networks.³

Peter Jarich, head of GSMA Intelligence at the GSMA, an industry group representing mobile network operators, notes that digital has evolved into a foundational aspect that has applications “across all sectors of the economy.”

Productivity growth that will come from the digital sector will drive economic growth for the next few decades. In many countries, growth in the digital economy is seen to outpace that of the overall economy as most firms are still focused on “general purpose technologies” that have helped drive 10% of total income growth, notes Mr Jarich.^{4,5,6}

"For all industries, being digitally progressive is the only way to be more competitive," says Blair Chalmers, managing director of infrastructure innovations at global professional services provider Marsh McLennan, in agreement.

The outsized growth of the digital economy has only been emphasised by the covid-19 pandemic, which accelerated the pace of digital adoption to breakneck speeds. Through high-speed, high-quality connections, digital technologies are enabling governments, companies and societies to innovate solutions to complex problems, and accelerate economic opportunity.

In our survey, digital adoption (15%), accelerating innovation (13%) and changing consumption patterns (11%) are top-ranked drivers of digital transformation in economies today.

Governments, for example, are utilising technologies to build digital government initiatives that enhance or ease access to public services for their citizens, while innovations in data technologies are helping drive smarter and more sustainable development. Digital platforms have helped bridge opportunity gaps by connecting people to jobs and expanding entrepreneurship opportunities to all.

For businesses, digital is not only bridging the gap between their current models and the changing demands of a consumer base that has firmly embraced digital, but also creating

new value streams. One example can be seen in terms of how digital technologies are introducing new revenue streams for telecommunications companies, Kushe Bahl, senior partner at management consultancy firm McKinsey & Company, says.

"Many telcos are creating business models to capture opportunities beyond the pipe by building platforms that take advantage of data demand and traffic," he says. "They're also able to monetise opportunities through advertising."

Digital drives productivity and resilience

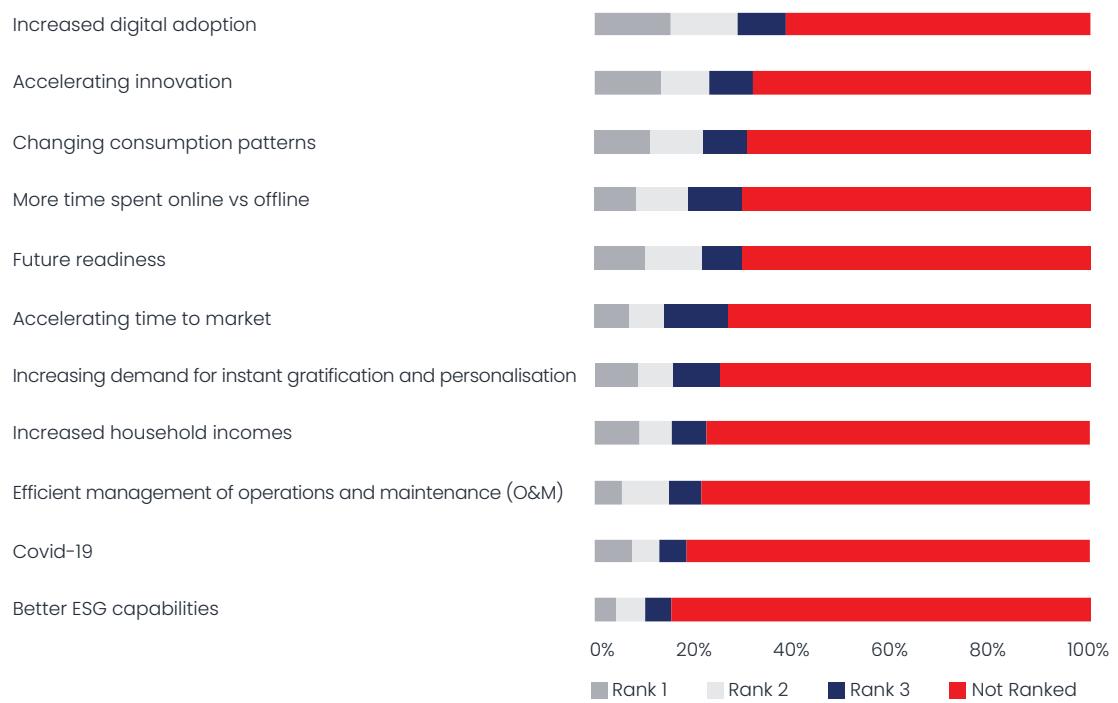
Digital technologies are helping organisations build more resilience in an increasingly uncertain world. By leveraging data analytics and predictive models, digitalised firms are finding themselves more capable of adapting to sudden disruptions to maintain seamless business continuity and identify new market opportunities.⁸

"If you think about the application of the IoT, artificial intelligence, automation, together with connectivity in many manufacturing plants, we are seeing huge boosts in productivity, cost savings, and also, importantly, improvements in the quality of products, and also in safety in the workplace," says Pau Castells, head of economic analysis at GSMA Intelligence.

In our survey, digital adoption (15%), accelerating innovation (13%) and changing consumption patterns (11%) are top-ranked drivers of digital transformation in economies today. These drivers are especially front-of-mind for company executives, many of whom are directly engaging with the nuances of how digital is changing their day-to-day work.

Exhibit 1: Digital adoption was the top-ranked driver of global transformation efforts

In your opinion, what are the top drivers of increased digital transformation in economies today? Please rank up to 3, where 1 is the most important driver. (Company executives only)



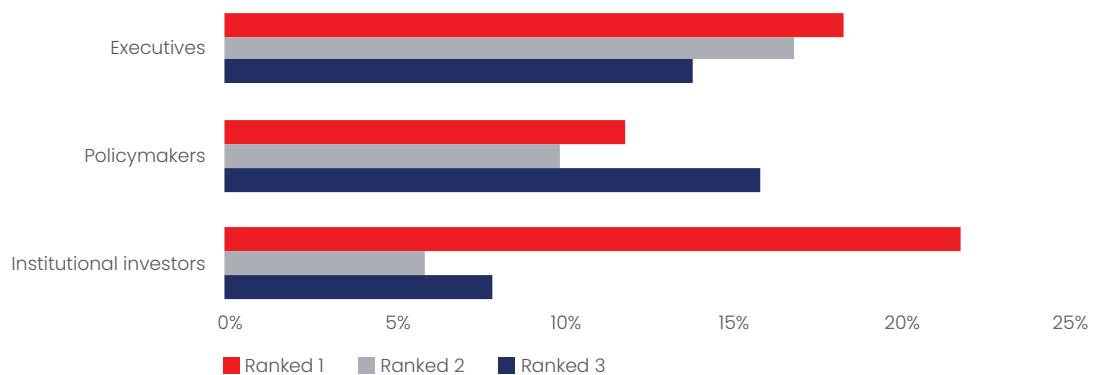
Source: EI Studios

As a result of this widespread adoption, the contribution of digitally-transformed organisations to global GDP has steadily increased over the years, with some estimates suggesting these firms will account for more than half by 2023.⁹ Southeast Asia (18.2%) is considered the digital economy with the most rapidly

growing set of opportunities in the next 10 years, closely followed by North America (17%) and Western Europe (16%). However, investors (22%) are markedly more bullish on Southeast Asia because of the region's relative nascentcy in terms of digital frameworks and regulation that underscore the pace and scale of growth expected.

Exhibit 2: Investors and executives see SEA as the heart of digital economic growth

Is Southeast Asia the region where you see the most rapidly growing set of opportunities related to the digital economy in the next 10 years?



Source: EI Studios

Digital drives social and economic empowerment

The benefits of the digital economy are not purely financial, as technology is helping to create a number of social impacts, says Atsuko Okuda, regional director of the International Telecommunication Union (ITU) Regional Office for Asia and the Pacific. “The economy doesn’t grow in a vacuum,” she says, adding that the covid-19 pandemic was a key educational moment for the world.

Increased digital access has positive links to several Sustainable Development Goals (SDGs), ranging from improvements in income levels to poverty reduction. For example, a 1% increase in e-commerce activity is correlated to increases in employment in Poland (0.14%) and Austria (0.17%).¹⁰ Notably, the resulting increases in employment led to boosts in wages—0.01% and 0.04% for Polish and Austrian workers, respectively.

During the worst of the health crisis, digital technologies helped secure continued access to health, education and government services for many communities. One study from Chicago and Tufts Universities, as cited by Ms Okuda, underscored the “life and death” importance of digital connectivity by linking covid-19 mortality rates to individuals’ internet access. According to the data, a 1% increase in broadband access lowered covid-19 mortality rates by 19 deaths per 100,000—these findings persisted even when the study accounted for differences in location, education, income, or employment status.¹¹

“It makes sense in hindsight, because the internet provided an informational lifeline that helped people cope,” says Ms Okuda.

Ms Okuda points to how digital technologies could significantly improve women’s economic participation, and therefore, the overall economy. “We have studies that show that if women were more included, the economic value of that activity would be astronomical.”

One example of this is the success of digital banking in driving financial inclusion across all segments of society, but especially for rural communities and populations in developing economies.¹² A 2021 study by the IMF of 52 developing economies shows that increasing access to and use of financial services boosted annual economic growth by 2.2%, with more to be gained given better access to credit.¹³

According to the data, a 1% increase in broadband access lowered covid-19 mortality rates by 19 deaths per 100,000—these findings persisted even when the study accounted for differences in location, education, income, or employment status.

With the falling costs of data plans and devices, both established financial institutions and digital competitors are increasingly offering digitised financial services that are making it more convenient for consumers to access banking products with even basic handsets. One example is bKash, a fintech initiative driven by Bangladesh's central bank designed to provide digital financial services to citizens by capitalising on the country's 80% mobile phone penetration.¹⁴

"bKash became an alternative lifeline, particularly during the pandemic when people failed to access formal channels and the local market was stuck and the banks were closed," according to Mohammad Azmal Huda, bKash's chief product and technology officer.

The impact of digital financial inclusion can be especially pronounced for women, many of whom remain under- or unbanked. Globally, 65% of women have a bank account with a financial institution, compared to 72% of men, leaving plenty of untapped potential on the table.¹⁵

The digital economy has also resulted in other forms of economic empowerment, such as expanding access to goods and services through e-commerce channels. For consumers, especially those in remote and rural areas, e-commerce platforms can benefit them by introducing a wider range of products and sellers which, in the long term, can result in more competitive prices.

Digital tools also enable everyday people to unlock their economic potential as entrepreneurs by providing them with the ability to start a new business or bolster their established ones. Examples of this abound throughout developing economies like Indonesia, where platforms such as Tokopedia and Shopee are enabling small business owners to become more visible to huge customer bases.

Underpinning all of these advances is greater digital connectivity, underscoring the importance of greater investment in ICT infrastructure.

Digital development sectors foundational to economic growth

While digital technologies are working their way into every sector of the economy, certain sectors will experience much faster growth rates than others.

- The **e-commerce industry** has experienced some of the biggest growth margins since its humble beginning in the 1970s to its post-Amazon evolution. Today, the sector (including B2B transactions) is estimated to grow to US\$58.7 trillion in value by 2028 (including B2B and B2C), growing at a CAGR of 27%,¹⁶ significantly higher than the overall retail market (17.7%).¹⁷ The success of the e-commerce sector has been driven in part by the flourishing of online payment options and mobile internet adoption.^{18,19} A unique aspect of the e-commerce industry is the diverse range of business models—from basic online shopping channels to social commerce—that are innovating new methods for brands and entrepreneurs to engage with their consumers. For example, voice search-enabled retail has facilitated US\$40 billion worth of transactions in 2022.²⁰

- The **digital financial services industry** is one of the most important technology sectors, thanks to its fundamental role in facilitating e-commerce as well as its outsized role in matching emerging technological innovations like artificial intelligence (AI) and data analytics to commercial use cases.²¹ By the end of 2022, the industry grew to a value of US\$28.1 trillion at a CAGR of 8.8% and is expected to become a US\$37.5 trillion market by 2027.²² Over time, this segment will continue to gain relevance as e-commerce adoption and financial inclusion becomes widespread, especially in developing economies.
- Once considered a niche technology, **AI** has fully entered the mainstream. Respondents to the EI Studios survey picked AI (31.6%) as the most in-demand ICT technology over the next two years, narrowly edging out cybersecurity (30.4%) and Internet of Things innovations (30.4%). This is not surprising, considering the near-infinite potential use cases for AI, ranging from process automation, transportation, healthcare management, disaster mitigation, cybersecurity management, and fraud prevention.²³ According to Ms Okuda at ITU, AI could also have a significant impact on sustainability solutions, particularly in reference to its role in the climate crisis.

For AI adoption to continue growing—or for other technologies to be more widely implemented—5G technology is needed to provide the significant bandwidth, low latency and robust connections needed for computationally intensive processes.

The potential of AI has lured a flurry of investor interest: global AI funding leapt 108% year-on-year as of 2021, with a strong emphasis on the healthcare and fintech sectors.²⁴ AI could potentially contribute US\$15.7 trillion to the global economy by 2030, thereby raising global GDP by up to 14%. However, these numbers belie the relatively low confidence of institutional investors in AI: only 28% ranked AI as the most in-demand tech, compared to policymakers (42%) and executives (30.8%). This could be because AI's commercial

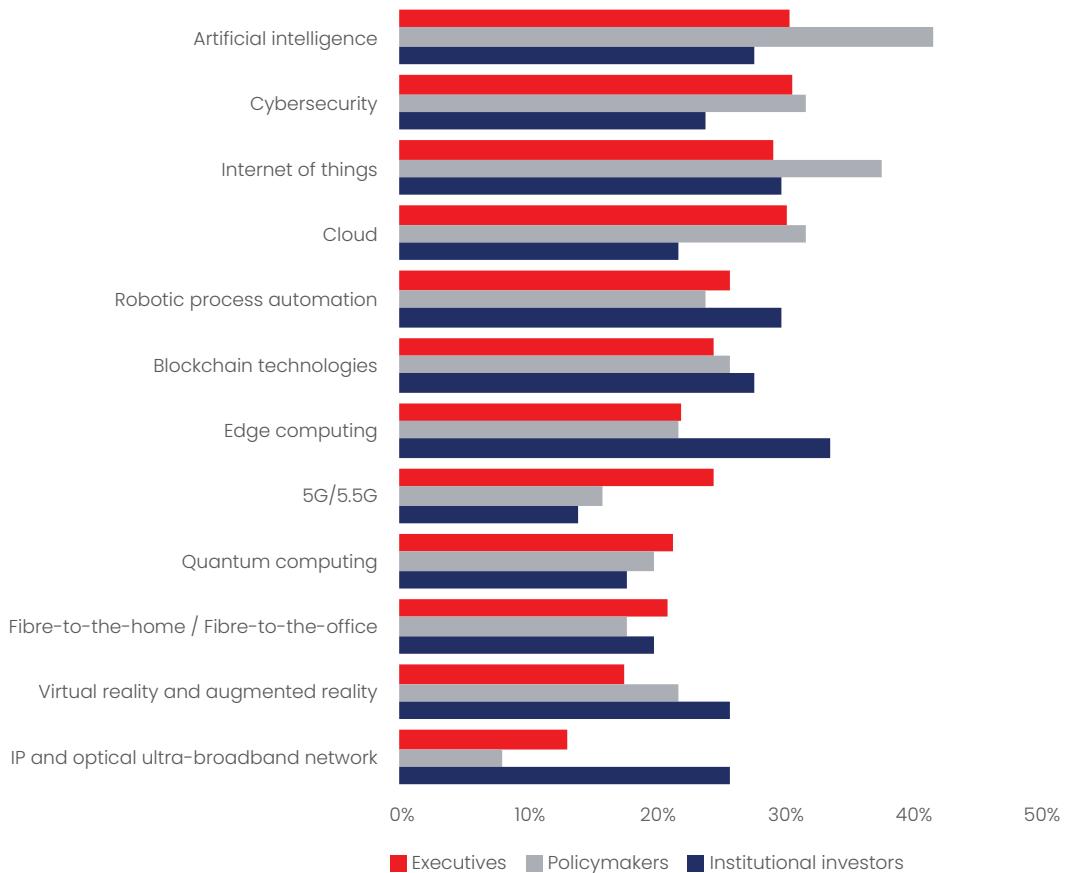
applications are still in-development, compared to investors' top choice, edge computing (34%), a technology with an established track record and immense relevance to digital transformation.

However, the survey findings mask the importance of 5G technology. For AI adoption to continue growing—or for other technologies to be more widely implemented—5G technology is needed to provide the

significant bandwidth, low latency and robust connections needed for computationally intensive processes. This also applies to other lower-ranked technologies such as edge computing, cybersecurity and IoT, all of which rely on strong connectivity. Though companies themselves will not be responsible for investing in 5G and 5.5G, their changing demands can and will influence telcos' strategies towards upgrading their network infrastructure and offerings.

Exhibit 3: Technologies most in demand are underpinned by 5G

In the next 12-24 months, which ICT technologies are going to be most in demand?
Please select up to three responses.



Source: EI Studios

Fundamental to the growth of the digital economy will be the continued development of broadband and fibre networks, especially 5G and 5.5G. 5G technologies are already having a strong impact on the economies where they are present, changing market dynamics by bolstering speed and networking abilities. According to the GSMA, 5G technology addresses three main use cases—creating ultra-reliable, low latency connections; enhancing the mobile internet; and enabling machine-to-machine communication—and its influence will be felt in every sector.²⁵



The development of 5G could also introduce a degree of inclusion by enabling service providers to remotely connect to rural communities through machine-to-machine communications.

Kushe Bahl, partner at McKinsey & Company

In the meantime, devices, content, experiences and business models are diversifying as more operators embrace 5G, illustrating a market shift from risk-based to benefit-based decision-making to increase the likelihood of business success. Since its roll-out in several economies, the 5G services market has grown to a value of US\$48 billion as of 2022, with some expectations that it will reach US\$3.8 trillion by 2032.²⁶ For operators alone, 5G technology could help realise a US\$1.6 trillion opportunity by 2030.²⁷ Though most investments in 5G technologies are being undertaken by telco operators, this value is spread out across a vast web of players including network operators, media providers, and others. 5G will be crucial to the development of smart transportation and smart city applications, next-generation entertainment, as well as AI and machine learning technologies. Mr Bahl of McKinsey suggests the development of 5G could also introduce a degree of inclusion by enabling service providers to remotely connect to rural communities through machine-to-machine communications.

Building atop the successes of 5G, a number of companies are already developing and advocating for next-generation connectivity. 5.5G connectivity is poised to provide a stepping stone to eventually realise machine-to-machine communications and ubiquitous 5G access. With greater bandwidth, spectrum efficiency and higher-order modulation, 5.5G will also enable greater use of AI/ML, IoT and cloud/edge computing among commercial customers without significantly increasing labour, resource and energy costs.²⁸

5G has already created significant economic and social value, and this will continue. An IHS Markit study estimates that US\$13.2 trillion in global economic value will be created by 2035, generating 22.3m jobs in the 5G global value chain alone.³⁰

It is said that 5G has opened the door to digitalisation and intelligence; 5.5G will further boost digitalisation and intelligence. 5.5G is the next evolutionary step of 5G. It has been developed to fill gaps in 5G and to enhance the key features of eMBB, URLLC and mMTC. It will also improve capabilities in broadband, ubiquitousness, eco-friendliness and intelligence.

To realise the converged interaction between the digital and physical worlds, mobile networks need to provide a ubiquitous 10 Gbps experience while maintaining latency within milliseconds. The vision for a digital, intelligent world requires an information infrastructure that supports 100 billion connections, thereby enabling the digital twin and intelligent upgrades of all industries.³¹

5.5G can help operators open five new business frontiers and drive a 100-fold increase in new business opportunities:³²

- Frontier 1: An explosion in services with immersive and interactive experiences
- Frontier 2: Further enabling industry digitalisation
- Frontier 3: Cloud applications entering a new era, creating new opportunities for network connectivity
- Frontier 4: Cellular networks covering all IoT applications and passive IoT enabling 100 billion connections
- Frontier 5: Facilitating new services, from communication to integrated sensing and communication

These developments will not only exert a positive knock-on effect for other sectors, but will be essential, interlocking elements as the digital economy becomes inextricably linked to the rest of the economy.

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According to the International Telecommunication Union (ITU), a 10% increase in mobile broadband penetration can yield growth of 0.9%-1.5% in GDP per capita globally.



Unlocking growth in the digital economy



**There is a “positive correlation—
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**Atsuko Okuda, regional
director of the International
Telecommunication
Union (ITU) Regional Office
for Asia and the Pacific**

In 2016, researchers from the Centre for European Economic Research drew causal links between telecommunications investments and GDP per capita growth.^{33,34} According to the International Telecommunication Union (ITU), a 10% increase in mobile broadband penetration can yield growth of 0.9%–1.5% in GDP per capita globally, with different levels of impact on countries depending on their levels of economic development.³⁵ In OECD countries, an increase of 10% in the CAF Digital Ecosystem Development

Index (a model devised by ITU) resulted in a 1.3% growth in GDP per capita, a 2.6% increase in labour productivity and a 2.3% increase in total factor productivity.³⁶ This research was reinforced in 2020, when the GSMA found that a 10% increase in mobile technology drove as much as a 2.55% increase in GDP.³⁷

No one dataset or econometric model can definitively and comprehensively link ICT investment to digital economy growth. Ms Okuda says the impacts of ICT investment on overall economic growth or growth in the digital economy vary based on when a study was done, what parameters were used for investment or to define a digital economy, and where the study was conducted. But, she stresses that almost all of the studies done to this effect clearly illustrate that there is a “positive correlation—and in cases, even a causal relationship—between ICT investment and growth.”

Post-covid, we are gaining a clearer understanding of the extent to which ICT investment can support socioeconomic growth and development, and how its shortfalls can be detrimental to the long-term potential of the digital economy. Even though a rapidly growing share of the world’s population is using the internet, 3.5 billion people remain offline due to the lack of affordability, digital skills and broadband networks, representing billions of dollars of lost potential.³⁸

"Post-covid, customers are also transacting differently," says Ms Anna Yip, chief executive officer, Consumer Singapore at Singtel. "For example, we saw a more than 12% increase in online mobile transactions during covid, and this has been persistent and appears to be the trend going forward, even though customers still like to come in to stores to experience new gadgets and if they have any questions about services," she adds.

Successful digital transformation hinges on ICT investment

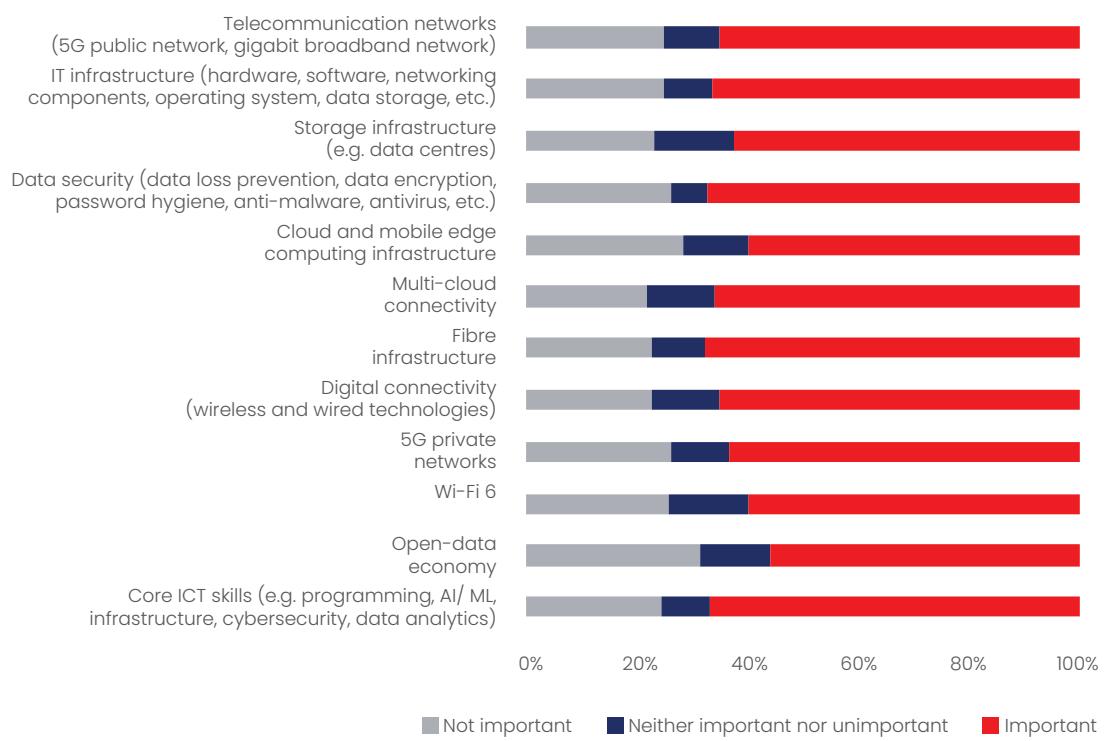
At its most basic level, digital economic activity depends on the existence of

foundational ICT infrastructure. Mr Castells characterises this "strong ICT backbone" as essential to driving the rest of the ecosystem, a sentiment repeatedly echoed by other interviewees who called ICT investments "prerequisites" to digital economic activities.

"There was a time when we thought we just needed to get everyone a laptop to progress but it's more than that," says Audrey Plonk, head of the Digital Economy Policy Division at the Organisation for Economic Co-operation and Development (OECD). She emphasises the importance of both physical and digital infrastructure, such as mobile and fixed networks, data centres, fibre infrastructure and cloud computing systems.

Exhibit 4: Fibre, data security and core ICT skills are the most important aspects of digital infrastructure

What aspects of digital infrastructure are most important?



Source: EI Studios

Her comments reflect the fact that a majority of respondents (67.8%) consider fibre infrastructure as among the most important forms of digital infrastructure. Data security (67.2%) emerges as a close second, followed by core ICT skills (66.6%).

Crucially, experts note that without ICT investment in foundational telecommunications infrastructure—such as 5G public or gigabit broadband networks—most companies would not be able to take advantage of current and next-generation digital innovations, including in-demand technologies such as AI/Machine Learning (ML), cybersecurity solutions, IoT tools and cloud computing.



Investments will also be needed if providers are to meet exponential demand for increasingly complex digital services that rely on more data centres and faster connections.

Blair Chalmers, managing director of infrastructure innovations at Marsh McLennan

For example, AI—the most in-demand technology according to the survey—has the potential to contribute significant economic and productivity gains by automating business processes and augmenting existing labour forces.³⁹ Yet, as a computationally intense technology, AI depends on robust connectivity, a network of finely-tuned hardware, immense data collection capabilities and supercomputers.

To realise the economic potential of any advanced technology—not just AI—ICT investment in fibre, broadband and 5G network is crucial to establish the necessary foundational infrastructure.⁴⁰ These latter aspects of digital infrastructure are low-ranked among organisations as they are not investing in this digital infrastructure, but firms clearly understand their importance—65% of survey respondents ranked telecommunications networks as a key aspect of digital infrastructure. Furthermore, investment in telecommunications networks is likely to be low among non-telco, despite the need for an economy-wide emphasis on these foundational technologies.

Even basic digital transformation projects will hinge on firms' ICT investments into foundational connective technologies, argues Mr Jarich. Research shows that firms that successfully digitally transform could generate 70% more value from digital initiatives compared to the average firm, while also unlocking more innovation and productivity.⁴¹

"Firms that use cloud computing or big data are more likely to innovate both their products and internal processes," adds Ms Plonk. "But the only way firms can collect or use data is if they have the connectivity infrastructure."

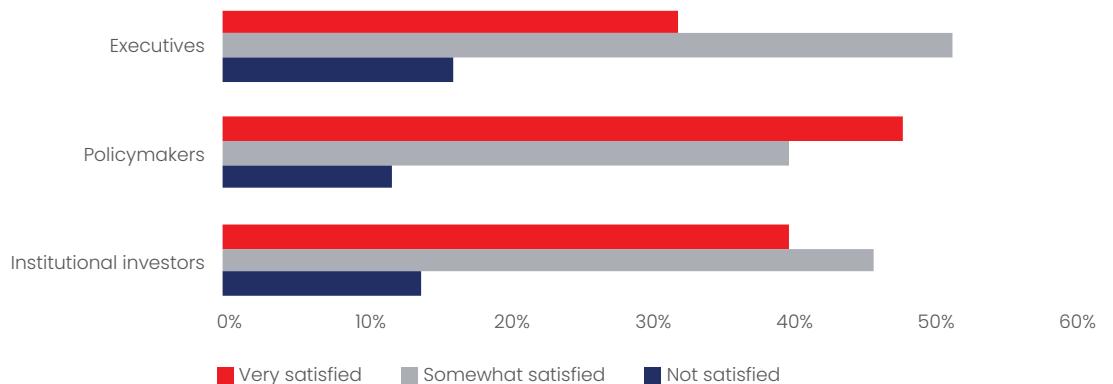
Mr Chalmers highlights that investments will also be needed if providers are to meet exponential demand for increasingly complex digital services that rely on more data centres and faster connections.

Yet, despite outsized demand for digital services, only a little over a third (34.6%) of those surveyed globally are “very satisfied” with the current ICT infrastructure in the market they operate in, underscoring the importance of greater—and sustained—ICT infrastructure to truly reap the benefits that new technologies can bring.

Across all demographics, most organisations (49.8%) are only “somewhat satisfied” with their current ICT infrastructure, demonstrating a strong sense among respondents that more investment is needed to take their digitalisation to the next level. Among executives (16.3%), dissatisfaction was somewhat higher than those in policymaking (12%) or investor (14%) roles, reflecting the disparities in perspective faced by those interfacing with the technologies and those dictating their applications.

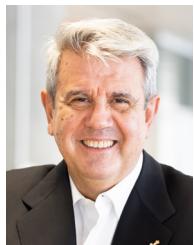
Exhibit 5: Most are only somewhat satisfied with their current ICT infrastructure

Are you satisfied with the current ICT infrastructure in the key market(s) you operate in?



Source: EI Studios

Enrique Blanco, global chief technology officer at Telefonica, underscores the importance of a shift in mindset. As the role of the telco has evolved from that of being a communications provider to something much more technology oriented as an enabler of a plethora of services, he says there must be industry and regulator understanding that it will not be possible for telcos to keep investing in technologies if their revenues do not increase. He is strongly of the view that telcos are like public utilities and they must be primarily concerned about benefitting society, but says it is critical these investments can be made sustainable and that cannot happen until the costs of investing in these technologies is shared.



"We need to, with the help of regulators and industry, change this way of thinking that the onus of investment lies on the telcos alone. We are trying to build an industry view that something needs to be done differently."

Enrique Blanco, global chief technology officer at Telefonica

"We need to, with the help of regulators and industry, change this way of thinking that the onus of investment lies on the telcos alone. We are trying to build an industry view that something needs to be done differently. We are trying to find ways for the monetisation of these new services that we want to offer."

To Mr Blanco, the present is "the perfect moment" in trying to bring about this change.

Sustainability agenda is not possible without ICT

The imperatives of digital technologies are not limited to just financial benefits, but also those related to the sustainability agenda.

"I think there is very little sustainable development you can do today without technology, be it addressing climate change or providing clean water," says Ms Plonk, citing how the rapid development of covid-19 vaccines depended on the availability of AI to model and sequence the virus.

In another example shared by Julian Gorman, head of Asia Pacific for the GSMA, increased advances in healthcare could also yield improvements in terms of health outcomes. In Hong Kong SAR and other markets such as Thailand, private 5G networks are laying the groundwork for smart hospital initiatives, providing innovation in hospital operations, healthcare management and monitoring of patients, and in the operating theatre with augmented reality and virtual reality.⁴²

As the climate crisis bears down on the world, investments in sustainable technologies will be key to reducing emissions and protecting communities. Ms Okuda quotes examples of how IoT and AI technologies are being used to track plastic and air pollution or reduce traffic congestion through smart transportation initiatives. Her comments dovetail with Mr Jarich's, who suggests that mobile and digital technologies could help reduce emissions by 40% by 2030 by enabling the use of automated robots, unmanned vehicles or smart meters.

"It's partly about leveraging little transformations to be more efficient, but we can also drive higher productivity by removing the need to commute to work by implementing flexible work arrangements," he expands.

Yet both Ms Okuda and Mr Chalmers acknowledge that the ICT sector itself contributes to the climate crisis—the latter points out how data centres, for one, account for 5% of global emissions. But Mr Chalmers stresses that investing in digital infrastructure can drive gains in energy efficiency and create meaningful progress. This is something that is borne out in the experiences of several telcos around the world.



"We put in continuous investment in more energy-efficient technology—for example, our Wi-Fi 6 routers—and also the reduction of e-waste."

Anna Yip, chief executive officer, Consumer Singapore at Singtel

Mr Blanco says that Telefonica approaches sustainability as a company strategy, with short- and medium-term objectives that are more ambitious than those defined in the Paris Agreement. Already, 84% of the telco's consumption comes from renewable energy, and the company is committed to reaching net zero emissions by 2040 across the value chain, in addition to neutralising emissions from its main operations by 2025.

Strong investments in technology have helped stabilise Telefonica's energy consumption despite a seven-fold increase in traffic, he adds. Additionally, the company has helped its customers in decarbonising their businesses.

"Digitalisation and sustainability work together, digitalisation is intrinsic to sustainability," he says.

"It is not necessary to choose." Singtel's Ms Yip speaks about the company's Green and Good programme. "We put in continuous investment in more energy-efficient technology—for example, our Wi-Fi 6 routers—and also the reduction of e-waste, and are maintaining our path towards net-zero emissions status by 2050 in our own value chain."

A professional woman with dark hair pulled back, wearing a red blazer over a white shirt, is looking down at a laptop screen. The screen displays a blurred image of a city skyline at night with lights reflecting on water. The background is dark and out of focus.

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In 2023, it is estimated that 30 markets will launch 5G mobile services, many of which will be developing markets across Africa and Asia.

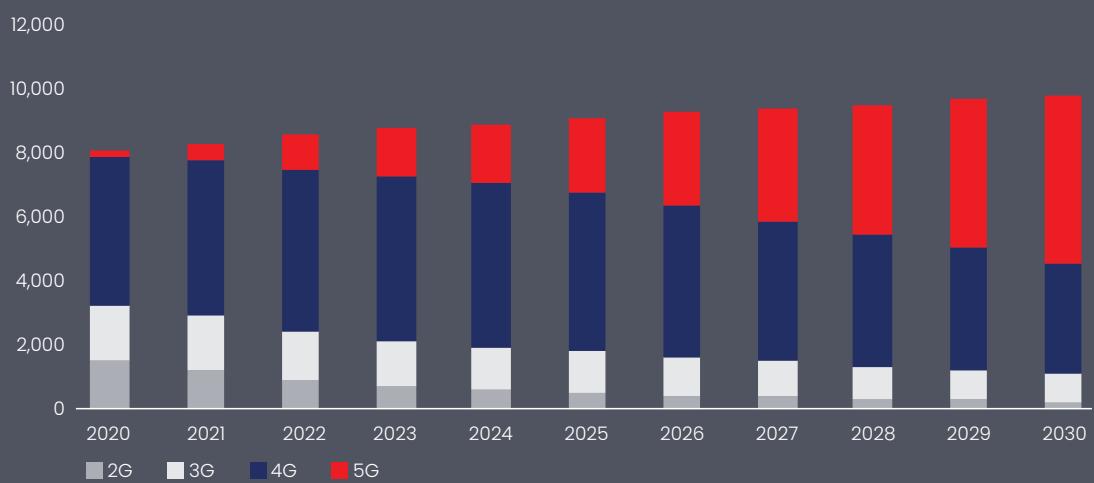
Growth in ICT investments and penetration over time

5G mobile network launches over time and penetration (global and selected regions)

5G mobile technology is now a global trend. Globally, there will be 9.8 billion mobile connections in 2030, of which 5.3 billion will be 5G. 2G, 3G, and 4G mobile connections will all decline, freeing space for 5G spectrum and

networks. However, 4G networks will continue to grow in developing regions, such as Latin America, the Middle East and North Africa, and Sub-Saharan Africa, where investments in 5G technology still need to pick up.

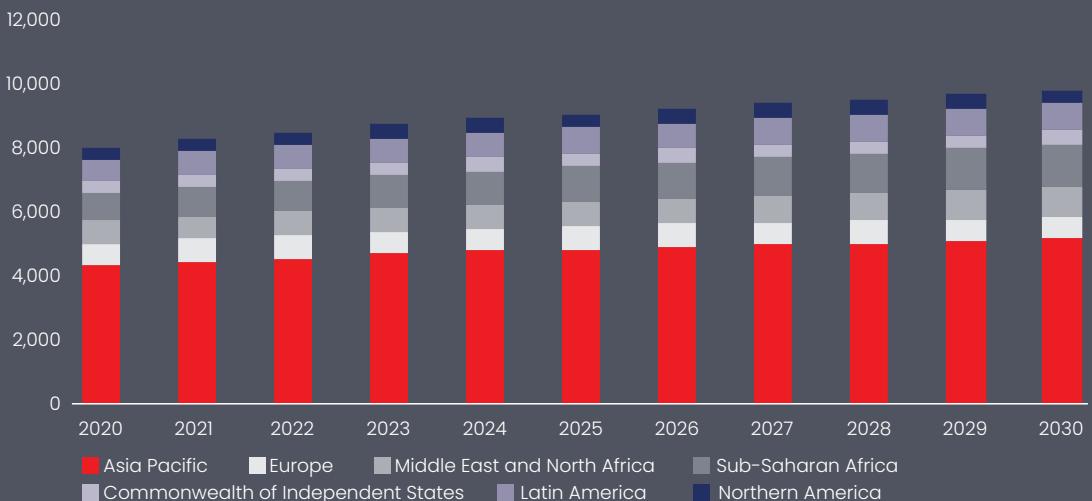
Exhibit 6: Total mobile connections globally by generation
US\$ million



Source: GSMA Intelligence

Exhibit 7: Total mobile connections globally by region

Million



Source: GSMA Intelligence

South Korea was the first country to launch 5G in 2018. It was followed by the US, Saudi Arabia and China in 2019. As of January 2023, there were 229 commercial 5G networks globally.⁴³ In 2023, it is estimated that 30 markets will launch 5G mobile services, many of which will be developing markets across Africa and Asia.⁴⁴

In the meantime, devices, consumer experience and business models are also diversifying as the 5G ecosystem grows. For example, 5G consumers are more interested than 4G consumers in adding services and content to their contracts, more engaged with video and gaming, and also tend to use more mobile connectivity than their 4G counterparts when watching video, which could have positive implications for 5G mobile ARPU.

Operators are increasingly outlining plans to shut down legacy (2G and 3G) networks, to repurpose spectrum assets for more efficient 4G and 5G networks. The highest proportion of 2G network shutdowns will happen in Asia Pacific (48% between 2015 and 2025), while the majority of 3G sunsets will happen in Europe (56%). In North America, meanwhile, 2G and 3G networks will be completely shut down between 2022 and 2024.⁴⁵

GSMA Intelligence data on cellular capex as a percentage of cellular revenue shows that legacy network shutdowns, network upgrading, and 5G launches have been possible because of operators' investment commitment in mobile assets, which has increased over the last five years. Between September 2021 and 2022, mobile operators invested around 15–20% of their revenue in mobile assets, globally.

Mobile subscribers, connections and internet users in selected regions

Exhibit 8: Mobile in Asia Pacific (2021 versus 2025)

Asia Pacific	2021	2025
Unique mobile subscribers (billion)	1.6	1.8
Penetration rate	59%	62%
Internet users (billion)	1.2	1.5
Penetration rate	44%	52%
% of 4G connections (excluding licensed cellular IoT)	62%	69%
% of 5G connections (excluding licensed cellular IoT)	2%	14%

In Asia Pacific, despite the growth in mobile adoption, there is a huge disparity in mobile technology uptake and mobile subscribers between developed and underdeveloped countries. In 2021, underdeveloped countries in Asia Pacific such as Bangladesh, Pakistan, Indonesia, and India had the highest usage gap, between 40% and 64%. Meanwhile, in developed Asia Pacific countries, the usage gap was between 16% and 28%.

Source: GSMA Intelligence

Exhibit 9: Mobile in Europe (2021 versus 2025)

Europe	2021	2025
Unique mobile subscribers (million)	474	480
Penetration rate	86%	87%
Internet users (million)	433	453
Penetration rate	79%	82%
% of 4G connections (excluding licensed cellular IoT)	75%	52%
% of 5G connections (excluding licensed cellular IoT)	4%	44%

Most countries in Europe have deployed commercial 5G services, with two thirds of regional operators having launched 5G networks. The UK and Germany are driving 5G adoption in the region, with delays in countries such as Albania, Slovakia and Montenegro. However, these countries will record the fastest subscriber growth rates in the future. In 2023, the percentage of 5G mobile connections will overtake 3G in Europe and reduce the gap with 4G. In 2023, 4G mobile connections will begin to decline. Meanwhile, 2G will be completely shut down by 2026.

Source: GSMA Intelligence

Exhibit 10: Mobile in China (2021 versus 2025)

China	2021	2025
Unique mobile subscribers (billion)	1.22	1.26
Penetration rate	83%	84%
Internet users (billion)	1.04	1.20
Penetration rate	71%	80%
% of 4G connections (excluding licensed cellular IoT)	69%	48%
% of 5G connections (excluding licensed cellular IoT)	29%	52%

In China, 4G adoption peaked in 2020 and fell throughout 2021 as consumers increasingly switched to 5G. 5G adoption in the country is supported by a growing device ecosystem, increasing sales of compatible handsets and aggressive network rollouts. All these factors make China a global leader in 5G connections, with a global share of 75% of total 5G connections in 2021.

Source: GSMA Intelligence

Exhibit 11: Mobile in North America (2021 versus 2025)

North America	2021	2025
Unique mobile subscribers (million)	329	341
Penetration rate	84%	85%
Internet users (million)	303	322
Penetration rate	77%	80%
% of 4G connections (excluding licensed cellular IoT)	70%	33%
% of 5G connections (excluding licensed cellular IoT)	14%	64%

The mobile market in the US is near saturation, and 5G is set to overtake 4G in terms of adoption in 2023 to become the dominant mobile technology in North America. The US and Canada are among the global leaders in 5G adoption.

Source: GSMA Intelligence

Exhibit 12: Mobile in Latin America (2021 versus 2025)

Latin America	2021	2025
Unique mobile subscribers (million)	439	487
Penetration rate	69%	74%
Internet users (million)	384	440
Penetration rate	60%	67%
% of 4G connections (excluding licensed cellular IoT)	59%	70%
% of 5G connections (excluding licensed cellular IoT)	0%	11%

5G is still in its nascent stages in Latin America. Instead, operators have largely focused on migrating 2G and 3G customers to 4G networks. 4G adoption is still rising in the region and is not expected to peak until 2024. 5G coverage in the region is still mostly limited to major cities, but there is growing evidence that deployments are ramping up. 5G coverage is available in 22 cities across Brazil, in all districts of Chile and in 40 Mexican cities.

Source: GSMA Intelligence

Exhibit 13: Mobile in Middle East and North Africa (2021 versus 2025)

Middle East and North Africa	2021	2025
Unique mobile subscribers (million)	412	456
Penetration rate	66%	68%
Internet users (million)	307	362
Penetration rate	49%	54%
% of 4G connections (excluding licensed cellular IoT)	41%	44%
% of 5G connections (excluding licensed cellular IoT)	1%	17%

By 2025, the number of mobile subscribers will grow by nearly 45m in the Middle East and North Africa, with North Africa driving this growth and contributing to nearly a third of new subscribers.

Source: GSMA Intelligence

Exhibit 14: Mobile in Sub-Saharan Africa (2021 versus 2025)

Sub-Saharan Africa	2021	2025
Unique mobile subscribers (million)	515	613
Penetration rate	46%	50%
% of 4G connections (excluding licensed cellular IoT)	17%	33%
% of 5G connections (excluding licensed cellular IoT)	0%	4%

Ethiopia and Nigeria are the largest markets in Sub-Saharan Africa. They will account for almost a third of the nearly 100m additional subscribers in the region by 2025. 3G will remain the dominant connectivity technology, accounting for over half of total connections by 2025.

Source: GSMA Intelligence

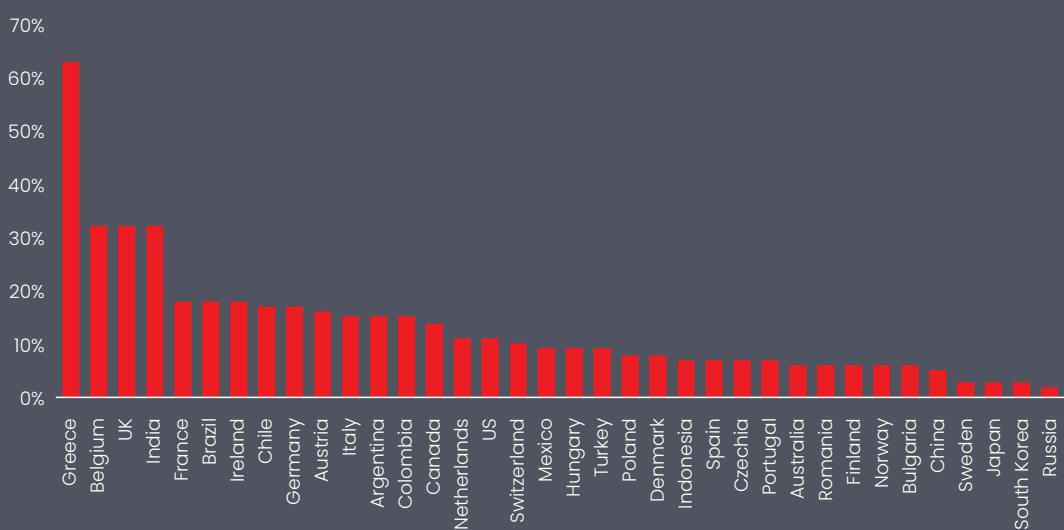
Fibre coverage and penetration

The rollout of fixed broadband (FBB) networks based on FTTP/B (fibre to the premises/building) technology has been growing for some years now. This is the result of both greenfield builds (including those deployed by alternative network providers specialising in FTTP/B) and the transition from existing xDSL (mainly) and cable networks.⁴⁶

Overall, FBB still has room for growth. Between 2020 and 2025, the average increase in FBB penetration will be 8% in developing markets. In developed markets, the average increase will be lower as penetration reaches saturation levels.

Between 2020 and 2025, the highest FTTP/B connections growth will occur in Greece, the UK, and Belgium.

Exhibit 15: FTTP/B connections growth, CAGR, 2020–2025



Source: GSMA Intelligence

Investment in FTTP/B rollouts has been accelerated by covid-19, which has boosted the importance of FTTP/B infrastructure. On average, 72% of FTTP/B's growth will come from shifts from DSL and cable. Meanwhile, there is early momentum building for 5G fixed wireless access (FWA) growth. Since late 2018, 79 providers have launched 5G FWA across 42 markets (to Q2 2022).⁴⁷

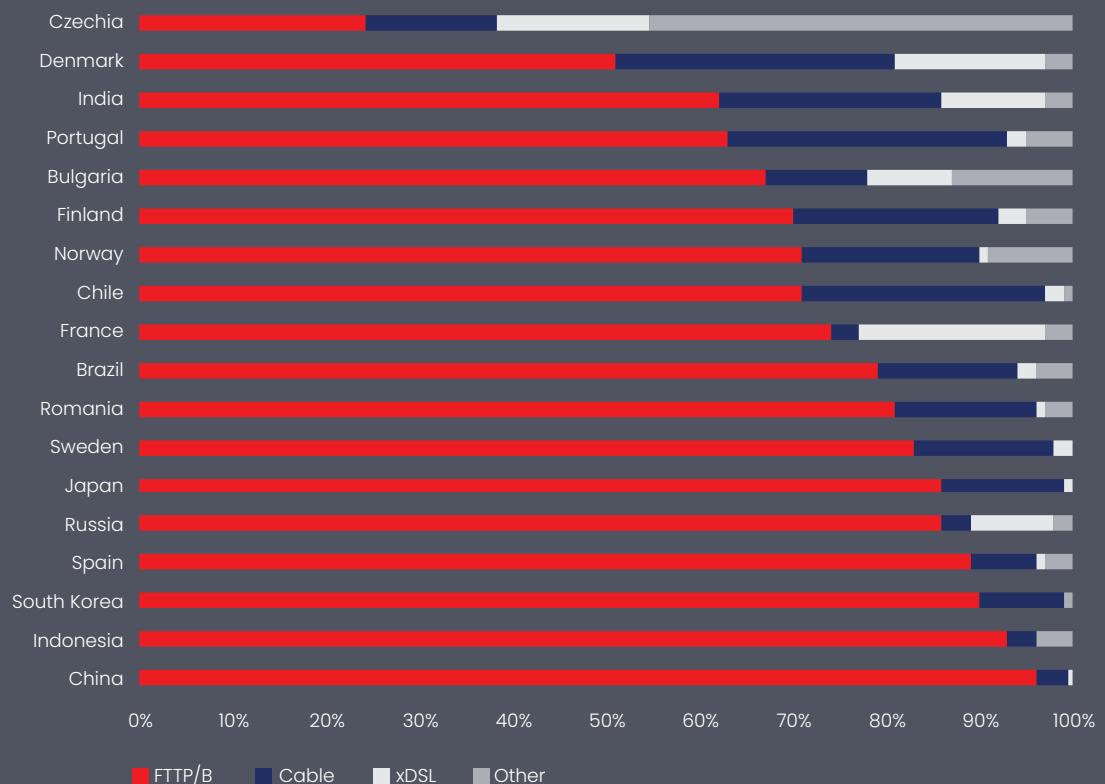
China: a global leader in FTTP connections

FTTP/B, which was non-existent in 2010, made up 90% of China's total FBB connections by 2019. With over 420m FTTP/B connections, China is a global leader in FTTP/B.⁴⁸

In Europe, Spain is the benchmark for FTTP/B rollout and customer adoption. Telefónica has been a major driving force here, with 22.7m fibre to the home (FTTH) premises passed and over 4.2m FTTH customers.

In Latin America, Brazil and Mexico have the highest FBB penetration rates. Brazil will also have the highest growth rate of FTTP/B connections between 2020 and 2026.

Exhibit 16: Fixed broadband connections by technology as a percentage of total fixed broadband connections, 2025



Source: GSMA Intelligence

Cloud and data centres

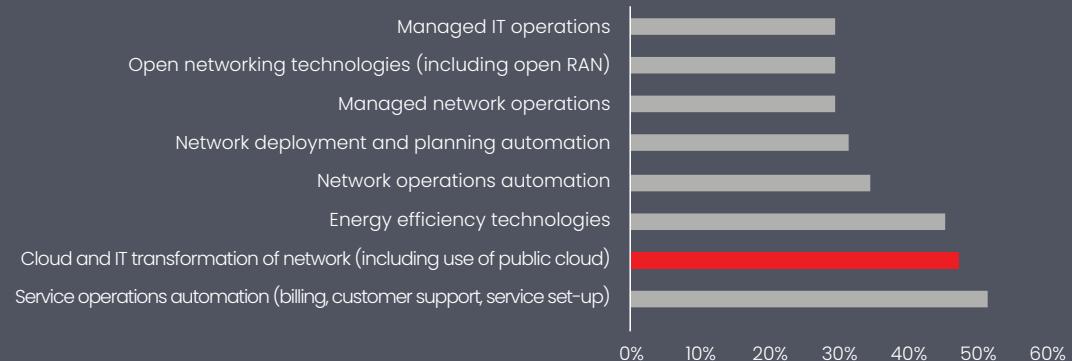
5G integrated with FTTP will be vital to support the network of the future, comprising traditional cloud data centres and a variety of computational capacities moving out from the cloud to the edge nodes closer to end users. Edge computing is at the core of IoT and enterprise digital transformation. Edge computers can be deployed in any IoT device and have an infinitely wide range of uses. Among their benefits is the ability to operate in places that require intermittent connectivity to the cloud and to safely

process, make sense of, and locally store data.⁴⁹ Additionally, there are cost benefits associated with the local processing capabilities of edge infrastructure, which reduce or obviate the need for backhaul links to central cloud servers.⁵⁰

A survey conducted by GSMA Intelligence in 2022⁵¹ shows that the cloud and IT transformation of the network are among the favoured technologies used by operators for reducing opex.

Exhibit 17: Favoured technologies for reducing operating expenses

Percentage of operators



Source: 'Operators in Focus; Network Transformation Survey Dashboard', 2022, GSMA Intelligence

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Demand for 5G will be driven not just by consumer applications, but by enterprises looking to capitalise on new services to accelerate their digital transformation.



Identifying what ICT infrastructures matter most

While the value of ICT infrastructure is clear to see, a “one size fits all” approach will not work for most organisations.

Survey respondents pick fibre infrastructure (67.8%), digital connectivity (65.2%) and telecommunications networks (65%) as among the most important aspects of network infrastructure.

However, there are commonalities: both survey respondents and interviewees agree that it is most important to focus investments on building the network infrastructure necessary to enable internet connectivity. Survey respondents pick fibre infrastructure (67.8%), digital connectivity (65.2%) and telecommunications networks (65%) as among the most important aspects of network infrastructure.

In the same vein, virtual infrastructure such as cloud and mobile edge computing were also considered highly important, especially in Africa (65.3%) and Asia Pacific (63.2%).

5G is an essential driver of digital transformation

Mr Jarich suggests the importance of networks becomes especially clear as 5G adoption enters what he calls its “second phase of growth” in markets where it is already available such as Asia Pacific and Europe. In this second phase, demand for 5G will be driven not just by consumer applications, but by enterprises looking to capitalise on new services to accelerate their digital transformation, like the metaverse or cloud storage technologies.

“It all goes back to connectivity and what’s needed to scale 5G,” he says, adding that future investments will likely be focused on identifying innovative use cases for new technologies.

Ms Okuda stresses the need for diverse digital network infrastructure supported by more redundancies in the form of more fibre capacity that can ensure continued access in the event of catastrophes or system failures. In doing so, providers could make affected communities more resilient, especially considering the increasing frequency of natural disasters in the Pacific and the reliance on digital applications and services.

"If internet access was so crucial to determining covid deaths, we need to make sure that the access is planned for and invested in as a national priority," she says.

Core digital skills are crucial to business today

Infrastructure isn't only about hardware and software, however. ICT skills and expertise are considered crucial inputs by both survey respondents and interviewees. Core ICT skills (66.6%) are considered highly important forms of digital infrastructure, as "without skills and familiarity, people can't take advantage of the digital economy," says Mr Jarich.

Ms Plonk adds that investments in digital literacy are becoming a major flashpoint for governments throughout OECD economies. Considering the rapidity of technological change, more and better training is especially needed at the early stages if companies are looking to enable digital transformations.

Ms Okuda lends further nuance to the discussion, noting that simply providing infrastructure and technologies is not enough to address specific targets or issues.

In one example she shares, though Thailand is a highly well-connected market, where even rural areas have access to the internet, many families were not able to benefit from online education during covid-19 lockdowns due to a lack of devices, sufficient bandwidth or digital skills.

The growing focus globally on digital skills is testament to the growing acknowledgement of their importance in the economy of the future.

Other focus areas for investment

Other key technologies cited in interviews include cloud technologies, which Mr Jarich says will continue to experience accelerated growth, especially as edge computing's value proposition becomes increasingly visible.

"The cloud and edge are helping organisations be more efficient—they offload what's usually done in terms of capex into opex, which will help particularly in the current economic climate," he says.

Ms Plonk says there is a strong need for investments into increasing computational capability in all markets, and especially developing one where the digital divide is growing. Currently, most computing power has been concentrated within the walled gardens of companies or academic institutions, and within richer economies that have the resources to build the necessary infrastructure.

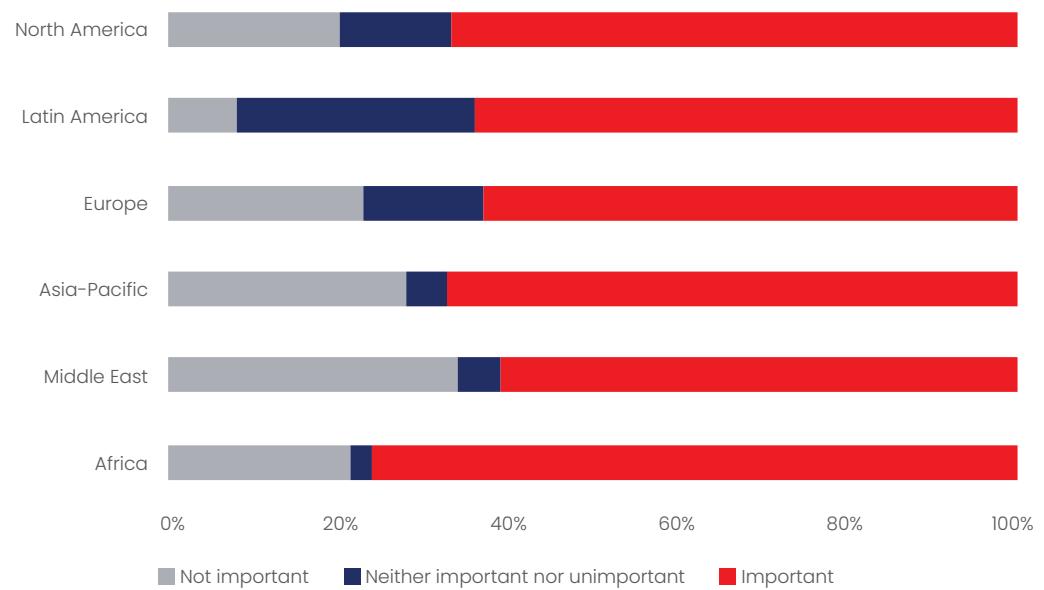
This lends relevance to the survey findings that for 76% of respondents in Africa, access to IT infrastructure—which includes hardware, software, and operating systems—is a bigger priority than it is for other markets.

This is because without these basic pieces of IT infrastructure, African companies' capacity to run computationally-intensive technologies like AI/ML, cloud tech and data analytics will be largely limited, thus impacting their overall digitalisation progress.

"Getting greater access to these technologies is essential—not to say that everything has to be built in an international capacity but thinking about the computing resources that you need to build digital infrastructure that you want is often an overlooked problem," she says.

Exhibit 18: Respondents in Africa are likelier to prioritise access to IT infrastructure than elsewhere

As the focus on the digital economy increases, how important is IT infrastructure (hardware, software, networking components, operating system, data storage, etc.)



Source: EI Studios



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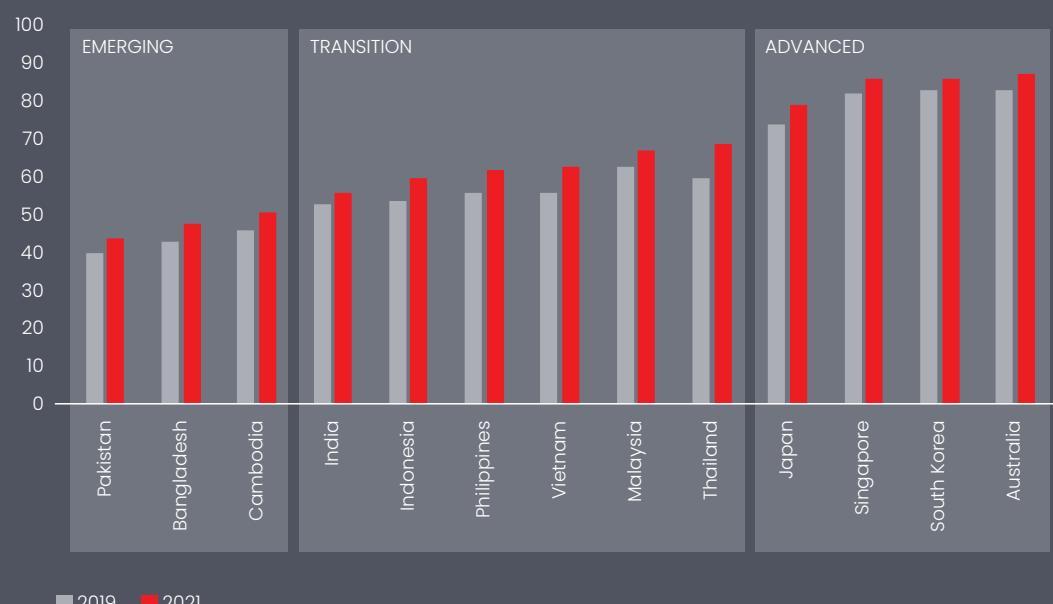
A holistic set of policies must be implemented to maximise the economic impact of digitisation.

Connectivity at the core of digitisation

Connectivity is driving digitisation and is the core component for measuring progress toward a digital society in both the GSMA Intelligence Digital Society Index⁵² and the Digital Economy and Society Index (DESI).⁵³ Fast, reliable, and continuous individual access to the internet is the foundation for the creation, distribution and consumption of digital applications and services.⁵⁴

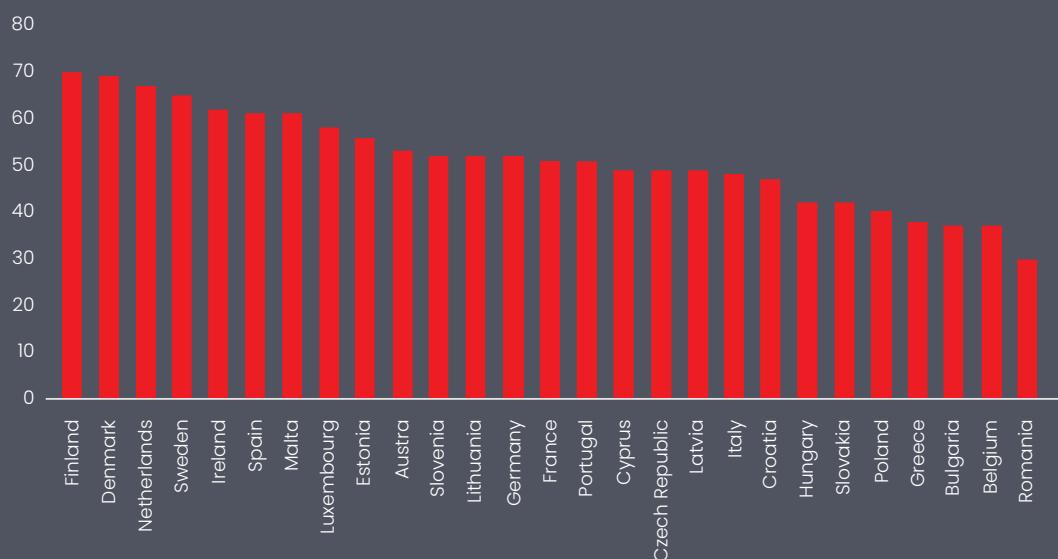
An increasing number of citizens are using a network of intelligently connected devices and services for daily activities, including work, play and communications. Countries worldwide, particularly in Asia Pacific and Europe, continue to advance along the path to fully digital societies.

Exhibit 19: Continued progress along the path to digital societies in Asia Pacific*



Source: GSMA Intelligence

Exhibit 20: Digital Economy and Society Index (DESI) 2022 rankings



Source: European Commission

Finland ranked 1st among 27 EU member states in the 2022 edition of the DESI. The share of employed people working as ICT specialists is above the EU average by nearly 3 percentage points. ICT graduates in Finland account for 7.5% of all graduates, and the share of companies providing ICT training to their employees in Finland is almost twice the EU average.⁵⁵

On the flip side, Romania ranks last among the 27 EU member states. The country's human capital has a lower level of basic digital skills compared to the EU average and it performs worse in the integration of digital technologies and digital public

services. The share of SMEs with at least a basic level of digital intensity (22%) and the percentage of enterprises sharing information electronically (17%) in Romania is also among the lowest in the EU.⁵⁶

Full digitisation must include the infrastructure of digital services, connectivity of devices, the digital transformation of households and production, the development of digital industries and services, and the availability of production factors such as skilled labour, intellectual property and mobile infrastructure, among others.

Examples of digitisation in a selection of verticals

Consumer

Exhibit 21: Mobile is providing people with access to a range of life-enhancing services⁵⁷

Vertical	Description	Example
Media and content	To support digital inclusion in Kenya, Safaricom has implemented digital projects to help the inclusion of visually impaired users.	For instance, the operator partnered with Dot Incorporation to launch the Dot Watch, enabling visually impaired users to read all SMS notifications in Braille.
Retail	To support approximately 30m unbanked users in Turkey, Turkcell launched Paycell in 2017.	Paycell enables more customers to readily access financial services by offering a fast and secure mobile payment solution. Paycell reached 6.6m active users at the end of 2020.
Healthcare	Covid-19 has magnified weaknesses and gaps in the healthcare system. To strengthen the healthcare system in the Philippines, Globe Telecom launched the first mobile health applications: KonsultaMD and HealthNow	KonsultaMD and HealthNow aim to strengthen the healthcare system by providing virtual health consultations as well as the management of e-prescriptions, e-laboratory requests, e-referrals, and e-medical certificates. KonsultaMD reached more than 1m members in 2021, a 168% increase from the previous year. Additionally, HealthNow processed 15,000 to 20,000 medicine delivery orders daily.

Source: GSMA Intelligence

Enterprise

Exhibit 22: Mobile is providing enterprises with sophisticated operations, safety and cost-management solutions

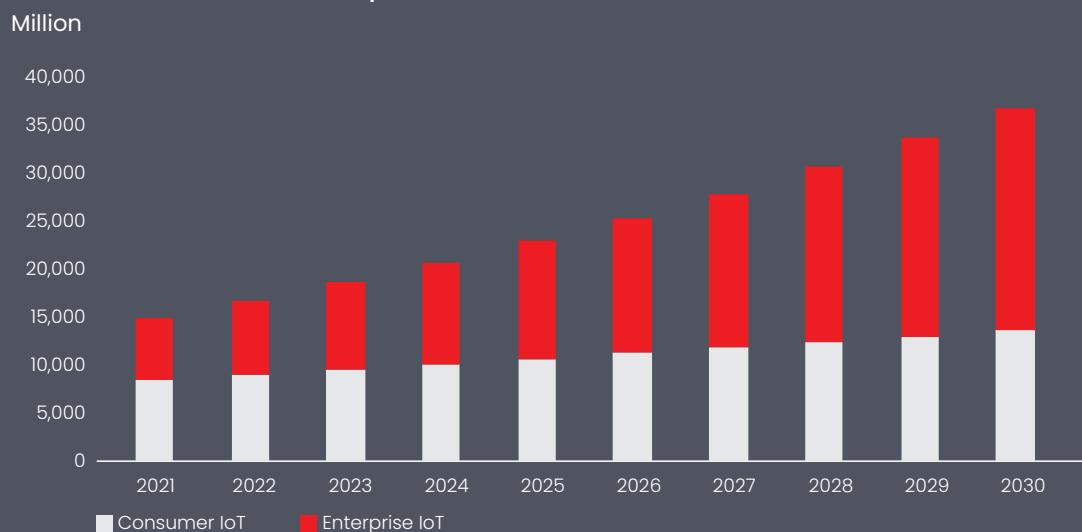
Vertical	Description	Example
Manufacturing	A leading automaker in Beijing is partnering with Chinese mobile operators, Qualcomm and ThunderSoft, to deploy 5G industrial transfer robots that employ artificial intelligence (AI) to help improve their performance over time through extended flexibility of the factory to respond to changes in demand and increase workers' safety.	The combination of 5G, robotics and AI could improve productivity in manufacturing plants by more than 10% and help factories respond to changes in demand as well as detect workers to take appropriate actions and prevent accidents.
Smart building	Since 2021, Claro Dominican Republic, a subsidiary of América Móvil, has been generating renewable energy in off-grid areas.	The operator is using energy as a service (EaaS) to allow the generation of renewable energy onsite and offset grid costs. It has allowed the operator to save on opex while reducing carbon emissions.

Source: GSMA Intelligence

Enhanced connectivity will drive the digitisation of enterprise verticals throughout the deployment of massive IoT. Enterprises are seizing the long-term benefits of 5G, edge computing and IoT in terms of

improved operations efficiency, cost reductions and new revenue opportunities. As a result, enterprise IoT connections will account for nearly two thirds of total IoT connections by 2030.

Exhibit 23: Consumer and enterprise IoT connections, 2021–2030



Source: GSMA Intelligence

However, in both developed and developing countries, not all consumers and enterprises are fully realising the benefits of digital and mobile technologies. As such, some sectors of the economy are lagging behind in the use of new technologies, causing stagnation in productivity growth.

In 2021, the International Telecommunication Union (ITU)⁵⁸ found that a 10% increase in digitisation yields an increase of 1.5% of GDP in OECD countries and 1% in non-OECD countries.

A holistic set of policies must be implemented to maximise the economic impact of digitisation. These include policies that enhance digital skills for children and adults and also enable enterprises—especially SMEs—to accelerate digitalisation.

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There is also the philosophical/policy debate over who should foot the bill for the investment in ICT infrastructure that enhances the connectivity and powers almost all aspects of the digital economy.

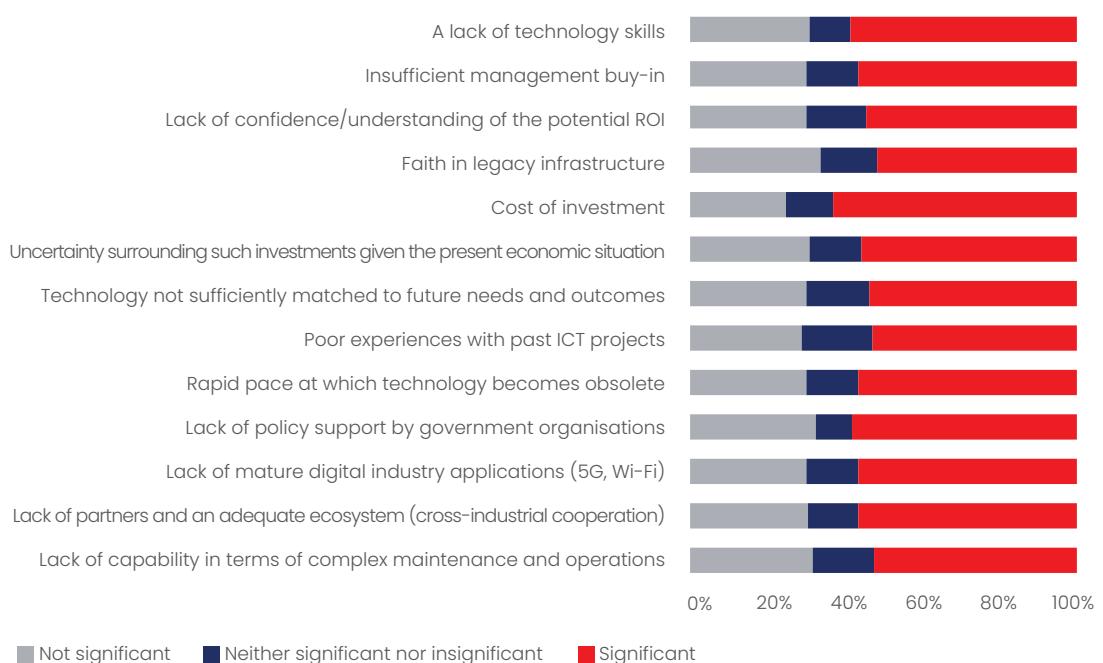
Barriers to ICT investment in the public and private sectors

While the EI Studios survey shows that most companies have upped their ICT investments over the past two years, these increases have settled at an average range of 10–30%. However, this is well above forecasts that

global IT spending will increase by 5.1% in 2023.⁵⁹ Several barriers remain to more ICT investment, with respondents in both the public and private sector pointing to costs as a significant one.

Exhibit 24: Costs exert pressure on private sector ICT investments

In your opinion, how significant are these barriers in impeding ICT investment in the private sector?



Source: EI Studios

Although rising costs are not dislodging investment plans, they remain at the forefront of 64% of policymakers' and institutional investors' concerns when it comes to private sector ICT investment, especially for those in Asia Pacific (66.4%).

There is also the philosophical/policy debate over who should foot the bill for the investment in ICT infrastructure that enhances the connectivity and powers almost all aspects of the digital economy. For a long time now, telcos have borne the burden of ICT investment of different kinds.



"One challenge I see is that we are still constantly looking into the sweet spot solution that can be scaled as we extend the solution to our regional associates [in terms of costs]."

Tay Yeow Lian, managing director, Networks, Consumer Singapore at Singtel

Tay Yeow Lian, managing director, Networks, Consumer Singapore at Singtel, says: "One challenge I see is that we are still constantly looking into the sweet spot solution that can be scaled as we extend the solution to our regional associates [in terms of costs]."

"We have a role to do good, but we also need to make returns," says Telefonica's Mr Blanco. "Every year, I am managing 50%-60% more data capacity than the year before and I am managing to maintain a flat capex because of innovation, but this is not going to be feasible for very long. We understand that we are here to serve societies, but we need to protect our returns and sustainability too. We need to find a way to combine both."

Other issues that are limiting private sector ICT investments are a lack of technology skills (58.4%), and inadequate policy support from government organisations (58%). In Europe, a lack of technology skills (65%) is considered a bigger issue while most North American (70.7%) companies cite poor policy support from government as a significant barrier.

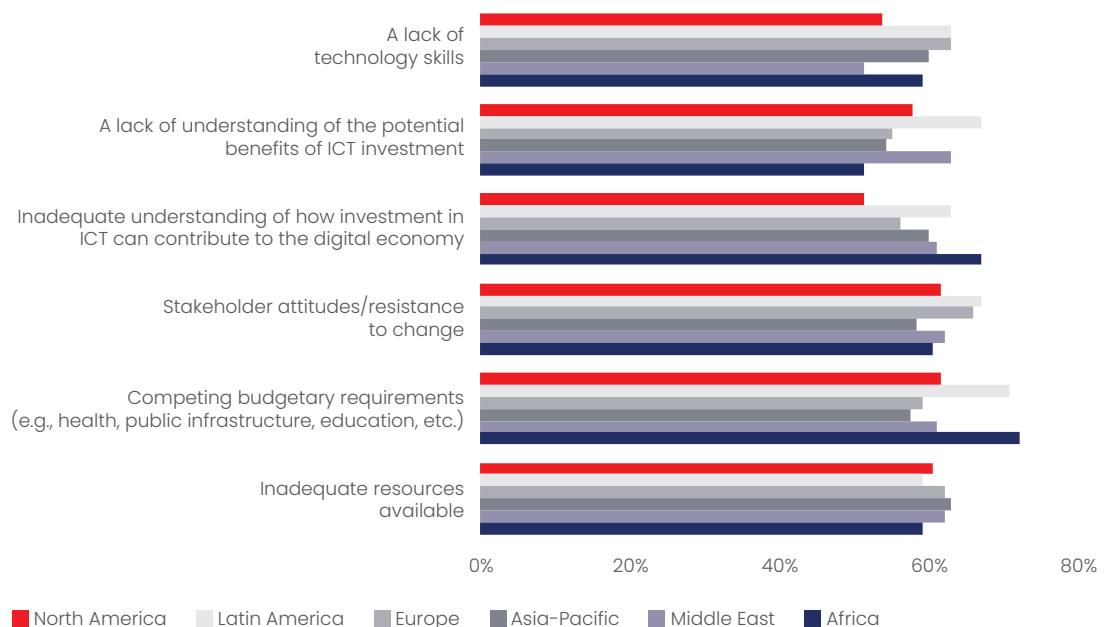
Ms Plonk of the OECD is not surprised that public policy has struggled to keep up with social change, but says the tech transition has posed uniquely difficult challenges because of how it is embedded into every sector.

"You can't really have healthcare or transportation regulation that isn't also digital regulation on some level," she explains. "Policy also tends to be retrospective—we didn't 'test' policy back then, we just learnt on the job. We don't want to stifle productivity and growth, so finding a balance is very difficult."

Costs aside, other barriers impeding public sector ICT investments include competing budgetary requirements (63%), stakeholder attitudes and resistance to change (62.8%) and inadequate available resources (62.4%).

Exhibit 25: Stakeholder resistance and competing interests limit public sector ICT investment

Significant barriers that are impeding ICT investment in the public sector



Source: EI Studios

Considering the responsibility of public institutions to address wide-ranging—and often, overlapping—societal problems, as well as the multi-stakeholder nature of government, it's not surprising that across various markets, competing priorities and perspectives are hindering ICT investments. Respondents in North America (62.7%), Latin America (72%) and Africa (73.3%) all point to competing budgetary requirements as major stumbling blocks.

Stakeholder resistance to change is seen as another barrier to ICT investments, especially among respondents from Europe (67%) and policymaking backgrounds (72%). This finding reflects the prevailing reality that the public sector is notoriously resistant to change, even when the imperative to modernise is well-accepted.

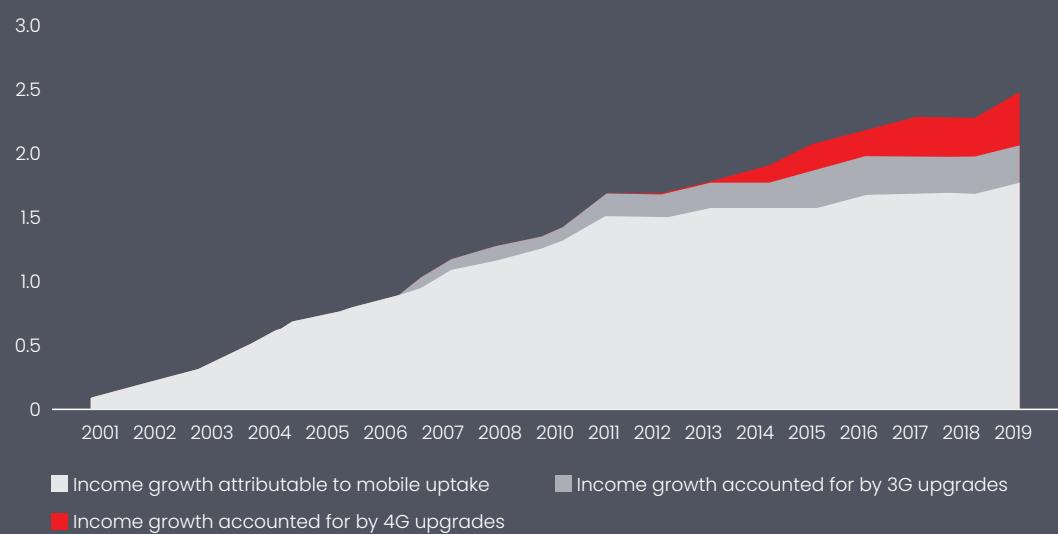
The link between 5G ICT investments and economic growth

Impact of network upgrades and 5G launches on global GDP

There is a vast amount of empirical literature indicating that information and communication technologies contribute to economic growth, productivity and employment. GSMA Intelligence research⁶⁰

finds that on average a 10% increase in mobile adoption increased GDP by 1%, with the effect increasing by approximately 15% when connections upgrade from one mobile network technology to another.

Exhibit 26. Global GDP growth driven by mobile technology (cumulative since 2000)
US\$ trillion

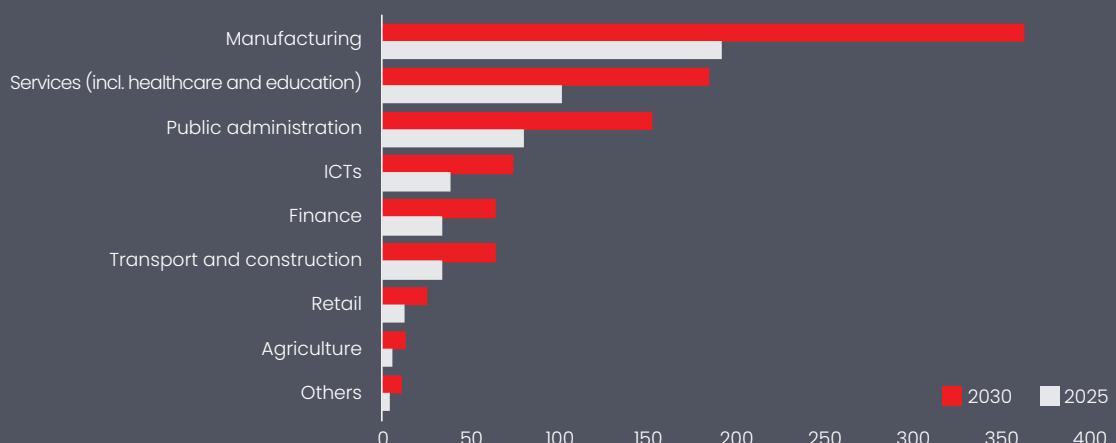


Source: GSMA Intelligence

According to GSMA Intelligence,⁶¹ 5G is expected to generate US\$960 billion in additional GDP value-add to the global economy, or approximately 0.70% of the global GDP forecast, in 2030.

5G spectrum will contribute positively to global GDP, bringing digital advancement to different sectors, primarily manufacturing, healthcare, and education. The economic benefits of 5G will rapidly increase, in particular from 2025 onwards as take up increases and technology evolutions like 5.5G enable additional use cases.

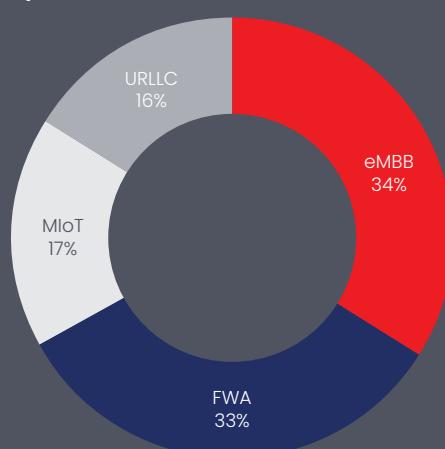
Exhibit 27: Estimated global contribution of 5G spectrum to GDP by sector, 2025 and 2030
US\$ billion



Source: GSMA Intelligence

5G will enable further digitisation and this will have a significant impact on economic growth. Over the next 10 years, the growth will be attributable to different use cases, with 67% of benefits expected to originate from enhanced mobile broadband (eMBB) and FWA use cases and related applications. Massive IoT (MIoT) and ultra-reliable low-latency communications (URLLC) will contribute 17% and 16%, respectively, mainly from collaborative robots and remote object manipulation.

Exhibit 28: Distribution of 5G benefits by use case



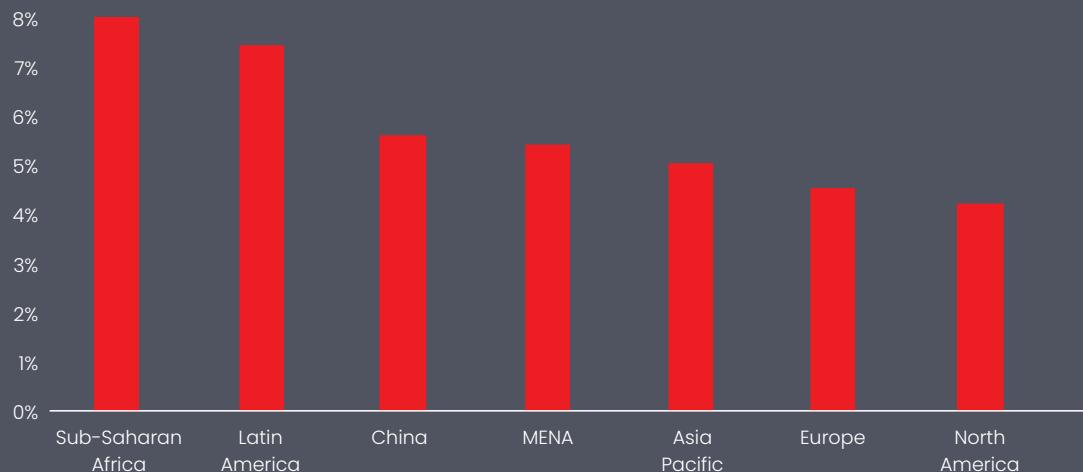
Source: GSMA Intelligence

Impact of mobile technologies and investments on GDP across all regions

GSMA Intelligence examined the mobile industry's impact on GDP growth across all regions. In 2021, the impact on economic growth, in terms of percentage of GDP, was most visible in Sub-Saharan Africa and Latin America, where mobile technologies

and services generated 8%⁶² and 7.4%⁶³ of GDP respectively. These gains came from digital technologies enabling more efficient allocation of resources within firms and markets, improving productivity.

Exhibit 29: Percentage of GDP generated by mobile technologies and services, 2021



Source: GSMA Intelligence

Moreover, the mobile ecosystem is supporting the creation of jobs (directly and indirectly) across all regions, making significant contributions to public sector funding.

For instance, in 2021, in Asia Pacific and China, the mobile ecosystem supported the creation of 8.8m⁶⁴ and 6m jobs⁶⁵ respectively. Mobile technologies have widened job opportunities for workers and the talent pool for firms. By driving GDP growth, the mobile sector has made a substantial contribution to public sector funding; for example, in Europe, almost €109 billion (US\$118.6 billion) was raised through taxation on the industry in 2021.⁶⁶

Examples of economic growth driven by ICT investments

Nigeria: impact of mobile broadband coverage in rural and remote areas

A joint paper between GSMA Intelligence and the World Bank⁶⁷ found that expanding mobile broadband coverage to rural and remote areas of Nigeria increased total consumption (by about 6% after one year) and reduced extreme poverty (by 4% after one year and 7% after two or more years of coverage).

South Africa: connectivity and multinational investments in developing countries

There is evidence that internet connectivity leads to wider economic benefits of multinational investment in developing countries, as shown by Hjort & Poulsen (2019),⁷¹ who found a large and significant increase in net firm entry, notably in sectors that use ICT extensively (finance, for example), shortly after the arrival of submarine internet cables in South Africa.

Gasovu, Rwanda: adoption of mobile phones by farmers

In 2016, in Gasovu, a small village in Rwanda, farmers adopted smartphones to get crucial weather and market information, helping them grow and sell their crops. Through a digital, mobile-enabled platform, 'buy from women', farmers can know the exact size of their land and forecast the production. The platform is improving farmers' capacity to produce a marketable surplus, providing real-time financial information and increasing market access, especially for women farmers.⁶⁸

China: impact of digital retail on consumers

On the consumer side, a study conducted between regions in China, Fan et al. (2018)⁷² found that adding e-commerce to the trade economy induces welfare gains by reducing prices and increasing overall intercity trade.

Europe: digitisation builds businesses' resilience

A study conducted by the European Investment Bank suggests that digital firms perform better overall than non-digital firms and displayed more resilience to economic disruption and climate change. In the EU, more advanced digital firms have a higher investment intensity (defined as investment spending over turnover). This higher investment intensity can be explained by the higher productivity of digital firms and the stronger demand for their goods and services. On average, EU firms that adopted advanced digital technologies and invested in becoming more digital during the covid-19 pandemic have increased the number of workers they employ since the beginning of 2022.

ICT investments have also been enabling a data-powered European economy. According to the European Commission, the data economy of the EU was almost €325 billion in 2019, representing 2.6% of GDP. The same estimate predicted that this will increase to over €550 billion by 2025, representing 4% of the overall EU GDP.^{69 70}

Saudi Arabia: digital investments a boost to economy

Saudi Arabia has taken decisive steps towards digital transformation to achieve its 2030 goal of diversifying the economy and becoming less reliant on hydrocarbon resources. As part of the Saudi Vision 2030 initiative, the development of localised fourth industrial revolution solutions will propel the country's shift towards an innovation-driven, knowledge-based economy. The digital economy in Saudi Arabia is estimated to have contributed 17.7% of GDP in 2020 and this is expected to reach 19.4% by 2025.⁷³ So far the plan has contributed to increasing the value of Saudi Arabia's digital sector to around \$40 billion,⁷⁴ employing 318,000 people.⁷⁵



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One big change is that governments are focusing on setting the ‘tone from the top’ through a variety of national strategies for the digital space.

Driving ICT investment

To realise the promise of technology, efforts must be made to create the right policies, financing structures and ecosystems capable of incentivising more ICT investments in every sector.

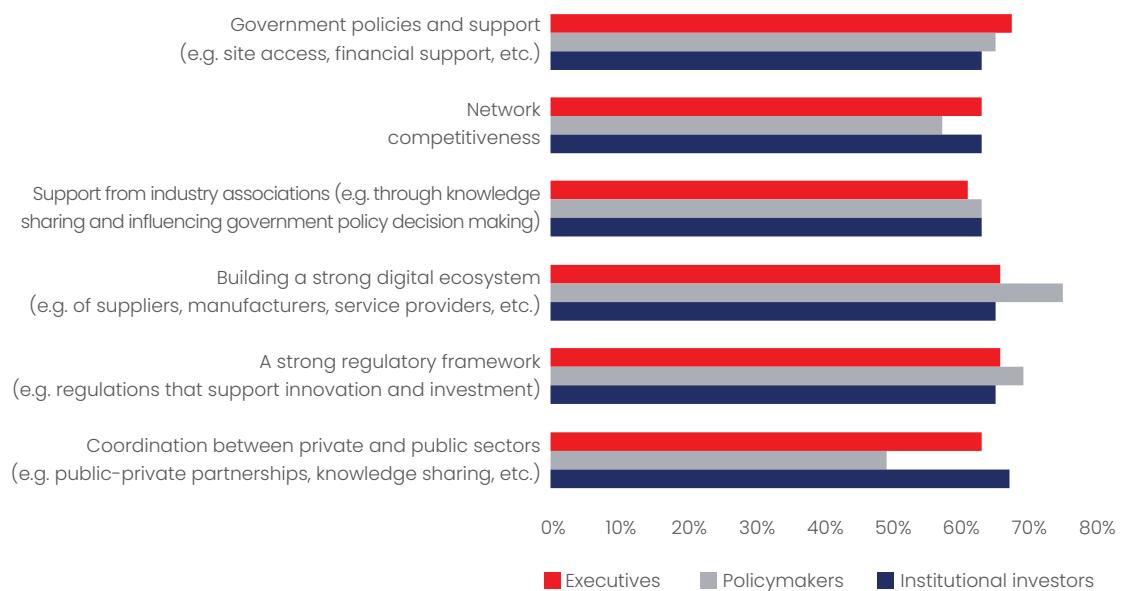
Government must encourage ICT investment

In both the survey and interviews, the role of government is repeatedly

referenced as a key linchpin to driving ICT investments. Most respondents (67.6%) pick government policies and support as an important lever of support for the digital economy. In a similar vein, another 68% point to the need to consider more private and public coordination—be it in the form of partnerships, or knowledge sharing.

Exhibit 30: Government's role in driving the digital economy was top of mind for all respondents

Important factors needed to leverage ICT effectively to support the digital economy



Source: EI Studios

Company executives (68.3%) are more likely to view government intervention as most important, compared to those in policymaking positions, a larger share of whom tend to support efforts to build a strong digital ecosystem (76%).

"Most investors in the connectivity space are telcos, who occupy only a small segment of the economy—governments could look into co-financing or broadening the contribution base to create incentives for the rest of the value chain to invest."

Peter Jarich, head of GSMA Intelligence

However, it is difficult to view these two levers as independent of one another considering how important government regulation and policies are to fostering an environment conducive to digital innovation. Although telcos are the main investors in networks as public utilities, their activities are ultimately subject to government regulation.

Though governments have traditionally been slow to respond to the need to invest in technology infrastructure, Ms Plonk says that there has been encouraging progress from policymakers.

"One big change is that governments are focusing on setting the 'tone from the top' through a variety of national strategies for the digital space," she explains. "Those focus on investment and the diffusion of technologies, and we see movement in specific areas such as AI."

Policymakers have several tools at their disposal to tackle these challenges, such as the scale of governmental initiatives and legislative powers. Mr Jarich suggests governments can develop policies, regulations and infrastructure that incentivise ICT investments or expand the demand for digital technologies. These could look like policies that govern spectrum allocation or tax reforms designed to align the tech industry with other sector standards.

There are myriad other examples of this across the world such as Singapore's Smart Nation strategy. To support their ambitions of driving their digital economy, the Singapore government provides networking opportunities to companies as well as access to testing centres to accelerate innovative technologies.⁷⁶

"Another way governments can help is by identifying additional funding sources for key ICT infrastructure," Mr Jarich adds. "Most investors in the connectivity space are telcos, who occupy only a small segment of the economy—governments could look into co-financing or broadening the contribution base to create incentives for the rest of the value chain to invest."

One aspect that will benefit from government intervention is in the realm of digital regulation, where local authorities are often playing catch-up with the tech. While governments must play their role as referee, Mr Chalmers highlights the need for regulators to “strike the right balance between competing national objectives” to ensure that innovation isn’t stifled by onerous legal requirements.



“Companies have a role to play, but so do governments in ensuring equitable and affordable access to everybody.”

Audrey Plonk, head of the Digital Economy Policy Division at the Organisation for Economic Co-operation and Development (OECD)

Regulatory reform could result in significant benefits for the industry. In an anecdote shared by Ms Plonk, a partnership between the OECD and the Mexican government to reform telco laws helped introduce more competition into the market, resulting in a 60% reduction in costs within a short time span.

“Companies have a role to play, but so do governments in ensuring equitable and affordable access to everybody,” she says. “We are still very much at the beginning of digital transformation, that’s a real policy opportunity.”

Sustained ICT investments create widespread socio-economic benefits

A key consideration for organisations is how sustained their ICT investments are, says Ms Okuda. For true change—rather than piecemeal gains—to be seen, organisations and governments must continue to focus on investing effectively.

She argues for a new approach to setting targets that focuses on a “higher level of socioeconomic” benefit. For example, rather than looking to achieve 85% mobile penetration, organisations can consider how mobile penetration can act as a vehicle to achieve certain health or educational outcomes, such as a 30% improvement in test scores or lower mortality rates.

“At ITU, we are promoting a ‘whole-of-government’ approach that takes into consideration not just financial aspects but also wider socioeconomic challenges and opportunities,” she says. “Then we can make sure that when there is an investment of 10 kilometres of fibre optic cables (for example), we can really address the health or education challenges on the ground.”

Wholesome development in turn contributes to better socio-economic outcomes such as higher earnings, greater consumer spending and economic growth. This is a point Ms Okuda is keen to emphasise, which underscores the importance of taking a broader view of socio-economic impact that goes beyond immediate monetary gains.

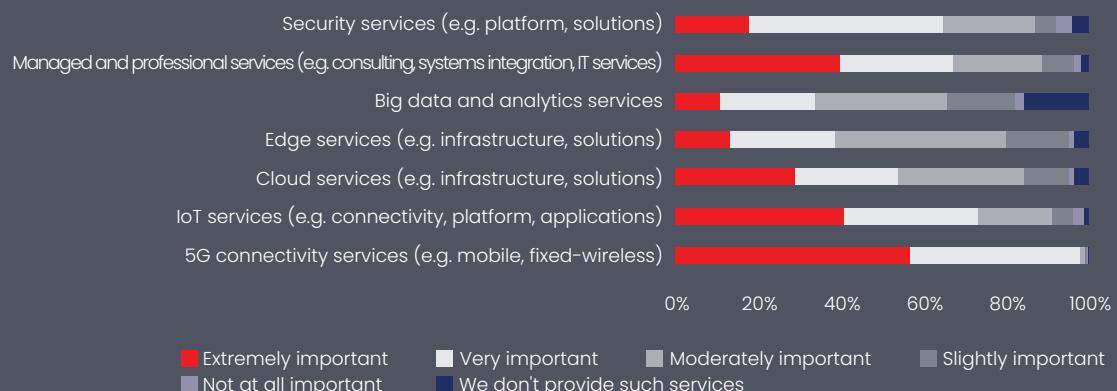


An energy-efficient network takes advantage of the improved characteristics of the purpose-built network elements and uses about as much energy as needed at the moment without impacting user experience.



Next-generation ICT infrastructure

Exhibit 31: Enterprise services portfolio: operators' priority rankings
Percentage of operators



Source: 'Operators in Focus: Enterprise Opportunity Survey', GSMA Intelligence, 2022

According to an operator survey conducted by GSMA Intelligence in 2022, 91% of respondents indicated 5G connectivity services (such as mobile and fixed-wireless) are a top priority for enterprises, while 75% pointed to IoT services and 55% highlighted cloud services.

New applications such as the metaverse, energy sustainability and security are the main use cases that enterprises need to satisfy through ICT investments.

Enterprise metaverse space

The enterprise metaverse involves applications that enable enterprises to offer new products and services or to transform their current ways of working. Enterprise metaverse could include industrial settings, professional services, or even customer-facing roles and frontline workers:

- In industrial settings, enterprise metaverse applications could allow safety and risk analysis simulations to take into consideration machines, people and current conditions such as temperature and lighting.
- Frontline workers, healthcare professionals and public safety services could instantly take and share video snippets—indoors or outdoors—to get feedback and guidance on the spot.

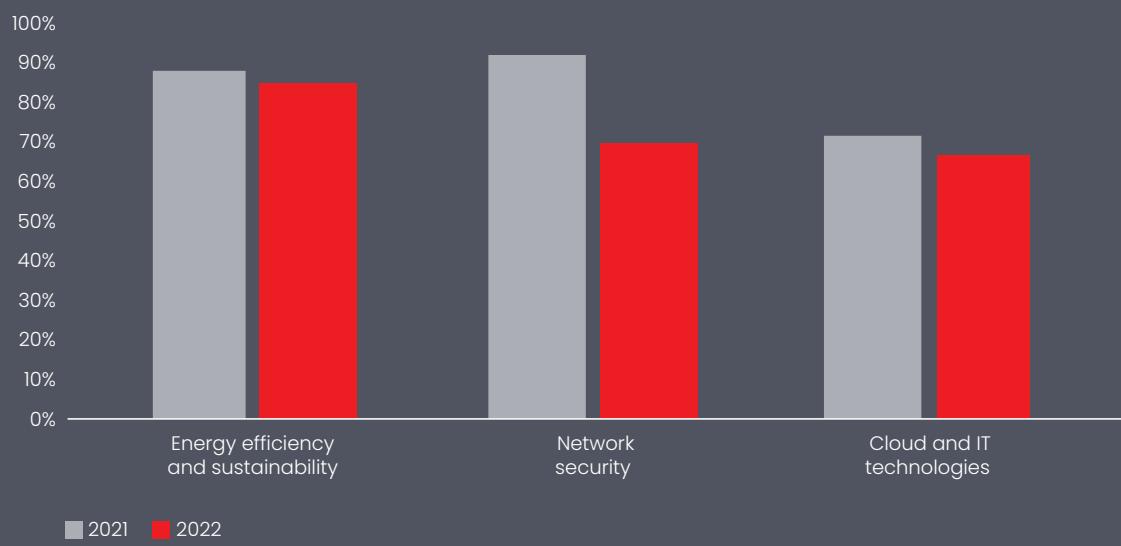
Energy sustainability and security

A survey conducted by GSMA Intelligence, of 100 operators worldwide in mid-2022, found that network security, energy efficiency and sustainability are top network investment priorities:⁷⁷

- **Security:** Massive enterprise IoT deployment and the amount of data generated by IoT sensors/connectivity nodes need security. Edge deployment plays a key role in security, as data-processing on-premises (rather than at offsite locations) has a lower risk of breaches during the transfer process.
- **Energy efficiency and sustainability:** Mobile operators are committed to upgrade their network equipment to improve energy efficiency of the RAN and core networks to save on opex and capex while improving sustainability.

Exhibit 32: Sustainability is now top of the network agenda

How important are the following priorities as part of your current network transformation strategy? (Percentage of operators). Top three choices displayed.



Source: GSMA Intelligence

In general, an energy-efficient wireless network is built on site simplicity and latest mobile generation technologies, frequently harvesting energy-efficient KPI data from almost every part of the network and turning these into actionable insights. An energy-efficient network takes advantage of the improved characteristics of the purpose-built network elements and uses about as much energy as needed at the moment without impacting user experience. The wireless site equipment should reduce power consumption by setting elements into sleep mode when the site traffic decreases during the non-busy hour, and re-activate the elements when the traffic increases to guarantee the user experience. Separate equipment and site visits are also limited to a minimum. Further, network elements are improving their energy efficiency day by day due to updates to energy-saving features. The combination of these factors can help operators to build a future-proof, energy-efficient and sustainable network that improves their overall competitiveness and satisfies their customers. Interventions to optimise power include:

- Energy efficiency and user-experience-oriented network indicators and standards
- Site simplification and modernisation
- Spectrum refarming and customer upward migration (e.g. 2G/3G up to 4G or 5G)
- Use of integrated hardware
- Advanced cooling (e.g. liquid cooling)
- AI and resource optimisation (e.g. AI-driven sleep states)
- Use of renewable energy (e.g. solar power)

The good news is that core energy efficiency in mobile networks is improving; the latest GSMA Intelligence telco energy benchmark study indicates it took around 0.17 kWh to transfer a GB of data in 2021/22 compared to 0.24 in 2020/21. The challenge is in conferring the benefits of more efficient technologies and a higher share of renewables in the global south and east.

The importance of telcos

Telcos play a critical role in efforts to leverage ICT investments and technologies—not only are they the “engines behind next generation networks”, they are also fundamental to ICT utilisation and driving the greater digital economy, says Mr Plonk.

“It is possible that you have digital processes and you build a digital approach, but without seamless connectivity and without low latency, the services you offer are not going to work.”

Enrique Blanco, global chief technology officer at Telefonica

Seventy-four percent of respondents say a strong digital ecosystem is needed to effectively leverage ICT. Implicit is the need for an ecosystem where access to basic and advanced connections is fundamental and will rely on carriers’ investments into physical and virtual infrastructure.

This has meant the role of telcos has seen tremendous change.

Ceyhun Özata, chief corporate sales officer of Turkcell, speaks of the evolution of the Turkish carrier along these lines. “Turkcell is not only just a telecommunications operator, but also a technology company. In the last 10 years, it was transformed from being a basic telecommunications operator to a technology service provider,” he says.

Mr Blanco of Telefonica says that while the first function of a telco is interconnectivity, this goes well beyond connectivity as we knew it two decades ago. “It is possible that you have digital processes and you build a digital approach, but without seamless connectivity and without low latency, the services you offer are not going to work,” he says, underlining the role telcos are playing in the digital economy today.

By taking fibre and 5G to even remote parts of Spain, Telefonica isn’t just allowing people to connect with one another, but providing them with improved access to a range of services and many necessities such as financial, health and retail services. Moreover, it supports the digital economy as even small businesses and institutions can become fully digitised.

“As telcos, we are spending a lot of money and time on this,” says Mr Blanco. “You have to reach customers with fibre, and this means

5G or FTTH, and then you've got to develop improved customer experience."

The provision of high-speed connectivity that is uninterrupted lays the foundation for other services such as automated capabilities, built on use cases that are based in algorithms and machine learning. "With all of the intelligence and AI capabilities, we are trying to build use cases for new services for the future," Mr Blanco says.

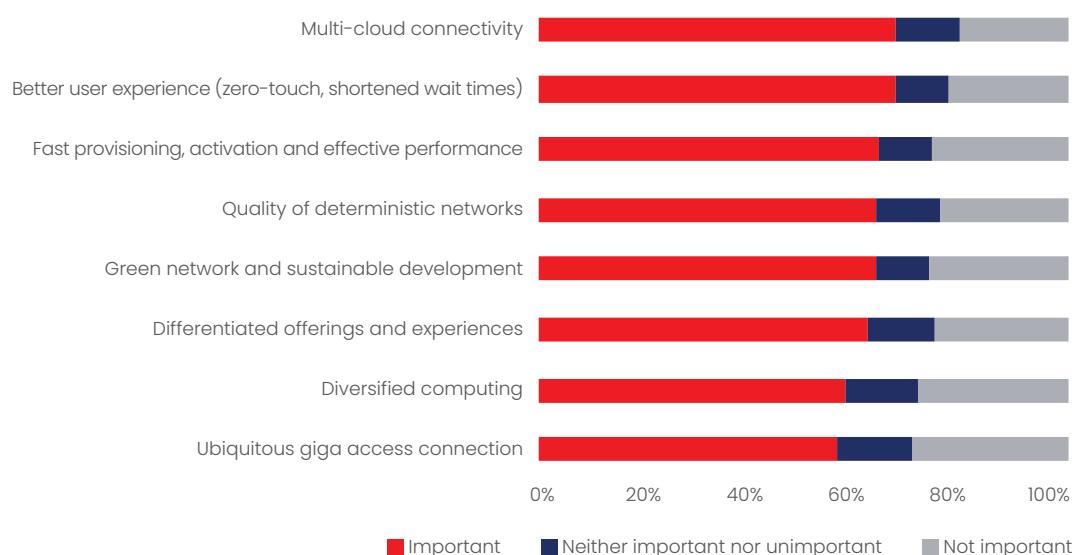
While ICT construction and maintaining high-quality network deployment will remain central to telcos' businesses, as Mr Bahl of McKinsey notes, their focus and strategies have shifted somewhat to "capture opportunities beyond the byte". Telcos' core revenue streams have expanded beyond providing mobile and fixed line connections towards providing access to OTT media, payment solutions, and even autonomous vehicles.

One benefit of this is that telcos will be able to contribute significantly in terms of research and development and industry standardisation, says Ms Plonk. Another is that telcos could improve other socioeconomic targets as telecommunications company Reliance Jio did with the development of e-commerce platforms and social media platforms.

There are several functions and/ or activities that respondents say telcos should prioritise. These include multi-cloud connectivity (considered important by 67.2% of respondents), better user experience (67%) and fast provisioning, activation and effective performance (63.8%). Underpinning all of these activities is the availability of uninterrupted connectivity everywhere. This reflects in 56% of survey respondents referring to ubiquitous giga access connection as a priority area for telcos.

Exhibit 33: Carriers have a multi-faceted role to play in building the foundations of the digital economy

The role of carriers is expanding as the digital economy grows. Which of their functions/ activities should they prioritise?



Source: EI Studios

“

The relevance of IoT devices will only increase as smart city and driverless vehicles initiatives gain traction; these technologies are highly dependent on fast and low-latency connections to ably monitor everything from air quality to obstacles on a motorway.



What should telcos focus on to support the digital economy?

As tech adoption continues its upward trajectory, there are a number of focus areas for telcos that will be fundamental to ensuring organisations in both the public and private sector are able to take advantage of the digital economy.

According to Ms Yip, customers' expectations of a telco have increased significantly. She says, "customers today value choice, service reliability, and security. Service reliability, especially while traveling, and security, in view of the rising number of scams, are top of mind for consumers."

Expanding access to the 5G ecosystem

While access to the internet opened the doorway to infinite possibilities, widespread access to 3G and 4G mobile data networks helped lay the groundwork for today's digital economy. However, with the emergence of 5G, the next digital revolution will go beyond the smartphone to enable technologies such as IoT, cloud computing and AI to leap ahead in their evolutionary journey.⁷⁸

5G has experienced the highest rates of adoption than any other gigabit technology that has come before it—coupled with fibre broadband, these networks will be

foundational to not just telco transformation, but also economic and social development, a point underscored by Mr Blanco, and in keeping with Telefonica's recent efforts.

Singtel, Singapore's largest telco provider, realised a sharp spike in internet consumption as the rise in on-demand video and online education rose through the pandemic. "We needed to ensure our broadband and mobile network have enough capacity to support the needs of consumers," says Mr Tay.

As 5G enters its second phase, the next generation of enabler technologies such as metaverse or AI/ML applications are bandwidth-hungry—they will require more advanced forms of connectivity. This is especially key as global reliance on IoT devices continues to rise—by 2030, researchers estimate that there will be 29.4 billion active IoT devices.⁷⁹ The relevance of IoT devices will only increase as smart city and driverless vehicles initiatives gain traction; these technologies are highly dependent on fast and low-latency connections to ably monitor everything from air quality to obstacles on a motorway.⁸⁰

To meet these changing needs, telcos will need to rethink "connectivity" as not just a people-centric service but an expansive utility

that also connects everything from discrete IoT devices, workplaces, manufacturing sites and so on. Telcos will need to strategise by expanding the available connective technologies, and rolling out advanced networks such as 10G-PON or 5.5G that can support fast deployment and mass market adoption.

For Ms Okuda, the extension of this 5G or IMT 2020 ecosystem will be especially important in efforts to expand internet access to the 2.7 billion people who remain unconnected, especially in remote areas, such as on islands and in villages. Carriers can do this in part by partnering with governments or implementing Universal Service Obligation initiatives.

"I hope the private sector sees this not just as a business opportunity but also a mandate to continue connecting these people," she says. "Even if we say one household is connected, that could mean 10 family members sharing a single device."

Telcos may also see significant benefits in their capabilities to expand beyond their traditional business services to explore new opportunities in industrial digitalisation. As businesses in every industry look to integrate digital tools into their workflows, telcos can play a role in supporting their transformation. For businesses, Industrial Revolution 4.0 can unlock significant value in terms of cost reductions, product quality and labour productivity⁸¹—for telcos, this US\$1.4 trillion market could pave the path to new, future relevance.⁸²

Speeding up future automation

As telcos expand the scope of their services on offer, the operational complexity of their base business models will also multiply.

For one, though plans to shut down legacy networks are in the works, telcos will still be expected to continue maintaining 2G, 3G and 4G networks for some time, even as commercial 5G becomes widely available. Secondly, as more 5G and 5.5G use cases emerge, telcos will face the challenge of meeting a diverse range of requirements from various industries and figuring out how to leverage their resulting data assets.

In the face of these myriad challenges, automation technologies will become a crucial focal point for telcos by improving operational efficiencies and optimising their networks at a low cost. According to TM Forum's 2022 survey on operators' autonomous networks, 54% of surveyed operators indicated that they "have a vision that involves the continual improvement and automation of operations with increased investment", while 37% replied that they "have an ambitious automation strategy with significant investment planning that will result in a full transformation of our operations". The applications of automation and intelligent technologies are driving operators' digital transformation forward, supporting operators to further realise network value, and facilitating a prosperous digital economy.⁸³

For example, with AI, telcos could accurately allocate bandwidth and resources between different end-customers to accommodate heightened or low traffic scenarios. Automation can also be applied to enable more effective analytics to make fuller use of large-scale datasets at telcos' fingertips, allowing them to more capably address customers' diverse and varying needs.

Advanced automation technologies will also have significant application for telcos as they look to explore new business opportunities

in growing and emerging markets, such as industrial digitalisation and driverless vehicles. More than a quarter (26.2%) of survey respondents say this will be an important in-demand technology in the next two years, especially in manufacturing sectors that rely on large workforces and predictive, repetitive processes that can be easily digitalised.⁸⁴

For telcos, supporting automation technologies can lend cogency to their ability to support a wider array of services and advanced use cases such as NaaS/Open API and automotive vehicles. During MWC 2023, the GSMA successfully drove 21 operators around the world to sign the Open Gateway initiative. Mats Granryd, director general of the GSMA, said the significance of the Open Gateway initiative is comparable to that of mobile voice roaming launched in 1987, with a potentially similar influence on digital services. The Open Gateway framework provides developers and cloud service providers with common operator-network APIs in order to deploy services, and network automation is clearly a key foundation for Open Gateway.⁸⁵ 5G's network slicing capabilities will be fundamental to providing the low latencies autonomous cars need to efficiently communicate with various wireless networks that provide crucial navigational information.⁸⁶

In addition to providing 5G connectivity, Singtel has built platforms that allow enterprises to automate self-help services, and manage and scale their business operations. In early 2022, it launched Paragon, a platform that allows companies to tap Singtel's 5G network to enable network slices as required, and edge computing. Paragon is an orchestration platform that allows enterprises to use 5G edge computing and cloud services, while

enabling quicker 5G MEC adoption, thereby reducing overall costs and time to market.

Telcos are increasingly going to provide tailored 5G solutions and platforms for different enterprises, depending on the needs of their industries. These will allow enterprises to use telcos' infrastructures independently, helping them reduce costs and the ability to access many services and applications swiftly. This can all be done with improvement in latency and with greater bandwidth, says Mr Tay.

He cites the example of Singtel's partnership with South Korean vehicle manufacturer, Hyundai Motor Group, to deploy its 5G infrastructure network solutions at Hyundai's innovation centre, which is the first to use the telco's 5G campus network with mobile edge core solutions. This will provide undisrupted connectivity at high speed, enabling precision in manufacturing. Similarly, Singtel has partnered with US technology company, Micron, to work on a 5G millimetre wave solution with edge core.

In Brazil, Mr Blanco says, all customer premises equipment management—all the provisioning and maintenance of the router that one has at home, for instance—is managed by blockchain technology. "So we can control every component of the provision and maintenance of the FTTH using blockchain," he says. "In this manner, we are improving the customer experience."

However, in order to support these custom and cutting-edge technologies, telcos will need to leverage AI and automation technologies to ensure their expanding scope does not come at the expense of their long-term sustainability.

Bridging cloud complexity

With 5G, 5.5G and next-generation technologies, as well as an ever-expanding web of IoT devices, telcos will see their data needs grow significantly. In order to facilitate automation and leverage the potential of data analytics, cloud computing is essential. Indeed, the relevance of cloud computing has grown as companies digitally transform and push more workflows into cyberspace. The covid-19 pandemic and the subsequent shift to remote/hybrid work has only deepened its importance to the digital economy. Enterprise transformation will only become more—not less—dependent on cloud and edge computing, but enterprises' ability to further leverage these technologies will depend on carriers to provide fast deployment, elastic bandwidth and intuitive performance visualisation.

As the digital economy develops, consumer and enterprise needs will only become more diverse and complex. Businesses, on the other hand, will increasingly move their operations onto cloud-based environments to take advantage of data-rich solutions, though this will pose a problem as these services proliferate. To address this issue, carriers will need to focus on enabling more cloud capabilities by building out the necessary infrastructure or collaborating with third-party providers such as Microsoft Azure, Google Cloud or Huawei Cloud.

"We want to leverage our capabilities in terms of our technology, knowhow and expertise to try and create an ecosystem around the cloud," says Turkcell's Mr Özata. To this end, the company has invested heavily in its public cloud business. "It is time to put new cloud features on top of robust connectivity and create value for all of our customers in Turkey."

Telcos will also need to focus on how they can enable increased multi-cloud connectivity, which 67.2% of respondents say is key to growing the digital economy. Multi-cloud connectivity has risen in importance over recent years as companies increasingly turn towards digital-first service providers whose solutions are more flexible, secure and sustainable than in the past. With the proliferation of digital services comes difficulties in integrating disparate cloud solutions, leading to lost time and labour resources.

Multi-cloud connections elide many of those solutions by connecting different cloud platforms—and their relevant datasets—onto a single, intuitive interface. Multi-cloud connectivity will open the door to more industrial application of data analytics, edge computing and even automation.

For telcos, exploring multi-cloud services also presents a significant business opportunity, especially in terms of B2B customers. As digital transformation develops across industries, more industrial applications will depend on real-time data analytics and automation. Telcos can capitalise on this by enabling these technologies with the power of their extensive resources like network infrastructure, data centres, local service teams, and sales expertise. In bridging the gap between devices and various public cloud providers, telcos can materially affect how companies can access, store, utilise and secure data, thus bringing more value to their B2B products. There are myriad examples of how carriers are enabling multi-cloud connectivity through partnerships with third-party service providers such as the single-interface, self-service platforms developed by BT, Vodafone, T-Systems and NTT to support customers' needs.

Tailoring for on-demand experiences

With the 5G revolution, consumers' expectations of their carriers have also become increasingly sophisticated, even as competition between telcos has intensified.

To stymie these outflows, telcos cannot rely on traditional approaches to providing broadband access—in fact, many are increasingly turning to collaborations and innovative bundling solutions with differentiated inputs and experiences. For example, telcos could explore speed-based price tiers that accommodate the limited resources of lower-income consumers. As social media applications are less bandwidth-hungry than cloud VR video, telcos could explore product bundles that provide free access to Instagram or WhatsApp. In doing so, they also open avenues to encourage users to eventually upgrade to premium packages equipped with faster and more reliable connections for metaverse products, or access to exclusive content.

In Ms Yip's view, a few key elements to business success today are the delivery of value to key segments, establishing trust with consumers, enabling intelligent controls and green connectivity, and forging key partnerships to strengthen value proposition to customers with the provision of digital content, lifestyle, insurance services and other regional or global operators. This helps "to build an ecosystem that enables connected, digital lifestyles," she says.

Partnerships with content providers have proven to be an especially popular strategy for telcos to retain a strong competitive edge against their counterparts. For example, Singtel customers can gain exclusive access to Xbox's All Access gaming platform.⁸⁷

There are also new needs emerging post-covid. When the pandemic drove many aspects of life into residences, basic home wi-fi connections were rendered insufficient to support remote work or education. This presents a major business opportunity for telcos as each home now has the potential to become an enterprise customer. Existing enterprise customers may also offer more opportunities for service value-add as more and more companies are expecting to integrate 5G technologies and increase spending, as noted previously. As such, telcos can expect that their existing enterprise accounts will expand in complexity as customers require tailored experiences that encompass on-demand bandwidth, fast customer service, and guaranteed quality.

To take advantage of these market changes, telcos will need to evolve their offerings into tailored, on-demand services that can provide customers with the needed bandwidth with the help of network slicing, edge computing, uplink enhancement, indoor positioning, and so on. This will require telcos to reorient their existing operations around a flexible and agile structure, and develop strong, trust-based relationships with their customers.

Improving carriers' energy efficiency

As the climate crisis bears down on the world, carbon reduction has shifted to the forefront of economic and social development as stakeholders across the value chain awake to its importance. The private sector's awareness has only been bolstered by the growing cohort of national governments making bolder commitments on emissions.

Among survey respondents, ESG issues are a major flashpoint: 75% of European companies said green networks and sustainable development were important focus areas for carriers.

ICT remains one of the least sustainable industries due to their energy- and carbon-intensive activities but their actions could have a dramatic impact on the world's climate trajectory. According to one study, increased use of digital solutions across all industries could lead to a 20% reduction in global greenhouse gas emissions by 2050, especially in high-emitting sectors like energy, materials and mobility.⁸⁸

Telcos will play a crucial part in supporting customers in their pursuit of net-zero targets. By building the necessary internet infrastructure, telcos can actively support companies as they digitalise manual, carbon-intensive processes.

They need to make strong investments into technological innovation that can improve the energy efficiency of their own systems, both Mr Blanco and Mr Tay say. Mr Blanco talks about the "multiplier effect" of low emissions services provided to consumers.

Advanced carbon capture solutions could also help carriers reduce emissions in the rest of their value chain. Many carriers have already made progress on this front, such as Vodafone, whose entire European operations are powered by renewable sources, and China Mobile, whose Jiangsu branch has reduced their electricity consumption by 20% thanks to a shift to solar.

Renewable energy sources are not the only places that telcos can make meaningful sustainable gains, however—carriers can look into decarbonising their overall ICT system, from their equipment to their sites. One such important step is introducing effective energy efficiency metrics, which should be globally accepted and standardised. Secondly, with a set of mechanisms and methods that include the whole process of measurement, reporting, analysing and monitoring, a metrics system can help operators to manage the network energy efficiency improvement progress in real time.



“

Underlying all this are the telcos, whose role in developing the foundational framework of the digital economy is hard to underestimate. Looking ahead, they will only become more relevant in driving more sustainable innovation and access for all.

Conclusion

With the next generation of technological innovations already emerging, there are many priorities clamouring for attention that require the efforts of both public and private sectors. From policy action and better financing tools, to more focus on broad strategy, governments and companies have many plates to juggle.

ICT investments will continue to be a fundamental cornerstone to their long-term success. Strong commitments to ICT investments yield not just financial gains but socioeconomic benefits that will positively impact the effort to fulfil the global SDG agenda. Firms' successful digital transformation will hinge on their commitment to invest in the power of emerging technologies.

Technologies such as AI/ML, data analytics, cloud and edge computing and automation will unlock untold productivity gains and innovations. In order for these tools to make a difference, firms must also understand and invest in 5G network connectivity, both public and private, that will supply the necessary bandwidths, low latencies and high speeds they need to embrace the digital economy. None of this will be possible without investment in 5G.

Although many countries are taking steps towards establishing policies to encourage the

use of ICT, Ms Okuda stresses that much "more can be done in terms of research, capacity development and funding." Collaboration will be key to this. Governments must actively partner with the private sector to ensure right regulations are in place to incentivise investment and innovation, not stifle it. Conversely, the private sector must also see government as an important engine of digital investment and growth.

Underlying all this are the telcos, whose role in developing the foundational framework of the digital economy is hard to underestimate. Looking ahead, they will only become more relevant in driving more sustainable innovation and access for all.

Some important developments will accelerate the development of the digital economy and go a long way in ensuring more people and enterprises benefit more greatly. Mr Blanco speaks about the importance of symmetric regulations. He also speaks about the challenges of improving ICT infrastructure and connectivity without an increase in prices. "We have a lot to do, and we can do it, but we also need some help in maintaining this effort," he says.

Whoever one listens to, it is clear the future lies in collaboration and cooperation.

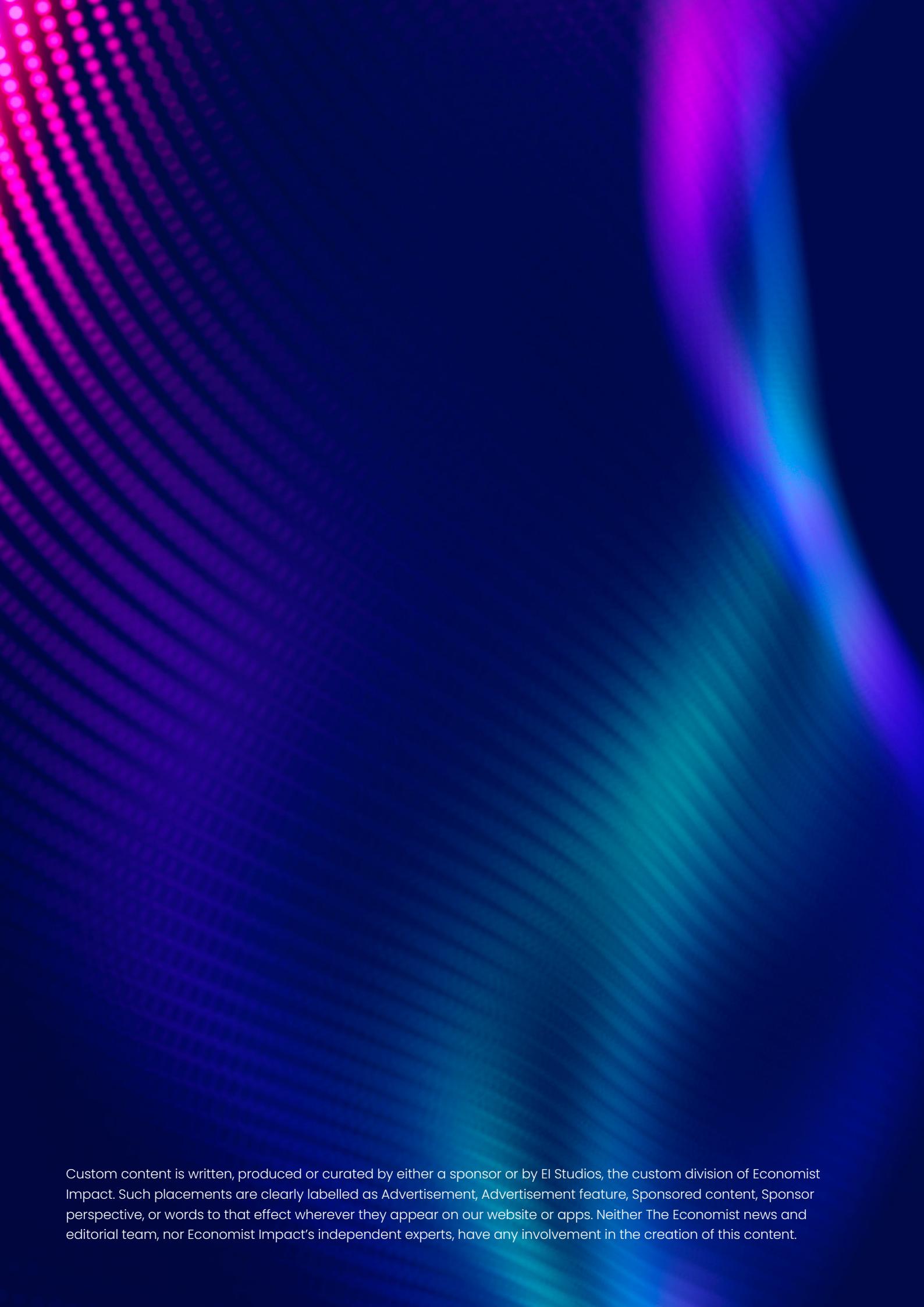
Key takeaways

- **Investment in ICT infrastructure and resulting digitalisation will drive the fourth industrial revolution.** Much as steam power and the mechanisation of production drove the industrial revolution three centuries ago, ICT infrastructure will drive the fourth industrial revolution through gains from digitalisation. A 10% increase in mobile adoption, for example, can result in a GDP increase of 1%, while 5G alone is expected to result in additional global GDP value-add of US\$960 billion, or about 0.7% of global GDP.⁸⁹ Moreover, the impact of mobile adoption increases by about 15% when connections upgrade from one mobile network technology to another. Investment in ICT infrastructure must therefore be a priority for all governments for the socioeconomic development of their peoples.
- **Telcos are at a tipping point.** Telcos have a pivotal role to play as enablers of the digital economy. They have been instrumental in providing necessary connectivity infrastructure and improvements in connectivity. So far, they've borne the burden of ICT infrastructure investment—partly in keeping with their role as public utilities. However, this is not sustainable, given the pace at which infrastructure requirements are changing and the ultimately limited resources telcos have. If ICT infrastructure is a “public good”, others in the ecosystem—such as other enterprises and the public sector—must play a bigger role in financing ICT infrastructure development.
- **5.5G connectivity is the undercurrent enabling technology adoption and its benefits.** There is a sharp focus on technology adoption and implementation, such as the greater use of AI, machine learning, and cloud and edge computing. However, the base requirement for all of this is the availability of and advancements in high-speed, reliable 5G network connectivity to 5.5G. Without investment in networks, the gains from technological developments will be stunted.
- **Public and private sector collaboration are “crucial levers for growth”.** Policymakers and governments play an important role in facilitating investment in ICT infrastructure and in facilitating the digital economy. Doing this effectively requires collaboration and dialogue with the private sector to put in place supportive regulatory frameworks and incentivise innovation in ICT, both of which are essential to boost the digital economy of the future.
- **Investment in ICT unlocks value for the planet and communities.** New and emerging ICT technologies are proving to be instrumental in energy use management, reduction in carbon emissions, in improvements in SDG benchmarks and contributing to community resilience. Traditional Investment in ICT mainly focuses on connectivity and computing. Green technologies will be the third new dimension to maintain long-term vitality of the whole digital economy, improving sustainability and resilience, while unlocking value for communities and the planet.
- **A virtuous cycle that leads from value creation through to value distribution.** The history of economic development shows that every technological upgrade has led to consumption upgrades, and following that, economic upgrades. These form a virtuous cycle of value creation, measurement and distribution for telco operators too. As operators continue to upgrade through the development of new ICT technologies that will drive new forms of business models, more diverse and increased consumption will be seen. Subsequently, new business models result in economic progress, which results in value distribution.

End notes

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