

Fibre Broadband Development Initiative

Towards a Gigabit Society in South Africa

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2. TURNING SOUTH AFRICA INTO A GIGABIT SOCIETY

We live in a world that is constantly changing. Emerging digital technologies are accelerating the transformation of our daily lives, private and public, from businesses to governments, to entire societies. Over the past decade digital transformation has begun to considerably impact the world around us. We increasingly rely on cloud-based, digital services for daily tasks. We have also become a lot more dependent on technology for social and economic advancement.

We are at a point where we have no choice. To remain competitive and relevant, businesses must embrace new technologies and learn to operate within the digital economy. Similarly, for the government to continue delivering services in expanding and progressively complex constituencies, it too must transform itself digitally. As far as the society is concerned, digital technologies need to be leveraged for continuous improvement, whether at work, at school or simply for a better quality of life.

2.1 A New, Intelligent World

Imagine what South Africa would look like if digital infrastructure were readily available, connected high-speed, good quality broadband services over fibre and 5G. If we all had unconstrained access to new technologies which would fundamentally transform our lives. Technologies such as artificial intelligence (AI), augmented / virtual reality (AR/VR) and Internet of Things (IoT) – transforming the environment around us into a more intelligent world.

These new technologies offer endless possibilities to make school, work, play easier, more enjoyable and fulfilling. They will enrich our life experiences; will enable us to do things differently; and will allow us to do things better, to achieve more in less time. They will place the services we often struggle to receive at our fingertips. And it can include everyone; not just a select segment of our society.

Below, we provide a few scenarios of how change is going to impact all of us across different spheres of life. By enabling the new technologies and harnessing their power to transform, we can build an intelligent bright future.



Smart City Living

For those living in cities, the quality of life will be transformed substantially for the better through a myriad of applications. These applications address areas such as security, energy, water, waste, transportation, healthcare, housing, economic development and community engagement.

With the continued urbanisation in South Africa, it means that most of the country's citizens will benefit from smart city advantages and the future development of urban areas will be more sustainable. New technologies such as IoT, AI, cloud, intelligent sensing and smart analytics will be used to improve the existing cities, making them more efficient and liveable.

Utilities such as water and electricity will be intelligently metered at individual homes, leading to more rationalised consumption and also cost savings by residents. Intelligent sensing will be used to continuously monitor various infrastructure (water and gas pipe leaks) and the air and water quality in real time, allowing time to implement mitigating measures in case of problems. Early warning systems will prevent accidents such as the gas explosion in central Johannesburg in July 2023. Waste collection, sorting and disposal will be optimised and automated, increasing the amount of recycled products and eliminating the waste commonly seen in the streets of South African cities today. Residents will only pay for the quantity of waste generated and removed.

Personal and property security will be greatly improved through an extensive network of cameras for standard and intelligent video surveillance. Video footage monitoring in real time will allow quick reaction to incidents. Residents will be safe not only in their own homes but also out in the streets, walking, riding bicycles and playing in the parks.



Living Spaces, Work and Entertainment

Linked to the smart city environment are smart living spaces, from individual homes to buildings to broader communities. An integral component of a smart city is a smart home, where new technology enables a comfortable, secure and healthy personal environment. The smart home will also be more cost-effective due to intelligent monitoring and control of the use of electricity and water. An array of IoT technologies will enable a fully automated, intelligent home, with connected appliances and sensors. The home will automatically respond to the residents' life pattern by

“intuitively” adjusting different appliances and the mood around the house. It will be connected to the digital ecosystem, making it possible to control the home sensors from anywhere and for the home to interact on its own with other smart facilities like shops or utility companies to signal when the food supplies need to be restocked or garbage collected.

Similarly, office, retail, municipal and other buildings will have their interiors controlled through the use of various technologies. These technologies will also monitor the buildings' external and internal condition to undertake preventative maintenance, as required. Apart from creating more human-friendly indoor spaces, building owners and management companies will be able to realise cost savings from intelligent premises and campuses.

Entertainment will become ubiquitous, not only in the home, but extended to mobile devices and even vehicles in the connected ecosystem of a smart community or a city. The metaverse, coupled with mixed reality and ultra-high definition video, will provide an immersive user experience whether gaming, watching movies or enjoying cultural tourism.

For many people, work has migrated to a hybrid model or outright work-from-home. In a gigabit economy, both the home and the office are conducive to more efficient and productive work. In fact, work could be undertaken from anywhere within a smart city, thanks to digital infrastructure.

A range of new technologies will improve workflow, collaborative interaction and management, leading to far greater productivity. All workloads, files and applications will be stored in the cloud, easily accessible from anywhere. AI-based automation applications, augmented and virtual reality, blockchain and 3D projection are examples of emerging technologies which will make work easier and more meaningful. These new technologies will result in quicker and better quality outputs, leaving more time for the family and leisure.



Health

Thanks to new technologies, medicine is going to shift from treatment of ailments to prevention of ailments. Wearing devices – whether fitness watches or portable medical monitoring equipment – will generate vast amounts of data about a person's health. With the use of AI, medical practitioners will be able to develop much better health profiles of individuals and react to early warnings of potential

ailments. This includes early diagnosis and focused treatment of cancer. The medical conundrum of the 20th century may finally be solved.

Smart health administration will be based on a national health record database which will make patient records available to all healthcare facilities in the country. This will make patient monitoring, diagnosis and treatment a lot more efficient. People will also be able to receive targeted guidance on how to improve their lifestyles through exercise, nutrition, sleep and mental health.

Telemedicine will make it possible to provide quality advice and treatment remotely to patients living far away from large medical facilities. Rural clinics will be supported by specialised medical staff and equipment normally located in large urban areas or even in other countries. Good broadband connectivity and real-time, ultra-high definition (HD) video communications will make remote consultations, diagnosis and treatment possible. Telemedicine will also allow patients to spend more time at home and less time in a hospital, freeing up medical facility resources for those really requiring hospitalisation. And, naturally, there is no place like home to get well quicker.

Life in a digital world has other health benefits as well. Apart from the fact that fibre is a “greener” technology than other broadband technologies, the digital lifestyle also results in lower carbon emissions. This improves health and lifestyle quality.



Education

The world will literally become the future classroom. Schools and other institutions of learning will no longer be constrained by the resources and teaching staff they have available at their premises. With fast internet connectivity, it will be possible for learners and teachers to be separated by long distances and still be part of the same lecture through ultra-high definition video links.

It will no longer be necessary to have all the teachers or professors “under one roof”. It will not matter whether learners live in a big city or a far-away village; sit in a classroom or learn from home. All will be able to obtain the same high quality education. The disparity between good quality education in the big cities and the poor quality of education in the deep rural areas will disappear. All youth will have equal opportunity to advance in life, building on their education.

The ability to tap into global educational resources has the additional advantage of doing “more with less”. A limited government budget will not be a constraint on the types of educational resources learners can access. If a rural school cannot afford to fully equip a chemistry lab, a virtual 3D simulation lab will more than compensate for that.

The classroom and the lab will become an immersive experience, enhanced through the use of augmented and virtual reality (AR/VR) teaching aids for much richer learning content presentation. For example, in a biology

class, learners will be able to learn human anatomy on a “real” body. Or in a science class, a virtual simulation lab can be used to discover the impact of rising global temperatures on sea levels. By the same token, new technologies will provide teachers with a wide array of teaching aids which will result in much better learning outcomes.

Learning programmes will be customisable, to an extent, to suit the learners’ specific interests in future professional work. Artificial intelligence (AI) will be used to analyse learning models and individual learner performance to modify content and teaching approaches to suit individual learner abilities. This will result in better quality education and will allow learners to excel in their areas of excellence.



Economy and Business

The gigabit economy will have a significant impact in all industries, across primary, secondary and tertiary sectors of the economy. This will manifest itself through greater work efficiencies, stronger economic growth and new employment opportunities. A higher skilled workforce, through better education and training, will be more globally competitive, increasing outward export prospects and inward investment. Remote work possibilities, out of South Africa for clients or employers anywhere else in the world, will expand the job market and provide an opportunity to learn new skills and gain new experience.

Precision agriculture, powered by data related to the crops, the soil and the weather conditions will help increase agricultural outputs from the same geographical areas, ultimately improving food security. Data will be gathered through a range of IoT measurement devices and processed in the cloud with the use of analytical tools to inform farmers on the exact condition of crops or animals, and provide advice on intervention measures. Food production per hectare will be further increased through vertical farming, where a data-driven approach will be even more important, controlling input factors at all stages of crop growth and harvesting – water, temperature, light and the provision of nutrients. Vertical farming can be even done in cities, on rooftops or in unused warehouses.

The era of smart manufacturing will arrive with the establishment of smart factories, integrating and interconnecting smart devices and control systems with the internet. Factories will typically have their own private broadband networks but will be interconnected up and down the value chain with suppliers of input products and recipients of manufactured products. The manufacturing processes will be largely automated, where humans will work alongside industrial robots. Through training and upskilling, humans will assume more oversight and control roles.

Technologies such as holographic simulation design, digital twins and automated optical quality inspection (AOI) of products will help make better production decisions, resulting in better quality products, lower production costs and higher revenues. The manufacturing process will also be more flexible, making possible a higher degree of customisation of products to specific client needs.

The mineral resources industry will also undergo extensive transformation. The mine of the future will be to a large degree automated or operated remotely, including autonomous machinery undertaking dangerous tasks, such as ore excavation and transport. The resultant work environment will be much safer for humans, while increasing the mining output.

Moving goods around and through the value chain will change fundamentally with the implementation of point-to-point logistics (where deliveries take place directly between geographic points) and the introduction of a low-altitude economy – using unmanned aerial vehicles (such as drones) to distribute goods. With a significant

reduction in road traffic, and intelligent management of the remaining road traffic, logistics will become a lot more cost-effective. This will reduce wastage and input cost into downstream products and services across all industries. Consumers can look forward to better quality and less expensive shopping.

Speaking of shopping, e-Commerce will play a far bigger role than it does today. Supply and distribution networks will be integrated with e-Commerce platforms, ensuring the availability of products and seamless delivery to the buyer's address or a smart collection box. With much of the trade moving onto digital platforms, the barriers to entry into the business world for young entrepreneurs will be lowered by not having to fund brick-and-mortar operations, such as a shop or office space. And the exposure for new start-up companies will be global, not just local. This will exponentially increase the potential sales market.

Cloud adoption by businesses is progressing and in the not-so-distant a future we will experience complete enterprise cloudification. With all data and applications based in the cloud, businesses will have the flexibility to establish co-operation between various organisations within the country or globally almost instantaneously. This will open a whole new world of collaborative opportunities for companies based in South Africa.



e-Government Services

Perhaps the greatest positive impact of a gigabit society will be felt by the people of South Africa in the realm of government services. Nowadays, the thought of having to deal with government agencies makes one despondent. But this will all change in the future, with various e-Government services being available at one's fingertips. Digitisation of a wide range of government services will make service delivery more efficient on the one hand, and enable broad

access to such services on the other. We will no longer have to go to government offices and stand in long queues only to be turned back because "the system is down".

e-Government services will include not only payment of municipal bills and online tax filing, already available today, but also identification document and driver's licence applications, vehicle and voter registration (with courier delivery of relevant documents), digital business licensing, digital online training and job platforms, all accessible from personal computers and smart devices. A government app will provide a one-stop virtual office for the entire range of services. Digital identity authentication, digital signatures and digital payment systems will make interacting with the government quick and painless for individuals and businesses alike.

Time spent travelling to government offices and standing in queues represents a significant cost to South Africa – in absolute cost and opportunity cost. It negatively impacts the poorer segments of the society particularly hard. With e-Government services available, the SASSA grant recipients will no longer have to spend time and money to collect their grants, for instance. The same will apply to Unemployment Insurance Fund (UIF) registration and payment receipts.

2.2 Bringing the Gigabit Society Vision to Life

Creating the Gigabit Society

A gigabit society is created over time, as digital infrastructure expands and various stakeholders – citizens, businesses, government and other entities – make increasing use of digital applications, tools and services to conduct everyday activities. The evolution path progresses from a society characterised by limited availability and use of digital services to a digital society to a gigabit society. Whereas the digital society is characterised by a fairly profuse use of digital technologies and services, the gigabit society is one where typically very high

throughput speeds, with very low latency are available to all premises across broadband infrastructure. This enables a whole new world of digital interaction and engagement among all stakeholders. In parallel with the creation of a gigabit society, a gigabit economy is created.

To achieve the gigabit society, a number of challenges need to be overcome. The challenges which South Africa faces currently can be divided into those related to: (1) digital infrastructure deployment, and (2) social evolution. The former relates to the ability to build digital infrastructure (including gigabit broadband networks) quickly and cost-effectively. The latter refers to affordability of broadband services and digital literacy within segments of our society.

Both types of challenges can be successfully addressed through policies, as well as government and private sector intervention measures.

To create the South African digital society, the right building blocks need to be put in place. They need to address the challenges and lay the foundation for the future expansion of digital infrastructure and services. The digital landscape evolution must take place within a legal framework conducive to rapid deployment and adoption of gigabit infrastructure and digital technologies. South Africa has already put in place a legal framework – policies, plans, legislation and regulations – to guide future development and service provision.

The existing framework needs to be reviewed to ensure that it is properly aligned with the goal of creating a gigabit society and it needs to be built on. The review should give rise to a focussed strategy, featuring a clear roadmap setting out the steps for South Africa to progress to a gigabit society. A key feature of this strategy must be effective co-ordination of existing government and private sector initiatives already aligned with a gigabit economy future.

Gigabit Society Means Growth

The deployment of a deep fibre fabric, enabling the creation of a gigabit society, will have a multiplier effect on social and economic development. It will enable extensive use of technologies such as artificial intelligence (AI), the Internet of Things (IoT), blockchain, smart, real-time analytics and others, driving efficiencies and growth. Life will improve significantly not only for those individuals living in the urban areas but also in remote rural areas.

As gigabit broadband penetration increases, its benefits will spread across the entire economy, from agriculture and mining through to all government services. An economy that is expanding at a faster rate will also result in higher employment. This will be evident across most of the sectors of the economy but in particular in the services industry, where opportunities will be unlocked for companies and individuals alike, and allow them to leverage digital infrastructure to become more efficient and competitive. In particular, it will enable more small businesses to be created and to grow.

A build-out of deep fibre infrastructure will also bring about change in the social fabric of the society. It will close the digital divide and bring the potential of affordable high-speed internet to all citizens. Closing the digital divide will not only achieve ubiquitous access, but create new labour, commercial and property markets in every locality connected to high-speed broadband, leading to an increase in localised job creation and a change in net migration patterns.

Digital infrastructure will support the government's objective to become more efficient and responsive to all who live in South Africa. Access to highly responsive e-Government services will also be made easier, regardless of location, eradicating the burden of travelling long distances to stand in queues.

Crucially, gigabit broadband will open up the digital economy to all citizens who will be able to take advantage of services such as online education content and live teaching, tele-medicine, and a wide range of other digital services. It will transcend geographic and income-constrained inequitable access, allowing all users to take advantage of digital services on a ubiquitous basis.

Fibre as a Critical Gigabit Society Enabler

To properly leverage various elements of the digital infrastructure, it needs to be interconnected with high-speed, high-capacity links which facilitate unhindered flow of data traffic. These links are like veins and arteries, providing vital network connecting all organs in the body.

The only technology able to provide the data network infrastructure underpinning a gigabit society is optical fibre. To realise the greatest benefit from fibre infrastructure, it needs to be deployed as deeply as possible in the network to develop a comprehensive deep fibre fabric. Fibre optic technology has the characteristics necessary to support new applications which require either high throughput rates or low latency on the network, or both. Fibre is also necessary to support other last mile technologies, such as fixed or mobile 5G and subsequent technologies.

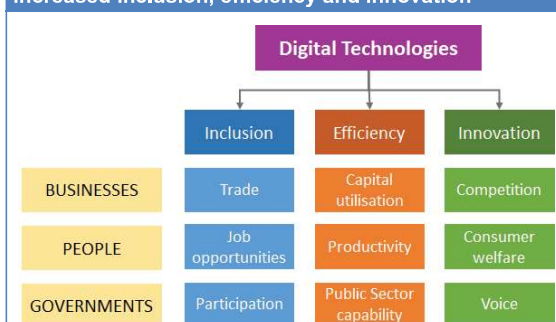
Gigabit broadband infrastructure does not mean that every individual, household and organisation needs to have at least a 1Gbps connection. A broadband connection must be sufficient in speed and quality to allow individuals and organisations to make use of a wide range of digital services. The requirements will vary for different entities. Many organisations will require gigabit connectivity to carry out their work activity; for example schools, hospitals, manufacturing plants or government offices. Furthermore, broadband requirements will grow over time, as the digital world expands, and ultimately many private households will have gigabit connectivity as well.

3. SOCIAL AND ECONOMIC IMPACT OF FIXED BROADBAND

3.1 Introduction

Governments around the world recognise access to broadband as a key enabler of economic and social development. Broadband infrastructure has the power to revolutionise the way we live and work. Our ability to grasp the digital opportunities will dictate our success at achieving a sustainable and inclusive long-term growth path. High-speed fixed line broadband is an enabler of social cohesiveness, and an enabler of competition, improved provision of government services and ultimately economic growth and job creation.

Exhibit 3.1: Benefits of digital technologies through increased inclusion, efficiency and innovation



Source: Kim, Y., Kelly, T., & Raja, S. (2010), Building broadband: Strategies and policies for the developing world. Washington, DC: World Bank.

During the last two decades, researchers have examined the impact of broadband penetration and its contribution to the social and economic well-being of countries. Our research found that increasing investments in fixed and mobile broadband lead to an increase in economic and social well-being of South Africa. High-speed broadband is a technology that has no gateways – every person can benefit from high-speed connectivity.

The scope of the benefits of high-speed broadband is enormous and covers all spheres of society, being government, people and businesses. The exhibit below illustrates how digital technologies, supported by high-speed broadband, positively impact on a country.

3.2 The Benefits of High-Speed Broadband for Society

Mobile telephony brought a significant connectivity benefit to South Africans. Millions of people who were reliant on fixed line public payphones could now communicate and contact family members directly. Today, South Africans deserve another connectivity dividend by bringing high-speed fixed line connectivity to the home and removing the digital divide.

Closing the digital divide and bringing high-speed broadband is proven to have significant benefits to the youth, women and children, opening opportunities for social and economic inclusion.

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Access to high-speed fixed broadband for women offers access to high quality healthcare in the privacy of their own homes, avoiding the intrusive nature of standing in queues at under-resourced medical centres.

Exhibit 3.2: Standing in queues vs. high resolution online medication consultations

Queues at the Block TT clinic, Shoshanguve, Gauteng Province, South Africa



Medical consultation using high-speed fixed broadband in the home



Source: Rekord, 2018: Long queues, poor service at north clinic; available at: www.rekord.co.za & Moosa, 2021: Primary Care and Telemedicine in Africa. Available at: <https://profmoosa.com/primary-care-and-telemedicine-in-africa/>

Closing the digital divide through high-speed fixed broadband access also serves to protect the vulnerable from criminal activities. Online access will allow individuals to report criminal activity and increase civic participation in crime prevention duties. Global studies show that the ability for members of society to report crimes through online portals² reduces both discrimination and the overall crime rate (Jayasinghe & Perera / IJCTT, 2021).

The Healthcare Sector

We have learnt from the COVID-19 experience that it is critical to connect all healthcare locations so that at least minimum services can continue to function, let alone effectively manage disasters. The lessons from COVID-19 indicate the potential benefits a “digital first” approach to healthcare services, where incident and resource response capability is dependent on the quality and frequency with which information is captured and shared, from the patient site to the final decision makers.

The South African Department of Health, under the District Health Information System programme has already made considerable progress towards creating and standardising a database of healthcare records per patient.

² The South African Police Service already offers the “My SAPS” mobile application.

Example: How online healthcare booking systems can improve access to healthcare

During the height of COVID-19, a county in Tennessee, USA opened an online booking portal for vaccine injections on a Friday. The 10 800 slots were booked within 48 hours.

South Africa's first nationwide public healthcare online platform was the South African government's online portal for booking vaccine appointments, with various provinces and healthcare facilities implementing their own online appointment booking systems.

The impact of online appointment booking systems is vast. A study conducted in Iran showed the following beneficial impacts:

1. Patient waiting time reduced by 38%.
2. Patient no-show rate reduced by 56%.
3. Physician punctuality improved by 50%.

Source: Department of Health, Annual Report for 2021/2022; Digital Planet, 2022; Mazaheri Habibi, Mohammad Reza & Mohammadabadi, Fahimeh & Tabesh, Hamed & Vakili-Arki, Hasan & Abu-Hanna, Ameen & Eslami, Saeid. (2019). Effect of an Online Appointment Scheduling System on Evaluation Metrics of Outpatient Scheduling System: a before-after Multicenter Study. Journal of Medical Systems. 43. 10.1007/s10916-019-1383-5.

The benefits of a "digital first" healthcare sector are not limited to improved information flow, but more directly to improvements in patient treatment. Various studies report that, through the direct introduction of high-speed broadband connectivity, artificial intelligence and predictive analytics in the healthcare system, significant time-savings and service benefits can be realised being:

- A 60% increase in a medical facility's ability to treat patients with complex medical conditions.
- Patients being allocated a bed up to 30% more quickly than current timelines (Amjad & Kordel, 2023).

A full-scale mobilisation of e-Medicine can have substantial productivity and societal benefits, as the example below provides context to.

Exhibit 3.3: The healthcare experience today vs. tomorrow

Today – the common story in rural areas	Tomorrow
<ol style="list-style-type: none"> 1. An over 60-year-old out-patient had to catch a midnight bus to make his appointment at Zithulele Hospital (Eastern Cape province). 2. The bus broke down because of the roads were in poor condition. 3. The hospital did not have the resources to attend to the patient. 4. The patient had to return to the hospital at another time, incurring additional costs and time loss. 	<ol style="list-style-type: none"> 1. The patient can contact the hospital from home, saving time and money. 2. The patient can talk to a local doctor and global experts at the same time, receiving the best consultation. 3. Medicine can be delivered to rural areas by locally manufactured drones.

An increased penetration of broadband in this sector will not only provide health-care benefits but also lead to improvements in procurement systems, stock and order management, challenges that public facilities currently frequently experience.

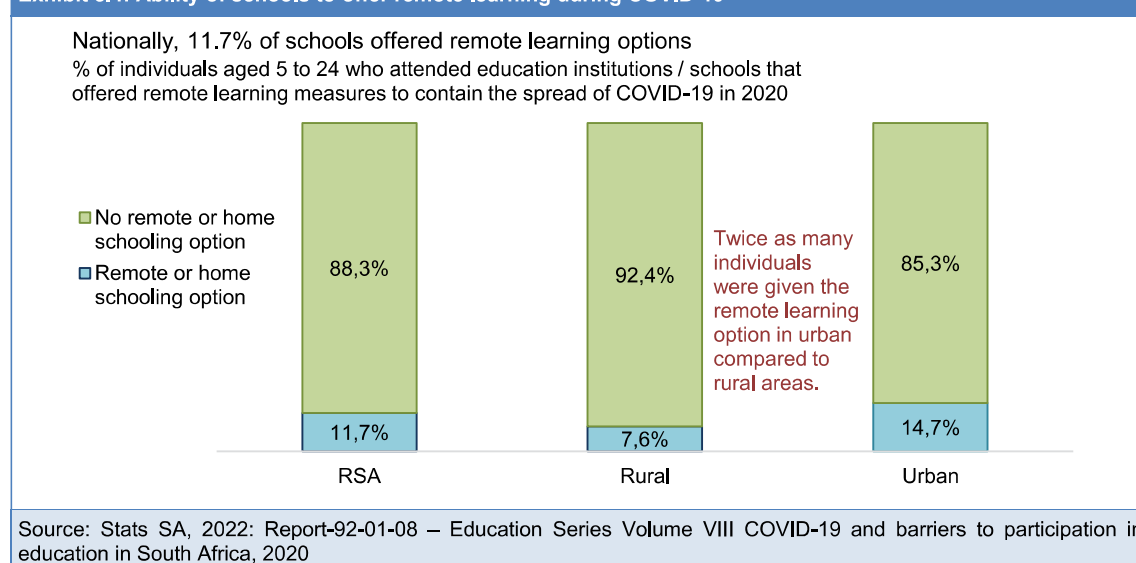
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With increased high-speed connectivity and the use of supporting technologies, it is possible to perceive the South African healthcare sector providing a greater social return to that measured historically. To estimate the potential of high-speed connectivity in South Africa's healthcare system, the co-efficient of high-speed broadband access to healthcare was increased by a transformative additional 0.5%.

The Education Sector

The benefits of increased fixed broadband penetration to schools are immeasurable, as this provides learners and educators access to the required teaching and learning materials, and provides support to the educators through improved workflow processes. Connectivity can be used as a dual goal tool – to increase the quality of teaching to the learners and to reduce the burden of learner record management on teachers, creating more time for learner-educator engagement.

Exhibit 3.4: Ability of schools to offer remote learning during COVID-19

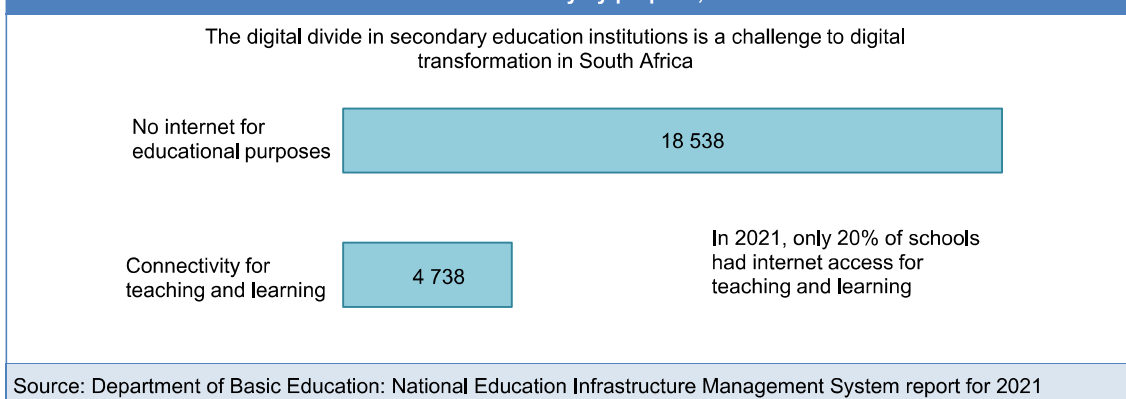


Various studies have found that online learning may have a significant impact on economic growth and development. One particular study found that online learning platforms may boost economic growth by as much as 0.24% (Omar, 2020), although the results are only marginally statistically significant.

In a country such as South Africa, with a wide disparity in access to resources, internet connectivity at schools must be viewed as a key component of reducing the digital divide. However, it is important to take note of the evidence that suggests that unguarded access to the internet at school may be detrimental.

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Exhibit 3.5: Number of schools with internet connectivity by purpose, 2021



Increased access to the internet for teaching and learning will reduce the amount of time a teacher spends on administrative tasks (e.g., attendance tracking and performance monitoring) and make more time available for actual learner-educator engagement with the subject matter, leading to an improvement in educational outcomes.³

However, the benefits of digital education are to be felt in both the short and long term. Key areas where research shows that digital education has significant benefits include:

- Increase in the speed and depth of learning in science and mathematics for primary and secondary age learners.
- Reduction of differences in educational attainment across income categories (when excluding digital access gaps).
- An improvement in the transition from schooling to employment as school-leavers are more able to seek out employment opportunities *before* leaving school.⁴

Exhibit 3.6: Eight reasons for digital education and digitalisation in a post-Covid world

1. Reduces the requirement for investment in physical infrastructure as more students can study from a location of their choice.	5. The need for digital education is widespread. Digital content is becoming more affordable; digital skills are now considered a foundational pillar for the growth of African economies.
2. Breaks the societal barriers to accessing education, especially for girls who are unable to attend school because of poverty or any other reason.	6. Digital options offer learners access to subject matter experts online in the absence of qualified teachers in their immediate physical environment.
3. Digital education can mitigate barriers to education – from geographical remoteness to disruptive, so that children can continue to learn wherever they are.	7. Digital education can transform the lives of learners by expanding their vision of what is possible through, for example, technology-related careers.
4. Digital education enables personalised monitoring – teachers can monitor a learner's individual progress and customise the learning journey so that it is at the right level for that learner. This is important because there is no one-size-fits-all.	8. Digital literacy is crucial to exploit the full benefits of the digital economy, such as how to efficiently access and use online services and resources.

Source: Vodacom, 2023: Connected Education: How digital technologies can transform education in sub-Saharan Africa.

³ Haleem, A., Javaid, M., Qadri, M.A. & Suman, R: Understanding the role of digital technologies in education: A review. *Sustainable Operations and Computers*, 2022. <https://doi.org/10.1016/j.susoc.2022.05.004>

⁴ ICF Consulting Services Ltd, 2015. Literature Review on the Impact of Digital Technology on Learning and Teaching.

3.3 High-Speed Broadband for Businesses

The availability of high-speed broadband changes the business environment dramatically. It opens up both local and global markets through a myriad of mechanisms, including:

- The ability to source new products and suppliers.
- The ability for businesses to market themselves to an entire new global market, rather than being confined to the traditional word-of-mouth and proximity-based market scale and scope.
- The ability to compete more effectively by improving sales channels and advertise more effectively.

High-speed broadband, based on a nationwide deep fibre fabric, also fosters business activities within the business sector that further enhance and increase the scope and scale of trade. The real-time tracking and GIS management of logistics chains has created the opportunities for global and local online stores to commit to service delivery timelines and often bring products to consumers which would otherwise have required expensive trips to shopping districts. A business model created directly out of access to high-speed broadband is the so-called “click and collect” courier business. This business typically involves a (courier) company installing lockers or creating pick-up points in regional towns. Consumers then access these lockers via online vouchers or coupons, signaling via broadband networks to a courier company to collect and then deliver a package in another part of the country, at a fraction of the cost of traditional courier services. This “click and collect” courier business label could be applied to the large retail distribution stores just as it could be to the courier businesses. Twenty years ago, the South African courier services market was concentrated around a few large courier businesses. Today, high-speed broadband has facilitated the ability for multiple new entrants, reducing prices; all to the benefit of consumers.

High-speed broadband, both within and between company premises, is used to introduce digital technologies that speed up processes and allow for the introduction of new products and services. One of the most impactful benefits of high-speed broadband in the banking sector is the ability to offer online banking services, and process thousands of transactions in minutes rather than days.

Examples of high-speed broadband in manufacturing include the potential of automation and digital twinning. Automation and digital twinning rely on the ability to install multiple sensors in multiple locations, all connected to a single network via high-speed deployment solutions. Digital twinning is growing in its application across almost all sectors in the economy, from livestock monitoring to advanced diagnosis and preventive treatments.⁵



Example: Emerging farmers preparing increased product yield due to larger, online-sourced orders

A digital agricultural sector would lead to increased efficiencies, with digital tools such as integrated, live databases on land ownership, livestock tracing for biosecurity (in masterplan) and carbon capture. Increased fixed broadband penetration will also allow aspirant job seekers to study and match skills requirements to job opportunities.

The adoption of high-speed broadband and the supported digital transformation has led to increases in operational and financial performance of companies.⁶ One example is the ability for consumers to self-complete

⁵ Attaranm M & Celik, B.G. 2023: Digital Twin: Benefits, use cases, challenges, and opportunities. Decision Analytics Journal. <https://doi.org/10.1016/j.dajour.2023.100165>

⁶ Guo L, Xu L. The Effects of Digital Transformation on Firm Performance: Evidence from China's Manufacturing Sector. Sustainability. 2021; 13(22):12844. <https://doi.org/10.3390/su132212844>

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forms online, representing a significant operational benefit, both in time saved and a reduction in the costs associated with back-office processing.⁷

Another example of digital transformation initiatives is the ability for sensors to support manufacturing processes by the early identification of operational or maintenance weak-points and the ability to act before a problem actually materialises.



Example: Digital transformation in coal beneficiation – Exxarro's Belfast coal beneficiation plant

Exxarro, a mining company with operations spanning the globe, operates numerous mines in South Africa. The company implemented a smart control solution at its Belfast, Mpumalanga Province coal beneficiation plant to monitor build-up of waste material in the production process. The system can automatically reduce feed if build-up occurs. The benefits are substantial, with stoppage time reduced by almost 80%, from 48 hours per month to 10 hours per month.

Source: Digital Transformation Case Study, Exxarro

Exports of key manufacturing and mining products will increase, with the transport and logistics sector being able to provide real-time and accurate location and time-scheduling. Creating a digital twin of South Africa's ports, along with online logistics tools, has the capacity to significantly reduce truck load and queue time periods, the amount of time a ship berths at the harbour, and reduce the consumption of diesel (Heilig et al, 2017). Transnet has already commenced this journey, with the installation of 100 Gbps links between all its logistics nodes.

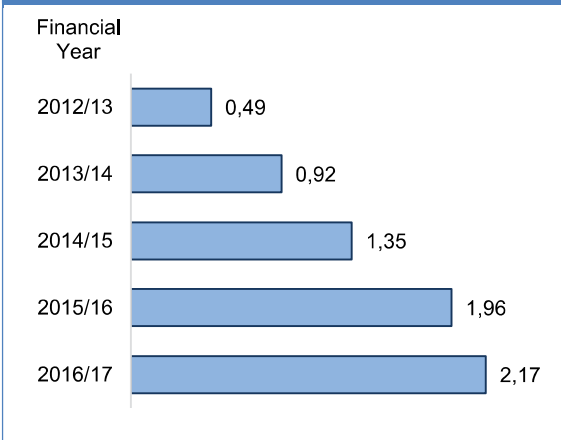
3.4 High-Speed Broadband for Governments

Research studies from around the world provide evidence that government adoption of a "digital first" strategy can lead to cost-reductions, improvements in efficiency and a reduction in the potential for corruption (World Bank, 2009) (Hasbi, 2017).

⁷ See exhibit below regarding the consumer's time saved from no longer standing in queues.

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Exhibit 3.7: Estimated cumulative savings based on digitising government services (GBP billions)



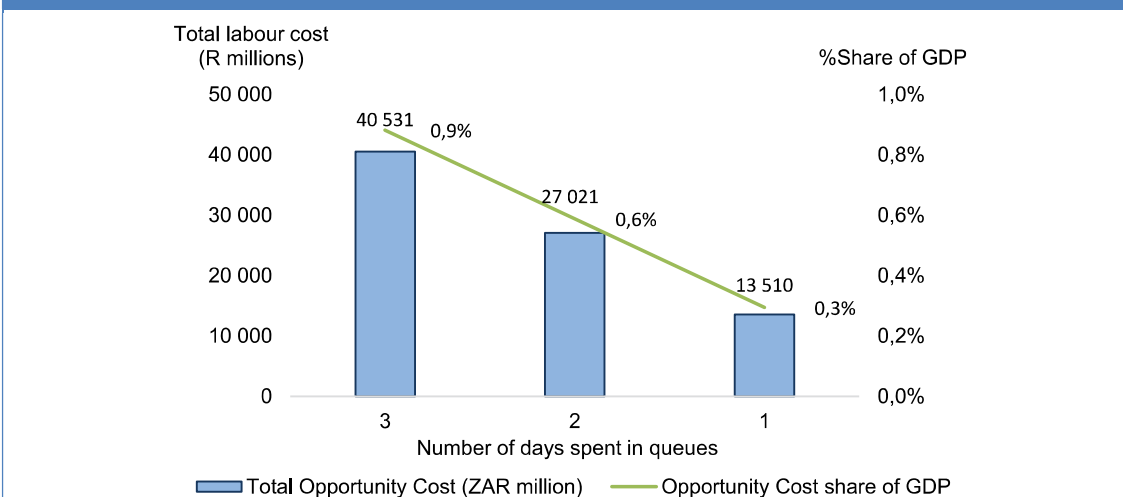
Source: UK government, 2012

Other studies indicate the importance of a data-driven public sector, where data is an asset and integral to policy making, service delivery, organisational management and innovation (van Ooijen, 2019). For example, McKinsey finds that digital tools used to share information about city infrastructure can reduce fatalities by about 8% to 10% and accelerate response times by 20% to 35% (McKinsey Global Institute, 2018).

One key measurement of potential productivity gains is the reduction in time spent standing in queues for government services. The UK government has estimated the number of government department customer-facing services⁸ that could be provided by online platforms and estimated the associated level of government savings, represented in the graphic to the left.

In South Africa, the benefit of digitising government services could be significant – a potential saving of 0.5% of annual GDP. This estimated saving is based on a reduction of the amount of time spent in queues from three days a year to one day a year. This is illustrated below. The assumption that South Africans spend a maximum of only three days a year in a queue is probably an under-estimate and, therefore, the productivity benefits of digitising services would most likely be far larger.

Exhibit 3.8: The opportunity cost of standing in queues in South Africa



Source: Stats SA, Africa Analysis calculations

⁸ Customer-facing services include: government to business (e.g., business registration); government to consumer services (e.g., ID application of school placement portals) or government to general (municipal accounts).

3.5 Measuring the Impact of Broadband on Society

Key Lessons from the Literature

There is a strong consensus in the literature that broadband has material positive impacts for national economies.

Mass market broadband services started to emerge in the late 1990s. However, empirical studies on national economic impacts of broadband only started to emerge from the late 2000s, as adoption rates and time-series data became available.

This section of the paper provides a brief literature review of research into the impact of investment in telecommunications network infrastructure, the externality impact of increased investments in this type of network industry, as well as spillover effects into how broadband adoption creates new opportunities, industries and employment growth.

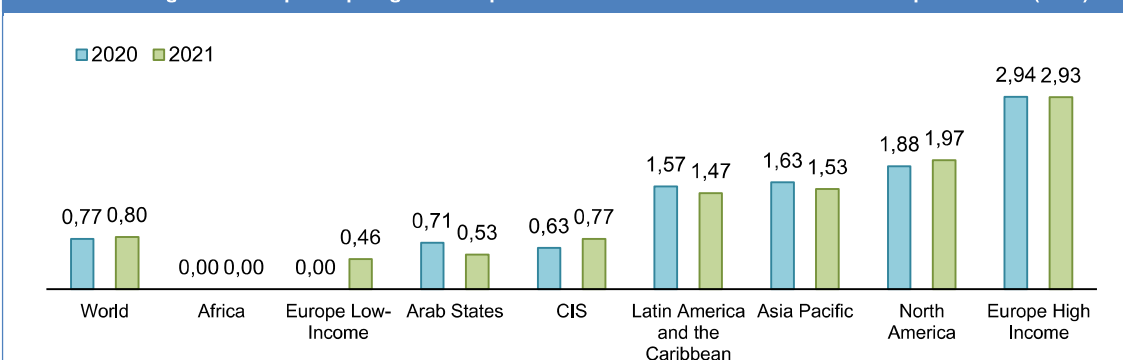
Impact of Broadband Penetration on GDP Growth

Studies from around the world confirm that increased broadband penetration and adoption contribute to economic growth, both directly through network investment, and through the creation of new digital businesses and platforms, i.e., the digital society. Importantly, these studies reveal that low and middle-income countries tend to benefit the most from increased penetration of fixed broadband. This result is in line with any technology development pathway, as the returns to adoption and use eventually taper off due to diminishing marginal returns.

Exhibit 3.9: Summary of literature on the impact of broadband penetration on economic growth			
Study Name/Author	Study period	Geographic Region	Impact on GDP of a 10% Increase in Fixed Broadband Penetration
Qiang and Rossotto, 2009	1980 to 2002	66 high-income economies	1.21%
Koutroumpis, 2009	2002 to 2007	OECD sample of 22 countries	0.24%
Czernich et al. 2011	1996 to 2007	OECD sample of countries	0.9% to 1.5%
Koutroumpis, 2018	2002 to 2016	OECD countries	0.38%
ITU, 2020	2010 to 2017	139 countries	<ul style="list-style-type: none"> Low-income countries: N/A Medium income countries: 0.5% High income countries: 1.4%
ITU, 2021	2010 to 2020	139 countries	<ul style="list-style-type: none"> Low-income countries: N/A Medium income countries: 0.85% High income countries: 1.25%
Source: Various literature			

The exhibit below compares the ITU 2020 to 2021 assessments of fixed broadband impact on GDP per capita, on a geographic region basis. There is no direct relationship evident between fixed broadband and GDP growth in Africa, but this is a result of the low penetration of this service across the continent.

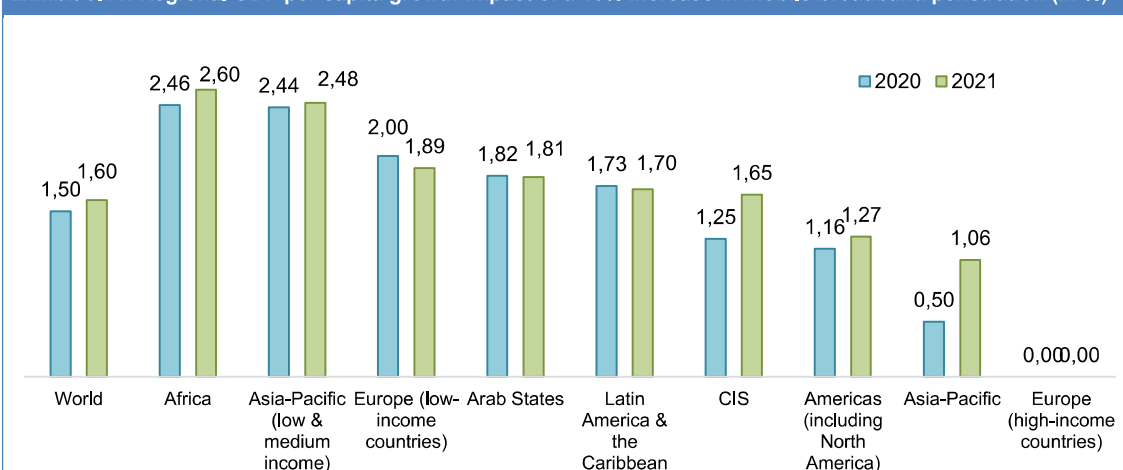
Exhibit 3.10: Regional GDP per capita growth impact of a 10% increase in fixed broadband penetration (in %)



Source: ITU, 2021

However, the ITU reports that the penetration of mobile broadband has a significant impact on economic growth in lesser developed nations, and particularly in Africa. We should expect this result given the historical legacy of limited fixed network expansion beyond core economic nodes within cities on the African continent.

Exhibit 3.11: Regional GDP per capita growth impact of a 10% increase in mobile broadband penetration (in %)



Source: ITU, 2021

South Africa Specific Studies

O'Conner, et al., 2020, found that for the period 2002 to 2017, a 10% increase in South Africa's fixed broadband penetration led to a 0.27% increase in GDP per capita. Google estimated that the economic impact of the landing of the Equiano sub-sea cable in South Africa will lead to an increase in average year-on-year real economic growth of 0.32 percentage points for the period 2022 to 2025, and indirectly create an additional 180 000 new jobs.

This forecast growth is driven by an increase in broadband penetration (both fixed and mobile), as well as a significant increase in average download speeds, from 25 Mbps in 2021 to 75 Mbps in 2025 – an increase in speeds of over 150% in merely four years.

Concluding Remarks

The two ITU studies, research focusing on other parts of the world, and the recent studies focussing on South Africa, conclude the following:

- The economic impact of fixed broadband increases with the level of general economic development.
- The complementary roles of mobile and fixed high-speed broadband penetration are a key driver of growth in low and middle income countries.
- Speed matters, where an increased average internet speed leads to an increase in the growth in GDP.
- The economic benefits of an increase in broadband penetration are limited to the ability and willingness of an economy to fully adopt the use of new digital tools (Koutrompis, 2018).

3.6 Increased Broadband Penetration Impact on the South African Economy

South Africa's Current Position

South Africa has been experiencing a significant growth in the number of fixed broadband connections, due to the rollout of fibre by the private sector, where the literature review (O'Conner, et al., 2020) shows that a 10% increase in fixed broadband penetration drives a minimum of a 0.27% increase in GDP per capita. Through the release of high-demand spectrum by ICASA in 2022, the mobile network operators can now expedite deployment of 5G networks and bring high-speed connectivity to most of South Africa. As the ITU (2021) shows, increased mobile broadband penetration has a significant impact on economic growth and the release of high-demand spectrum is expected to substantively close the digital divide that exists today. A combination of other wireless solutions also plays a significant role in the provision of high-speed broadband to South Africans.

South Africa is in a position to capture the considerable benefits of the digital society, once it has reached the critical mass of fixed broadband penetration.⁹ Our growth model, using the standard methodology developed by the ITU, forecasts that South Africa can return to a significant growth period over the next ten years.

Future Growth Trajectory and Sectors That Will Drive Success

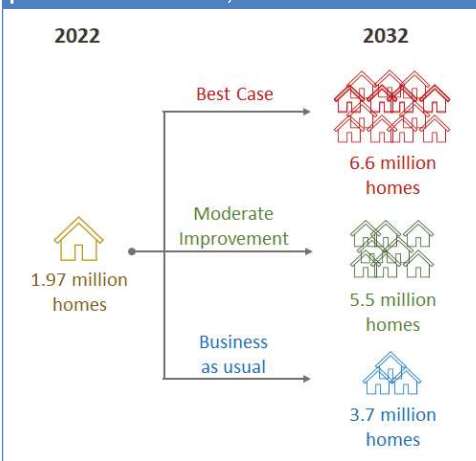
We have developed a ten-year scenario for fixed broadband penetration, where in the Best Case scenario, South Africa will see 6.6 million homes connected to fixed wireline broadband (i.e., fibre), increasing the current connection level more than 3x within ten years. The three scenarios are illustrated below.

An increase in fixed broadband penetration will provide up to R1.46 trillion additional GVA value. This would be a substantial boost for the government and all stakeholders to embrace the concept of a gigabit society and pursue a digitally-driven, inclusive growth trajectory. Our analysis demonstrates that our economy can reach an average annual growth rate of over 3% just by increasing fixed broadband penetration. It also shows that the gigabit economy will play an increasingly important role in the economic development of South Africa.

⁹ South Africa reached 10.8 fixed wireline connections per 100 households and almost 24 connections, if FWA is included.

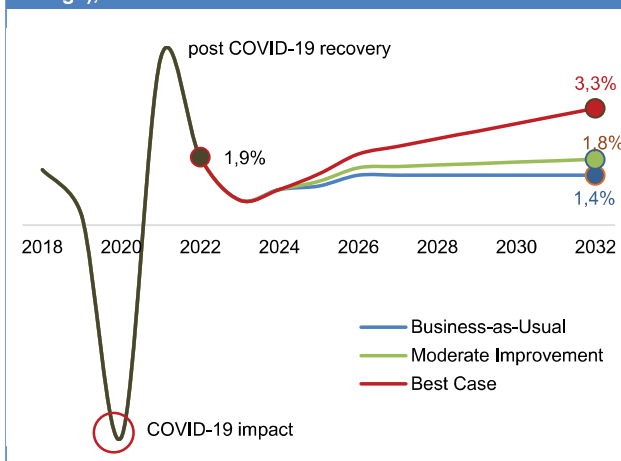
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Exhibit 3.12: Fixed wireline broadband penetration scenarios, 2022 to 2032



Source: Africa Analysis calculations based on Stats SA and ITU data

Exhibit 3.13: Real GDP growth scenarios forecast (annual % change), 2023 to 2032



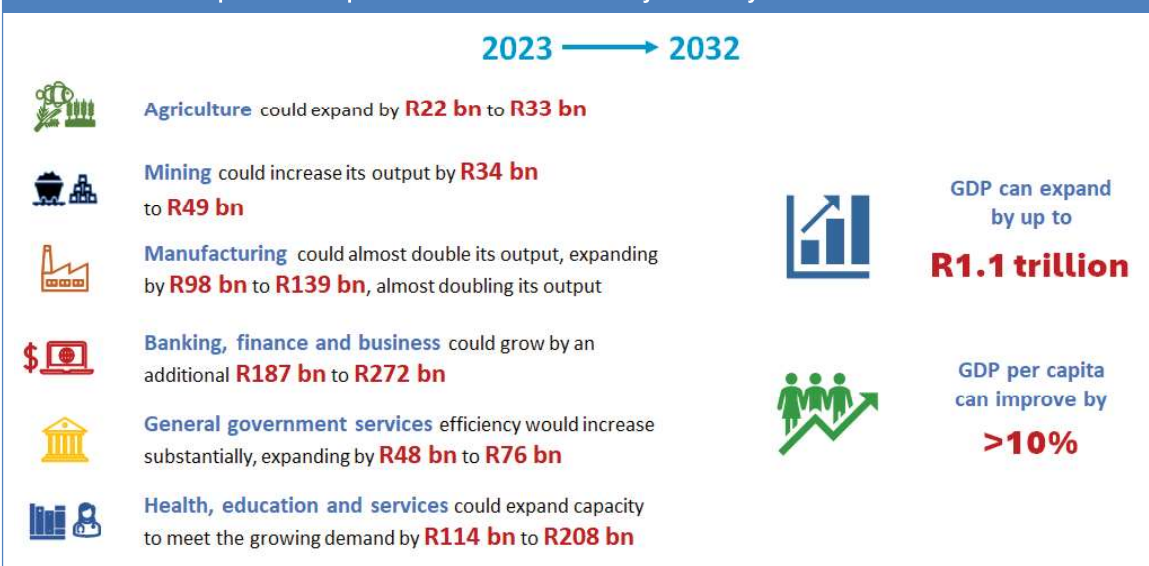
Source: Africa Analysis calculations

New growth areas will also emerge, with traditionally low digital intensity sectors capturing the benefits of high-speed broadband to transform their activities. They can use this connectivity to reach new markets, adopt new ways of working and increase their contribution to South Africa, as illustrated in the exhibit below. Our model indicates that increased fixed broadband penetration may stimulate the GDP to almost double that which the economy would generate without any intervention. Without intervention, the GDP is expected to expand by R581 billion over the next ten years. However, increasing fixed broadband penetration would result in economic expansion by R1 063 billion over the same period, with the potential for further spillover effects creating additional value and economic opportunities. This is almost double the expansion expected, should the economy remain on its current trajectory. At the same time, real GDP per capita could improve by more than 10%, from R75 889 to R83 653. This can be compared to less than 1% appreciation if no growth in fixed broadband penetration takes place.

Our model indicates that the banking and finance sector will benefit strongly. However, the largest social benefits are in government service delivery, and in health and education – key areas of an inclusive economy.

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Exhibit 3.14: Growth potential in specific sectors of the economy over ten years

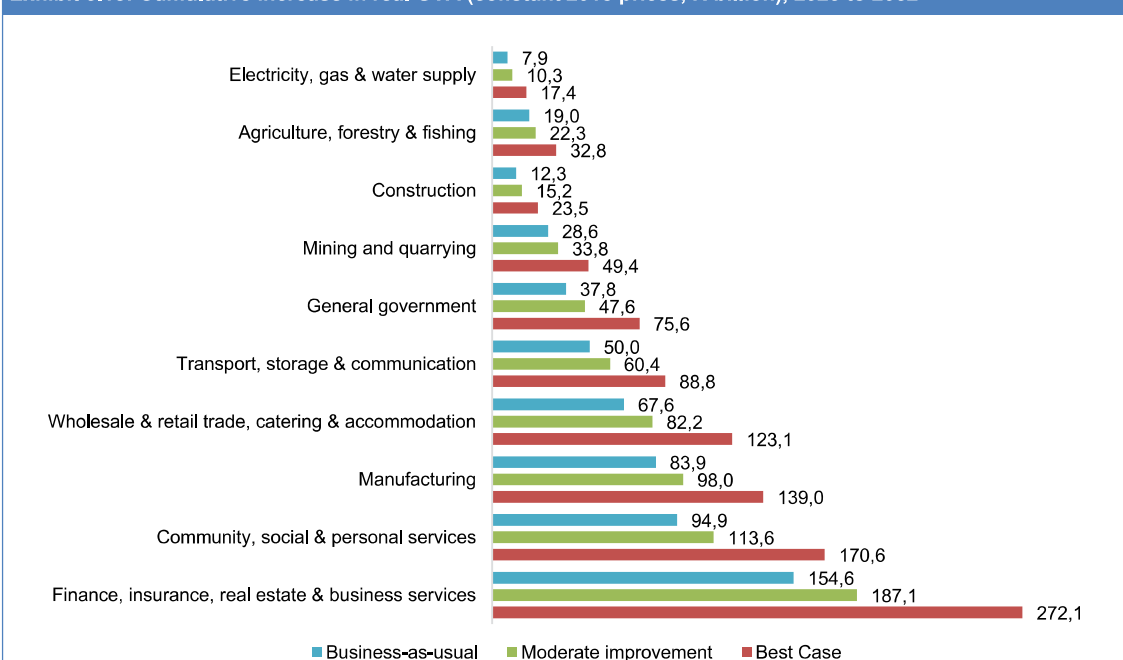


Note, the rand values provided range from the Moderate Improvement scenario to the Best Case scenario.

Source: Africa Analysis calculations

The exhibit below illustrates the cumulative potential growth in real Gross Value Added for all economic sectors over the forecast period.

Exhibit 3.15: Cumulative increase in real GVA (constant 2015 prices, R billion), 2023 to 2032



Source: Africa Analysis calculations

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Those sectors that rely the most on digital technologies (high digital intensity¹⁰) show the largest increases. However, increasing fixed broadband penetration could almost double the economic contribution of key social sectors, including:

- Electricity, gas and water;
- General government; and
- Community, social and personal services (health and education).

Our model only covers a ten-year period. But a fixed broadband connection installed today remains a social asset for years to the come. The ability for children to access online education and online healthcare will transcend and remain throughout their lives. In other words, fixed broadband today represents an ever-increasing social benefit into the future.

¹⁰ These are: banking and finance; community and personal services; transport, storage and communications; and general government.