Google

Equiano

Economic Impact Assessment

Namibia

This assessment was commissioned by Google and delivered by Africa Practice based on economic modelling assistance from Genesis Analytics. It provides an overview of Namibia's connectivity ecosystem and highlights Equiano's expected key impacts on the economy, job creation and sustainability. This report is accompanied by a technical annex that details the methodology and assumptions adopted in this assessment, as well as the underlying economic modelling and analysis.

Africa Practice
Africa Practice is a strategic advisory firm operating at the nexus of industry and government since 2003. It advises corporations, investors, and foundations across Africa, enabling them to drive sustainable and equitable development.

Genesis Analytics
Founded in 1998, Genesis Analytics was one of the first economics-based consulting firms in Africa. It uses its technical capabilities to improve decision-making and unlock substantial value for clients and society.

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Executive summary

Equiano - a next-generation subsea internet cable spearheaded by Google - will run from Portugal to South Africa, along Africa's Atlantic Ocean coastline. In 2022, it is expected to land in Sesimbra (Portugal), Lomé (Togo), Lagos (Nigeria), Swakopmund (Namibia) and Cape Town (South Africa), with branching units in place for further phases of the project. Last year, the cable landed in Rupert's Bay (Saint Helena).

Globally, sub-Saharan Africa remains the most underserved region in terms of internet infrastructure. Internet penetration stands at 29%, while for the entire continent (including North Africa), it is 40%. According to the Broadband Commission for Sustainable Development, USD 100 billion in private and public investment is needed to achieve universal and affordable access to good quality broadband in Africa by 2030.

In Namibia, the share of people using the internet stands at **41%** as of 2020 –more than triple what it was in 2012. While Namibia is among the countries in Africa where mobile internet access is the most affordable, data prices remain marginally higher than the target set by the Broadband Commission and there is scope for them to decline even further. Likewise, further investments in the country's first-, middle- and last-mile connectivity infrastructure will improve coverage, penetration, and the reliability and quality of internet access. Insufficient connectivity hinders economic growth, poverty reduction, human development and progress towards the Sustainable Development Goals.

Equiano will have a direct impact on connectivity in Namibia following its landing, resulting in faster internet speeds, improved user experience, and reduced internet prices. Internet speeds in the country are projected to almost triple from **10 Mbps** in 2021 to **26 Mbps** in 2025, while retail internet prices are forecast to decline by **16%** over the same period. Improved speeds and lower prices are expected to boost penetration by **7.5 percentage points** over this period.

By increasing international bandwidth, Equiano will indirectly broaden access to the internet in Namibia, thus contributing to narrowing the digital divide within the country, as well as narrowing the gap between Namibia and other regions that currently have more developed connectivity infrastructure.

Africa's digital transformation and its internet economy - projected to grow from USD 115 billion in 2020 to USD 180 billion in 2025 and USD 712 billion by 2050 - depend on well-developed connectivity infrastructure. Strong connectivity and more affordable and reliable internet access can help Namibia diversify its economy away from historically dominant sectors, such as mineral extraction and processing, and agriculture, unlocking new pathways to collective prosperity. For Namibia's population, businesses, and government, the digital economy can be a gamechanger and a key lever to accelerate growth, industrialise, innovate and improve people's lives.

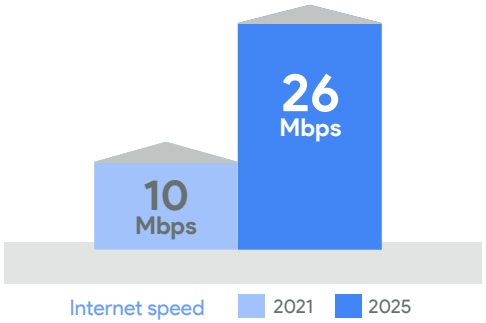
Between 2022 and 2025, average year-on-year real growth in Namibia is expected to increase by **0.50 percentage points** due to Equiano. By 2025, real GDP is forecast to be **USD 237 million** higher than it otherwise would have been without the cable. Between 2022 and 2025, Equiano is expected to lead to an additional USD 543 million in total economic output in Namibia.

Improved connectivity also accelerates job creation. Between 2022 and 2025, Equiano should indirectly create **21,107 new jobs** - equivalent to **5,277 per year** over the assessment period - driven by the expansion of the digital economy and peripheral sectors.

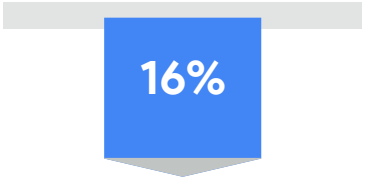
Equiano's key impacts in Namibia

A boost for connectivity

Average internet speeds are set to rise following Equiano's landing

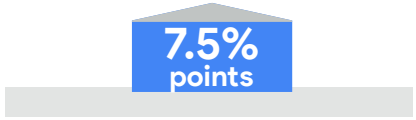


Equiano will also result in major price reductions for consumers, improving affordability of access



Decline in internet retail prices (2021 - 2025)

Improved speeds and affordability will result in greater internet penetration



Increase in internet penetration (2021 - 2025, % points)

A catalyst for growth, job creation and sustainability

By 2025, real GDP expected to be higher than it otherwise would have been by:

USD 237 million

Equiano will boost job creation (2022 - 2025)

21,107 jobs

Tonnes of CO_2 emissions to be saved (2022 - 2025)

21 kilo tons

Namibia's connectivity ecosystem

The case for investing in Namibia's telecommunications infrastructure

The digital divide

While Namibia has comparatively high internet penetration at 40.5% - above the sub-Saharan Africa average of 29% and continental average of 40% - there is significant scope to increase the share of individuals going online to fully unlock the internet's transformative potential. Similarly, while the country performs well in terms of mobile broadband affordability, there is room for prices to decline even further, allowing new users to begin accessing the internet and existing users to increase their internet consumption.

Investments at all stages of the connectivity value chain - from submarine cables, to terrestrial fibre networks and last-mile infrastructure - are needed to achieve this and reduce the digital divide within Namibia, and between the country and markets with more developed internet infrastructure.

As outlined in the box below, Namibia relies on one submarine cable - West Africa Cable System (WACS) - for its international connectivity. Equiano will offer an alternative route for the long-haul transmission of data, diversifying Namibia's routes and reducing its upstream network dependency

An enabling policy environment

Namibia has long recognised the societal and economic benefits of connectivity, placing a strong emphasis on ICT within its long-term development plans.

THE DIGITAL ECONOMY: A KEY PRIORITY FOR NAMIBIA

Namibia's long-term development framework - Vision 2030 - positions ICT as a key pillar of the country's economy. Published in 2004, the vision called for the development and implementation of a comprehensive ICT policy and greater investment in human capital development, particularly in science, technology and mathematics.

Since then, the government has launched several initiatives to boost connectivity, including the:

- **5th National Development Plan (2017/18 - 2021/22)**, which targets provision of broadband access to 90% of the population, 100% of schools and public agencies and 80% of healthcare facilities by 2022.
- **Harambee Prosperity Plan II (2021-2025)**, which aims to ensure the implementation of an open-access infrastructure sharing regime for the telecommunication sector, as well as the establishment of a new government entity to finance investments in ICT infrastructure.
- **National Broadband Strategy (2019-2029)**, which seeks to guarantee universal access through the provision of broadband infrastructure, generation of content, promotion of innovation, and the creation of a conducive environment of broadband deployment. The strategy targets 95% broadband coverage by 2023/24.

Promoting infrastructure sharing on an open access basis is one of the government's main priorities in the connectivity sphere. Separately, in April 2021, Minister of Information and Communications Technology Peya Mushelenga indicated that the ministry was considering reviewing Namibia's multiple ICT-related policies and potentially consolidating them into a uniform national ICT policy. It is unclear whether the ministry has progressed with these potential plans.

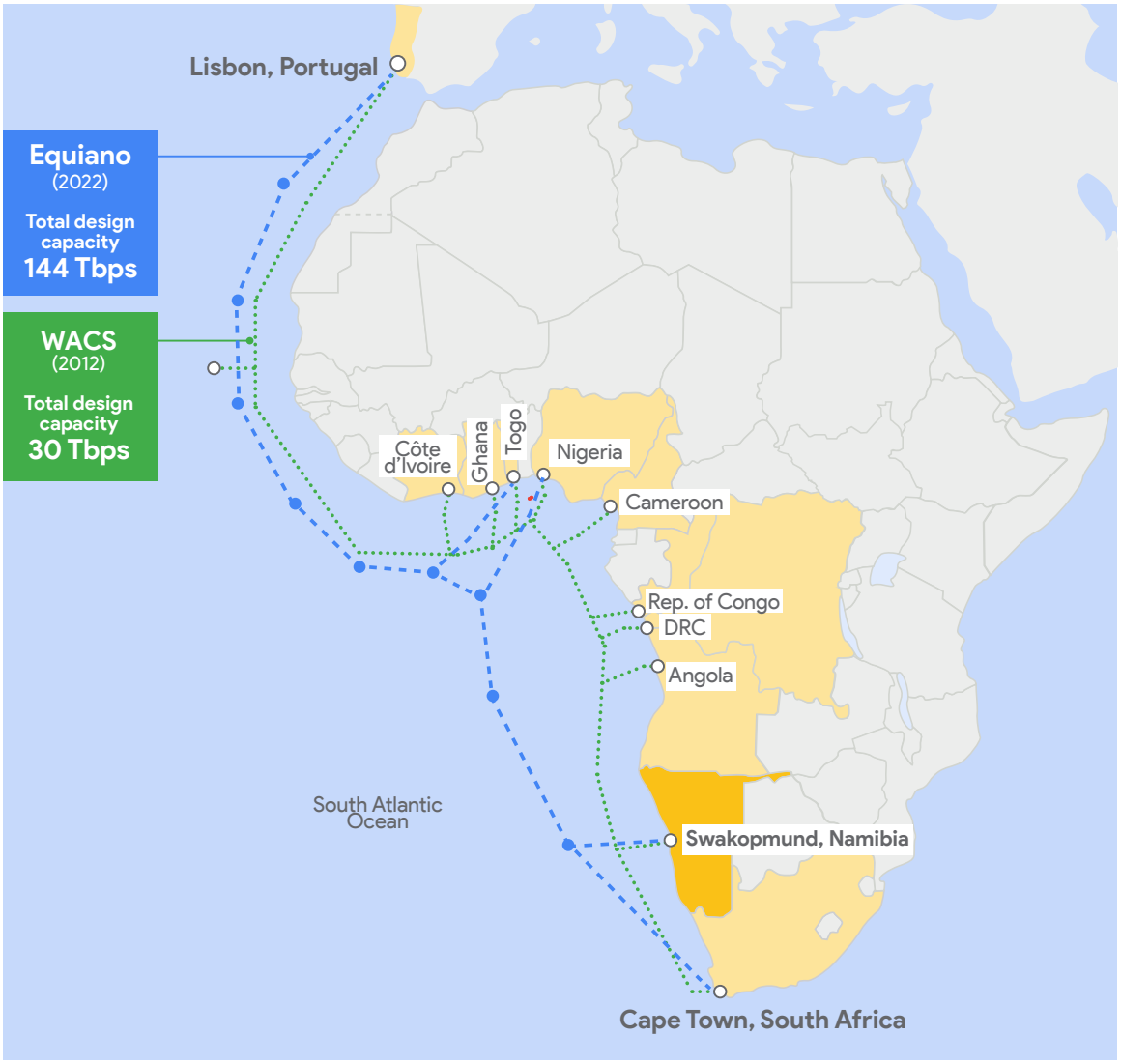
Sector diagnostic: taking stock of Namibia's connectivity infrastructure

The following section provides an overview of Namibia's connectivity infrastructure, detailing the country's current and future submarine links, terrestrial infrastructure and internet coverage, as well as speeds and latency.

International connectivity links

Namibia relies on a single submarine link - WACS - for the bulk of its international bandwidth. WACS has a total design capacity of 30 Tbps and lands in Swakopmund, linking Namibia to the global internet backbone infrastructure. The country also has terrestrial links with neighbouring countries and via satellites.

FIGURE 1 : Installed and soon-to-be installed subsea cables in Namibia



Sources: TeleGeography, Global Bandwidth Research Service, 2021.

In the short term, Equiano is the only additional submarine cable set for installation in Namibia. The branch of the cable landing in the country is expected to be ready for service in 2022. With a design capacity more than four times greater than WACS, Equiano is expected to significantly increase Namibia's international bandwidth capacity. The cable will also provide Namibia with the necessary redundancy as a connectivity backup, ensuring better stability of bandwidth connectivity in the country as a whole, as well as lower latency and higher speeds in the long-haul transmission of data. As detailed in the box below, this is particularly important given Namibia's reliance on one submarine link for the bulk of its international bandwidth.

CABLE DAMAGE AND DISRUPTION TO CONNECTIVITY IN NAMIBIA

On 16 January 2020, internet users in Namibia and other African countries began experiencing disruption following accidental damage to WACS. Submarine cables regularly experience physical damage due to weather, other natural conditions and fishing vessels, resulting in major disruptions to services.

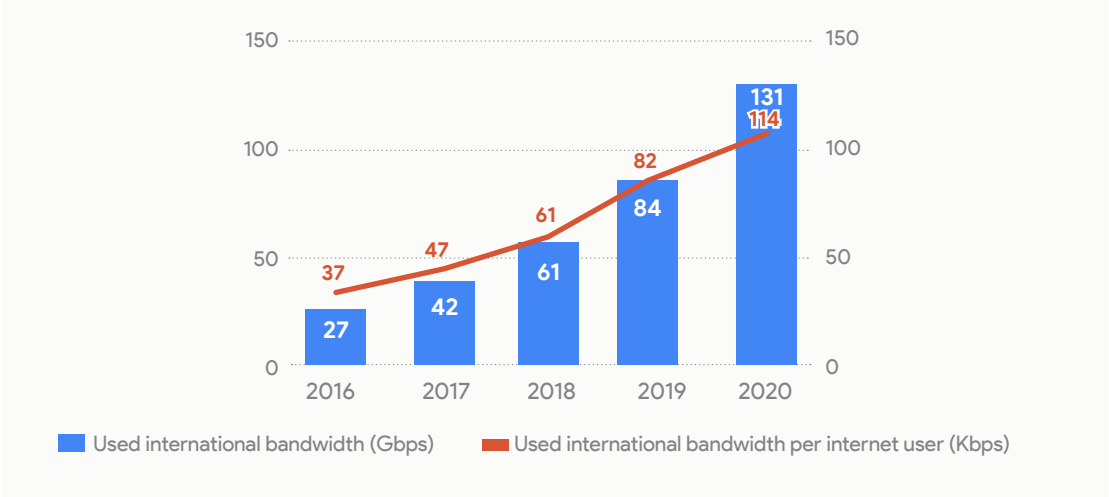
While Namibia typically uses SAT-3/WASC's connectivity[1] if WACS is down, the SAT-3/WASC cable system also experienced damage in January 2020. WACS's connectivity was restored two days after the system was damaged, with Namibia relying on terrestrial links to the east coast of Africa for its international bandwidth in the interim period.

Having a diversity of cable routes and landing stations provides safety in numbers. The landing of Equiano will provide Namibia with additional network redundancy, ensuring better stability of bandwidth connectivity, as well as lower latency and higher speeds in the long-haul transmission of data.

Namibia's used international bandwidth capacity grew by an average of 49%, year-on-year, between 2016 and 2020, reflecting the growing demand for bandwidth in the country.[2,3] On a per capita basis, this translates to an average year-on-year growth of 32% in used international bandwidth capacity per internet user.[4]

Figure 2 illustrates Namibia's used international bandwidth in Gbps and per internet user between 2016 and 2020. In 2020, used international bandwidth capacity per internet user in Namibia stood at 114 Kbps. Figure 3 provides a comparison of used international bandwidth capacity per user in selected African countries.

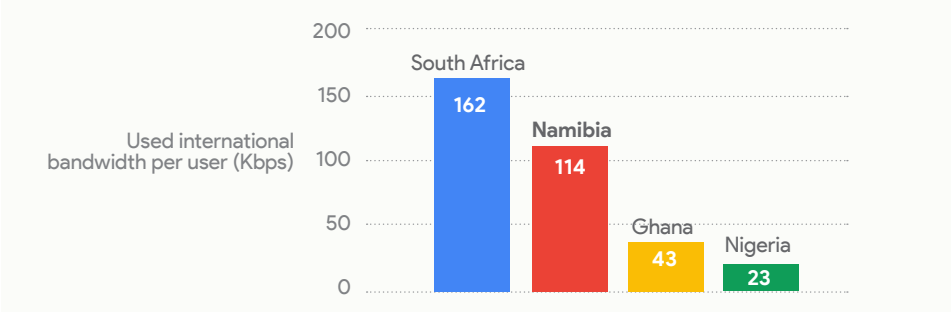
FIGURE 2 : Used international bandwidth capacity in Namibia 2016 - 2020



Source: TeleGeography, Global Internet Geography, Regional Analysis, 2021 | DataReportal, Digital Reports: Namibia, 2017 - 2020 | Genesis Analytics, 2022, team analysis.

1. While Telecom Namibia is a member of the SAT-3/WASC consortium, the cable system does not currently have a landing point in Namibia. The country can leverage SAT-3/WASC's connectivity via its landing in Cape Town and terrestrial links to Namibia, in the event of disruption to WACS.
2. TeleGeography, 2021, Global Bandwidth Research Services.
3. Used international bandwidth, also referred to as 'used capacity', is the sum of all capacity deployed by internet backbone providers, content providers, and research/education/enterprise networks. Used bandwidth does not refer to traffic, but rather to capacity.
4. Genesis Analytics, 2022, team analysis.

FIGURE 3 : Comparison of used international bandwidth capacity per user in selected African countries 2020



Sources: TeleGeography, Global Internet Geography, Regional Analysis, 2021 | Genesis Analytics, 2022, team analysis.

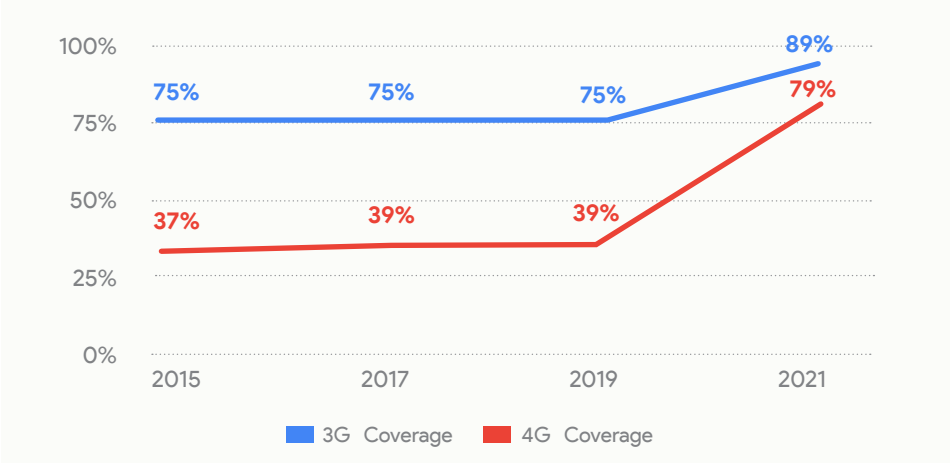
INTERNATIONAL BANDWIDTH PRICING

While specific data on Namibia's international bandwidth pricing is not available in databases such as TeleGeography, IP transit prices have remained comparatively high due to the fact Namibia only has one international submarine fibre optic cable. In turn, this contributes to the relatively high - in absolute terms - internet retail prices in the country (see section 4.3.1). However, long-haul data transmission prices have been declining as ISPs have invested in diversifying terrestrial routes to neighbouring countries, including Angola, Botswana, South Africa and Zambia.

Internet coverage

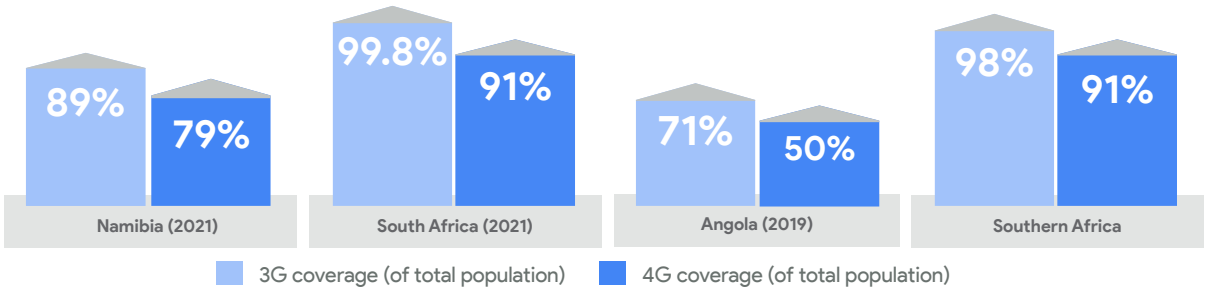
Namibia has significantly expanded 3G and 4G coverage over the last two years, as illustrated in Figure 4, though the country's vast size and low population density remain major constraints to universal mobile broadband access. Prior to this, coverage had been stagnant and Namibia performed relatively poorly compared to South Africa and Angola. 4G coverage is mostly concentrated in the five largest urban areas - Windhoek, Swakompund, Walvis Bay, Rundu and Oshakati. Despite improvements in 3G and 4G coverage, Namibia performs slightly worse than the average for Southern Africa. Namibia was notably the second country in Africa to offer 4G/LTE services in 2012 when MTC upgraded its network.

FIGURE 4 : Mobile broadband coverage in Namibia (% of population) 2015 - 2021



Source: GSMA, 2021, Mobile Connectivity Index Database.

FIGURE 5 : 3G and 4G coverage in Namibia, South Africa and Angola 2019, 2021



Note: Most recently available data: Namibia (2021), South Africa (2021), Angola (2019). Sources: CRAN, ICASA, GSMA.

There are also strong disparities in Namibia's 3G and 4G coverage across the country's regions. As of October 2021, 10 out of 14 regions had 4G population coverage under 90%; 7% had less than 90% 3G coverage. Three regions - Kunene, Kavango West and Omaheke - had less than 50% 4G coverage, while Kunene and Omaheke had 3G coverage of 66%.

EXPANDING NAMIBIA'S FIBRE NETWORK

Namibia has a terrestrial fibre network that interconnects all major towns with a point of presence. The country's fibre optic network has been extended to the country's borders with Angola, Zambia, Botswana and South Africa in order to provide terrestrial access routes and network redundancy.

Telecom Namibia and Paratus Namibia have been leading the way in constructing and upgrading Namibia's fibre network. Since 2020, Paratus has invested a total of NAD 150 million (USD 10 million) annually in terrestrial fibre infrastructure. Paratus' investment in fibre infrastructure is also geared towards infrastructure sharing with licensed telecommunications operators to boost last-mile fibre connectivity. In March 2021, Paratus signed its first fibre Open Access agreement with ISP Africa Online, enabling the two firms to share the same fibre infrastructure and deliver services to their respective customers without duplication. In November, the company signed a roaming agreement with MTN Namibia, allowing the operators to expand their networks without duplicating infrastructure.

Paratus is also expanding into data storage, acquiring land to construct a Tier III data centre. The facility is expected to be completed during Q3 2022 at a total cost of NAD 123 million (USD 8 million).

EXPANDING MOBILE DATE COVERAGE

MTC - Namibia's leading mobile operator with 2.6 million active subscribers, equating to a 91% market share – is driving the expansion of mobile data coverage across the country. The company launched a NAD 1 billion (USD 67 million) network expansion project in 2017, aiming to achieve 100% population coverage by installing 554 new base stations by the end of 2023, in strong alignment with the government's connectivity goals.

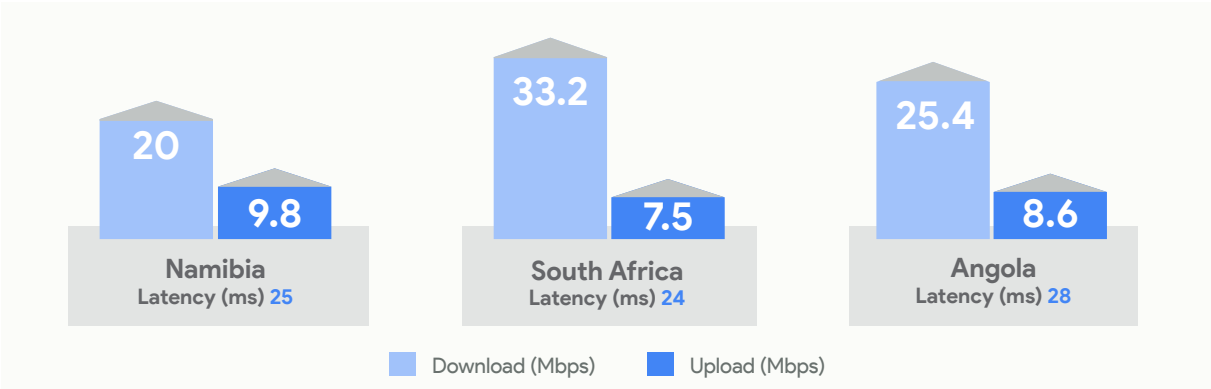
Meanwhile, Telecom Namibia has also invested in infrastructure, upgrading 63 sites and deploying ten new base stations between December 2019 and April 2020.

The roll-out of 5G services has been delayed owing to public concerns about the safety of the technology, which prompted the government to order an environmental impact assessment in July 2020, while ordering the telecoms regulator to elaborate a 5G development strategy for consideration by cabinet.

Internet speeds and latency

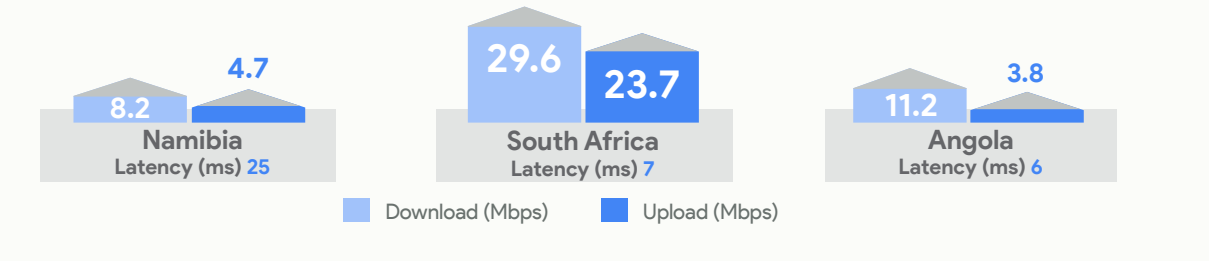
Namibia has relatively low internet speeds, ranking 85th out of 138 countries for mobile broadband speeds on Ookla's Global Index as of January 2022. The country is ranked 156th out of 178 countries for fixed broadband. Figures 6 and 7 below illustrate mobile and fixed broadband speeds and latencies in Namibia and two of its coastal neighbours that have international submarine links - South Africa and Angola.

FIGURE 6 : Mobile broadband internet speeds and latencies in Namibia, South Africa and Angola **January 2022**



Source: Ookla, 2022, Global Index. Note: Lower latency indicates better user experience.

FIGURE 7 : Fixed broadband internet speeds and latencies in Namibia, South Africa and Angola **January 2022**



Source: Ookla, 2022, Global Index. Note: Lower latency indicates better user experience.

Using the internet

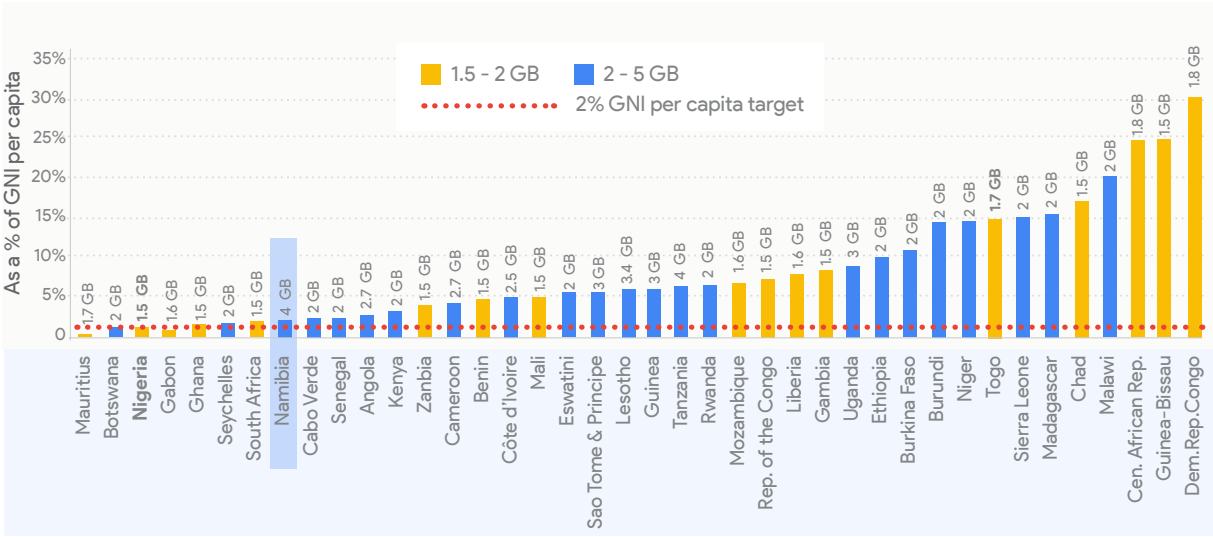
Improving the adoption of broadband, quality of access and affordability has significant potential to accelerate Namibia's socioeconomic development. The subsections below detail the country's connectivity infrastructure, highlighting key trends, progress and challenges.

Affordability

Figure 8 highlights mobile data prices as a percentage of Gross National Income (GNI) per capita. In Africa in 2020, only four countries - Mauritius, Botswana, Nigeria and Gabon - had mobile broadband baskets that meet the Broadband Commission's affordability target of 2% of GNI per capita.

As shown below, Namibia is among the countries in Africa where internet access is the most affordable for consumers. In 2020, a 4GB mobile data bundle in Namibia cost USD 8.45 - equivalent to 2.54% of GNI. By comparison, a 1.5GB bundle in South Africa, the next best performing country on the ranking below, cost USD 10.21 - equivalent to 2.53% of GNI.

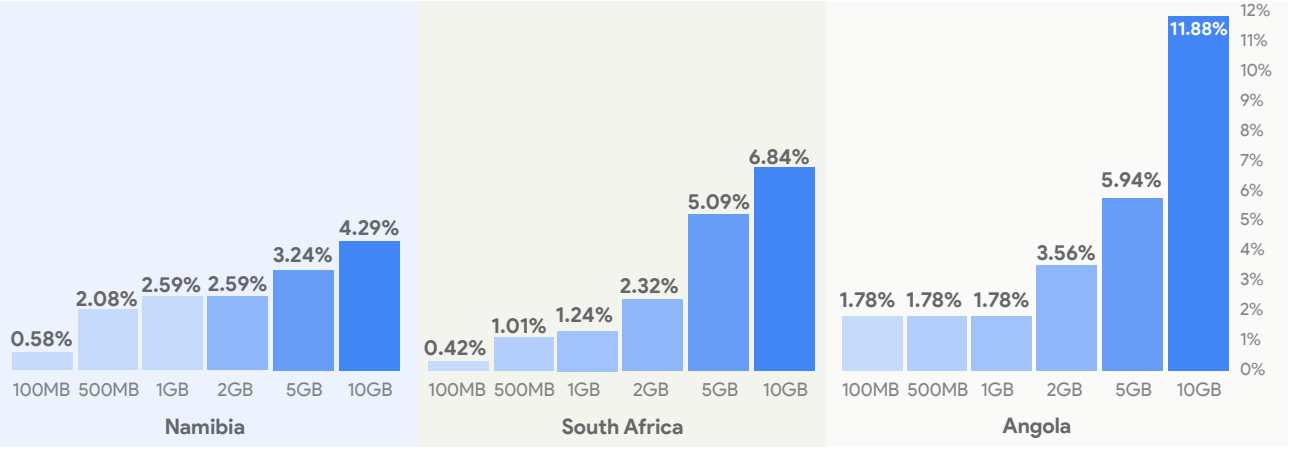
FIGURE 8 : Mobile data prices as a percentage of GNI per capita and monthly data allowance in Africa **2020**



Source: ITU, adapted from *"Measuring Digital Development, ICT Price Trends 2020"*

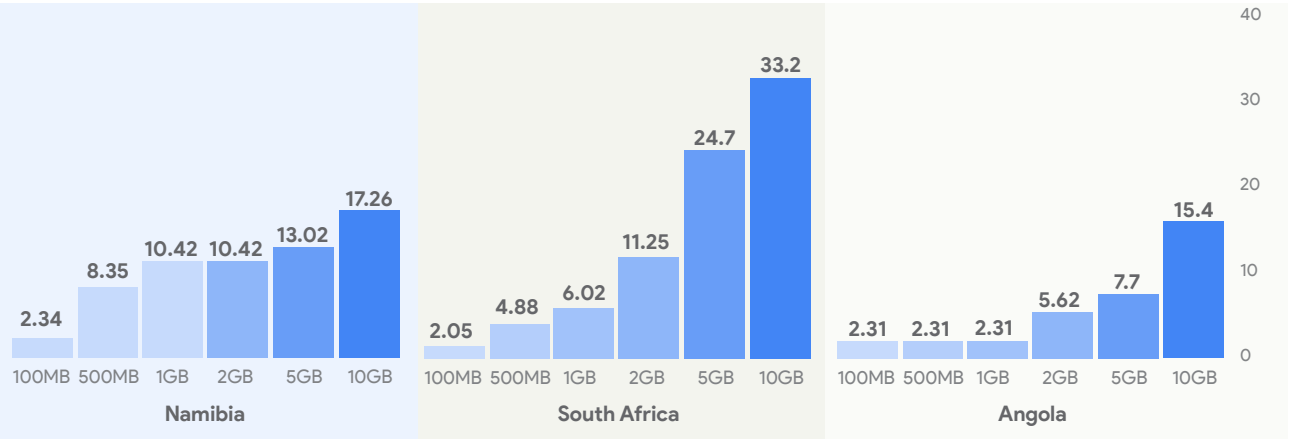
Figure 9 and 10 below illustrate the affordability of mobile broadband in relation to average incomes and in absolute terms (USD) in Namibia, South Africa and Angola. While Namibia's mobile data prices are broadly comparable to those in South Africa and Angola, particularly for smaller bundles, the country performs well when local incomes are taken into account.

FIGURE 9 : Affordability of mobile broadband bundles as a percentage of monthly average incomes 2021



Source: Alliance for Affordable Internet, Mobile Broadband Pricing for 2021.

FIGURE 10 : Affordability of mobile broadband bundles in USD 2021



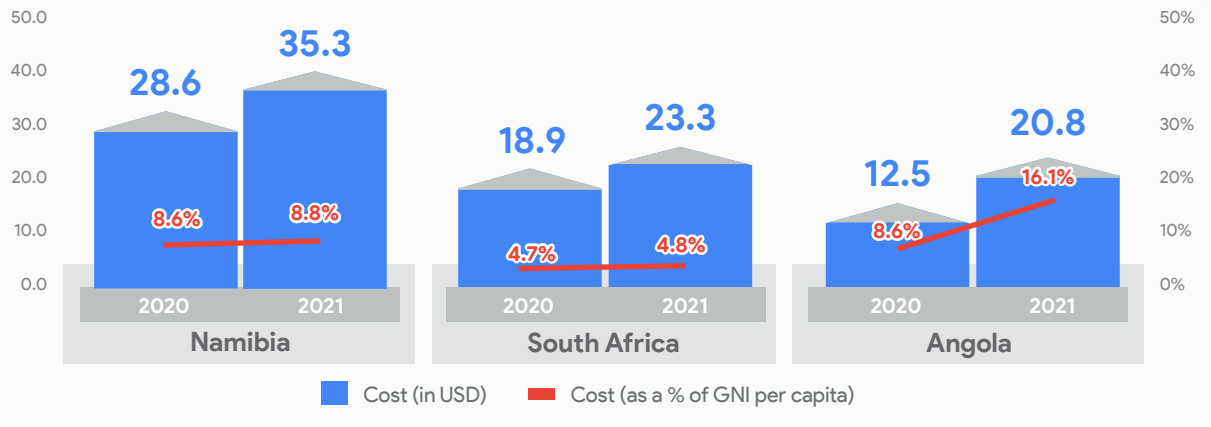
Source: Alliance for Affordable Internet, Mobile Broadband Pricing for 2021.

DECLINING INTERNET PRICES

Internet prices in Namibia have been declining steadily in recent years, with a particularly sizable drop in 2019-2020. Whereas in 2019 a 1.5GB mobile data bundle cost USD 18 - equivalent to 4.1% of GNI per capita - a 4GB bundle cost USD 8.45 in 2020, representing 2.54% of local monthly incomes. In 2018, Paratus cut the price of mobile data bundles by 80% following the "Data Must Fall" campaign in South Africa.

With regard to fixed broadband basket affordability, Namibia performs worse than South Africa and Angola in absolute (USD) terms, but comparably when adjusted for local incomes, as illustrated in Figure 11.

FIGURE 11 : Fixed-broadband bundles in Namibia, South Africa and Angola 2020 - 2021



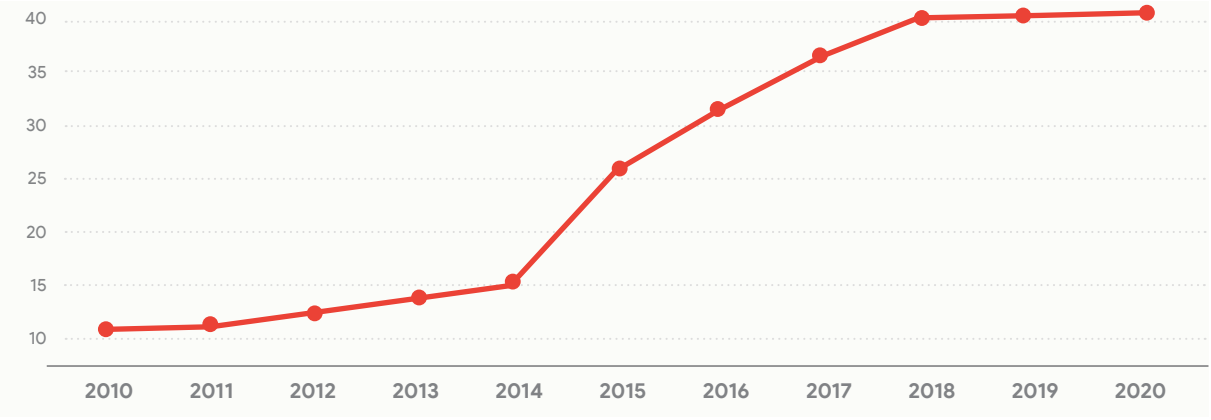
Note: Refers to the cheapest plan providing at least 5GB of monthly high-speed data (>256 Kbps) from the operator with the largest market share in each economy. Source: International Telecommunication Union, 2022, ICT Price Baskets.

Penetration and usage

The share of individuals using the internet in Namibia has risen steadily in recent years, almost quadrupling to 41% between 2010 and 2020. This is significantly higher than sub-Saharan Africa's average of 30% in 2020. Globally, 60% of individuals were internet users in 2020.

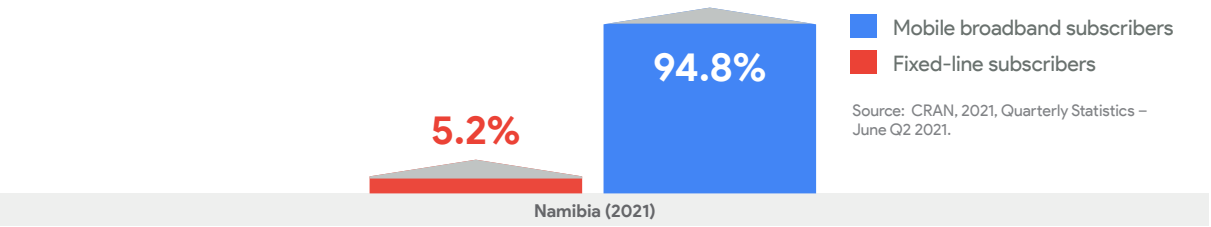
Internet usage is overwhelmingly via mobile broadband. According to the Communications Regulatory Authority of Namibia (CRAN), as of Q2 2021, there were 1,853,000 mobile broadband subscribers, versus 102,781 fixed-line subscribers. Following several years of stagnation, the number of fixed-line subscribers dropped considerably by over a quarter between Q1 and Q2 2021.[5]

FIGURE 12 : Internet penetration in Namibia 2010 - 2020



Sources: ITU World Telecommunications / ICT Indicators Database, 2022.

FIGURE 13 : Mobile versus fixed-line subscribers 2021



5. CRAN, 2021, Quarterly Statistics – June Q2 2021.

Equiano
A landmark investment in Africa

Bridging the divides: the critical role of submarine cables

Submarine cables are integral to achieving the above transformational objectives - they are the world's information superhighways and form the cornerstone of the internet. They carry an estimated 99% of global international communications and USD 10 trillion in daily financial transactions.[6] The remainder of international traffic is satellite-based. Highspeed, high-capacity connections - underpinned by submarine infrastructure - are central to today's hyperconnected global economy. Cables enable high-quality video streaming and conferencing, international phone calls, and support the growth of cloud computing.

A next-generation project

In June 2019, Google announced the subsea internet cable, Equiano, that would ultimately run from Portugal to South Africa along the Atlantic Coast of Africa. In 2022, it is expected to land in Sesimbra (Portugal), Lomé (Togo), Lagos (Nigeria), Swakopmund (Namibia) and Cape Town (South Africa), with branching units in place for further phases of the project. Last year, the cable landed in Rupert's Bay (Saint Helena).

The next-generation Equiano cable will be the first subsea cable to incorporate optical switching at the fibre-pair level, rather than the traditional approach of wavelength-level switching. Equiano will also be the first spatial-division multiplexed (SDM) cable deployed along this route, allowing for a greater design capacity of 144 Tbps. The relative cost of deploying the Equiano cable with respect to its capacity will therefore be lower than the other cables built to date.

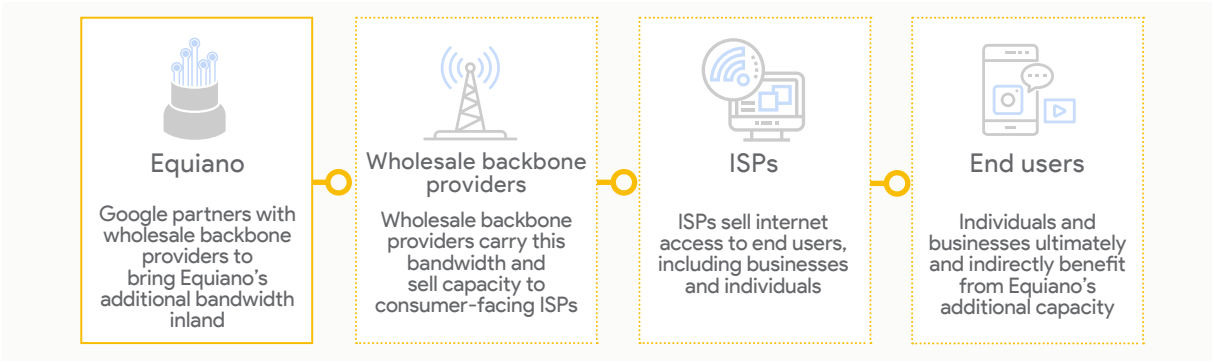
A cable system that serves the wider ecosystem's needs

While Google is spearheading the construction of the Equiano cable, other partners - namely wholesale backbone providers - will be able to use and benefit from the cable's additional capacity. Google does not directly provide broadband access to end users but instead partners with multiple key telecom players such as telcos or infrastructure operators where Equiano lands to ensure that the cable's additional capacity benefits the most end users and businesses across the continent (see Figure 14 below).

This is achieved when key telecom players acquire capacity from the Equiano cable on an indefeasible right of use (IRU) basis. This allows Google's partners to benefit from Equiano's additional capacity over a pre-agreed, long-term time frame for their own use or to lease to third parties. Terrestrial infrastructure players may also avail their fibre routes to Google in exchange for a portion of Equiano's capacity.

6. Reuters, 2022, U.S. recommends approving Google, Meta undersea cable to Asia.

FIGURE 14 : How Equiano indirectly benefits end users



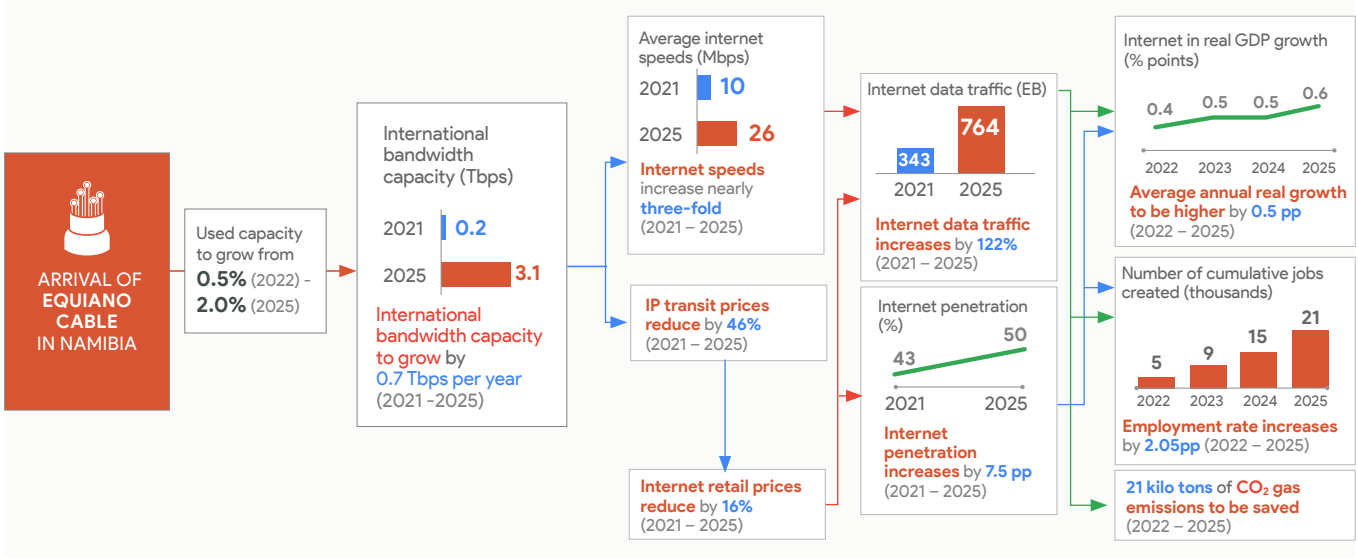
Source: Genesis Analytics, 2022

Equiano's cable landing stations will operate on an open-access and non-discriminatory model where all network players can interconnect with them if they wish to do so. By guaranteeing open access, Equiano aims to encourage more efficient and cost-effective equipment, ultimately resulting in better outcomes for consumers, businesses and the economy more broadly.

Equiano
A catalyst for connectivity

Equiano will have a direct impact on internet connectivity in Namibia, resulting in faster internet speeds, lower latency, and lower wholesale and retail internet prices. The cable system will also spur higher economic growth and accelerate digital transformation, and is expected to contribute to a decline in greenhouse gas emissions. Figure 15 below provides a high-level overview of Equiano's expected impacts and their related pathways. The impact assessment model, assumptions and economic analysis are detailed in the technical annex.

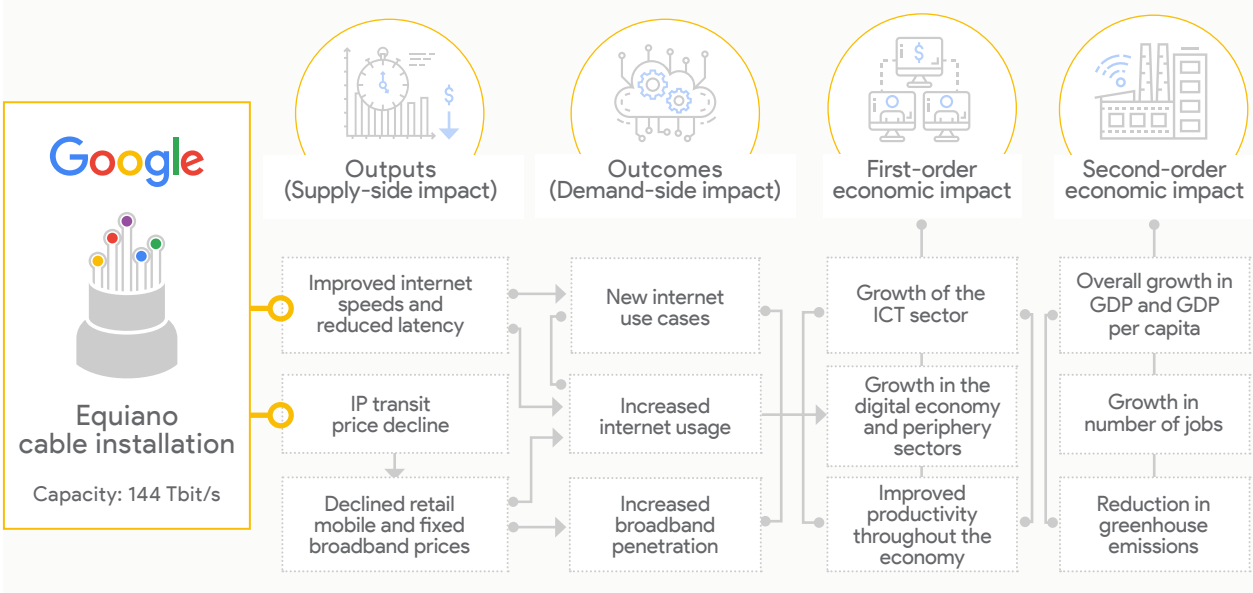
FIGURE 15 : Overview of Equiano's impacts 2021 - 2025



Source: Genesis Analytics 2022, team analysis | Note: pp – percentage points; 2021 figures are forecast based on the 2017 - 2020 trends and the impact assessment model specifications. 2025 figures are results of the impact assessment model.

These impact pathways are illustrated in Figure 16 and detailed in the following subsections. In-depth economic modelling and analysis is provided in a separate annex, along with a comprehensive literature review. The pathways show the successive impact of Equiano on the supply- and demand-side components of the internet market, the ICT sector, and the economy as a whole. This framework is based on existing literature concerning the impact of subsea cables on the supply and demand for internet broadband, as well as on literature on the impact of broadband on economic performance.

FIGURE 16 : Equiano's economic impact pathways



Source: Genesis Analytics, 2022.

Changes in the supply-side metrics following Equiano's landing are expected to boost demand for, and uptake of, the internet by government, businesses and individuals. In turn, this will contribute to specific sectors benefiting directly from greater internet use, as well as boosting productivity in other sectors of the economy. These sectoral and productivity effects are the first-order economic impacts of the cable. Ultimately, they will lead to higher economic growth, greater job creation and a reduction in greenhouse emissions - the second-order economic impacts. Table 1 below expounds on these impact pathways, which are driven by:

- Faster internet speeds and reduced latency **(pathway 1)**
- More affordable internet access **(pathway 2)**

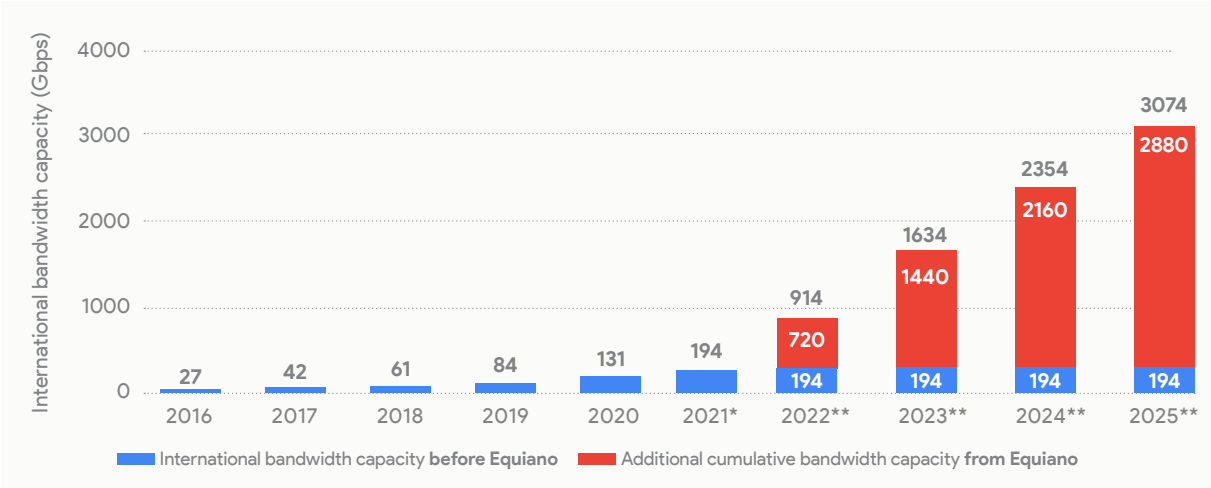
Table 1: Equiano's impact pathways and effects on the economy

	Supply-side impact	Demand-side impact	First-order economic impact	Second-order economic impact
Pathway 1	**Internet speeds and latency** The increased international bandwidth capacity from the Equiano cable means that more data can be transmitted within a given time frame. This will translate into faster internet speeds and lower latency, especially for non-cacheable content, and in areas with an established connection to the internet infrastructure backbone of the country.	Faster internet speeds and lower latencies are likely to enable new internet use cases, such as online learning and virtual conferencing, which have greater broadband requirements. Improved internet speed and latency will also result in greater internet usage demonstrated by greater data traffic.	Increased demand for and usage of the internet arising from increased penetration, growing adoption of new use cases and an overall increase in data traffic have the following immediate economic effects: • Growth of the ICT sector: greater demand and usage of the internet increases ISPs' revenues, induces the expansion of their networks and causes them to hire more labour, creating more jobs within the sector. • Growth of the digital economy and peripheral sectors: as more people increasingly provide and/or access services online and make transactions, internet penetration and usage increases, as does adoption of new use cases. Peripheral sectors such as transport and storage also experience growth as a result. • Improved productivity: increased adoption and usage of the internet will boost economic output with fewer resources. Examples of this are efficiencies in communication, payments and the various operational activities of businesses in a wide range of sectors. Such efficiencies lead to increased economic output within a shorter time frame.	Growth in the ICT sector, the digital economy and its peripheral sectors - as well as productivity improvements in the wider economy - enable: • Faster growth of GDP and GDP per capita. • Growth in the number of jobs in the economy. • Diversification of the economy away from agriculture. • Reduction in greenhouse emissions.
Pathway 2	**IP transit prices** The cost of long-haul transmission of data is a major determinant of local IP transit prices. The creation of an alternative long-haul transport route through the Equiano cable, together with the greater capacity of the cable, will directly (through a lower installation cost relative to design capacity) and indirectly (through increased competition for long-haul transmission of data) lower transmission and IP transit costs. The benefits of lower IP transit costs could in turn be directly passed on to consumers by ISPs through decreases in internet prices, or indirectly, through the provision of more data, uncapped data limits or higher speeds at the same price. Lower IP transit prices could improve ISPs' bottom lines, enabling them to invest in the expansion of their networks, thereby increasing coverage.	A reduction in retail fixed and mobile broadband prices will boost adoption and usage of internet through: • New internet subscribers (especially for fixed broadband) who previously could not afford the cost of a subscription. • Increased internet usage by subscribers who will be able to use more data at the same price or access higher internet speeds at a lower price. • Increased adoption of new internet use cases with high data requirements that had previously been too costly.		

Connectivity impact of Equiano

The increase in international bandwidth capacity following Equiano's landing (see Figure 17 below) is expected to have an immediate impact on average IP transit prices, speeds and latency. For end users in Namibia, this will translate to cheaper and more reliable internet access, leading to a substantial growth in traffic and internet penetration.

FIGURE 17 : International bandwidth capacity in Namibia **2016 - 2025**



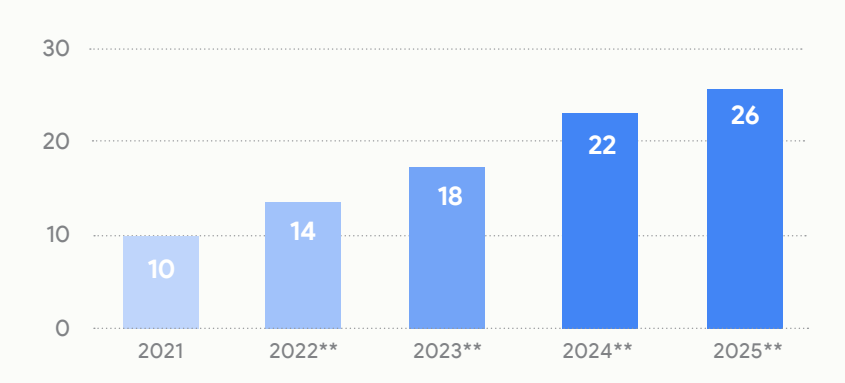
Sources: Telegeography, 2021, Global bandwidth services | Genesis Analytics, 2022, team analysis.
Note: *Forecast | ** Equiano impact analysis period.

Accelerating internet speeds

Investments in submarine cables boost internet speeds

The increased international bandwidth capacity from the Equiano cable means that more data can be transmitted to Namibia within a particular time frame. This will translate into faster internet speeds and lower latency, particularly with regard to non-cacheable content, and in areas in close proximity to a terrestrial fibre optic cable.

FIGURE 18 : Equiano's impact on internet speeds (Mbps) **2021 - 2025**



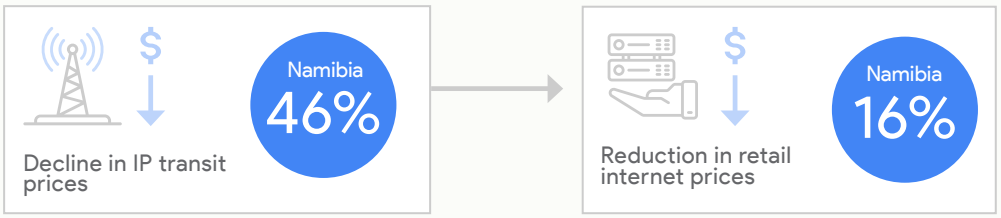
Sources: Ookla, 2022, Speedtest Global Index | Genesis Analytics, 2022, team analysis.
Note: **Equiano impact analysis period.

Making the internet more affordable

As detailed above, internet access in Namibia remains marginally more expensive than the target set by the Broadband Commission. The cost of long-haul transmission of data is a major determinant of local IP transit prices. Equiano's landing in Namibia will create a new, high-capacity route for international data transmission.

The cable's lower installation cost relative to design capacity, as well as increased competition for the long-haul transmission of data, will lead to lower IP transit prices. In turn, lower IP transit prices could be passed on to customers through decreases in internet prices, or indirectly, through the provision of more data, uncapped data limits or higher speeds at the same price.

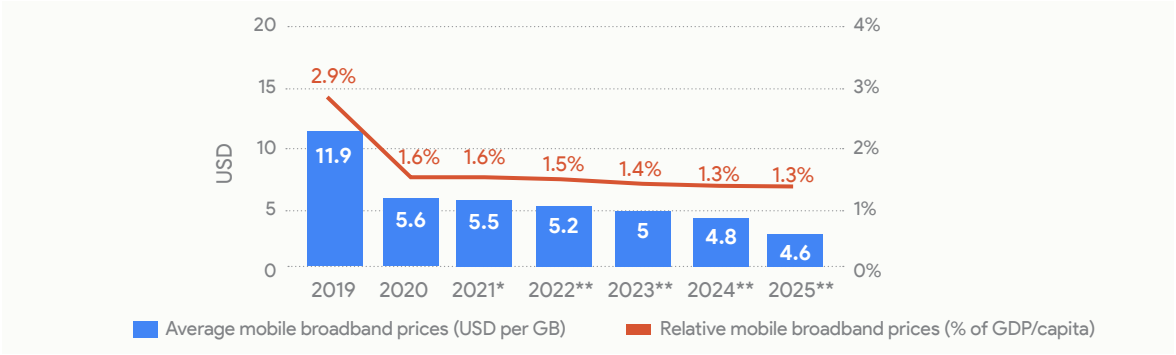
FIGURE 19 : Equiano's impact on internet prices **2021 - 2025**



Source: Genesis Analytics, 2022, team analysis.

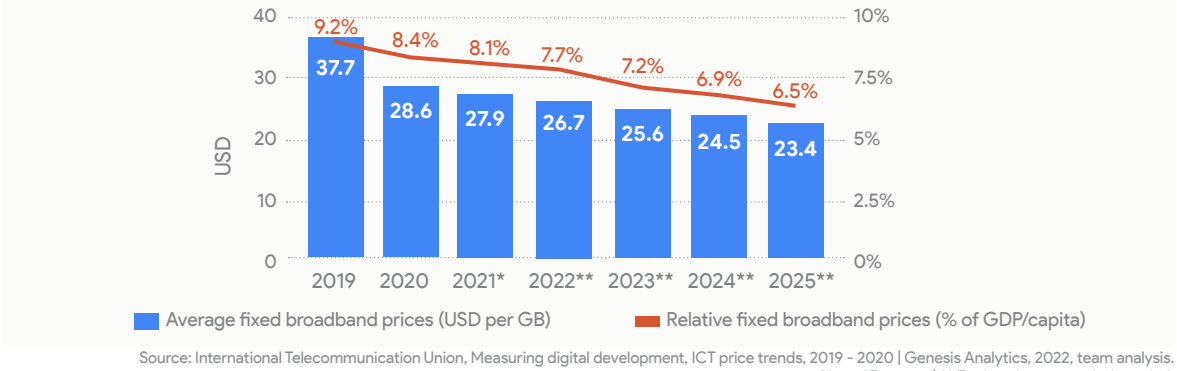
Figures 20 and 21 below illustrate the expected decline in average mobile and fixed broadband retail prices, immediately prior to and during the Equiano impact assessment period (2022-2025).

FIGURE 20 : Average mobile data retail prices[7] **2019 - 2025**



Source: International Telecommunication Union, Measuring digital development, ICT price trends, 2019 - 2020 | Genesis Analytics, 2022, team analysis.
Note: *Forecast | ** Equiano impact analysis period.

FIGURE 21 : Average fixed broadband retail prices **2019 - 2025**



Source: International Telecommunication Union, Measuring digital development, ICT price trends, 2019 - 2020 | Genesis Analytics, 2022, team analysis.
Note: *Forecast | ** Equiano impact analysis period.

7. While internet affordability is typically defined in relation to GNI per capita, GDP is a metric that can be used to forecast growth figures with greater confidence. We have therefore selected the GDP per capita metric for Figures 20 and 21, which detail Equiano's impact on internet prices up to 2025.

Equiano impact on internet penetration and traffic

Lower prices, combined with improved speeds and latency, are expected to increase internet penetration in Namibia by 7.5 percentage points between 2021 and 2025. Figure 22 below illustrates the two pathways which lead to this increase, while Figure 23 highlights the anticipated growth in the number of internet users and penetration following Equiano's landing.

FIGURE 22 : Lower prices and improved speeds increase internet penetration and improve user experiences

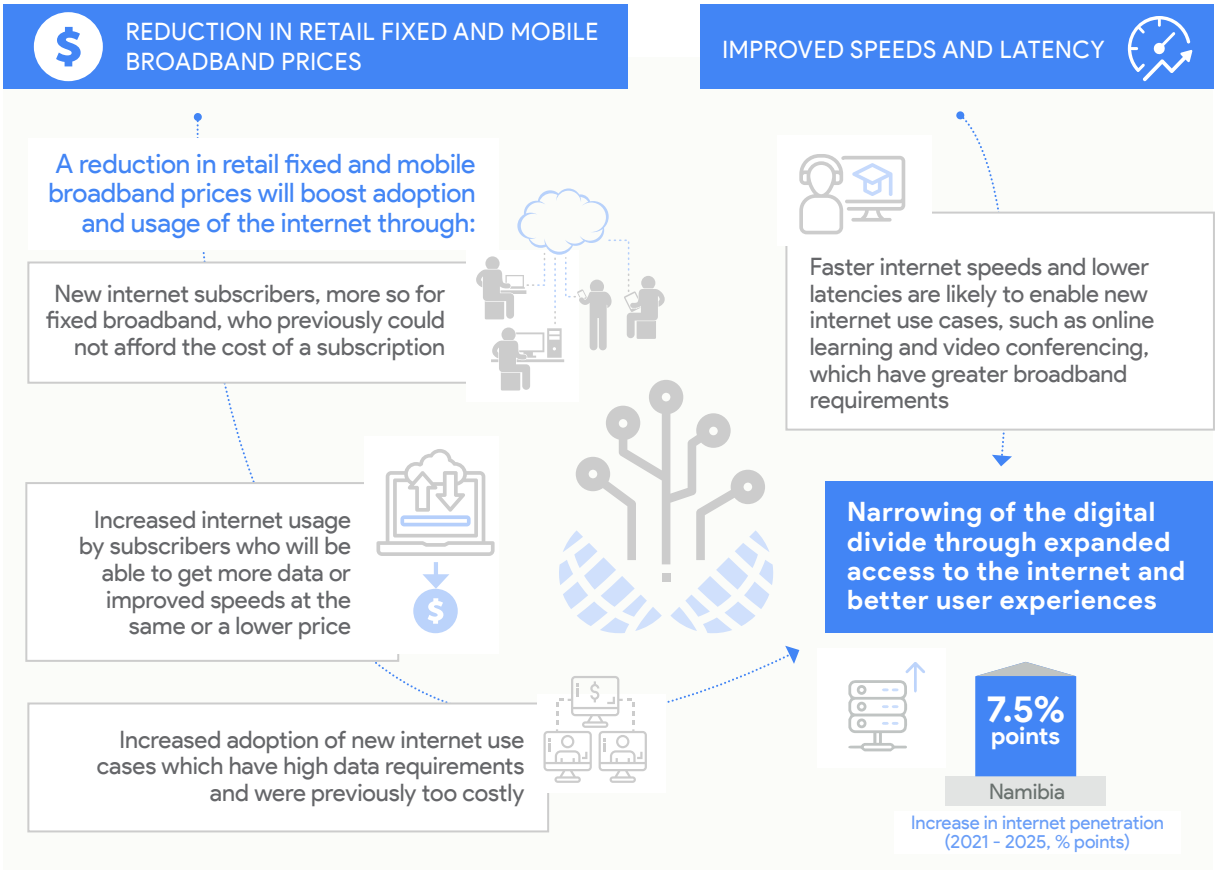
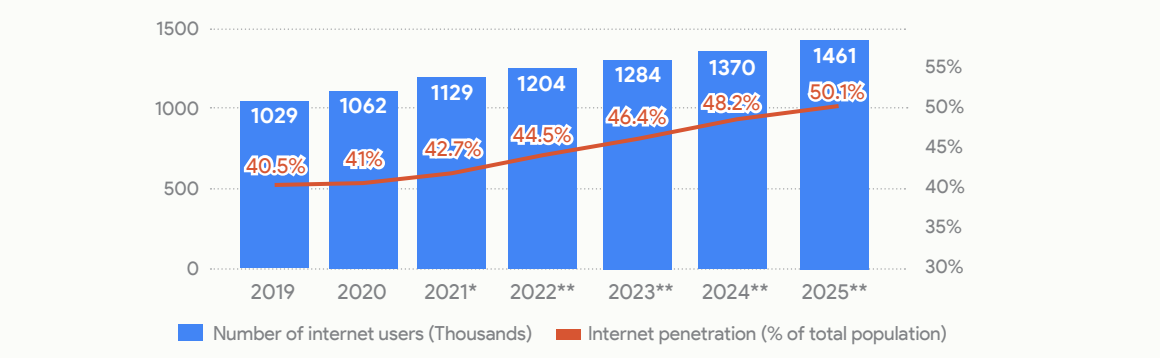


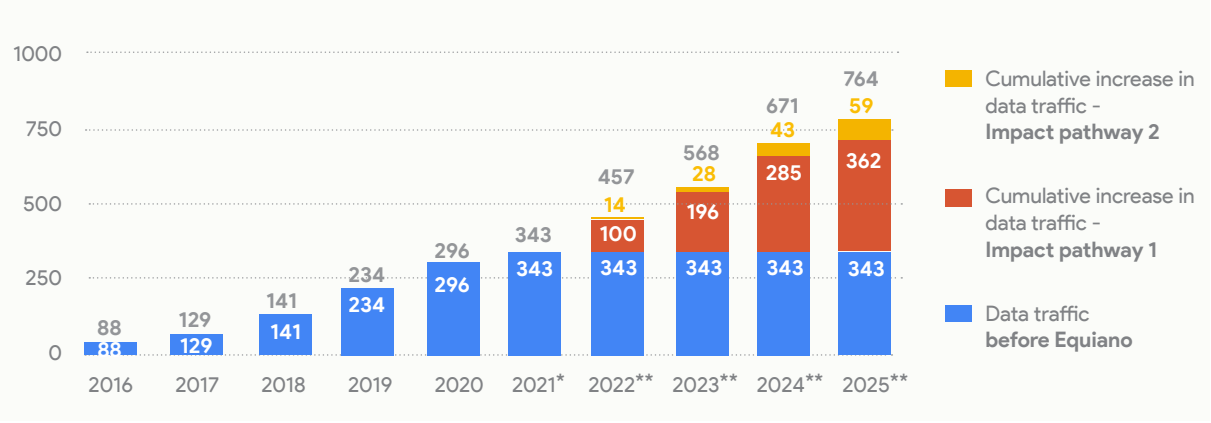
FIGURE 23 : Number of internet users and internet penetration in Namibia 2019 - 2025



Source: ITU World Telecommunications / ICT Indicators Database, 2022 | Genesis Analytics, 2022, team analysis.
Note: *Forecast | **Equiano impact analysis period.

Faster internet speeds will lead to a higher demand for data traffic. In parallel, lower internet retail prices will increase internet usage both extensively (by enabling new users to get online for the first time, as well as providing new ways of using the internet for existing users) and intensively (by enabling existing users to consume more data). The growth in total data traffic in Namibia following Equiano's landing estimated from faster internet and more affordable access is illustrated in Figure 24 below.

FIGURE 24 : Total data traffic in Namibia (PB) 2016 - 2025



Source: Genesis Analytics, 2022, team analysis.
Note: *Forecast | **Equiano impact analysis period.

Catalysing network expansion

Submarine cables' impact on speeds and prices described above can catalyse investments by ISPs and infrastructure operators, thereby expanding terrestrial networks. Specifically, lower IP transit prices following the landing of cables such as Equiano improve ISPs' bottom lines, enabling them to invest in the expansion of their networks to reach new customers.

In parallel, greater demand and usage of the internet following Equiano's landing is also expected to increase ISPs' revenues, inducing the expansion of their networks.

Cheaper and quicker internet underpins better user experiences

Improved speeds, lower latencies and more affordable internet bundles and subscriptions following Equiano's landing will support the types of users outlined in the table below. More reliable connectivity will improve the quality of their experience using latency-sensitive products and applications.

Table 2 : Internet use cases, minimum digital requirements and Equiano's impact

USE CASE	MINIMUM DIGITAL REQUIREMENTS	EQUIANO CABLE IMPACT
Online learning Many educational institutions in Namibia transitioned to a virtual learning experience as a result of the pandemic. **User profile:** Students, remote workers, job seekers, gig economy workers and migrant families.	1. A 1.5 Mbps Internet speed as a minimum requirement (both upload and download speed). 2. Institution platform, EDX, Coursera, Google Classroom, Google Meet, Zoom etc. Google Meet requires that outbound signals from a participant in all situations must meet a 3.2 Mbps bandwidth requirement for HQ video calls. The minimum requirement for SD video calls is 1 Mbps. 3. Educational materials require ~20 GB per month.	Internet speeds are set to almost triple from 10 Mbps in 2021 to 26 Mbps in 2025, while retail internet prices are set to decrease by 16% within the same time frame. Through the value chain illustrated in Figure 14, Equiano will improve the ability of businesses and individuals to meet the minimum digital requirements for various use cases by: • **Delivering** more than the required speed and latency to enable good connectivity for all use cases. • **Improving** the bandwidth available to users in order to seamlessly access the digital tools for each of the use cases. • **Enabling** the acquisition of monthly data requirements for various use cases, more so for those requiring 20 GB per month or less. • **Boosting** the adoption of the outlined use cases, giving more businesses and individuals access to an internet connection which meets the minimum digital requirements. • **Increasing** the intensive and extensive usage of the internet for these use cases.
Entertainment and gaming As individuals remain at home due to the COVID-19 pandemic, users are now increasingly using the internet for entertainment and live gaming. **User profile:** Students, remote workers, job seekers, gig economy workers and migrant families.	1. Netflix requires 3 Mbps for SD (standard definition) quality. YouTube videos can be streamed in standard definition for just 500 Kbps, with live events requiring at least 1 Mbps. Live gaming requires 10Mbps. 2. YouTube, Netflix and Showmax. 3. Videos, audio and games require ~100 GB per month.	
Job search and application A growing share of job recruitment processes are now conducted online from application to interview. **User profile:** Job seekers.	1. To search and complete job applications requires 500 kbps. Google Meet requirements as stated above. 2. Namijob.com, LinkedIn, Grow with Google, Google Meet, and Zoom. 3. Job forms and remote interviews require ~5 GB per month.	
Remote work Remote workers require high internet bandwidth and reliable internet connectivity. **User profile:** Students, remote workers, job seekers.	1. Google meet has a minimum 3.2 Mbps bandwidth requirement. 2. Google Workspace, Meet, Firebase, Slack, Adobe, call centre apps, and Upwork etc. 3. Documents, coding, video and audio require ~ 100 GB per month.	
Gig economy work Gig economy workers include workers who provide a temporary service on digital platforms. **User profile:** Gig economy workers.	1. Internet bandwidth of ~500 Kbps to ~2 Mbps. 2. Google Maps, LEFA. 3. GPS, audio, text, and voice call require ~20 GB per month.	
E-commerce and online business management Businesses require the internet to offer online retail services and manage operations. **User profile:** Businesses.	1. WhatsApp Business required 64 Kbps and 500 Kbps for other business applications. 2. Buy Online Namibia, JABU, Google Cloud, Google My Business, WhatsApp Business, Shopify. 3. GPS, audio, video, text, and voice call require ~20 GB per month.	
Remittances Remittances include local and cross-border payment to peers and merchants. **User profile:** Students, remote workers, businesses, job seekers, gig economy workers and migrant families.	1. A minimum of 500 Kbps. 2. WorldRemit, TransferWise etc. 3. Payment rails (P2P, P2B, P2G, B2P, and G2P) require < 1 GB per month.	

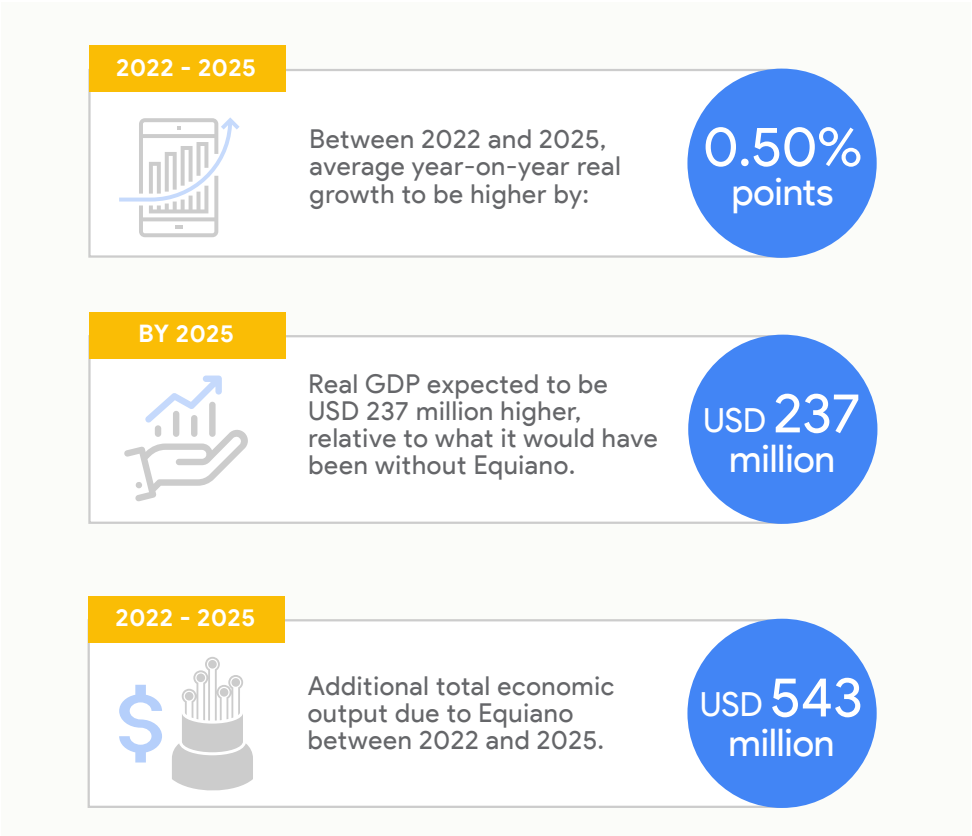
Macroeconomic impact of Equiano

Internet connectivity unlocks significant economic opportunities - more so in developing countries than their developed counterparts. A landmark study by the International Telecommunications Union in 2019 found that in Africa, a 10% increase in mobile internet penetration increases GDP per capita by 2.5%.[8] According to a separate study by the World Bank, achieving universal and affordable access to the internet across the continent would increase GDP growth by 2 percentage points per year and would boost employment opportunities by up to 13%.[9]

Boosting economic growth

More affordable and reliable internet access - following the landing of submarine cables such as Equiano - accelerates digital transformation and stimulates the digital economy, boosting GDP and growth rates.

FIGURE 25 : Equiano's impact on the economy



Source: Genesis Analytics, 2022, team analysis.

8. International Telecommunication Union (ITU), 2019, Economic Contribution of Broadband, Digitization, and ICT Regulation: Econometric Modelling for Africa.
9. World Bank, 2020, Togo: Could more digitalization be the solution?

Underpinned by reliable connectivity, the digital economy can be a game-changer for Namibia's economy and society: it represents an opportunity to accelerate growth, industrialise, innovate and improve people's lives. This takes place through a wide range of mutually reinforcing and overlapping pathways, classified below by three key stakeholder categories:

At the individual level, broadband access plays a crucial role in developing human capital, which is essential for economic growth and competitiveness. It helps people acquire new skills and knowledge that are key to identifying and unlocking new employment opportunities. Improved connectivity also means better access to public services, as well as more affordable products and services from the private sector.

For businesses, broadband access lowers costs, raises productivity, drives innovation, introduces new processes and extends commercial links. Broadband also lowers the cost of international communications, thereby benefiting export-oriented firms. For information-intensive companies in the service sector (the knowledge economy), broadband is an integral part of business models. A wide range of sectors - such as fintech, e-commerce, healthtech, media and entertainment, local transportation, food delivery and business-to-business (B2B) e-logistics - are leveraging internet access and adoption to innovate and lead the way in the continent's digital transformation.

For governments, digital transformation can fundamentally improve the way the public sector operates - leading to more efficient service delivery in areas such as health, education or public administration. This, in turn, contributes to a more productive and efficient economy.

For Namibia, attracting investments that boost connectivity and pivoting towards a digital-first economy offers an opportunity to diversify the country away from its reliance on mineral extraction and processing, and agriculture - the historically dominant sectors. Leveraging ICT can unlock new pathways to collective prosperity, increasing government revenues and creating much needed economic opportunities.

Accelerating job creation

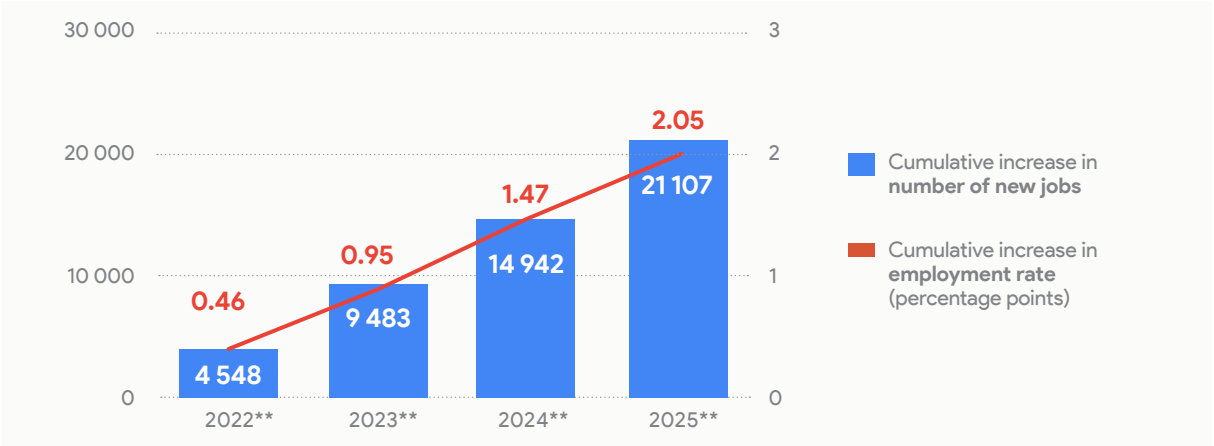
Between 2022 and 2025, Equiano is expected to indirectly create **21,107 new jobs** in Namibia following the cable's landing. By 2025, the employment rate is expected to be **2.05 percentage points higher** as a result of Equiano, driven by two main pathways:

Growth of the digital economy and peripheral sectors.
The decline in internet retail prices and improved speeds lead to growing adoption by new users, and more intensive usage by existing ones. In turn, this facilitates the entry of new firms, particularly so in sectors that rely heavily on ICT such as finance and services. Peripheral sectors such as transport and storage also experience growth as a result of the development of e-commerce.

Growth of the telecoms sector.
Rising internet access boosts ISPs' and telcos' revenues, inducing the expansion of their networks, prompting them to hire more.

Figure 26 below illustrates expected job creation following the cable's landing and the associated increase in the employment rate.

FIGURE 26 : Increase in employment due to Equiano 2022 - 2025



Source: Genesis Analytics, 2022, team analysis. Note: **Equiano impact analysis period.

Sustainability impact of Equiano

Savings in CO_2 emissions and contribution to the SDGs

The expected increase in broadband penetration and adoption by consumers, businesses, government institutions and educational establishments is expected to lead to savings of CO_2 emissions, as a result of three main impact pathways:

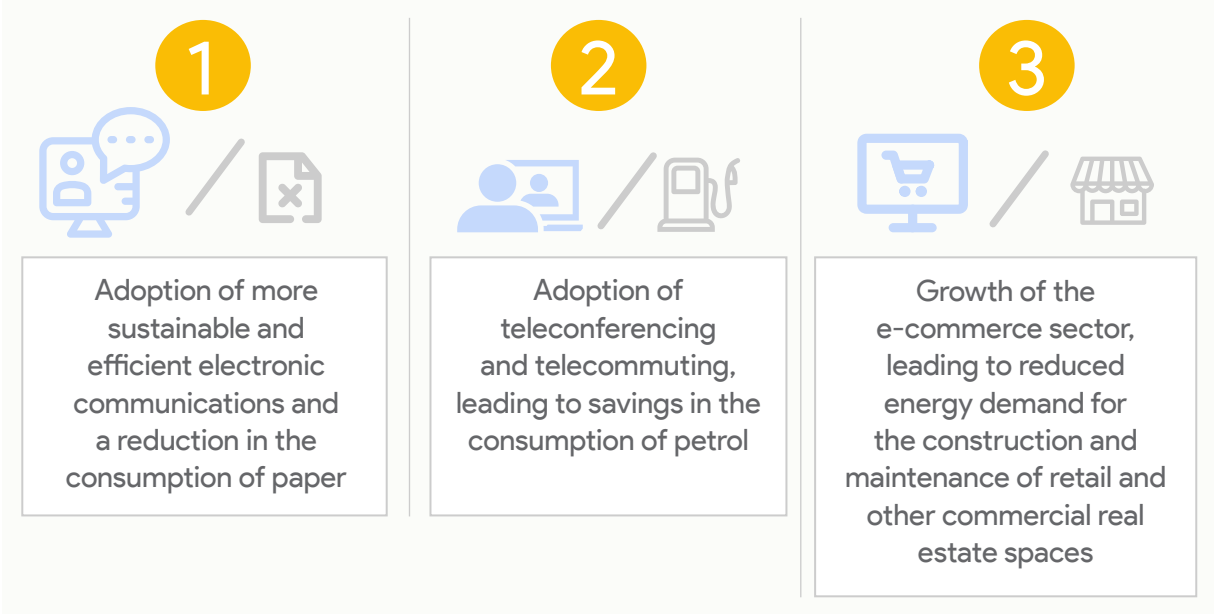
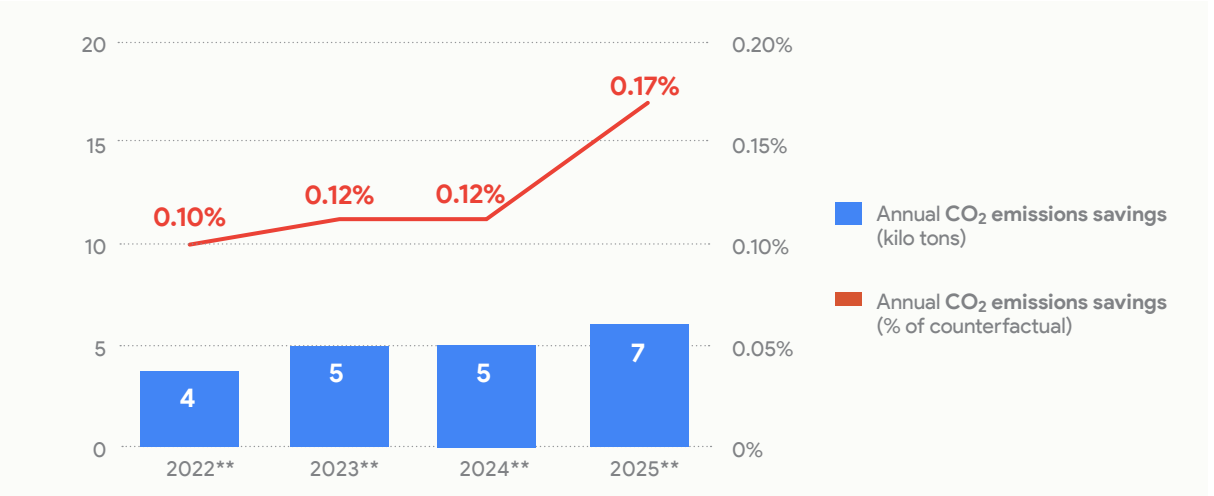


Figure 27 below illustrates the cumulative savings in CO_2 emissions from Equiano, which amount to 21 kilo tons between 2022 and 2025. These savings are relatively modest given Namibia's CO_2 emissions are among the lowest in the world.

FIGURE 27 : Savings in CO_2 gas emissions from Equiano **2022 - 2025**



Source: Genesis Analytics, 2022, team analysis. Note: **Equiano impact analysis period.

More broadly, investments in connectivity can significantly accelerate progress towards achieving the UN's SDGs by 2030. The SDGs are a blueprint for a better and more sustainable future for all. SDG 17 - Partnerships for the Goals - emphasises that technology is a cross-cutting theme that underpins the attainment of all other SDGs, including economic development, health and education.

Concluding remarks

As outlined in the preceding sections, boosting connectivity can play an important role in realising Namibia's economic potential. Attracting domestic and international investments in internet infrastructure – at all stages of the value chain, ranging from submarine cables to terrestrial fibre networks that bring access to end users - is central to reducing the digital divide within Namibia. The development of connectivity infrastructure will also reduce the access gap between Namibia and other countries with more mature digital ecosystems.

The digital economy can unlock new pathways for inclusive growth and has the transformative potential to spur innovation, create jobs, improve service delivery and reduce poverty in Namibia. While the country performs comparatively well in terms of internet penetration and affordability relative to other African economies, there is significant scope to broaden access and lower prices for consumers. Between 2021 and 2025, Equiano is expected to boost internet penetration by 7.5 percentage points, and lead to a 16% decline in retail internet prices over the same period. By 2025, the cable will boost the employment rate by 2 percentage points, translating to a total of 21,107 new jobs created.

NAMIBIA ECONOMIC IMPACT ASSESSMENT: Technical Annex

Table of contents

Introduction and methodology

This study provides technical background to the Namibia Economic Impact Assessment, which features an overview of Namibia's connectivity ecosystem, the national policy environment, background on Equiano, and insights into the role of submarine cables in the global economy. The Namibia Economic Impact Assessment highlights the cable's key impacts on connectivity, the economy, and sustainability, which are elaborated upon in the below sections.

This study is based on a theory of change framework that outlines the mechanisms through which the arrival of the Equiano cable will impact Namibia's economy. The pathways show the successive impact of Equiano on the supply- and demand-side components of the internet market, the ICT sector, and the economy as a whole. This framework draws on existing literature concerning the impact of subsea cables on the supply and demand for internet broadband, as well as on literature on the impact of broadband on economic performance.

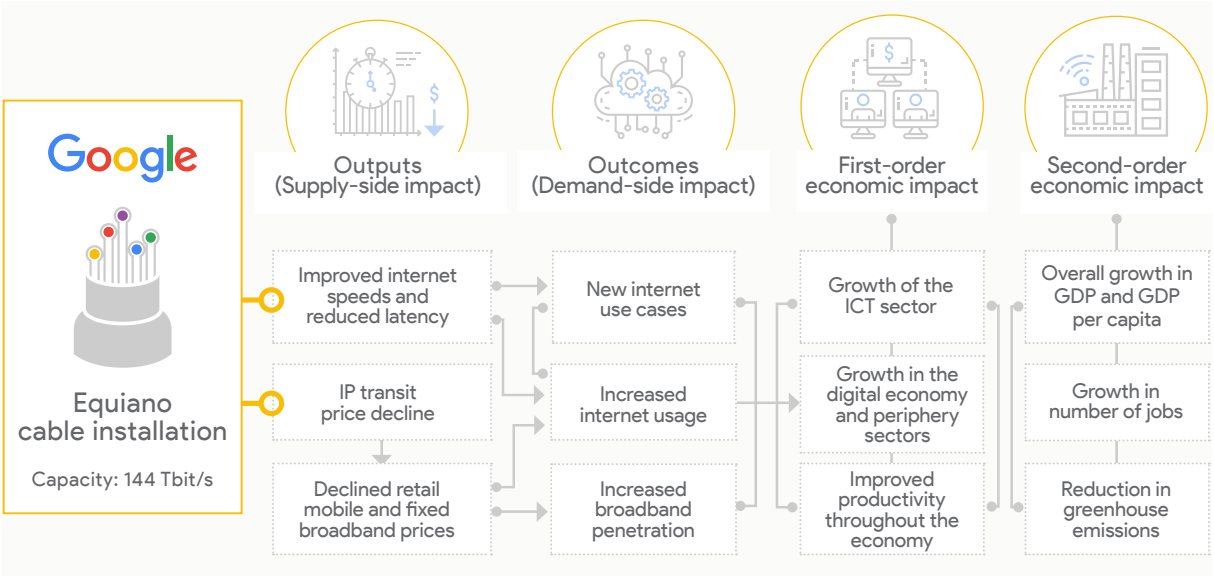
In order to estimate the impact of the Equiano cable on Namibia's economy, we establish the relationship between the different variables within the impact pathways. The change coefficients quantifying these relationships are obtained from the results of several studies which have run empirical models with multiple data sets. These studies and their results are outlined in the literature review in the annex. Based on the change coefficients, the change in each variable within the impact pathway framework is then modelled. These calculations serve as the basis for estimating the macroeconomic impacts of the Equiano cable.

Equiano cable assessment

Equiano cable impact pathways

Based on a review of the relevant literature, the Equiano cable is expected to impact Namibia's economy through the impact pathways shown in Figure 1 below. Increased bandwidth capacity resulting from the installed cable will have an immediate effect on the supply-side metrics, i.e. the quality, accessibility, and cost of internet in the country.

FIGURE 1 : Equiano's economic impact pathways



Changes in the supply-side metrics following Equiano's landing are expected to boost demand for, and uptake of, the internet by government, businesses and individuals. In turn, this will contribute to specific sectors benefiting directly from greater internet use, as well as boosting productivity in other sectors of the economy. These sectoral and productivity effects are the first-order economic impacts of the cable. Ultimately, they will lead to higher economic growth, greater job creation and a reduction in greenhouse emissions - the second-order economic impacts. Table 1 below expounds on these impact pathways, which are driven by:

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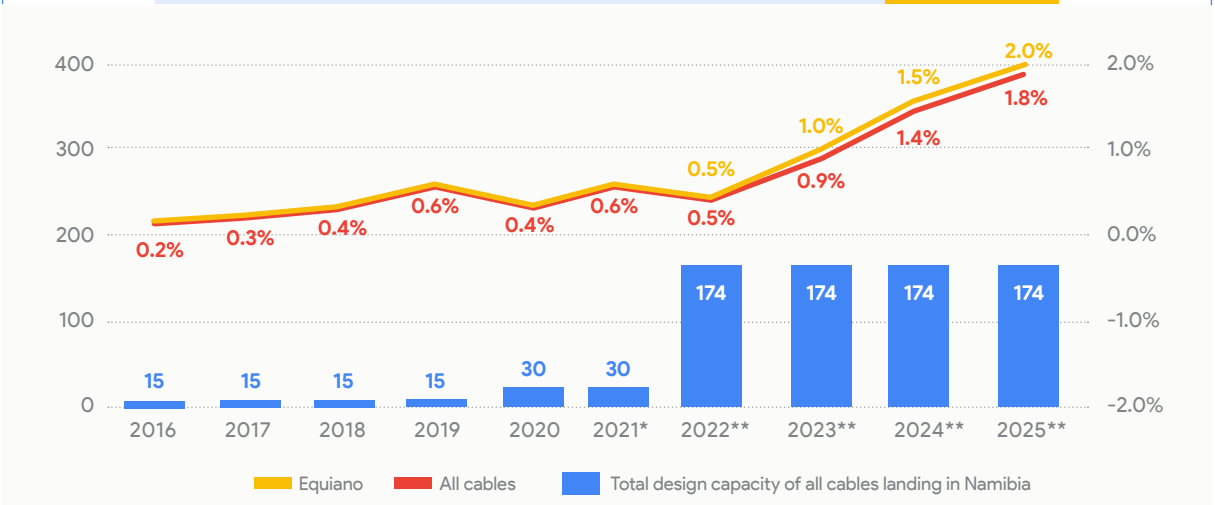
Equiano cable impact analysis

Based on the impact pathways shown in Figure 1, this section presents the results of the Equiano cable impact assessment in Namibia, quantifying the changes in terms of connectivity, economic growth, employment and greenhouse gas emissions.

The Equiano cable has a design capacity of 144 Tbps. As with other subsea cables globally, only a portion of this capacity will be utilised and translated into additional international bandwidth capacity for Namibia.[1] Although the design capacity of West Africa Cable System (WACS), Namibia's only active submarine link is 30 Tbps, the country's utilised international bandwidth capacity in 2020 stood at 131 Gbps, equating to a utilisation of only 0.4% of the design capacity of the cable.

Figure 2 below shows that while the ratio of utilised capacity to design capacity has been growing, it has remained below 1%. Equiano's lit capacity is therefore likely to start off very low in order to match the currently low demand for bandwidth relative to the cable's capacity.

FIGURE 2 : Proportion of used design capacities of cables landing in Namibia **2016 - 2025**

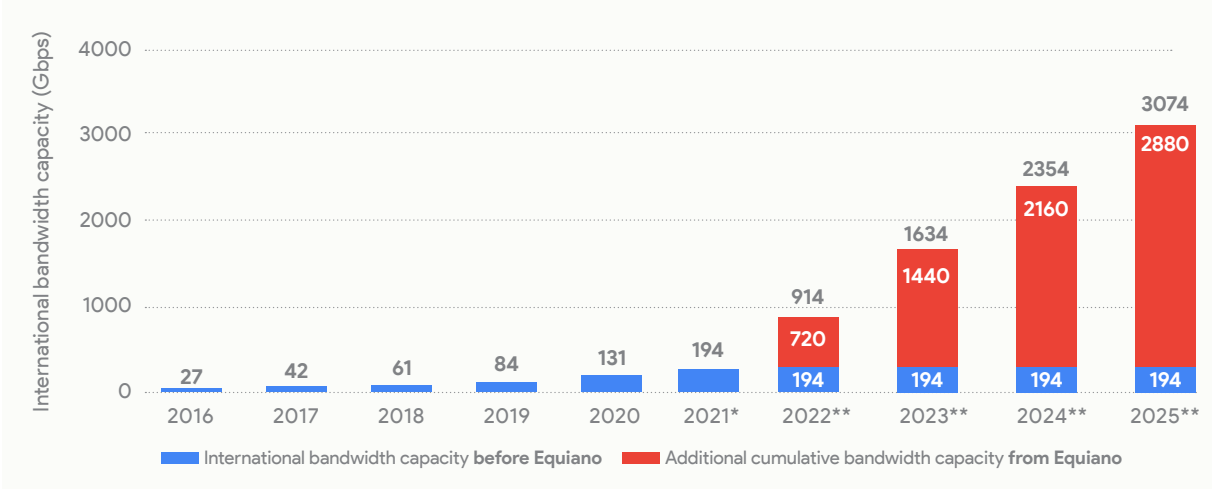


Sources: Submarine Cable Networks, WACS Overview, 2020 | Genesis Analytics, 2022, team analysis.
Note: *Forecast | ** Equiano impact analysis period.

The utilised capacity of the Equiano's branch landing in Namibia is therefore modelled to start at 0.5% of potential capacity in 2022. As demand for bandwidth increases, with internet access becoming more reliable and affordable, utilised capacity - relative to the potential capacity - is expected to rise by an average of 0.5 percentage points every year, reaching 2% by 2025. This will then translate, one-for-one, into higher international bandwidth capacity for Namibia, as shown in Figure 3 below. This increase in bandwidth capacity in turn affects the Namibian internet market's supply-side metrics.

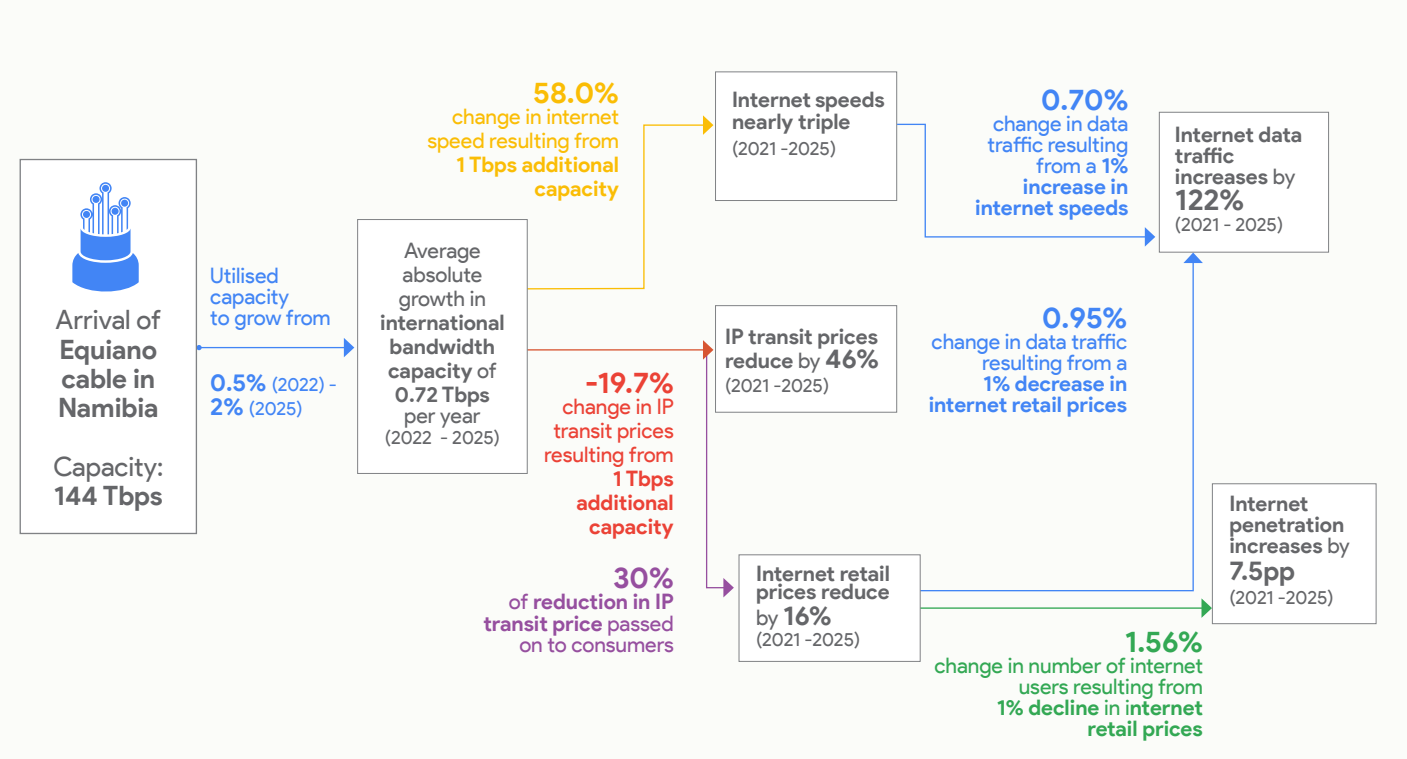
1. The average lit capacity of undersea cables globally remains below 30%. Across the cables from Europe to sub-Saharan Africa, the average lit capacity stood at 17% in 2017, having risen from 5% in 2013 according to TeleGeography.

FIGURE 3 : International bandwidth capacity in Namibia 2016 - 2025



Sources: Telegeography, 2021, Global bandwidth services | Genesis Analytics, 2022, team analysis.
Note: *Forecast | ** Equiano impact analysis period.

Overview of the supply-side and demand-side impacts of Equiano



Source: Genesis Analytics, 2022, team analysis. Note: pp - percentage points.

Supply-side impacts

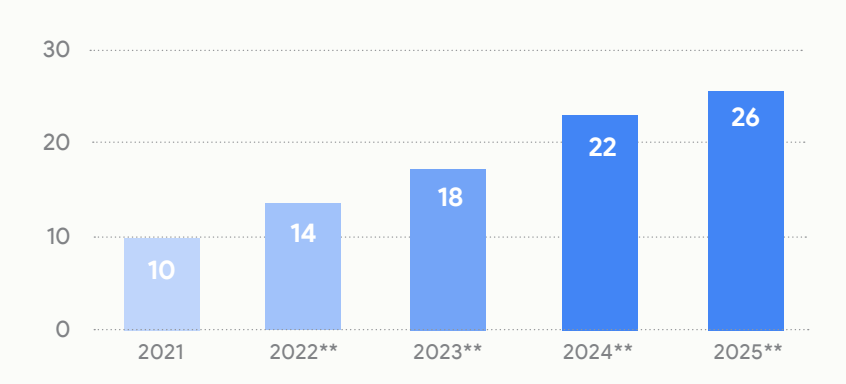
The expanded international bandwidth capacity modelled in the previous section is expected to have an immediate effect on average internet speeds, latency, and IP transit prices. According to a 2019 study by Hjort and Poulsen[2] performed across 12 sub-Saharan African markets between 2007 and 2014, average internet speeds increased by 35% after the arrival of a subsea internet cable. Within this period, the subsea internet cables that arrived in the region were ACE, WACS, EASSy and SEACOM, with respective design capacities of 12.8 Tbps, 5.1 Tbps, 4.7 Tbps and 1.5 Tbps respectively. These cables therefore had an average design capacity of 6.0 Tbps. Assuming an average lit capacity of 10% across the cables at the time of installation, the average increase in international bandwidth capacity from the arrival of a subsea cable was 0.6 Tbps.

An average increase of 0.6 Tbps in international bandwidth capacity improved internet speeds by 35% on average. Accordingly, we calculate that an increase of 1 Tbps in international bandwidth capacity would have led to an increase in internet speeds of 58%.[3]

However, it is expected that the marginal increment in internet speeds due to additional international bandwidth capacity is likely to decline as the country's capacity substantially increases. Accordingly, we model a 25% decline in the value of the coefficient (between bandwidth capacity and internet speeds) year-on-year between 2022 and 2025.

Applying the above coefficient results in internet speeds in Namibia almost tripling between 2021 and 2025. Average internet speeds are expected to rise from 10 Mbps in 2021[4] to 26 Mbps in 2025 as a result of Equiano's arrival (see Figure 4).

FIGURE 4 : Average internet speeds in Namibia (Mbps) 2021 - 2025



Sources: Ookla, 2022, Speedtest Global Index | Genesis Analytics, 2021, team analysis.
Note: **Equiano impact analysis period.

The change in IP transit prices due to increased international bandwidth capacity is derived from the results of a 2020 Analysys Mason study,[5] which quantifies the impact of Google's investment in internet network infrastructure within the Asia-Pacific (APAC) region. The results from the Analysys Mason study can be applied in this study on Namibia, as the state of the APAC region internet market during the period covered by the study (2010 -2019) was comparable to the current and predicted near-future state of connectivity in sub-Saharan Africa.

2. Hjort, J. and Poulsen, J., 2019, The Arrival of Fast Internet and Employment in Africa, American Economic Review.
3. Given Namibia's relatively low international bandwidth capacity and the fact that the country has only one submarine cable landing on its shores, we do not apply a discount to this coefficient, unlike the previous studies on Equiano's economic impact in South Africa and Nigeria.
4. Based on median speeds provided by Ookla's Global Index.
5. Analysys Mason, 2020, Economic Impact of Google's APAC Network Infrastructure.

The Analysys Mason study finds that as a result of the growth in the network of subsea cables, IP transit prices declined by 74% between 2010 and 2019 in countries that connected to these cables. The subsea cables Google invested in the APAC region are SJC, Indigo and JGA, which have design capacities of 28 Tbps, 36 Tbps and 36 Tbps respectively. Assuming an average lit capacity of 15% by the end of the period implies an additional bandwidth capacity of 15 Tbps from the three cables. Thus an additional 1 Tbps of international bandwidth capacity results in a decline in IP transit prices of 4.9%.

Since Namibia has only one installed submarine cable, once activated, Equiano will provide the only alternative submarine route for long-haul transmission of data. Moreover, given the extent to which the additional international bandwidth capacity from Equiano is set to exceed current capacity (see Figure 3), the cable is expected to have a much greater impact on IP transit prices than implied by the Analysys Mason study. This is because the majority of countries included in the study had two or more existing submarine cables, as well as significantly higher international bandwidth capacities than Namibia.

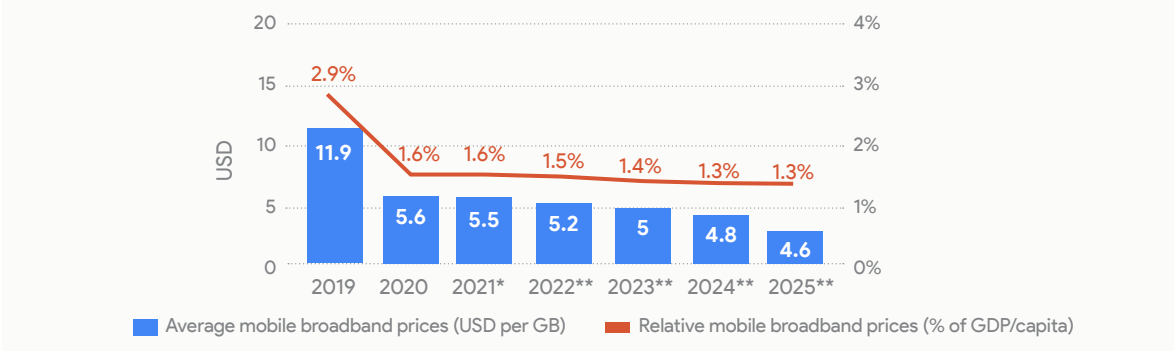
We therefore model an additional 1 Tbps of bandwidth capacity to lead to a 19.7% reduction in IP Transit Prices. This is four times greater than the coefficient of 4.9% implied in the Analysys Mason study. **By this coefficient of change, IP transit prices in Namibia are expected to fall by 46.2% between 2021 and 2025 as a result of Equiano's landing.**

In the absence of sufficient data or extensive literature on the relationship between IP transit prices and internet retail prices, it is assumed that only 30% of the reduction in IP transit prices is passed on to consumers. This figure is based on the assumption that ISPs will seek to increase the capital available to them through retained earnings for the purpose of investing in last-mile infrastructure. Last-mile infrastructure investments are more likely to be made in rural areas, where connectivity is low due to limited infrastructure networks and challenging topographies.[6]

Accordingly, the reduction in internet retail prices year-on-year is 30% of the decline rate of IP transit prices. **Cumulatively, internet retail prices are therefore expected to decline by 16% between 2021 and 2025 as a result of Equiano's landing.**

Figures 5 and 6 illustrate the reduction in average mobile data and fixed broadband retail prices.

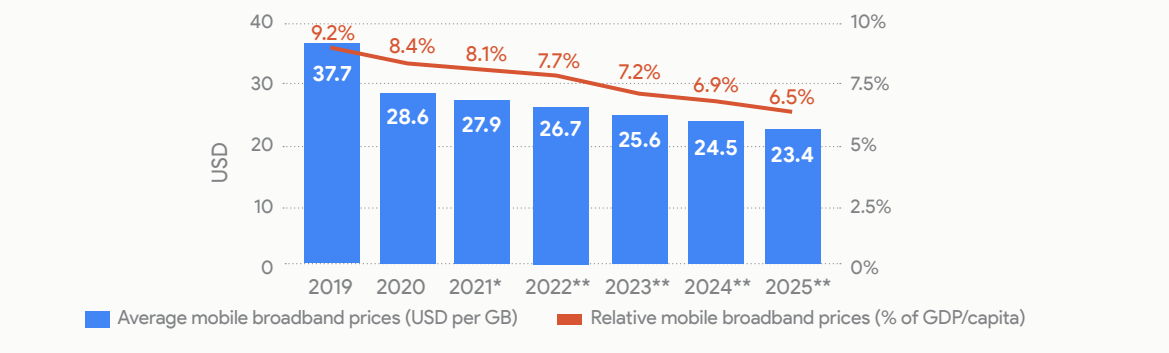
FIGURE 5 : Average mobile data retail prices 2019 - 2025



Source: International Telecommunication Union, Measuring digital development, ICT price trends, 2019 - 2020 | Genesis Analytics, 2022, team analysis.
Note: *Forecast | ** Equiano impact analysis period.

6. We note that commercial operators have typically been reluctant to invest significantly in unprofitable, remote areas that are characterised by low population density, relative to investing in more urban areas. In this respect, incentives by governments, minimum coverage requirements established by telecommunications regulators and investments by universal service funds all play an important part in bringing connectivity to underserved areas.

FIGURE 6 : Average fixed broadband retail prices 2019 - 2025



Source: International Telecommunication Union, Measuring digital development, ICT price trends, 2019 - 2020 | Genesis Analytics, 2022, team analysis.
Note: *Forecast | **Equiano impact analysis period.

Demand-side impacts

As illustrated in Figure 1, Equiano is expected to impact the demand-side of the broadband economy - with faster speeds and cheaper broadband access, consumer demand for connectivity is expected to increase.

Faster speeds (impact pathway 1)

Equiano is expected to improve the speed of connectivity across Namibia, leading to better user experiences and a higher demand for data traffic. To establish the extent to which higher internet speeds will lead to a growth in internet data traffic, we refer to the Hjort and Poulsen study.

Hjort and Poulsen found that, as a result of a new subsea internet cable's arrival, the probability that an individual will use the internet daily rises by 8.2%, while the probability of weekly usage rises by 12.3%. As Namibia was not part of the study and has limited data on the frequency of internet use, we utilise data from South Africa to establish the relationship between increased internet speeds and increased data consumption. In 2018, approximately 34% of South Africans used the internet less frequently than daily, while 12% used the internet less frequently than weekly.[7]

We assume that individuals who start using the internet daily increase their frequency of use from twice a week to every day - and that rising frequency of use is matched by rising data consumption. These individuals will see their data consumption increase by a factor of 3.5. We also assume that individuals who start using the internet weekly increase their frequency of use from once a month on average to four times a month - and that rising frequency of use is matched by rising data consumption. These individuals will see their data consumption increase by a factor of 4. These increases in data consumption translate to an overall increase in data traffic of 12.2%.

7. Statista, 2020, Internet usage frequency in South Africa as of January 2018.

This increase in data traffic, however, arises from both faster internet speeds and lower retail prices, which are both observed in the study. There is no information to infer which pathway contributed more to the increase in data traffic. We therefore assume an evenly split contribution between faster internet speeds and lower internet retail prices. The change in internet data traffic resulting from faster speeds is therefore 6.1%. In the study, internet speeds increased by 35% implying a change coefficient of 17.4%, i.e. a 100% increase in internet speeds leads to an increase in data traffic of 17.4%.

Given data consumption has increased rapidly since 2019 - when the Hjort and Poulsen study was published - and is expected to continue rising over the Equiano impact assessment period (2021-2025), we apply a change coefficient of 68.6%. This is four times the implied change coefficient in the study. **Applying this coefficient, data traffic is expected to increase by 105% between 2021 and 2025 due to faster internet speeds arising following Equiano's landing in Namibia.**

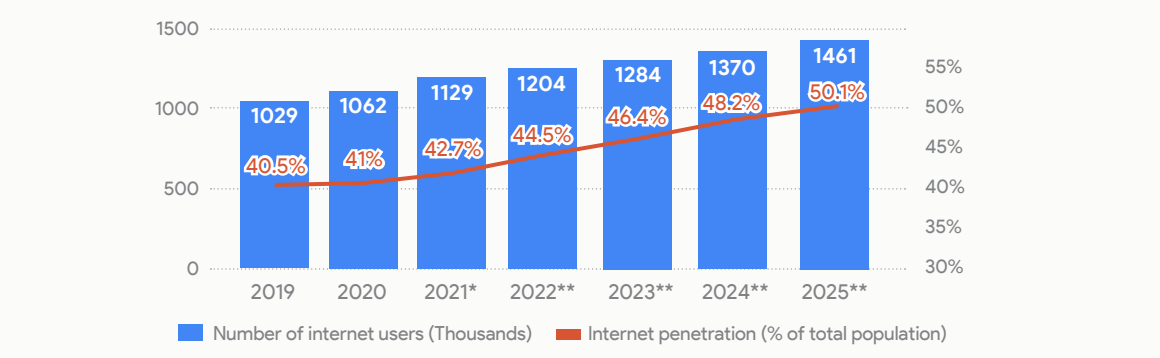
Lower retail prices (impact pathway 2)

The decline in internet retail prices is expected to drive up both penetration rates and the number of subscribers, while allowing existing users to consume more data and broaden the ways in which they use the internet.

The increase in the number of internet subscribers following a decrease in prices reflects the price elasticity of demand for the internet. An estimate for this can be derived from data on the price elasticity of demand for satellite TV, given the average pricing of satellite TV across different plans and packages is comparable to the average pricing of various internet subscription packages.

A 2012 study by the Commonwealth Telecommunications Organisation[8] charts the number of subscribers of satellite TV as a function of price. From this, we estimate the elasticities at different price points. We take the average elasticity between the USD 80 and USD 40 price points, which is -1.56. By this price elasticity, it is expected that the projected overall decline in retail prices of 16% between 2021 and 2025 will increase the number of internet users by 29.4%. **This translates to an increase in internet penetration of 7.5 percentage points over the same time frame, as shown in Figure 7 below.**

FIGURE 7 : Number of internet users and internet penetration in Namibia 2019 - 2025



Source: ITU World Telecommunications / ICT Indicators Database, 2022 | Genesis Analytics, 2022, team analysis.
Note: *Forecast | **Equiano impact analysis period.

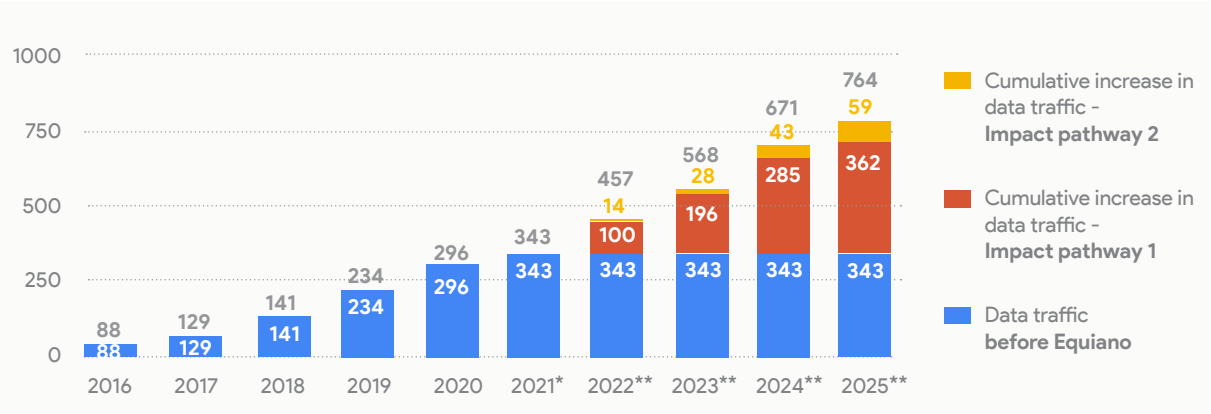
8. Commonwealth Telecommunications Organisation, 2012, The Socio-Economic Impact of Broadband in Sub-Saharan Africa: The Satellite Advantage.

As mentioned in the above section, the total increase in internet data traffic based on Hjort and Poulsen's study is estimated at 12.2%. Half of this increase is attributable to improved internet speeds, while the other half is attributable to lower internet retail prices. However, as outlined in the previous section, we model the impact of increased internet penetration on data traffic to be four times lower than in the study. This translates to an increase in internet usage of 6.1%, attributable to a 25.7% decline in internet retail prices, yielding a change coefficient of 23.7%. We apply a coefficient four times higher than implied in the Hjort and Poulsen given the expected significant increase in data consumption between the publication of the study and 2025 - the end of the Equiano impact assessment period. **By this coefficient (i.e. 94.7%), the expected change in data traffic between 2021 and 2025 attributable to lower internet retail prices is 35.9%.**

It is worthwhile to note that the Equiano impact pathway distinguishes increased data traffic caused by *intensive* internet usage from that caused by *extensive* internet usage. Greater intensive internet usage arises from existing subscribers using the internet more actively for existing use cases. More extensive internet usage is a result of new subscribers and new internet use cases. Though this distinction exists in the theory of change (Equiano impact pathway), quantifying it credibly is a challenge. The total modelled increase in data traffic of 122.5% between 2021 and 2025 therefore encapsulates both intensive and extensive increases in internet usage.

Figure 8 illustrates the increases in data traffic attributable to the two impact pathways (increased speeds and reduced retail prices) discussed above.

FIGURE 8 : Total data traffic in Namibia (PB) 2016 - 2025



Source: Genesis Analytics, 2022, team analysis. Note: *Forecast | **Equiano impact analysis period.

First-order economic impact

Examining the first-order economic impact of Equiano[9] is critical to assessing the cable's overall contribution to Namibia's economy. The increased data traffic and growing number of internet subscribers will likely boost revenues for ISPs, enabling them to expand as well as invest in improving their fixed and wireless broadband reach. In addition to increasing economic output, this will create a multiplier effect, whereby improved fixed and wireless broadband connectivity spurs a further increase in internet demand, ultimately leading to notable growth in the ICT sector.

9. Though not quantified, the economic growth that should result from the installation of the Equiano cable will manifest primarily through first-order economic impacts. The modelling and quantification of the first-order economic impact requires rich sectoral data, business micro data and data on the digital economy, none of which are readily available. Since the relationship between the outcome variables and the second-order economic impact variables can be established through the results of other empirical studies on this topic, modelling and quantifying the first-order economic impact is not necessary to quantify the ultimate economic impact of the Equiano cable.

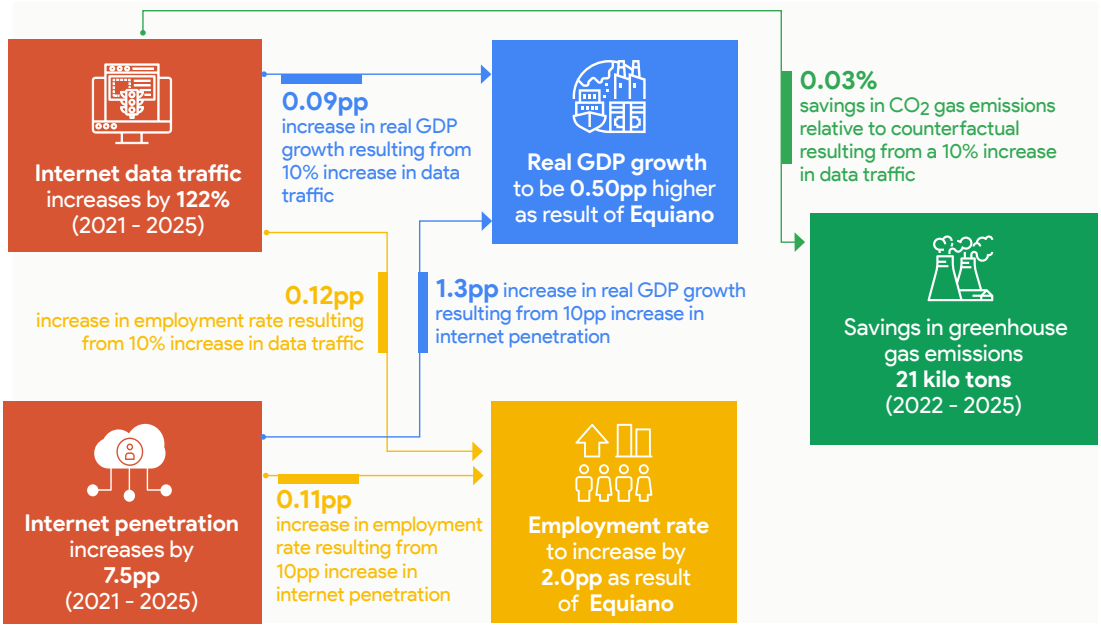
Increased adoption of the internet by more people and for more uses will lead to additional growth in the digital economy and peripheral sectors. Although it will cause a shift in business and service delivery models, this will not necessarily entail the demise of traditional businesses. Retailers in countries with large e-commerce industries have reported that some sectors have experienced growth in revenues from their physical stores concurrently with growth in their online sales.

Growth of the digital economy will also spill over into peripheral sectors, such as transport and storage due to the growth of e-commerce. A greater share of business operations being undertaken online will enable improved coordination, collaboration and automation. This in turn will boost the productivity of labour and capital, resulting in greater economic output.

Second-order economic impact

Figure 9 summarises Equiano's second order economic impacts on real GDP growth, employment and savings in greenhouse gas emissions.

FIGURE 9 : Macroeconomic impact of Equiano



Source: Genesis Analytics, 2022, team analysis. Note: pp - percentage points.

Real GDP growth

Based on the literature review, increased internet usage and broadband penetration are expected to yield higher real economic growth. A 2020 RTI study[10] found that a 10% increase in international bandwidth consumption per user in South Africa results in a 0.15% increase in GDP per capita.[11] By reconstructing the total international bandwidth consumption (data traffic) in the context of the RTI study (2005-2017) - as well as the resultant increase in GDP based on the observed increase in per capita income - we found a change coefficient of 0.92%.

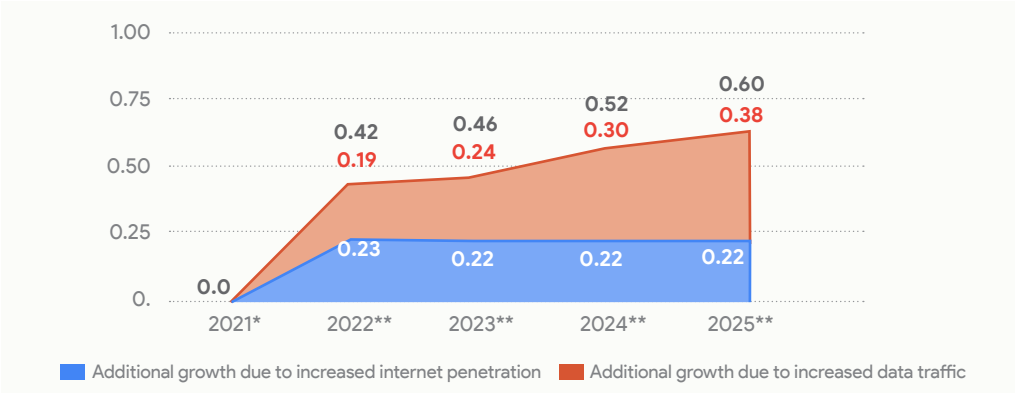
10. RTI International, 2020, Economic Impacts of Submarine Fiber Optic Cables and Broadband Connectivity in South Africa.
11. The RTI series on the economic impacts of submarine fibre optic cables does not cover Namibia. The only country covered for which the relationship between international bandwidth consumption per user and GDP per capita is analysed is South Africa. The coefficients from the South African study are applied in this report.

This means a 100% increase in data traffic leads to a 0.92% increase in real GDP, or an increase in the real growth rate of 0.92 percentage points.[12] The resultant increase in average real GDP growth between 2021 and 2025 - due to the 122.5% predicted increase in data traffic by the same year - is thus 0.22 percentage points.

Two separate studies - by Scott[13] and Qiang et al.[14] - found that an increase in broadband penetration of ten percentage points in developing countries leads to a rise in the real economic growth rate, observing increases of 1.35 and 1.38 percentage points respectively. **Taking the average of the two coefficients and applying the result to this model, we find that the increased internet penetration in Namibia of 7.5 percentage points between 2021 and 2025 will lead to a rise in average real GDP growth of 0.28 percentage points.**

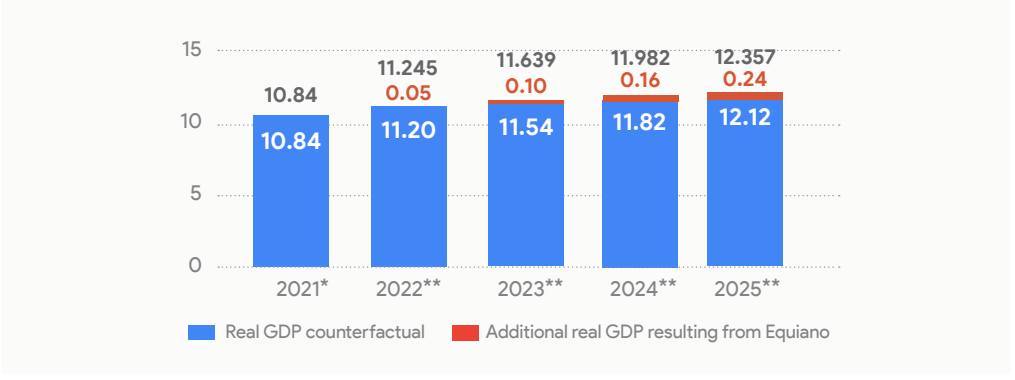
Accordingly, Namibia's real GDP is expected to be USD 237 million more than it otherwise would have been in 2025, reflecting an increase in the average year-on-year real economic growth rate of 0.50 percentage points between 2022 and 2025. The Equiano cable will have led to an additional USD 543 million in total economic output between 2022 and 2025. In the context of an average population growth rate of 2.4%, the additional overall economic growth will result in a higher GDP per capita growth rate of 0.49 percentage points.

FIGURE 10 : Increase in real GDP growth due to installation of Equiano (percentage points) 2021 - 2025



Source: Genesis Analytics, 2022, team analysis. Note: *Forecast | **Equiano impact analysis period.

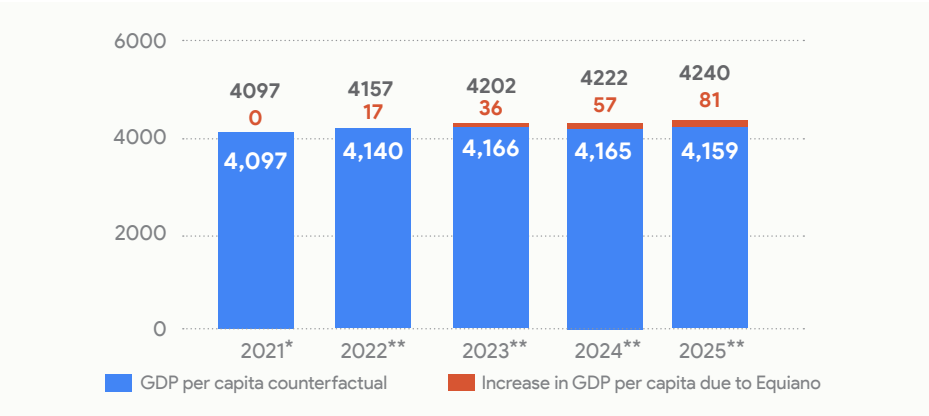
FIGURE 11 : Increase in real GDP due to installation of Equiano (USD billions) 2021 - 2025



Source: IMF, 2021, World Economic Outlook | Genesis Analytics, 2022, team analysis. Note: *Forecast | **Equiano impact analysis period.

12. At the stage of the analysis, population growth – which impacts GDP per capita – is not yet factored in. It is however incorporated into the modelling, as outlined in the last sentence above Figure 11.
13. Scott C., 2012, Does Broadband Internet Access Actually Spur Economic Growth?
14. Qiang C. et al., 2009, Economic Impacts of Broadband. Information and Communications for Development.

FIGURE 12 : Increase in real GDP per capita due to installation of Equiano (USD) 2021 - 2025



Source: IMF, 2021, World Economic Outlook | Genesis Analytics, 2022, team analysis. Note: *Forecast | **Equiano impact analysis period.

Employment

The increase in data traffic and internet penetration will allow many Namibians to access the digital world for the first time. It will also enable existing users to find new ways of using the internet, leading to greater employment within the digital economy and the ICT sector. To quantify Equiano's impact on the employment rate in Namibia, we incorporate the findings of Hjort and Poulsen's study on the impact of the arrival of new submarine cables on employment in South Africa.

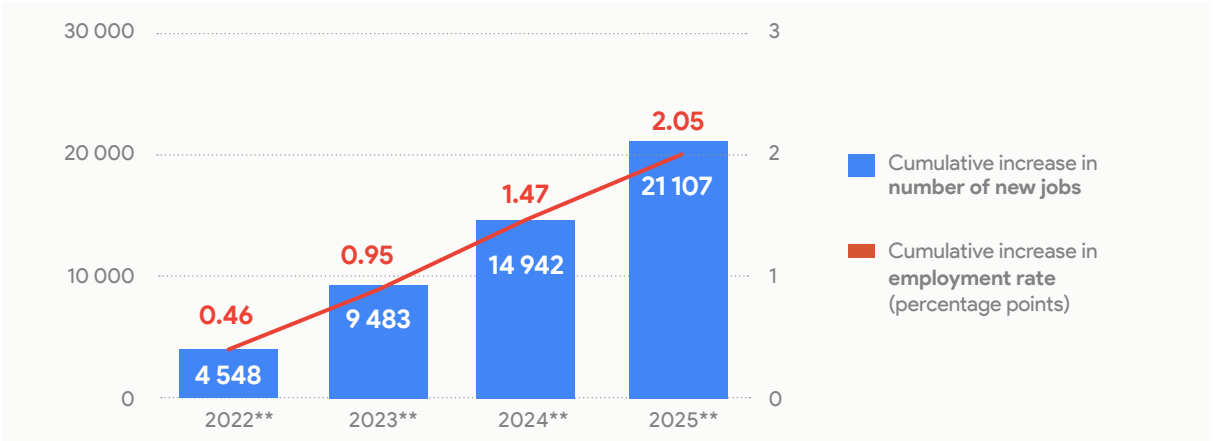
The study finds that on average, the arrival of a subsea cable in South Africa led to an increase in the employment rate by 2.2 percentage points in the connected areas, defined as those within 500m of a terrestrial fibre optic cable. There was no impact on the employment rate in the areas not connected to the internet network backbone of the country.

We assume that the proportion of South Africa's population living in connected areas equated to 20% of the urban population, translating to 12.5% of the country's total population. In this context and based on the Hjort and Poulsen study, a 2.2 percentage point increase in the employment rate among the 12.5% of the total population translates to an increase in the country-wide employment rate of 0.27 percentage points. We further assume that the contribution of increased data traffic and increased number of internet users to the 0.27 percentage points increase in employment rate is split equally. By constructing the implied increase in data traffic and internet penetration, within the context of the paper, we find that the change coefficients for employment with respect to data traffic and number of internet users are 0.78 percentage points and 0.73 percentage points.

However, we expect Equiano will have an even higher impact on employment in Namibia in the context of its relatively low bandwidth capacity and growing digital economy. As such, we have increased the coefficients calculated for South Africa by 50%. A 100% increase in data traffic will therefore lead to an increase in the employment rate of 1.17 percentage points, while a 100% increase in the number of internet users will lead to an increase in employment rate of 1.09 percentage points. The value of the change coefficient is set to grow as use of the internet increases intensively and extensively.

Therefore, the growth in data traffic of 122.5% between 2021 and 2025 is thus expected to increase the employment rate by 1.6 percentage points. Meanwhile, the increase in internet penetration of 8.5 percentage points over the same time frame should result in an increase in the employment rate of 0.45 percentage points by 2025. **The employment rate in Namibia should therefore be 2.05 percentage points higher by 2025, representing a cumulative total of approximately 21,107 new jobs created between 2022 and 2025 as a result of Equiano's landing. This equates to an average of 5,277 jobs created annually over this time frame.**

FIGURE 13 : Increase in employment due to Equiano 2022 - 2025

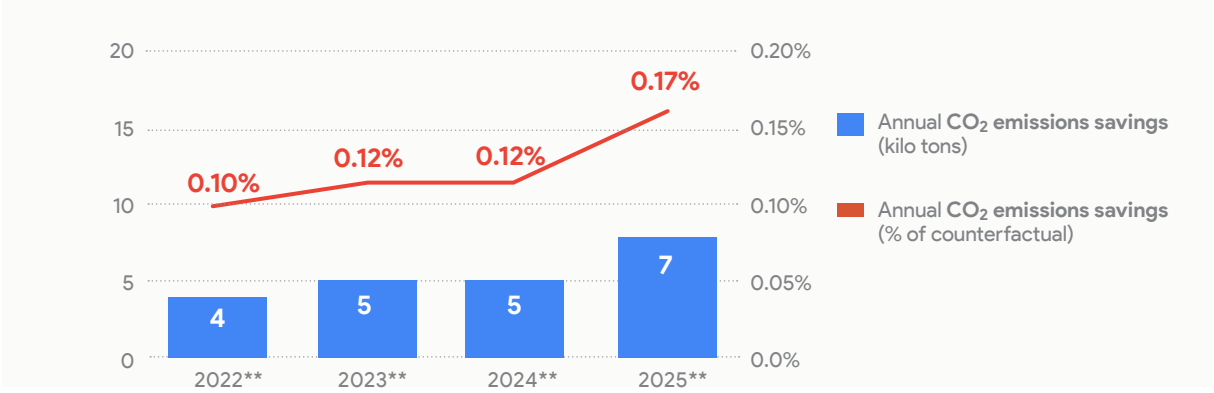


Source: Genesis Analytics, 2022, team analysis. Note: **Equiano impact analysis period.

Greenhouse gas emissions

According to a 2013 SQW study[15] in the UK, an average increase in internet speeds of 48% in 2012 yielded an average saving in CO_2 gas emissions of 0.7 million tonnes. This is equivalent to 0.14% of the counterfactual CO_2 gas emissions for that year. Given that internet speeds only affect data traffic within the framework of this study, the results of the SQW study imply that a 100% increase in data traffic would yield a savings in CO_2 gas emissions equivalent to 0.29% of the counterfactual. **Applying this coefficient to this study, while allowing for an increasing impact of data traffic on CO_2 gas emissions as a result of new internet use cases, yields relatively modest cumulative savings in CO_2 emissions of 21 kilo tons, given that Namibia's emissions - and emissions per capita - are very low.**

FIGURE 14 : Savings in CO_2 gas emissions 2022 - 2025



Source: Our world in data, Annual CO_2 emissions, 2021 | Genesis Analytics, 2022, team analysis. Note: *Forecast | **Equiano impact analysis period.

15. SQW, 2013, UK Broadband Impact Study, Impact Report.

Literature review

A number of studies have been conducted analysing the effect that improvements in various elements of internet provision have on the economies of different countries and regions. The following variables have previously been analysed in these studies: the landing of a subsea cable, broadband penetration, broadband consumption, digitisation, and ICT regulation.

Impact of a subsea cable on the internet market and wider economy

RTI analysed the impact of the landing of subsea fibre optic cables and improved broadband connectivity on South Africa between 2009 and 2014.[16] The studies focused on the cables that landed during this period - SEACOM, EASSy and WACS. The hypothesis is that the arrival of a subsea cable stimulates network expansion by ISPs, which leads to increased data traffic competition and therefore to decreased internet retail prices, as well as increased speeds. As a result, consumers increase their consumption of digital content, products and services, while some become first-time internet subscribers. The ease of doing business also improves with higher internet speeds, quality and reliability; more businesses use the cloud and e-commerce for the first time. This results in the emergence of new firms and startups, as well as growth in productivity, efficiency and revenue for businesses.

The RTI study finds that the arrival of the aforementioned subsea cables led to an increase in the employment rate by 2.2 percentage points between 2009 and 2014, though only in areas that are in close proximity to a terrestrial fibre optic cable. At a national level, no impact was observed on employment. Firms in areas that are close to terrestrial fibre optic cables were found to have a 23% increase in net firm entry[17] on a quarterly basis, on account of recently installed subsea cables.

The arrival of subsea cables is also seen to increase growth in GDP per capita by 1.21 percentage points, leading to per capita income being 6.1% higher after five years as compared to the counterfactual. In the long run, the RTI study finds that increased international bandwidth consumption and broadband penetration have an impact on GDP per capita. A 10% increase in international bandwidth consumption leads to a 0.15% increase in GDP per capita, while a 10% increase in broadband penetration leads to a 0.27% increase in GDP per capita.

Hjort and Poulsen measured the effect of the arrival of subsea cables on employment and wages in 12 African countries, including South Africa, between 2007 and 2014.[18] They found that employment increases by 2.2 to 3.1 percentage points in areas that are connected (within 500m) to the internet backbone network - the terrestrial fibre optic cable network - in South Africa. The increase in the employment rate in the connected areas does not result from a shift in jobs from the unconnected areas (through migration of employees or businesses) as the impact of the arrival of subsea cables in unconnected areas is near zero and statistically insignificant.

16. RTI International, 2020, Economic Impacts of Submarine Fiber Optic Cables and Broadband Connectivity in South Africa.
17. Net firm entry refers to the number of new firms entering a market minus the number of firms closing.
18. Hjort J. and Poulsen J., 2019, The Arrival of Fast Internet and Employment in Africa, *American Economic Review*.

Hjort and Poulsen also found that the increase in overall employment is driven specifically by more employment in skilled occupations. The increase in employment in the connected areas was found to be accompanied by 2.4% to 3.3% increase in average incomes, as proxied by light density at night.

Hjort and Poulsen also identified the mechanism through which the increase in employment is achieved. The arrival of a subsea cable boosts internet speeds and decreases retail prices, which in turn increases internet usage both intensively (greater and more diverse internet usage by existing users) and extensively (the emergence of new users). This leads to the entry of new firms, particularly in sectors that rely heavily on ICT, such as finance and services.

Internet speeds in areas connected to the internet backbone were found to have increased by up to 35% after the arrival of a subsea cable. Fixed broadband subscription prices decreased by 25% to 35% annually in the first four years following the installation of a subsea cable, as shown in Figure 15 below. In the connected areas, the probability that an individual uses the internet daily increased by 8.2% to 12.4%, while the probability that an individual uses the internet weekly increased by 12.3% to 14.2% after the landing of a new subsea cable.

Analysys Mason measured the impact of Google's USD 2 billion investments in network infrastructure - six subsea cables, edge infrastructure and Google Global Cache - in the APAC region between 2010 and 2019.[19] These investments enabled the acceleration of the supply of international bandwidth capacity and increased the diversity of routes, not only benefiting Google's services, but also the broader connectivity ecosystem in the region.

Specifically, 367 Tbps of additional capacity was achieved through the installed submarine cables. This resulted in download speeds four times faster, a 12% to 49% reduction in end-user latency, and a 74% decrease in IP transit prices in the countries that had strong subsea cable connectivity. From this improvement in the connectivity ecosystem, three new internet use cases could be supported - video conferencing, commerce and transactions, and cloud services. Ultimately, between 2010 and 2019, the improvement in the connectivity ecosystem led to the creation of 1.1 million jobs and USD 430 billion in additional GDP within the APAC region.

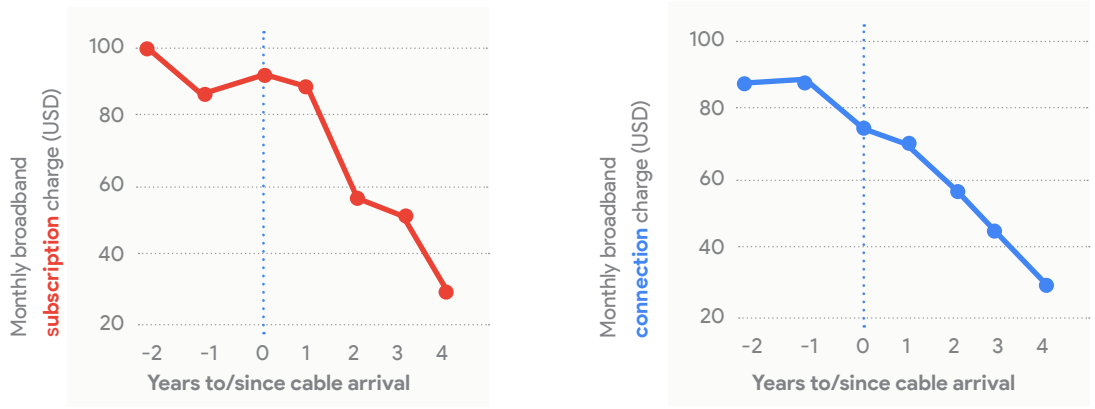
Impact of increased broadband penetration on economic output

A number of studies have specifically looked at the impact of increased broadband penetration on economic output. In 2016, Minges published an extensive literature review on this subject, outlining the results of various studies that have sought to establish a relationship between these two variables. Katz and Callorda's 2018 study[20] examined the economic contribution of fixed and mobile broadband. Table 2 below shows the results of these studies. All the coefficients were statistically significant, with a significance level of at least 10%.

19. Analysys Mason, 2020, Economic Impact of Google's Apac Network Infrastructure.
20. Katz R., Callorda F., 2018, The Economic Contribution of Broadband, Digitization and ICT Regulation. *ITU Publications.*

The results from the studies all show a positive relationship between broadband penetration and economic growth, including in emerging economies such as Nigeria. The higher income levels are not only at a national but also a household and per capita level. Qiang et al.[21] and Scott [22] modelled the impact of an increase in fixed broadband penetration on developing countries' real growth rate. The average between the two authors' findings for this change coefficient is an increase of 1.37 percentage points in real economic growth, following an increase in fixed broadband penetration of ten percentage points. Mobile broadband penetration was found to have a greater economic impact than fixed broadband penetration: a one percentage point increase in the former induced a 0.18% increase in GDP per capita, compared with 0.06% for fixed broadband penetration.

FIGURE 15 : Broadband subscription and connection charges before and after subsea cable arrival[23]



21. Qiang C. et al., 2009, Economic Impacts of Broadband. Information and Communications for Development.
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Table 2: Impact of broadband penetration on economic output – meta analysis

Author(s)	Focus country(s)/ region	Study time frame	Key explanatory variable	Change in explanatory variable	Dependent variable	Change in dependent variable
Czernich, Falck, Kretschmer and Woessmann (2009)	OECD countries - 25	1996 - 2007	Broadband penetration (% of population)	10 percentage points increase	GDP growth rate	0.65 percentage points
Koutroumpis (2009)	EU countries - 15	2003 - 2006	Broadband penetration (% of population)	10 percentage points increase	GDP growth rate	0.26 - 0.85 percentage points
Zaballos and Lopez-Rivas (2012)	LAC countries - 26	2003 - 2009	Broadband penetration (% of population)	10 percentage points increase	GDP per capita	3.19%
Qiang, Rossotto & Kimura (2009)	Developed countries - 120*	1986 - 2006	Fixed broadband penetration (% of population)	10 percentage points increase	GDP growth rate	1.21 percentage points
Qiang, Rossotto & Kimura (2009)	Developing countries - 120*	1986 - 2006	Fixed broadband penetration (% of population)	10 percentage points increase	GDP growth rate	1.38 percentage points
Scott (2012)	Developed countries - 86*	1980 - 2011	Fixed broadband penetration (% of population)	10 percentage points increase	GDP growth rate	1.19 percentage points
Scott (2012)	Developing countries - 86*	1980 - 2011	Fixed broadband penetration (% of population)	10 percentage points increase	GDP growth rate	1.35 percentage points
Thompson and Garbacz (2011)	Developed countries	2005 - 2009	Fixed broadband penetration (% of households)	10 percentage points increase	GDP per household	0.77 percentage points
Katz and Callorda (2012a)	Panama	2000 - 2010	Fixed broadband penetration (% of households)	10 percentage points increase	Real GDP	0.44%
Katz and Callorda (2018)	Global - 139 countries	2010 - 2017	Fixed broadband penetration (% of population)	1 percentage points increase	GDP per capita	0.08%
Katz and Callorda (2018)	High income countries	2010 - 2017	Fixed broadband penetration (% of population)	1 percentage points increase	GDP per capita	0.14%
Katz and Callorda (2018)	Middle income countries	2010 - 2017	Fixed broadband penetration (% of population)	1 percentage points increase	GDP per capita	0.06%
Thompson and Garbacz (2011)	Developed countries	2005 - 2009	Mobile broadband penetration (% of households)	10 percentage points increase	GDP per household	0.52%
Katz and Callorda (2012b)	Philippines	2000 - 2010	Mobile broadband penetration (% of households)	10 percentage points increase	Real GDP	0.32%
Katz and Callorda (2018)	Global - 139 countries	2010 - 2017	Mobile broadband penetration (% of population)	1 percentage points increase	GDP per capita	0.15%
Katz and Callorda (2018)	Middle income countries	2010 - 2017	Mobile broadband penetration (% of population)	1 percentage points increase	GDP per capita	0.18%
Katz and Callorda (2018)	Low income countries	2010 - 2017	Mobile broadband penetration (% of population)	1 percentage points increase	GDP per capita	0.20%
Czernich, Falck, Kretschmer and Woessmann (2009)	OECD countries - 25	1996 - 2007	Introduction of broadband	-	GDP per capita growth rate	2.7 - 3.9 percentage points
Katz and Callorda (2013)	Ecuador	2009 - 2011	Household having broadband	-	Average annual household income	3.67%
Deloitte (2012)	Global - 96 countries	2008 - 2011	Substitution from 2G to 3G penetration	10 percentage points increase in 3G penetration	GDP per capita growth rate	0.15 percentage points

* Total number of countries included in the study, inclusive of developing and developed countries

Impact of broadband penetration and internet usage on greenhouse gas emissions

The potential of increased broadband penetration and adoption in commercial and social activities to positively contribute to the reduction of greenhouse gas emissions has long been recognised. Several impact pathways lead to this outcome, including: reductions in the use of paper arising from electronic communication and publications; savings in the consumption of petroleum products due to teleconferencing and telecommuting; and reduced energy demand for the construction and maintenance of retail and other commercial real estate spaces due to the proliferation of e-commerce.

In 2007, Fuhr and Pociask[24] estimated the savings in greenhouse gas emissions arising from wide adoption and use of broadband-based applications between 2007 and 2017 in the US. By reviewing scientific literature, they estimated that the potential impact of changes from the delivery of broadband is an incremental reduction in greenhouse gas emissions of more than 1 billion tonnes over the ten-year period. E-commerce would contribute about 21% to the estimated savings in greenhouse gas emissions, teleconferencing 20%, increased electronic publication and communication 7%, while 52% of the savings would be attributable to telecommuting.

In 2013, SQW[25] estimated the environmental impacts of the increase in broadband speeds in the UK, arising from both public and private sector initiatives. Public and private investments in broadband infrastructure are projected to lead to an average increase in broadband speeds across the UK of approximately 48% annually between 2008 and 2025. This in turn is expected to lead to savings of 1.6 million tonnes of CO_2 emissions annually by 2024, and a total of 12.4 million tonnes of CO_2 emissions between 2009 and 2024.

These savings in greenhouse gas emissions are modelled to arise from the following reductions:

- 2.3 billion kms in annual commuting, predominantly in car usage due to increased remote working.
- 5.3 billion kms in annual business travel, largely in car usage, through increased use of video conferencing and online collaboration tools.
- 1 billion kWh of electricity usage per annum through the shifting of server capacity onto more energy-efficient public cloud platforms by broadband-using firms.

Despite this, internet usage and the ICT sector as a whole have their own carbon footprint, resulting from the energy requirements of running data centres, servers, applications and networks.[26] The ICT sector currently contributes 2 to 3% of global greenhouse gas emissions. There has therefore been an effort by various governments, businesses and organisations to mitigate the sector's carbon footprint through new energy-efficient data centres and servers, as well as the increased use of both renewable and carbon-free energy to power internet infrastructure.

24. Fuhr J.P., Pociask S., 2007, Broadband Services: Economic and Environmental Benefits, The American Consumer Institute.
25. SQW, 2013, UK Broadband Impact Study, Impact Report.
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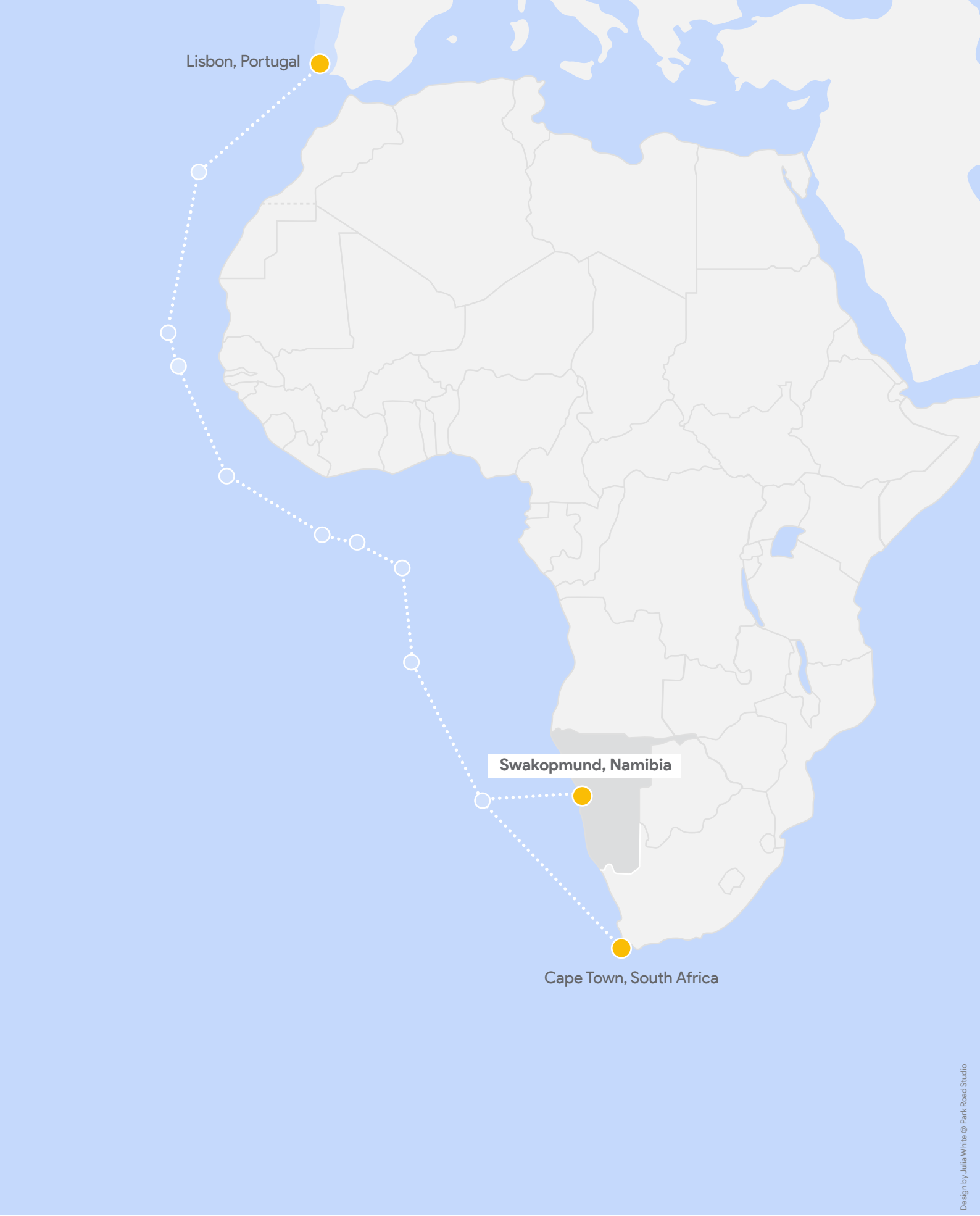

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