The economic and social impact of investment in the nbn network

Methodology Report
January 2024

accenture

This report has been commissioned by **NBN Co** and prepared by Accenture.

We acknowledge the Aboriginal and Torres Strait Islander peoples as the traditional custodians of our land – Australia.
We acknowledge the continuing culture and contributions of First Nations Peoples and pay our respects to Elders past, present and emerging.

NBN Co is a wholesaler only and provides wholesale services to phone and internet providers. To order a plan, end customers should contact their preferred phone and internet provider.

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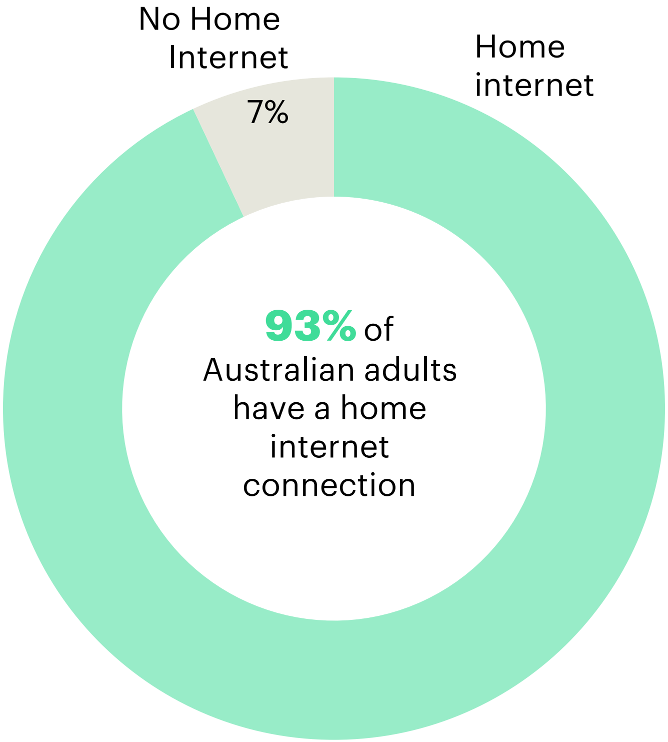
Section 1
Economic impact

Broadband is the primary means through which Australia connects to the internet

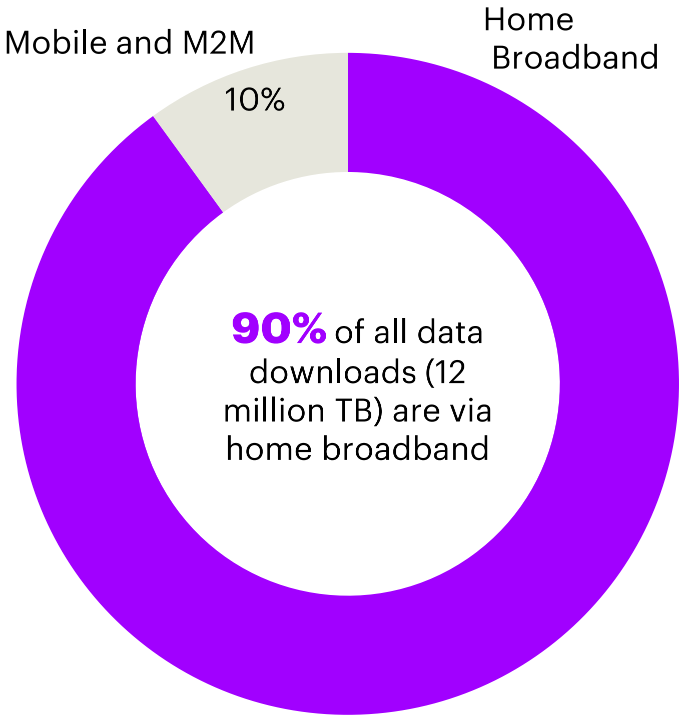
Home internet is ubiquitous

Adults with home internet connections, %



The vast majority of data downloads are via home broadband connections

Percentage of data downloaded by type of access connection



Home broadband refers to the high-speed, always-on internet connection that is delivered to Australian residences.

Home broadband is facilitated through a range of technologies including fibre, DSL, fixed wireless, satellite, and home wireless.

Currently, 93% of Australian adults have a home internet connection, reflecting near-ubiquitous uptake across the country. By providing seamless access to digital platforms and services, household broadband has fostered innovation and paved the way for a more connected Australia.

Despite the growth in mobile internet technologies, in 2023, an estimated 90% of all data downloads in Australia were delivered via broadband, demonstrating its centrality to Australia's digital economy.

Source: LHS Chart: ACMA How We Use The Internet (2022). RHS Chart: ACCC Record Keeping Rule 2023.
Note: Households are defined as those occupied and partially occupied residential households in Australia based on the Census. Home broadband assumed to include the following technologies: Fibre, HFC, Fixed Wireless, Satellite, Home Wireless (4G/5G for home). Mobile data is pre-paid and post-paid data on mobile phones and is not considered 'home broadband'. M2M is Machine-to-Machine and is a direct communication between devices using any communication channel, including fixed/wired and wireless. M2M is not considered home broadband. The latest ABS data on internet connectivity finds that 14% of all households do not have home internet access in FY17. The most recent ACMA 'How we use the internet' research finds that 93% of adults had a home internet connections (December 2022). Estimates vary across sources due to difference in definitions (of included technologies and of the unit of interest – households or adults etc.).

Broadband is a key enabler to the benefits derived from the internet; which is broadly considered a *General Purpose Technology* ('GPT')

There are 25 recognised GPTs according to Lipsey et al. (2006)

1 **Domestication of plants** *(9000-8000 BC)*

...

Money *(9000-6000 BC)*

Wheel *(4000-3000 BC)*

...

Electricity *(20th century)*

Computer *(20th century)*

23 **Internet** *(20th century)*

24 & 25 **Nanotechnology & Biotechnology** *(21st century)*

The Internet as a GPT

The emergence of **the internet** has been a defining feature of the 21st century, revolutionising the global economy in just two decades.

Since its inception, enabling technologies have facilitated many iterations of the internet, each more influential than the last.

The internet has generated immense economic growth, both by enhancing the productivity of existing industries (through its enablement of communication, data storage and information sharing), and by generating a flood of new technologies and business models such as e-commerce, social media, and cloud computing.

What is a General Purpose Technology ('GPT')?

First defined by economists Richard Lipsey and Kenneth Carlaw in their book, 'Economic Transformations: General Purpose Technologies and Long-Term Economic Growth', a GPT is a product, process or organisational system that dramatically affects the incumbent economic system and fundamentally transforms where economic value is created.

To be considered a GPT, a technology must:

1. be a single, recognisable generic technology
2. initially have much scope for improvement but come to be widely used across the economy
3. have many different uses
4. create many spillover effects

To date, the preeminent GPT of the 21st century is the internet which has reshaped the way that economic activity is organised, impacting every industry.

Household broadband has been an invaluable enabler of fast, ubiquitous internet

Some researchers consider broadband itself to be a GPT (Briglauer et al., 2021, Frontier Economics, 2023, Bresnahan and Trajtenberg, 1995). However, for the purposes of this research, we consider broadband to be a 'GPT enabler' (OECD, 2008), that is, critical infrastructure that is a necessary pre-requisite for the internet to function as a GPT.

In practice, the impact of high-speed broadband on economic activity is transmitted primarily through enhancements in internet performance and growth driven by digitalisation. As such, we consider any measurable improvements in economic output attributable to digitalisation following the rollout of broadband to be wholly attributable to the broadband infrastructure itself. In practice, this means that our overall modelling approach is consistent with those exhibited in the economic literature (Hasbi, 2021, Briglauer et al., 2021, Bai, 2016).

Source: Lipsey et al., 2006; Briglauer et al., 2021; Note: The classification of GPTs is conceptual and subject to debate and change. In the years following the publication of Lipsey et al. (2006) there has been a strong emergence of next generation technologies that could well be classified as GPTs in the future (e.g., artificial intelligence, quantum computing). As such, this list is considered a useful indicator of existing GPTs, rather than an exhaustive list.

There are a range of broadband technologies in Australia

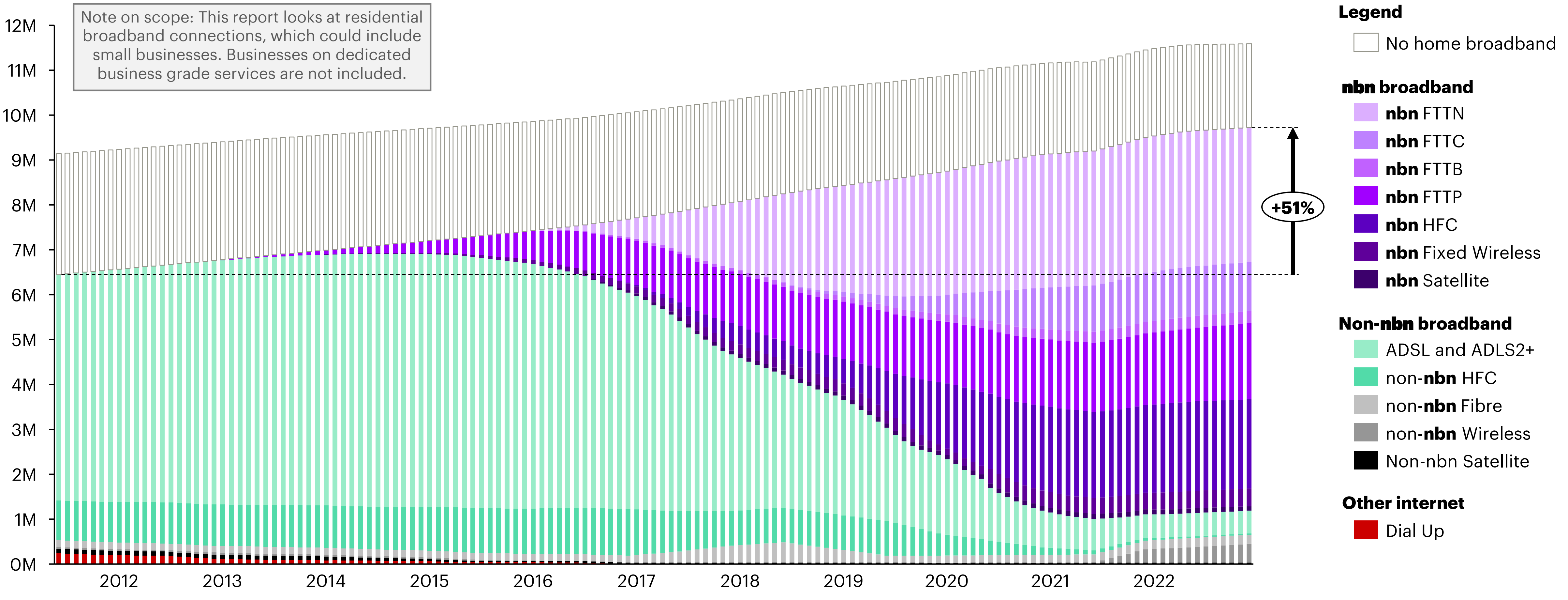
Group	Technology	Description	Potential maximum download speed 2023[2]	nbn technology?
Fibre	Fibre-to-the-households (FTTP)	Uses fibre optic lines to connect to the users' households.	Up to 1000 Mbps	Yes
	Fibre-to-the-building (FTTB)	Uses fibre optic lines to connect to a buildings' communications room, with existing copper/phone technologies to connect the communications room to the users' apartment.	Up to 100 Mbps	Yes
	Fibre-to-the-node (FTTN)	Uses fibre optic lines to connect to a node near the households, with existing copper/phone technologies to connect the node to the households.	Up to 100 Mbps	Yes
	Fibre-to-the-curb (FTTC)	Uses fibre optic lines to connect to close to the households, with existing copper/phone technologies to connect the curb to the households.	Up to 100 Mbps	Yes
Digital Subscriber Line (DSL)	Asymmetric Digital Subscriber Line (ADSL)	Uses copper wires of existing phone lines to connect to the households.	Up to 8 Mbps (ADSL)	No (legacy technology)
	ADSL2+	Similar to ADSL, but with double the bandwidth, offering higher speeds.	Up to 20 Mbps (ADSL2+)	No (legacy technology)
Others	Hybrid Fibre Coaxial (HFC)	Uses an existing 'pay TV' or cable network to connect to the households. For **nbn** HFC, this cable network connects from an **nbn** node or curb to the households.	Up to 1000 Mbps	Yes
	Fixed Wireless	Internet broadcast as radio signals from towers to receivers on the households. Is available via the **nbn** (Fixed Wireless) or via mobile providers providing 4G or 5G.	Up to 75 Mbps (**nbn**)	Yes
			Up to 600 Mbps (Mobile Network Operators, 5G)	n/a
	Satellite	Delivers internet services via a satellite to a satellite dish on the households. Is available through the **nbn** (Sky Muster) and through LEO Satellite (e.g. Starlink).	Up to 100 Mbps[3] (Sky Muster)	Yes
			Up to 240 Mbps (LEO Satellite e.g Starlink)	n/a
	Dial-up[1]	Uses existing phone lines and a modem to dial up an internet service provider	< 1 Mbps	No (legacy technology)

Notes: 1. Dial-up is not considered to be 'broadband' under some definitions. Dial-up connections have been superseded by the rollout of the **nbn** network. The ABS stopped counting dial-up connections after 2016; See appendix for a summary of definitions. 2. Actual speeds may vary according to provider and other factors impacting technology performance such as congestion and latency. 3. Recently released in June under Sky Muster Plus Premium. Offers burst download speeds of up to 100Mbps. Sources: **nbn** (FTTP, FTTB, FTTN, FTTC, HFC, Fixed Wireless, Satellite); Southern Comms (ADSL); Junotelecoms (ADSL2+), Digital Unite (Dial-up); CRN (2018); ABS (2013, 2018) **nbn** data, Accenture analysis.

The **nbn** network roll out has had a profound impact on broadband availability and technology quality

The nbn network has improved broadband ubiquity; today there are over 50% more broadband connections than in 2011

Number of household broadband connections[1], by technology and **nbn** v non-**nbn** segment

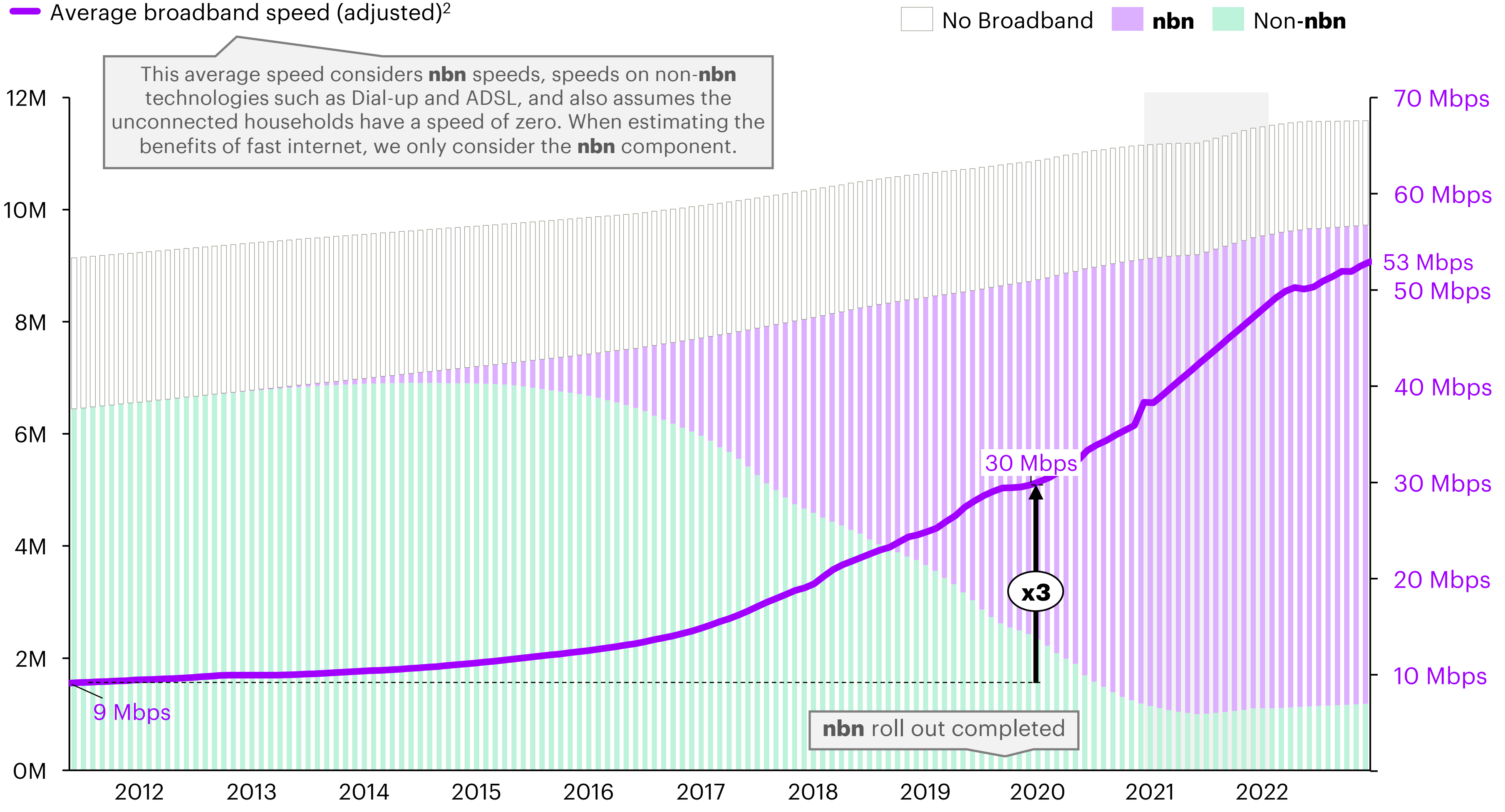


Source: Accenture analysis and modelling; data sourced from **nbn**, Dept of Communications Broadband Availability and Quality Report, ACCC Internet Keeping Rule, ABS. Notes: 1. Based on occupied and partially occupied residential households in Australia based on the Census. This number may include small businesses run out of homes, but who are not connected to dedicated business grade services. See slide 7 and the appendix for definitions of each technology.

Broadband speeds have increased 3-fold over the course of the **nbn** network roll out and today are 6-times faster than in 2011

Broadband speed has grown from 9 Mbps in 2011 to 53 Mbps at the end of 2022

Number of households by connection type (bar, left axis)[1]; average broadband download speeds (line, right axis), Mbps



Broadband download speed plays a critical role in shaping internet user experience, enhancing the accessibility and experience of major digital services such as high-definition streaming, video conferencing and file sharing.

Since the rollout of the **nbn** network, the quality of Australian broadband infrastructure has increased significantly. From 2011 to 2023, average download broadband speeds have risen by almost **500%**, marking the transformative impact of the **nbn** in bolstering both broadband speeds and ubiquity across Australia.

While speed is a valuable feature of broadband quality, the **nbn** network has also driven improvements across a multitude of broadband features such as reliability, upload speeds and latency. Each of these features also play a significant role in shaping overall user experience and driving economic growth.

Source: Accenture analysis and modelling; data sourced from **nbn**, Dept of Communications Broadband Availability and Quality Report, ACCC Internet Keeping Rule, ABS. Notes: 1. Based on occupied and partially occupied household households in Australia based on the Census. 2. Adjustment normalises average speed during the Focus on Fast campaign which ran through calendar year 2021. Note: Definition of broadband includes all technologies shown on the previous page; including both non-**nbn** and **nbn** services. When the benefits of increased broadband speeds are estimated, we only consider the **nbn** component. Speeds shown are headline download speeds.

The nbn is Australia's wholesale broadband access network

The nbn network enables Australians to access fast and reliable internet, and being a regulated wholesale only network, the benefits of retail competition mean that the more of the value of the network benefits customers than might otherwise be the case with a vertically integrated model of broadband supply. The network build and roll out took place between 2010 and 2020. Today, over 8.6 million households are connected via **nbn** broadband connections, via FFTx, HFC, fixed wireless and satellite technologies.

The network build, technology and infrastructure upgrades and ongoing operation is managed by NBN Co, a Government Business Enterprise. NBN Co provides wholesale access to the network to Retail Service Providers ('RSPs'), who provide retail plans to household, business, enterprise and government consumers. In the **nbn**'s Statement of Expectations, issued in December 2022, "*The enduring purpose of the **nbn** is to provide fast, reliable and affordable connectivity to enable Australia to seize the economic opportunities before it and service the best interests of consumers. It is essential to enabling access to key services, maximising employment and educational opportunities, and driving productivity and economic growth. NBN Co will enhance Australia's digital capability by delivering services to meet the current and future needs of households, communities and businesses, and promote digital inclusion and equitable access to affordable and reliable broadband services.*" This research serves the purpose of contributing to a common understanding of the economic benefits generated by the **nbn** to and to assist in the assessment of NBN Co's performance against this core objective.

Note on the scope of this report

The economic modelling presented in this report estimates a relationship between average broadband speeds and economic activity (GDP, productivity, business creation and employment outcomes). Whilst the majority of home broadband connections in Australia are made via the **nbn** network (81%[1] in 2023), this was not always the case, and there are alternative ways to connect (for example, via legacy technologies such as ADSL and competing networks/emerging technologies such as Fixed Wireless provided by Mobile Network Operators, alternative fixed line networks and more recently LEO satellite networks).

Our approach has been to consider all home broadband technologies, not just **nbn** connections. This presents a more complete picture and is particularly important when considering historical time periods when the **nbn** network was nascent. Given the importance of the **nbn** network in driving increased access to broadband and higher speeds, we have then estimated the proportion of the total economic benefits that is attributable to the **nbn** network by considering the pattern of take-up and speeds over time.

Source: Accenture, **nbn**. 1. ACMA 2023, Communications and media in Australia: How we use the internet

A brief history of the nbn network

- **2007** — The idea of a national broadband infrastructure program is first proposed during the federal election campaign
- **2009** — The Commonwealth Government announces plans to establish the **nbn** network, intending to deliver high-speed broadband access to all Australians
- **2010-11** — The rollout of the **nbn** network starts, with initial trials in areas of Tasmania, New South Wales, Queensland and Victoria
- **2013** — A change in government policy shifts the **nbn** from a majority FTTP network to a mixed-technology model
- **2016** — The first FTTN and HFC connections become available
- **2020** — **nbn** rollout is officially completed, having met its target of providing access to 11.5 million households across the country
- **2021+** — NBN Co continues to improve the network, upgrading technology, increasing capacity and speeds, and enhancing customer service

For the first time, the impact of the broadband speeds on the Australian economy has been modelled at a detailed location level (SA2)

The insights in this report are based on a first-of-its-kind model in Australia that links broadband speeds to economic development. The approach used leans on the highly cited international academic literature of Wolfgang Briglauer, based on county-based analysis in Germany. The method requires detailed data at the granular location level, including of economic outcomes, broadband take-up and speeds obtained and for appropriate control variables such as population size, labour and capital inputs. Using publicly available data and detailed **nbn** network data we developed a bespoke panel dataset at the SA2 level to enable this first-of-its-kind analysis.

Our approach to estimate productivity benefits is adapted from Briglauer et al (2021) and links GDP per capita at a regional level to average broadband speeds, controlling for the key inputs to economic output: capital (K) and labour (L). By controlling for these factors, the model identifies **changes in GDP that are attributable to multifactor productivity**[4]. Other control factors include educational attainment (to control for human capital stock), a variable to recognise mining regions[3] and fixed effects for region and time (α).

We have **constructed** two models to measure the impact of broadband speeds on productivity:

Model 1: Our basic model mimics that baseline specification in the Briglauer study, but does not account for diminishing returns. This was done for comparative purposes.

$$\log(GDPpc_{it}) = \beta_1 \log(K_{it}) + \beta_2 \log(L_{it}) + \beta_3 \log(EDU_{it}) + \beta_4 BSpeed_{it} + \beta_5 \log(mining_{it}) + \alpha + \epsilon_{it}$$

Model 2 (preferred): Our second, preferred model was constructed to account for diminishing marginal returns to speed. It assumes a non-linear model between GDP and broadband speeds. This model is identical to Model 1 but with a square-root transformation of the broadband speed variable. The marginal impact of changes in broadband speed under this model is shown on the next page.

$$\log(GDPpc_{it}) = \beta_1 \log(K_{it}) + \beta_2 \log(L_{it}) + \beta_3 \log(EDU_{it}) + \beta_4 \sqrt{BSpeed_{it}} + \beta_5 \log(mining_{it}) + \alpha + \epsilon_{it}$$

Leveraging international academic literature

This report leans on the methodology established in Briglauer et al. (2021). The paper uses an econometric identification approach to estimate the average causal effect of a 1 Mbps increase in the average broadband speed on GDP, accounting for diminishing marginal returns to higher speeds. This paper was selected because:

- Country-specific methodology – approach used is to estimate economic impact at the regional level
- Time period – the dataset is relatively recent in that it spans 2010 to 2015
- Economic development – Germany is a developed G20 economy as is Australia

Briglauer et al. (2023) find that an increase in bandwidth by 1 Mbps increases regional GDP by 0.18%.

A note on the author[2]: Dr Wolfgang Briglauer is the head of Digitalisation and Regulation research at EcoAustria, and a leading voice on European broadband infrastructure and policy. His work in this field is regularly published in leading academic journals and he has previously been a member of the editorial review team of the journal *Review of Network Economics*. He is currently based out of the University of Passau, Germany where he is a lecturer and research affiliate. Since 2017, Briglauer has published 26 research articles relating to the impact of broadband infrastructure on economic activity, attracting over 500 citations.[1] In particular, Briglauer et al (2023) has attracted 18 citations since publication in 2023.[1]

Source: Accenture; 1. Google scholar, Wolfgang Briglauer; 2 EcoAustria, Dr. rer. pol. habil. Wolfgang Briglauer, https://ecoaustria.ac.at/en/dr-wolfgang-briglauer-2/. 3. The Briglauer specification did not include this variable. Given the structure of Australia's economy, particularly the concentrated impact of mining in some regional areas (e.g. Pilbara where up to 20% are employed in mining), we have controlled for this effect to improve the robustness of estimates. 4. Multifactor productivity (MFP) is defined as a ratio of GDP to combined inputs of labour and capital. MFP is also called Total Factor Productivity (TFP). Throughout this report references to productivity refer to multifactor productivity (or synonymously, total factor productivity).

We have modelled the benefits of broadband at an SA2 level

What is an SA2?

A Statistical Area 2 (‘SA2’) is a medium sized region defined by the Australian Bureau of Statistics. There are around 2,400 SA2s in Australia – with no overlaps or gaps. An average of 10,000 people live in each SA2. In this report, ‘local geographic communities’ refers to SA2s.

Why have we modelled at an SA2 level?

Modelling at the SA2 level allows us to examine the impact of fast broadband on specific regions. This is helpful in two primary ways:

(a) We can use the model to understand how broadband has impacted specific types of regions; for example, rural and remote regions compared to major cities, or, lower to higher socio-economic regions. This is important given a key rationale for the **nbn** network was to improve access to previously underserved communities.

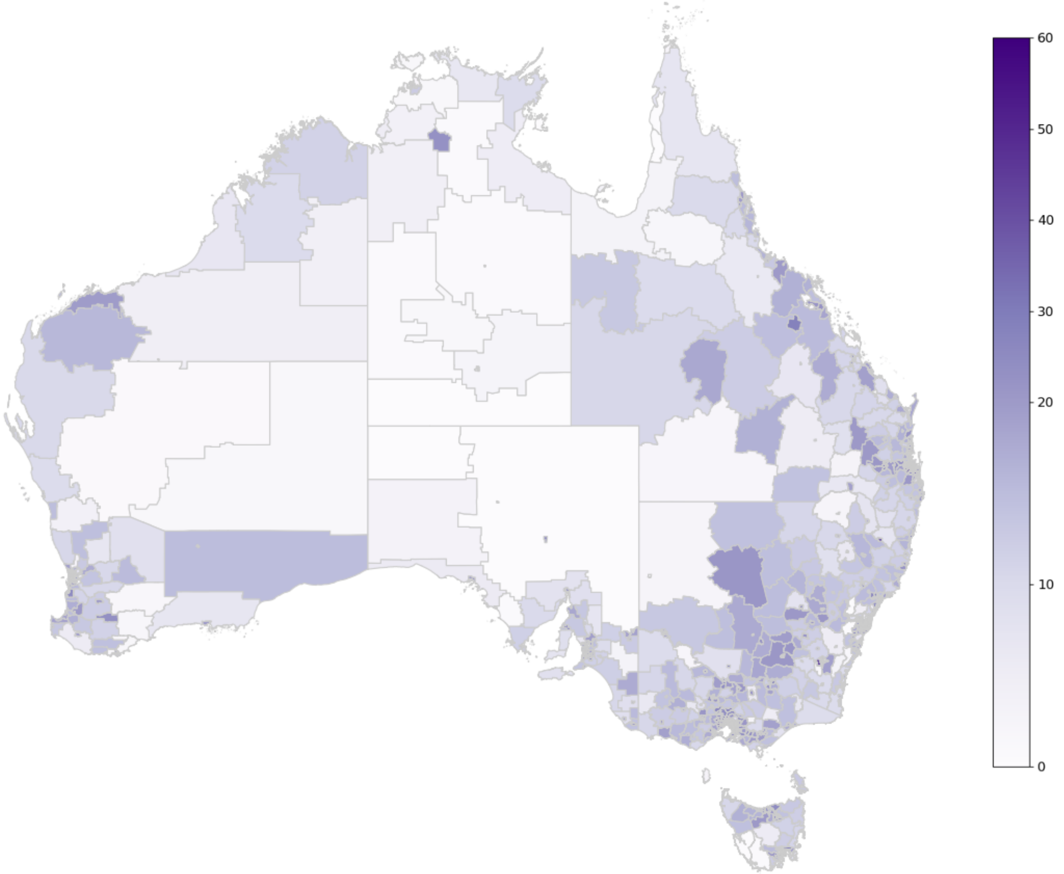
(b) The model can be trained on a larger set of observations; distinguishing between otherwise similar regions that had different broadband speeds.

How have we modelled at an SA2 level?

Modelling at the SA2 level requires us to build a time-series dataset for all SA2s in Australia, including estimating all variables used in the analysis at the SA2 level. This included estimating average broadband speed for each SA2 between 2011 and 2023, as well as estimating Gross Regional Product (‘GRP’) for each SA2. More detail on our approach can be found in the appendix. SA2 boundaries are set by the ABS and have changed several times in our time period of interest. To solve for this, we choose to use the 2011 boundaries throughout our time period of analysis. Based on 2011 boundaries there are 2,196 SA2s, compared to 2,310 based on 2016 boundaries and 2,472 using 2023 boundaries.

Regional local geographic communitieshave seen some the largest speed uplifts over the roll-out

Average broadband speed uplift between 2011 to 2023, by local geographic community, Mbps



Source: ABS, Accenture modelling

Our primary model has been supplemented with two further models to estimate the impact of faster broadband on employment and businesses

Employment Model

The employment model estimates the impact of broadband speed on the level of employment in the economy. To do this, we leverage a similar panel dataset as the preceding model, with variables more suited to modelling the labour market. We account for diminishing marginal returns by using a log-log specification:

$$\log(No.Workers)_{it} = \beta_1 \log(BSpeed)_{it} + \beta_2 \log(No.Workers)_{t-1} + \beta_3 No.Businesses_{it-1} + \beta_4 SEIFA_{it} + \beta_5 mining_{it} + \alpha + \epsilon_{it}$$

We control for variables that are specific drivers of labour market outcomes consistent with the literature (Hasbi, 2022; Bai, 2016; Lapointe, 2015), including the number of businesses and the socio-economic status of the region (SEIFA). We also follow the literature by including a lagged version of the dependent variable ($\log(No.Workers)_{t-1}$) which helps to isolate the impact of the other regressors at time *t*, and also controls for omitted variables that are relatively constant over time. As per the main models, we include fixed effects for time and region (α).

We find, on average:

+ 1% Speed
% increase in average broadband speed

+ 0.008%
Increase in aggregate employment

Business Model

The business model seeks to estimate the impact of broadband speed on the net number of businesses in the economy. Similar to employment, we use a variation of our panel dataset to estimate the following model:

$$\log(No.Businesses)_{it} = \beta_1 \log(BSpeed)_{t-1} + \beta_2 No.Businesses_{t-2} + \beta_3 Unemp.Rate_{t-2} + \beta_4 Pop.Density_{t-2} + \beta_5 EDUC_{t-2} + \beta_6 mining_{t-2} + \alpha + \epsilon_{it}$$

We select control variables that are suited to describing business counts in region, including the unemployment rate, population density, and the average level of education. Uniquely, the business model looks at the impact of broadband speed in year *t-1* on the count of businesses in year *t*. This accounts for the time-lag in the process of business formation and reflects a delay in the impact of broadband improvements, aligning with Hasbi (2020). The use of additional lags on the control variables also reflects the literature and helps mitigate the effect of reverse causality. As per the main models, we include fixed effects for time and region (α).

We find, on average:

+ 1% Speed
% increase in average broadband speed

+ 0.026%
Increase in business counts

Source: Accenture modelling, see appendix for detailed modelling approach. Note: Results are statistically significant at the 1% level. When applying these models an attribution factor is used to consider jobs and businesses supported by the **nbn** network, relative to other available technologies.

Constructing a dataset (1 of 2)

Overview

Our modelling approach required building a panel dataset at a granular location level (down to the SA2 level). Publicly available data was combined with detailed **nbn** network data between 2011 and mid-2023.

The 2011 ASGS boundaries were used to aggregate the panel dataset. This provided a set of stable geographic regions and minimised impacts from populations growing without established baselines. SA2s which are purely industrial areas, or with very low population (<500) were excluded from the sample.

Historical broadband speeds

Historical estimates of average download broadband speeds were constructed by firstly forming a view of the distribution of technologies. Associated speeds where then mapped to each technology. c. This was done by drawing on data from:

- Detailed ***nbn network data,*** which included the number of households connected to each technology type and speed tier back to 2011.
- The underlying data from the ***Broadband Availability and Quality Report***, which was produced by the Department of Communications between 2013 and 2016. This report (and its associated data cubes) were based on Telstra and Optus operations at a Distribution Area level, including the median ADSL speed at the time. This report also scored regions based on overall broadband and availability. Data was mapped to a SA2 level using **nbn** digital boundaries.
- **Census** data was used to estimate the number of total households, as well as understand SA2 level information on rates of household internet access (2011; broadband dial up; 2016; whether internet was accessed from home).
- **Publicly available** broadband data from the **ABS** (Internet Activity) and **ACCC** (Internet Record Keeping Rule) were used to form a view of dial-up, non-**nbn** fibre, HFC and home wireless.

Using these sources we could form a comprehensive and robust view of **nbn** broadband, and before this, ADSL connections. Modelling was then undertaken to estimate alternative non-**nbn** connections such as dial up, HFC, satellite and Home Wireless. Where possible, the future **nbn** distribution across these technologies was used to inform the modelled historical view in a given SA2.

Future speeds

Future **nbn** average download speeds were calculated based off projected speed tier mixes provided by the **nbn**. The future speed tier mix allows for the expected impact of the Fibre Connect upgrade program (~5 million households being upgraded to full fibre from FTTC or FTTN), upgrades to the fixed wireless network, and the expected impact of growth in customer bandwidth demand on **nbn** network's speed tier mix over the period. For simplicity it is assumed that the number of households grows inline with population growth and the percentage of households connected to the **nbn** network remains constant. The average speed of non-**nbn** households (connected to alternatives or not connected) was assumed to stay constant.

Gross Regional Product at the SA2 level

The primary model relies on a view of Gross Domestic Product at the regional SA2 level (also referred to as 'Gross Regional Product' or 'GRP'). GRP is not published nor readily available at the SA2 level. As such, we developed an allocation approach to arrive at an informed estimate of GRP at the SA2 level across our time period of interest (2011 to 2023). Our approach involved:

1. Estimating a measure of Industry Value Added per employed worker, at the State level. For this calculation we drew on the ABS's annual Gross State Product data and Labour Force statistics. Ratios were estimated at the detailed industry level.
2. Estimating the number workers employed in each industry in each SA2 (i.e. by 'place of work'). We drew on the census estimates (2011, 2016 and 2023) and interpolated between these dates.
3. Estimated GRP by multiplying our ratios from (1) to our estimates from (2).

Our results were then benchmarked against several approaches (including estimates made public by REMPLAN, and our own calculations based on business turnover statistics).

Capital

Capital was represented in the model by the share of capital inputs in the production process for each SA2. This was not available as a direct observation, and thus was computed as follows:

1. Estimate the relative capital intensity of each industry for each state and year. Using state national accounts data, this was estimated as the share of total gross operating surplus (GOS) in total factor income (TFI) for each ANZSIC industry for each year.
2. Estimate the industry composition of each SA2. Using the GRP estimates, the industry composition of each SA2 was estimated as the share of SA2 GRP attributable to each industry.
3. Estimate capital intensity by SA2 and year. For each SA2 and year, a single estimate of capital intensity was produced as the average of industry capital intensity estimated in (1), weighted by the industry share of GRP estimated in (2).

Source: Accenture

Constructing a dataset (1 of 2)

Labour and jobs

In our GDP/productivity model, labour was represented in the model by the unemployment rate by SA2 by year. This was retrieved directly from the National Skills Commission's Small Area Labour Markets (SALM) dataset.

For our jobs models, the number of people employed in each SA2 was sourced from the National Skills Commission's Small Area Labour Markets Data. This metric uses the place of residence, not the workplace, to determine total employment, by region, by year.

Data on female and male employment across various regions was obtained from the ABS Labour Force Survey, enabling an examination of the influence of broadband speed on employment from a gender perspective. It should be noted that due to the reliability of the data, sex-specific employment figures were sourced at the larger SA4 level rather than the SA2. Therefore, in running this specific analysis, the rest of the panel dataset was also aggregated to the SA4 level.

A population density measure was also constructed to be applied in the business creation model. This was computed as the quotient of the residential population in an SA2 and its area in square kilometres.

Education

Level of education was observed directly as the share of residents in an SA2 with a bachelor's degree or higher. This was retrieved from Census data from 2011, 2016 and 2021. Non-Census dates were estimated by linearly interpolating education attainment as a share of population in that SA2 between Census dates.

Mining

A mining variable was also included to control for the degree to which an SA2's GRP is driven by mining activity. As mining represents a significant share of Australian GDP and is highly driven by fluctuations in international commodity prices (factors that are not internalised by our control variables), this variable was considered a necessary control. The mining variable was computed as the share of an SA2's GRP attributable to the mining industry.

Business counts

The number of businesses in each SA2 for each year was obtained from ABS Counts of Australian Businesses data.

Data adjustments

The economic, employment, and business models were subject to sample trimming to minimise the impact of outliers and edge cases in the sample on the overall model estimates. These adjustments included:

- Removing observations from 2020 onwards - this was necessary to avoid the endogeneity induced by COVID-19
- Removing some SA2s from the analysis. For the productivity and jobs models, this involved removing SA2's with a population less than or equal to 500 – this filtered out very small SA2s, or SA2s that have been drawn around exclusively industrial/non-residential zones (e.g., parks, airports, manufacturing or industrial zones, and some lakes). For business model, we removed SA2s with a population above 50,000 or with business counts above 5,000. This trimming removed a minority of either ultra-dense business zones or ultra-dense residential zones that added noise to the broader relationship. Collectively, this removed just 10 SA2s. Regions without complete reporting on key measures (e.g. business turnover and formation counts) were also removed.

Regions or observations with missing data were typically excluded from the analysis.

Source: Accenture

Section 1
Economic impact
GDP & Productivity Model

Literature review – broadband and economic growth

There is a strong body of international literature that finds increases in broadband availability and speeds contribute to economic growth (GDP). The literature adopts a range of methodologies to identify causal effects. In the absence of firm- or individual-level randomized control trials, there are two predominant methodologies:

- macro-econometric growth accounting-based methodologies, which estimate coefficients using cross-country panel data
- micro-econometric approaches using county or region-level panel datasets, predominantly adopting instrumental variable approaches and fixed effects models.

A summary of key papers and their findings are below.

Paper	Sample	Key Findings
Brigalauer et al. (2021)	Germany (401 counties, 2010-2015)	A **one unit** (1 Mbps) increase in average download speed translates to productivity increases in GDP of **0.18%.** When accounting for regional spillover benefits (the impact of neighboring regions), this grows to 0.31%.
Briglauer and Gugler (2018)	27 EU countries (2003-2015)	A **one percent** (1%) increase in adoption translates to **0.002%-0.005%** rise in GDP.
Katz and Callorda (2019)	159 countries (2008-2019)	A **one percent** (1%) increase in download speeds translated to: • Countries with speeds <10Mbps: No impact. • Countries with speeds 10-40 Mbps: **0.003%** GDP increase • Countries with speeds > 40Mbps: **0.007%** GDP increase
Kongaut and Bohlin (2014)	33 OECD countries (2008-2012)	A **ten percent** (10%) increase in download speeds translated to: • All countries : **0.80%** in GDP/capita • High-income countries: **0.59%** GDP/capita • Low-income countries: **0.97%** GDP/capita
Carew et al (2018)	US	A **one percent** (1%) increase in speeds translates tor **0.02%** rise in GDP. Noting this author did not include broadband adoption as a control variable which means the speed coefficient subsumes the penetration effect (and is hence higher than comparative studies).

The approach used in this report aligns most closely with Briglauer et al (2021), as the purpose was to conduct a country study for Australia using region-level data (i.e. SA2 level data). Our baseline specification is a log-linear model such to be comparable to this paper (as much as data and context allows).

The coefficient found is our comparable log-linear model is 0.1%, which whilst statistically significant, is lower than Briglauer's 0.18% for every unit (1 Mbps) increase in average download speeds. We see several reasons for these differences:

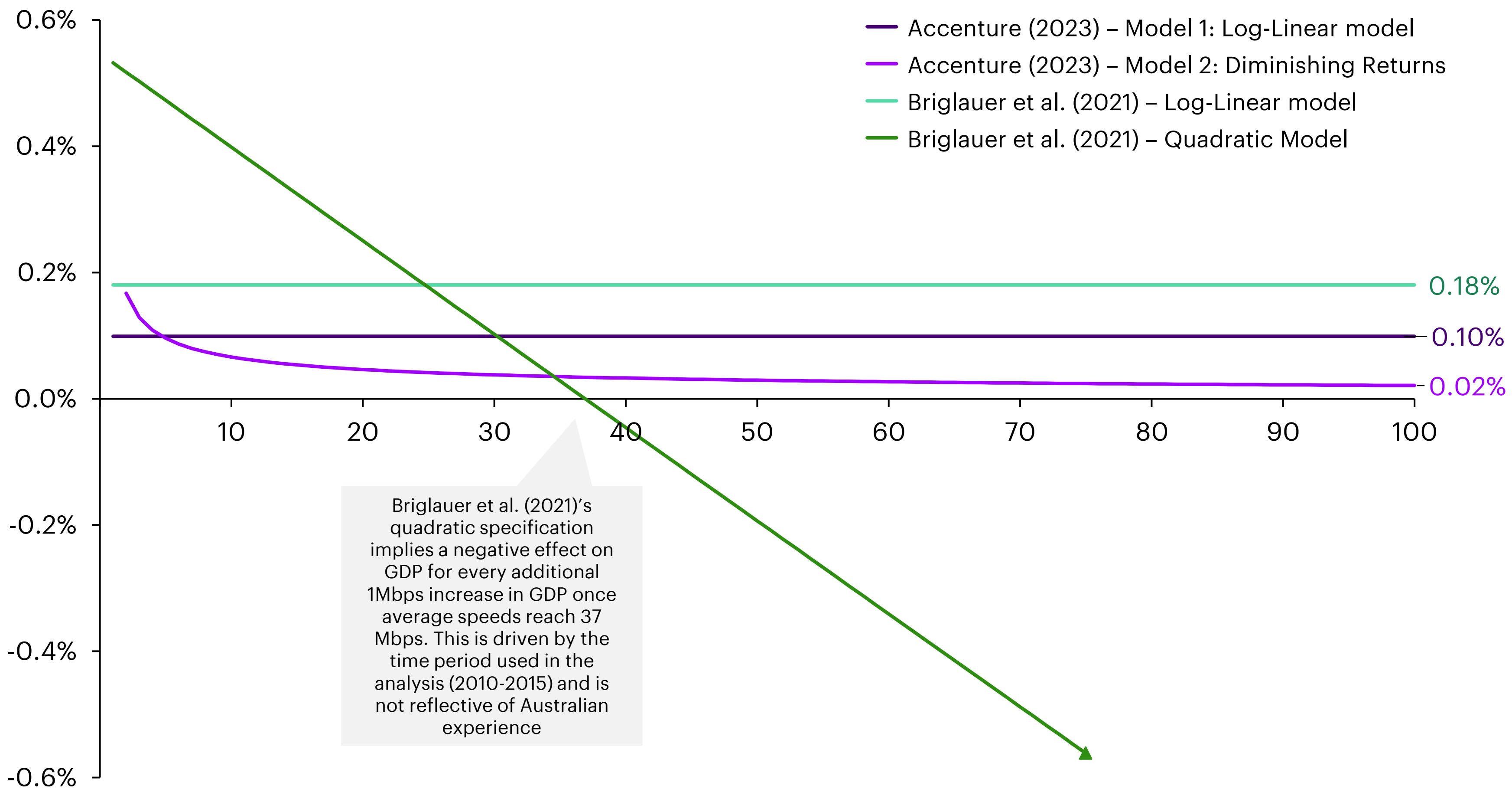
1. **Time period:** Our model is trained on data between 2012 and 2020, compared to Briglauer's 2010-2015. Due to the impact of diminishing marginal returns, we would expect a reduced impact over time, impacting the average effect.
2. **Differences in data quality and variable definitions:** Our model uses data on actual broadband speeds achieved, rather than the assumed speeds based on coverage. We have modelled estimates of GRP at the regional level and used different definitions for Labour and Capital controls due to data availability and quality.
3. **Differences in economies, particularly at the regional level:** Australia is significantly more sparse, with many regions of low density, and economic activity concentrated in major cities. Australia is also mining intensive, a factor that can significantly impact regional GDP, for which we have controlled through an additional independent variable.

Source: Accenture

Comparison of results to Briglauer et al. (2021) study

Comparison of results in this study to Briglauer et al. (2021)

Y-axis: Incremental % change in GDP per 1 Mbps increase in average broadband speed
X-axis: Average broadband speed at start of year



The primary model used in this research is denoted by the purple line to the left. This model accounts for diminishing marginal returns to speed. As shown, each additional 1 Mbps increase in average broadband speeds, has a positive, but marginally smaller impact on GDP. This line is asymptotic – it slowly approaches zero and is never negative. We see this as a sensible characterisation of the relationship between broadband speeds and productivity.

Our second model (a log-linear specification, shown by black line) was developed as a way to compare the Australian results to the primary specification in the Briglauer study (denoted by the light green line), and uses broadly the same model parametrisation. The Australian model of this type finds that broadband speeds have a smaller (but still statistically significant) impact on productivity (0.1% compared to 0.18%). This is mostly explained by the time period used, with the Australian model using more recent data.

Briglauer's quadratic specification (shown in dark green) was fit on this older data and is not a sensible point of comparison. We have not found evidence of negative marginal returns in an Australian context.

Source: Accenture, Briglauer et al. (2021)

Model specifications for the relationship between broadband speeds and productivity

Overview of model specifications

The productivity impact of faster broadband speeds was estimated using a structural regression model, based on a Cobb-Douglas production function in which regional economic output (GRP) is assumed to have a log-linearised relationship to the level of capital (K), labour (L) and human capital (EDUC) within a region, *i*. Fixed effects for region and time (α) were also used. As an enabler to a general purpose technology, broadband speed is assumed to effect economic output through its impact on total factor productivity (TFP). Thus, the effect of a 1Mbps increase in average broadband speeds on GRP can be directly interpreted from the coefficient β_4 in the following equation:

$$\log(GRP\_pc_{it}) = \beta_1 \log(K_{it}) + \beta_2 \log(L_{it}) + \beta_3 \log(EDUC_{it}) + \beta_4 BSpeed + \beta_5 \log(mining_{it}) + \alpha + \epsilon_{it}$$

Except for the $mining_{it}$ term and the absence of regional spillover variables[2], this model is identical to the one implemented in Briglauer et al. (2021)[3]. This model estimates a comparable effect of broadband speed on regional economic output (0.10% increase in GRP per Mbps, versus 0.18% in the 2021 Briglauer study.)

In the square root model, the specialisation of capital, labour, human capital, and mining are identical, with the broadband term replaced by the square root of speed. This transformed parameter describes a relationship of diminishing marginal returns between broadband speed and regional economic output. The specification for the square root model is:

$$\log(GRP\_pc_{it}) = \beta_1 \log(K_{it}) + \beta_2 \log(L_{it}) + \beta_3 \log(EDUC_{it}) + \beta_4 \sqrt{BSpeed} + \beta_5 \log(mining_{it}) + \alpha + \epsilon_{it}$$

Both models were trained on data between 2012 and 2020. Observations during 2021 and 2022 were excluded due to the atypical experience in this window due to COVID-19 (effecting both broadband speeds and the economy).

Summary results – Coefficient (p-value)

Variable	Linear model	Square root model
$Broadband\ Speed_{it}$	0.0009916 (0.0000002)	
$\sqrt{Broadband\ Speed}_{it}$		0.0040199 (0.0118602)
$\log(K_{it})$	0.5669810 (0.0000000)	0.56650588 (0.00000000)
$\log(L_{it})$	-0.0128961 (0.0014043)	-0.0122992 (0.0022986)
$\log(EDUC_{it})$	-0.0194974 (0.5348524)	-0.0123190 (0.6966201)
$\log(mining_{it})$	-0.0149651 (0.0000040)	-0.01559859 (0.0000017)

Notes: 1. This variable captures the share of a region's GRP that is attributable to the mining sector. This was considered an important inclusion to the model in the Australian context, given the significant share of mining in total Australian GDP, and the role of international commodity prices in determining this share. Factors that are not otherwise incorporated in this domestically focused model. That said, the effect of broadband speed on GRP was robust to the exclusion of this variable; 2. Regional spillovers increased the observed effect of broadband speed on GRP. These were excluded from our model to ensure results were sufficiently conservative. 3. While the variables controlled for in each model were largely the same, the data used to proxy for each variable differed in some circumstances.

Results by remoteness area, socioeconomic status and industry

Further variants of the productivity model were developed to understand and report on the impact by remoteness area, socioeconomic status and industry. Details are summarised in the table below.

Model variant	Approach
Remoteness areas	The Australian Statistical Geography Standard includes boundaries describing five level of remoteness. These regions are codeveloped by the Australian Bureau of Statistic (ABS) and the University of Adelaide and measure the accessibility of services on a 1km grid covering Australia. This data is aggregated into five classifications used in this project: major cities, inner regional, outer regional, remote and very remote. SA2s were assigned into one of these categories based on their remoteness score in the most recent release (2021) to provide a stable classification over time. Where a SA2 region incorporates multiple remoteness classifications the classification covering the largest amount of the SA2's physical area is taken as the classification. The linear and square root regressions were run on the subset of the panel data in specific remoteness area(s) to produce results that describe the impact of broadband speed on the economic activity of just those regions. Coefficients across the models were compared to understand relative impacts. The results shown in the main report are for the log-linear variety of the model.
Socioeconomic status	The ABS's Socio-Economic Indexes for Areas measures relative socio-economic advantage of SA2s. This study utilises the Index of Relative Socio-Economic Advantage and Disadvantage which takes inputs on drivers of both relative advantage and disadvantage for people living in a particular community. The ABS describes it as a measure of people's access to material and social resources and their ability to participate in society. Following the same methodology as the remoteness area analysis, each SA2 was given a stable classification based on the latest release (2021) and analysis was performed on subsets of the panel data set sharing the same SEIFA score(s). Coefficients across the models were compared to understand relative impacts. The results shown in the main report are for the log-linear variety of the model.
Industry	Industry results were estimated in line with the methodology outlined in Frontier Economics (2021) 'The economic impacts of new **nbn** investments on business'. Primarily, this involved computing the relative 'IT intensity' of capital for each industry, as the share of IT Capital Stock in Total Capital Stock, sourced from the ABS Australian System of National Accounts. IT Capital stock is composed of Computers and peripherals, Electric and electronic equipment, and Computer software. The calculation can be summarised as follows, for each industry *i:* $IT\ Intensity_i = \frac{IT\ Capital\ Stock_i}{Total\ Capital\ Stock_i}$ $Relative\ IT\ Intensity_i = \frac{IT\ Intensity_i}{IT\ Intensity_{All\ Industries}}$ Relative IT intensity was then adjusted to reflect diminishing marginal benefits, as per Frontier Economics (2021): $Relative\ IT\ Intensity\ (adj)_i = 100 * [Relative\ IT\ Intensity_i * 0.75 + (1 - 0.75)]$ The percentage productivity uplift for each industry was then computed as: $Productivity\ Uplift_i = Productivity\ Uplift_{average} * Relative\ IT\ Intensity\ (adj)_i$ The GDP impact was calculated using the square root transformation model, to account for diminishing marginal returns (and thus be more conservative).

Source: Accenture analysis, Frontier Economics (2021).

Applying the modelled results to estimate GDP impacts 2012 to 2030

The following steps were undertaken to estimate the GDP impact in each year:

1. **Estimate average broadband speed in each year**

   a. Historical years: In historical years this is straightforward, taken straight from our comprehensive dataset as the weighted average of each technology and the speed of that technology. In simple terms, the average speed in a given year is:

   $$Average\ broadband\ speed\ (Speed_{All}) = n\ Speed_{nbn} + (1\ - n)Speed_{non-nbn}$$

   Where *n* is the percentage of all households on the **nbn** network and $Speed_{nbn}$ is the average speed obtained by households on the **nbn** network, accounting for the known speed tier distribution. $Speed_{non-nbn}$ is the average broadband speed across all non-**nbn** broadband technologies, including unconnected households which have a broadband speed of zero. This implicitly accounts for coverage over time.

   b. Future years: In future years we project forward $Speed_{nbn}$ based on speed tier forecasts provided by the **nbn**. These forecasts account for the expected impact of growth in customer bandwidth demand on **nbn**'s speed tier mix , and the impact of upgrade programs from the **nbn**'s latest integrated operating plan. Whilst over 5 million households are expected to be eligible for upgrades, not all switch on the technology and take-up assumptions have been applied to allow for a conservative uptake pattern between now and 2030. These assumptions are conservative.

   For simplicity, the value of n and $Speed_{non-nbn}$ are kept at their latest actual values (early 2023).

2. **Estimate the GDP impact due to an increase in broadband speed in each year**

   a. Estimate GDP in each year. We took historical estimates from the ABS, and for years beyond 2022, forecasts from the Budget 2023-2024[2]. Figures were adjusted to be as-at December in each year, and were expressed in 2020-2021 dollars, unadjusted for inflation or discounting.

   b. Estimate the uplift percent in that year due to the increase in broadband speeds. When estimating GDP impacts, the square-root model specification was used. This approach is more conservative, as it allows for diminishing marginal returns to speed over time. The formula used was based on our square-root model specification;

   $$\%Increase\ in\ GDP = \exp(b * ((x + M)^{0.5} - x^{0.5}))\ - 1$$

   where b is the coefficient on the broadband speed variable (0.0040199) in the square-root specification, x is the average broadband speed at the start of the year and M is the increase in average speed since the baseline year (December 2011). Note, where comparisons of the log-linear model are shown (for ease of comparison to Briglauer), the following formula is used:

   $$\%Increase\ in\ GDP = \exp(b\ * M)\ - 1$$

   where b is the coefficient on the broadband speed variable (0.0009916) in the log-linear specification and M is the increase in average speed since the baseline year (December 2011).

   c. Estimate the GDP dollars in that year as GDP in the previous year, multiplied by the increase in GDP factor above.

3. **Determine the proportion of this uplift attributable to the nbn network**

   Our model describes a relationship between total average broadband speeds and GDP. To fairly represent the impact of the **nbn** network (only one part of the total broadband story in Australia), we then disaggregate this total GDP impacts into **nbn** and non-**nbn** effects. In each year we calculate the weighted impact of the **nbn** network on the all-Australian average broadband speed, accounting for take-up and average speeds, using the following formula:

   $$\%GDP\ Uplift_{nbn} = \left(\frac{Households_{nbn} * Speed_{nbn}}{Households_{total}}\right) / \ Speed_{All}$$

   This fraction increases over time with the **nbn** roll out, from 0.6% in 2012 to close to 90% in 2023. This fraction accounts for the fact the other non-**nbn** technologies exist and these too are providing some of the GDP benefit. This same scaler factor was applied to the business and jobs estimates.

Notes: 1. ABS National Accounts (Expressed in FY20-21 dollars). 2. Australian Federal Government Budget Paper 1 (2023-2024)

Section 1
Economic impact
Jobs & Businesses Models

Literature review – Employment and business effects

A comprehensive review of the economic literature was conducted to explore the impact of broadband infrastructure on employment and business creation. This scan facilitated understanding of historical estimates and provided insight into considerations related to modelling assumptions, techniques, and contextual findings from previous studies.

Although these studies did not align as directly with this work as Briglauer (2021) did with the productivity model, they guided the modelling considerations and specifications. These studies served as a foundation, providing valuable methodologies and findings that have been applied to similar topics in the past.

The final specifications for the employment and business models align largely with those found in the reviewed literature. However, adaptations were made to meet specific research requirements and data availability. These adaptations included the inclusion of a mining-related variable and careful selection of control variables to address data availability and multicollinearity issues. Despite these modifications, consistency between these models and those in the existing literature reinforces the reliability of the approach.

Employment

Paper	Key Findings
Hasbi (2022)	• Broadband quality is positively correlated with an unemployment reduction for low-skilled workers in small cities with broadband over 100Mbps • Other sub-samples also demonstrate significant effects, such as high-skilled, medium and small cities experiencing reductions in unemployment associated with broadband speed • More generalised estimates generate no significant relationship
Bai (2016)	• Finds a positive relationship between broadband availability and county-level employment • When compared to normal-speed broadband, faster broadband availability did not generate greater positive effects on employment
Lapointe (2015)	• Finds a positive association between increased access to fibre-based broadband and employment (a positive association is also found for the number of firms) at the county level • A 25-50% change in the access of a country to fibre generated a 1.78% increase in employment and 2.08% increase in firms on average

Business Creation

Paper	Key Findings
Hasbi (2020)	• A 'very high-speed broadband network' is associated with a positive effect on establishment creation across a number of French sectors • The number of new establishments increases by 2.8% on average with the presence of a very high-speed broadband network • This effect is reduced to 1.6% when adding region-specific time trends, and becomes insignificant with department-specific time trends • Effects are stronger (up to 6%) at the sector-specific level
Deller, Whitacre & Conroy (2022)	• Focusing on non-metropolitan counties, finds a positive relationship between broadband coverage and new business creation • Observes heterogeneity in the impact of broadband speeds across industries • Broadband coefficients tend to peak at 50Mbps for download speeds
Stephens, Mack & Mann (2022)	• Examining data from 2000 to 2007, this study finds that access to broadband was positively associated with an increase in new business activity and in the net creation of new businesses • One additional broadband provider resulted in an approximately 8% increase in new establishment over the eight-year period

Source: Accenture

Model specification and results – employment

Overview of model specifications

As with the productivity model, the employment impact was similarly estimated using a fixed effects regression, but incorporated control variables more suited to modelling relationships in the labour market. This model was constructed based on similar research conducted in Lapointe (2015), Bai (2016) and Hasbi (2022). The specification used was:

$$\log(No.Workers)_{it} = \beta_1 \log(BSpeed)_{it} + \beta_2 \log(No.Workers)_{i\,t-1} + \beta_3 No.Businesses_{i\,t-1} + \beta_4 SEIFA_{it} + \beta_5 mining_{it} + \alpha + \epsilon_{it}$$

This model is very similar to that implemented in Hasbi (2022), with the key exception of most independent variables being expressed in present (time = *t*) terms, rather than in lagged (*t-1*) terms. This decision was made such that the employment effect being measured in this model, was more comparable with the productivity effect measured in the preceding model.

When this model is run with a lagged broadband regressors instead, the effect increases 28% to 0.0107. Thus, our specification also gives us a more conservative estimate of the employment impact of faster broadband speeds.

The women's employment model mirrored the same specification; however, this was modelled at the SA4 level, rather than the SA2, due to data availability. To maintain consistency with the primary unemployment model, the effect on women's employment was based on the relative difference in employment effects between women and all persons at the SA4 level, applied to the findings from the SA2 model.

Applying this model to estimate the impact of the **nbn** network on jobs, the following equation is estimated:

$$\%Increase\ in\ employment = \exp(b * (Log(x + M) - Log(x))) - 1$$

Where b is the coefficient on speed (*0.0084), x is* broadband speed in the baseline year (December 2011) and M is the change in speed since. This estimate was applied to employment estimates, sourced from ABS labour force. In future years, a simple growth rate equal to projected population growth was applied (1.10%), sourced from the Australian Government's Centre for Population.

Summary results

Variable	Coefficient	P-value
$\log(Broadband\ Speed)$	*0.0084**	*0.0000*
$\log(No.Workers)_{t-1}$	*0.6959**	*0.0000*
$No.Businesses_{t-1}$	*0.0001**	*0.0000*
$SEIFA$	*0.0136**	*0.0000*
$mining$	*-0.1648**	*0.0001*

Source: Accenture

Model specification and results – business starts

Overview of model specifications

Again, the impact of broadband speed on business creation was estimated using a fixed effects regression model, catered to control for key drivers of business activity. We modelled the net number of businesses. Again, this model was informed by the existing economic literature, including Hasbi (2020), Deller, Whitacre & Conroy (2023) and Stephens, Mack & Mann (2023). The specification used was:

$$\log(No.Businesses)_{it} = \beta_1 \text{Log}(BSpeed)_{i\,t-1} + \beta_2 No.Businesses_{i\,t-2} + \beta_3 Unemp.Rate_{i\,t-2} + \beta_4 Pop.Density_{i\,t-2} + \beta_5 EDUC_{i\,t-2} + \beta_6 mining_{i\,t-2} + \alpha + \epsilon_{it}$$

Contrary to the preceding models, the business model looks at the impact of broadband speed in year *t-1* on the regional count of businesses in year *t*. This was incorporated to account for the inherent time-lag in the process of business formation and to reflect a delayed impact of broadband improvements on new business counts. This aligns with the specification used in Hasbi (2020).

Applying this model to estimate the impact of the **nbn** network on businesses, the following equation is estimated:

$$\%Increase\ in\ businesses = \exp(b * (Log(x + M) - Log(x))) - 1$$

Where b is the coefficient on speed *(0.0194)*, x is broadband speed in the baseline year (December 2011) and *M* is the change in speed since. This estimate was applied to businesses counts from the ABS. Future business counts from 2023 to 2030 were estimated using a simple growth rate equal to historical growth (1.7% p.a.) Estimates are based on the pre-2020 definition which includes superannuation funds.

Summary results

Variable	Coefficient	P-value
$\log(Broadband\ Speed)_{t-1}$	*0.0229**	0.0000
$No.Businesses_{t-2}$	*0.0003**	0.0000
$Unemp.Rate_{t-2}$	*-0.1223*	0.3575
$Population.Density_{t-2}$	*0.00006*	0.0666
$EDUC_{t-2}$	*0.01236**	0.0013
$mining_{t-2}$	*-0.5134**	0.0246

Source: Accenture

Section 1
Economic impact
Assumptions & Possible Refinements

Key assumptions, limitations and possible refinements (1 of 3)

Component	Assumptions/Limitations/Possible Refinements
Selecting an appropriate measure of broadband	We have used **broadband downloads speeds as the variable used to proxy the impact of broadband** for several reasons, including: a. Download speeds is the most commonly used metric used in the literature (e.g. Briglauer et al.), b. We see download speeds as the best proxy for overall broadband usage and experience. Download speed plays a critical role in determining user experience, including use of more advanced (and productivity-driving) activities such as use of cloud, automation, high quality video streaming and file sharing and; c. Data availability and quality. Download speeds is a more accessible measure and could be more easily calculated for **nbn** and non-**nbn** connections. We recognise that download speeds is not a holistic measure, as is does not account completely for the intensity of use of broadband, nor the reliability and user experience if speeds are impacted by poor network reliability or latency. Furthermore, users may subscribe to higher speeds without necessarily performing activities that require these high speeds, and users may not have an option to increase their speed tier due to availability. Alternatives that could be considered include **upload speeds**, **data downloads** and measures of **downtime, reliability or latency**. Whilst each measure in isolation does not paint a complete picture of the broadband experience, in future, a composite measure could be considered to capture broader effects. To date, the majority of the literature focuses on download speeds. There is an opportunity for the **nbn** to leverage their unique microdata to contribute in a meaningful way by considering broader effects.
Selecting appropriate measures of economic growth	We have used three measures: **productivity (expressed in terms of GDP)**, **job creation** and **business creation.** These measures are some of the most commonly used by economists to measure economic development and health. In particular, productivity is a priority metric given sluggish productivity growth experienced in Australian over the last decade. But these metrics are not without their limitations. Gross Domestic Product ('GDP') is the unit in which we have quantified productivity growth (based on the literature and our model specification), and whilst GDP typically a good measure – it is not an all inclusive one. **Our estimates of the impact of the nbn network on GDP are conservative as they do not include two components:** • GDP does not include wider welfare benefits to the household, which are considered as 'consumer surplus'. **Consumer surplus** is the value individuals put on a good or service beyond what they pay for it. For the **nbn** this can include the benefits of improved digital literacy, time savings and access to "free goods" via the internet such as health information, government services etc. Individuals place a value on these benefits which is not captured in GDP. A 2021 study by Accenture found that the consumer surplus attributable to the **nbn** network was $15.7b p.a.. • The GDP impacts in this report do not include the '**spend impact**' of the build of the **nbn** network or of any upgrades. The spend impact is the economic activity generated from the build of the network and is typically split into direct impacts (such as the wages of those employed to install **nbn** infrastructure) or indirect impacts which capture the supply chain activity required to build the network (e.g. increased demand for materials used in the upgrades).

Source: Accenture

Key assumptions, limitations and possible refinements (2 of 3)

Component	Assumptions/Limitations/Possible Refinements
Estimating average broadband speeds	For this analysis we built a first-of-its-kind longitudinal dataset of broadband information at the SA2 level. This includes the full range of broadband technologies (Dial up, ADSL, ADSL+, non-**nbn** Fibre and HFC etc, plus the **nbn** technologies). For this work, the **nbn** has provided detailed data of technologies by SA2 over time. We have included unique households with **nbn** connections and excluded Voice Only plans. To form a view of non-**nbn** technologies we have leaned on publicly available data, including that from the ABS, ACCC, and most importantly a dataset provided by the Department of Communications. This dataset underpinned the Broadband Quality and Availability report in 2016 and provided suburb level information on ADSL availability and median speeds. Whilst granular, there are limitations to this data. Most notably, ADSL information is based on what was available, whether or not the technology was actually used. Using national estimates of the number of other technologies (e.g. HFC and Home Wireless) from the ABS and ACCC, as well as learnings from the **nbn** distributions across technologies, we then modelled the number of households on non-**nbn** technologies over time. For example, to estimate non-**nbn** satellite, we considered national level information of the number of non-**nbn** satellite connections and identified regions today that have a high prevalence of satellite. We have assumed that users obtain headline (i.e. advertised) speeds. This is usually a sensible assumption, but can vary by technology (e.g. Fixed Wireless can be impacted by congestion on the network more so than other technologies). In future, actual speeds could be modelled accounting for such nuances. As we have excellent data for the two largest cohorts over the time period (**nbn** connections and ADSL connections), we are confident that our overall dataset is largely representative. The distribution of other technologies is approximate, but align with the overall pattern of these technologies (after the **nbn** roll out) as well as adding to national aggregates. In future, there is scope to refine the approach to estimating the distribution of broadband connections, particularly if more granular information can be obtained about non-**nbn** and non-ADSL connections.
Mobile internet	Mobile internet data (i.e. data accessed via mobile phone) was not in scope for this study. This is for several reasons: a. Data availability: Building in a view of mobile broadband requires detailed location-based view of mobile data speeds over time, of which data is not readily available. b. Consistency with international literature: Most literature focuses on either mobile data or fixed line broadband. c. Materiality and impact on economic development: Our study focuses on the impact of broadband speed on the economy, where broadband is defined as fast internet used in the home. Whilst mobile data can be used in the home, only a small portion of all data downloads are via mobile (<10%), and mobile data is not typically used for data intensive activities such as video conferencing or working from home. It is also common for households to use both home broadband (such as their **nbn** connection) and mobile internet simultaneously. We see these impacts as complementary but not necessarily additive. We recognise that mobile internet does play a related role in economic development. We have included control factors in our models, including fixed effects by region and time period, to help control for non observed factors. A future refinement to the model could be to consider the impact of mobile internet speeds explicitly (by building this factor into the model) or by building a separate model to help quantify materiality.
The impact of COVID-19	Across 2021 and 2022, COVID-19 lockdowns had a significant impact on the Australian economy and on broadband speeds. GDP growth slowed as lockdowns stymied economic activity and unemployment increased. Simultaneously, Australians became increasingly reliant on the home broadband internet, with a sharp increase in working from home arrangements and spending time at home. This global shock introduces a significant source of endogeneity into the panel dataset. Despite efforts to control for its impact through time fixed effects and the inclusion of COVID/lockdown dummy variables, the extent and persistence of this shock, which are highly correlated with regressors used in the models, inevitably confound the results. This experience was atypical, and not what we would see as reflective of future trends. As such, we have excluded the 2021 and 2022 years of data from our sample when training each model. This decision also means that extrapolation of model results to estimate impacts beyond 2019 involves out-of-sample modelling, with the inherent risk that changes in the external environment, such as the pandemic, may alter relationships between variables, potentially reducing the accuracy of these extrapolations. In future, as more data emerges (that is reflective of post-covid patterns), we would recommend adding these data points and re-estimating the model.

Source: Accenture

Key assumptions, limitations and possible refinements (3 of 3)

Component	Assumptions/Limitations/Possible Refinements
Future take-up rates	Our future uptake assumptions are based on **nbn** projections of network upgrades and household adoption of these upgrades. A future refinement could be to consider different uptake scenarios (e.g. higher uptake) to determine a range of likely outcomes.
Reverse causality	A potential source of endogeneity arises from the possibility of reverse causality. Areas with high GRP, higher employment or high rates of business activity are more likely to demand faster broadband, which could confound the observed relationships. While efforts were made to control for this through the inclusion of controls for education (EDUC) and/or socio-economic status (SEIFA), as well as through lagged control variables, potential issues of endogeneity remain.
Accounting for regional spillovers	Our models assume that GDP, employment and business outcomes within a region are driven solely by the characteristics of that region. The absence of cross-regional variables means that potential regional spillover effects are not accounted for, unlike in Briglauer's (2021) model of GDP. This limitation likely results in an understatement of the observed effect. A key contribution of Briglauer et al. (2021) is its quantification of spillover effects to faster broadband in neighbouring regions. This paper found that accounting for these benefits increased the estimated impact of broadband on regional GDP significantly (0.31% compared to 0.18%). To ensure a robust estimation we have adopted the conservative assumption to exclude such effects.
Separate models	The estimates for GDP, employment, and business counts are derived from separate models, each trained on a different set of variables. Comparing these estimates thus relies on the assumption that each measure is independently unbiased and reflective of reality. Although this assumption has clear limitations, the results align with intuition and exhibit similar relative effects.
Functional improvements	In contrast to the productivity model, the employment and business models were not based on a structural equation derived from economic theory. Consequently, the theoretical underpinnings of these model specifications are weaker. This provides significant scope for further refinement and experimentation with different model specifications, functional forms, and relationships between dependent and independent variables, within a more empirical framework. Furthermore, the employment and business models could be disaggregated at a regional level to investigate potential heterogeneity in impacts across different regional categories. This additional layer of granularity could yield deeper insights into the spatial dimensions of broadband impact and inform targeted interventions and policy decisions.

Source: Accenture

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02

Section 2
Social impact

Section 2
Social impact
Designing a Social Impact Approach

Social impact is the net effect of an activity on people and society

where an activity could mean an organisation, program, product or service.

Social impact is usually considered in terms of wellbeing, which is a state of satisfaction encompassing physical, mental and social aspects of life.

The terms 'social value' and 'social impact' are used interchangeably in the literature.

See appendix for definitions found in the literature which have informed this definition.

The existing landscape for measuring social impact is complex and there is currently no standardised approach

General (less prescriptive)

Social Impact Principles

- IRIS+ System
- Five Dimensions of Impact
- Social Valuation, *Enacting Purpose*
- The Australian Social Value Bank and the Social Value Principles
- Social Value International
- Australian Government principles for social impact investing
- Social Value UK
- Pacific Community Ventures, *Impact Due Diligence*

Social Impact Standards

- Standards Australia, *Measuring and valuing social impact: Guidance on approach and methodologies*
- EU, *Proposed approaches to social impact measurement*
- Impact Management Platform, *Actions for Organisations*
- British Standards Institution, *Social Value – Understanding and enhancing – Guide*
- Social Value International, *Understanding What Changes*

Social Impact Measurement Approaches

Government & country level:

- OECD, *Compendium of OECD well-being indicators*
- South Australia Department of Human Services, *Social Impact Framework*
- Department of Treasury, *Measuring What Matters*
- NZ, *The Living Standards Framework*
- ACT, *Government Wellbeing Framework*
- Centre for Social Impact, *Australian Social Progress Index*

Industry & business level:

- GRI Standards
- UK Social Value Bank
- Sustainability Accounting Standards Board, *SASB Standards*
- MSCI, *ESG Ratings*
- Thomson Reuters, *ESG Score*
- WEF, *Towards Common Metrics and Consistent Reporting of Sustainable Value Creation*
- UNCTAD, *Guidance on reporting contribution to UN SDGs*
- RepTrak, *ESG*
- ICMA, *Harmonised Framework for Impact Reporting for Social Bonds*

Specific (more prescriptive)

Non-exhaustive sample of the available literature on social impact.

Whilst published approaches use varying terminology, a 'scientific approach' to social impact typically involves seven steps

Proposed social impact approach based on approaches outlined in the literature

Our social impact approach corroborates various sources from the literature to set out a practical set of stages to work through.

1 Objectives and principles → 2 Hypothesis → 3 Impact thesis → 4 Measurement framework → 5 Measure impact → 6 Analyse impact → 7 Conclude & report

Published approaches broadly align on an approach, despite using different terminology

Scientific method outlined in Standards Australia (2022)

Observe → Hypothesis → Experiment → Analyse → Conclude

Impact Management Platform, Actions for Organisations (n.d.)

Governance, strategy, & management → Set objectives → Identify topics → Measure performance → Assess impact → Estimate value created → Verify → Integrate & act → Disclose → Benchmark

European Union, Proposed approaches to social impact measurement (2014)

Objectives → Stakeholders → Set relevant measures → Measure, validate, value → Report, learn, improve

British Standards Institution, BS8950 – Social Value – Understanding and enhancing – Guide (2020)

Plan for data collection → Identify & consult stakeholders → Collect data → Data assurance → Analyse data → Report to stakeholders → Consider changes to data collection

Social Value International, Understanding What Changes, (n.d.)

Engage stakeholders → Chain of events[1] → Create well-defined outcomes → Design metrics to measure outcomes → Design data collection methods → Collect data → Analyses and interpret data

1. 'Chain of events' refers to the impact thesis referenced in Standards Australia.

The seven-step approach, based on industry referenced frameworks, guides NBN Co through necessary stages to report on its social impact

	1 Objectives and principles	2 Hypothesis	3 Impact thesis	4 Measurement framework	5 Measure impact	6 Analyse impact	7 Conclude & report
Definition	*Defining objectives and principles allows decision makers to develop an approach which aligns to their context*	*The hypothesis is the potential answer to the question formed through observation of an initiative or change*	*An impact thesis is the chain of logic which could or is intended to result in social impact*	*A measurement approach is used to operationalise a hypothesis so it can be evaluated*	*Measure the impact*	*Analyse findings*	*Conclude whether there is a social impact, whether this impact is positive or negative and the level of confidence in the conclusion*
Actions	• Align on the objectives of the organisation • With the objectives in mind, determine the principles which are most important to the organisation	Develop hypothesis around two points: • There is some impact (positive or negative) • Social impact can be attributed to the observed initiative or change for a specific set of reasons[1]	Define the following: • Resources • Activities • Outputs • Outcomes • Impact	• Decide between management, measurement and valuation approaches • Determine the key domains of social impact • If applicable, determine metrics to measure the impact on wellbeing [2]	• Within the selected measurement approach, determine the means of measurement • Collect data, through methods such as surveys or interviews[3] • Consider pros and cons of qualitative and quantitative approaches	• Assess whether the outcomes are achieved in practice, whether they are apparent to the stakeholder they are intended to impact and whether they are valuable to the stakeholder[4]	• Results need to be reported in a way which is transparent and useful so they can be reviewed to determine how services can be improved[4]

Sources: 1. Standards Australia: Measuring and valuing social impact 2. OECD, Compendium of OECD well-being indicators 3. Evaluation of the Economic Impact and Public Value of the Superfast Broadband Programme 4. EU - Proposed approaches to social impact measurement

Existing standards and input from NBN Co has informed four guiding principles, which makes up the first stage of the approach to social impact

Guiding principles for the nbn Social Impact Approach

1	2	3	4
Approach is fit for purpose and based on industry referenced frameworks	**Approach is systematic and comprehensive as it reflects a wide variety of impacts**	**Approach is data-led and robust to deliver credible results**	**Approach is repeatable and insightful**

Principles from Standards Australia (2022)[1]

1	2	3	4
Social impact measurement is a scientific pursuit	Measure the lived experience	Measurement results should be assurable	Measurement results should be actionable
Measure social impact in terms of wellbeing	Practice cultural safety (particularly in considering specific groups)		Measurement results should be comparable
Use subjective wellbeing as the overall measure of impact			

What we heard from you related to this principle

1	2	3	4
• Social impact is measured in terms of wellbeing • Aim to understand value created and eroded	• Acknowledge how data is captured and is measured • Credible approach • Fit for purpose in respect to maturity of the **nbn**	• Assurable results • Transparent measurement approach with documentation of assumptions, limitations and exclusions	• Repeatable measurement process • Provision of insights overtime • Inform decision-making

Source: 1. Australian Standards: Measuring and valuing social impact.

The second stage requires establishing a hypothesis to test through the social impact approach

Hypothesis structure from Standards Australia:[1]

1. There is some impact (positive or negative)
2. Social impact can be attributed to the observed initiative or change for a specific set of reasons

Hypothesis for the nbn's social impact:

The nbn network has a net positive impact on wellbeing

Populations considered

- All **nbn** users (individuals)
- Target groups including remote and regional communities, First Nations Australians and low-income households.[2]

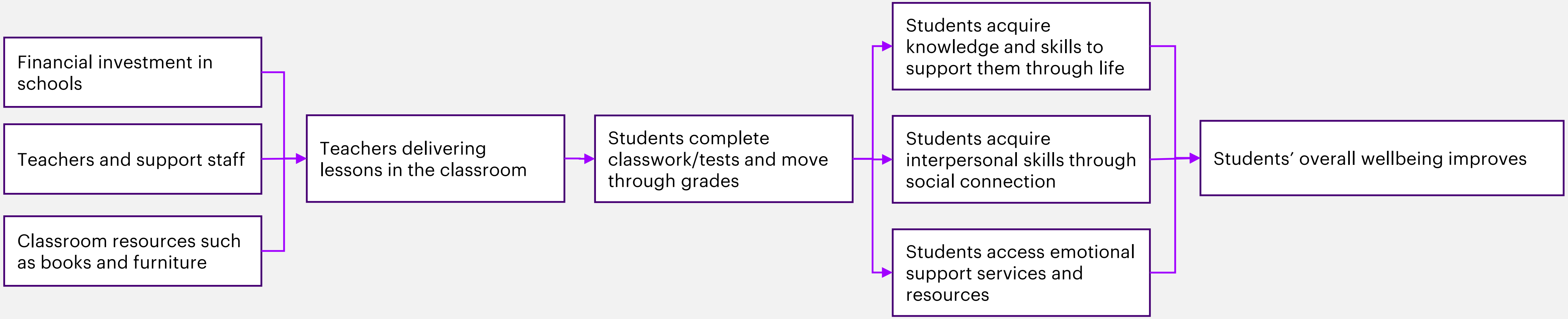
Source: 1. Australian Standards: Measuring and valuing social impact 2. NBN Co Limited Statement of Expectations

An impact thesis sets out the chain of logic through which social impact is created and informs what data to collect, assess and analyse

Stages of the impact thesis[1]

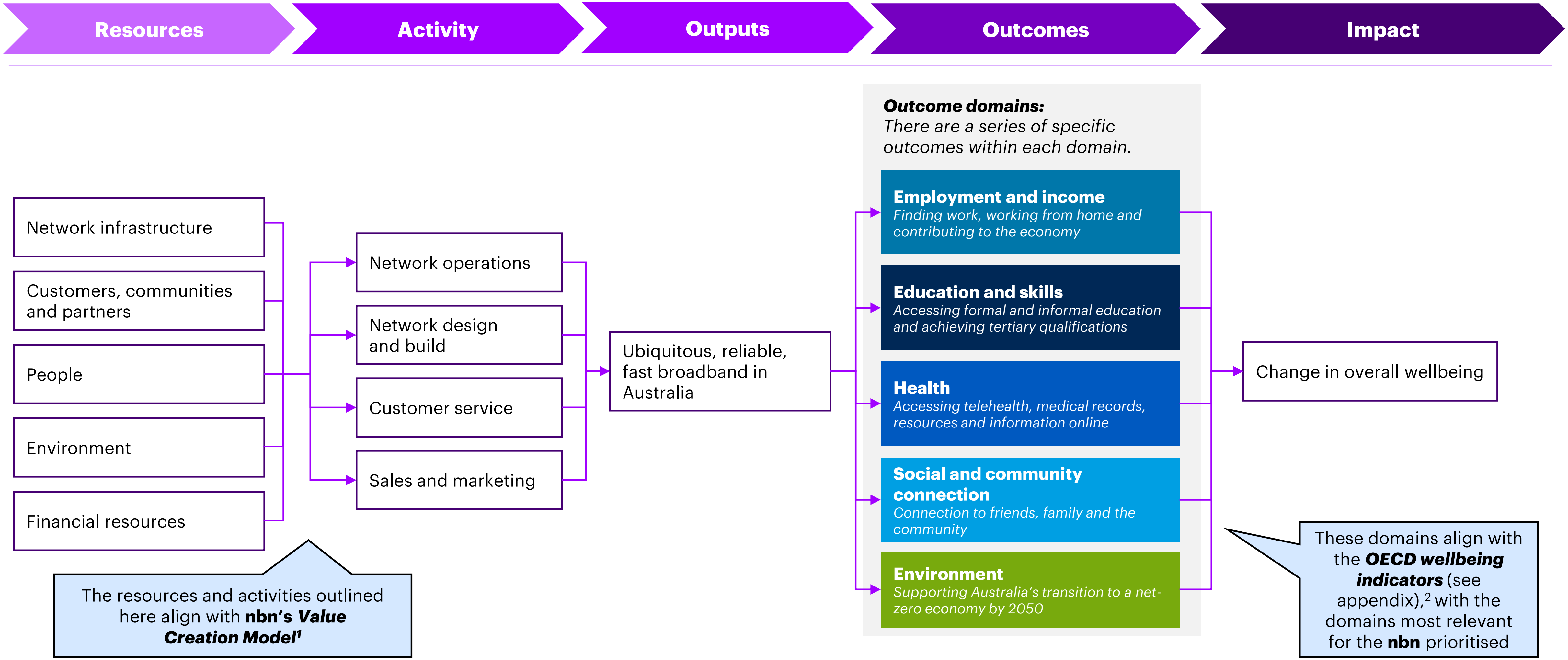
Resources	Activity	Outputs	Outcomes	Impact
The financial, human and material resources needed to conduct the activities	Actions taken or work performed to achieve the outputs	Tangible results that an initiative delivered in order to achieve the outcome	The necessary conditions to achieve the impact, defined in terms of specific human needs	Long-term or ultimate effects produced by an initiative, directly or indirectly, intended or unintended. Measured in terms of a single overarching measure of subjective wellbeing

Example impact thesis



Source: 1. Australian Standards: Measuring and valuing social impact

An impact thesis for the nbn sets out the chain of logic through which social impact is created and informs what data to collect



Source: 1. **nbn** *How we create value* 2. OECD (n.d.) *Measuring Well-being and Progress: Well-being Research*

Section 2
Social impact
Measurement

A survey of 1,500 users was the primary source of insights in measuring nbn's social impact

Primary data source: Standalone survey

Methodology:

- Nationally representative group of 1,518 **nbn** users, aged 18 and over were surveyed. **nbn** users have an incidence rate in the broader Australian population of approximately 75%.
- The survey was conducted through a market research panel, managed by Fiftyfive5, and contained 38 questions which took around 11 minutes for respondents to complete. For the full list of questions, see survey instrument.[1]
- The survey data was weighted by gender, age and geographical location (based on the ABS Greater Capital City classification of postcodes) to ensure the sample was nationally representative.
- First Nations survey responses were also weighted by income and remoteness, with low-income respondents and regional and remote respondents allocated a higher weighting in order to be more representative of the First Nations population. Weighting was required for the First Nations group as the survey sample had more high-income respondents and more respondents from capital cities than the national First Nations population.
- Fiftyfive5 reviews all verbatims, straight lining, speeding and other sense checking to ensure high quality data. Fiftyfive5 used a product called Imperium to assist the data cleaning.

Data collection period:

- Survey was run over a period of five days in August 2023 and will be repeated annually.
- Respondents are asked to consider the way they use the internet and the impact of the use of home internet over the last 12 months.

Target groups:

- Regional and remote Australians n = 422. This groups is defined based on respondent's postcode. Postcodes were matched to the Australian Statistical Geography Standard (ASGS) Remoteness Structure. Within this structure, individuals who live in a postcode classified as either Inner Regional Australia, Outer Regional Australia, Remote Australia or Very Remote Australia are regional and remote and Major Cities of Australia are classified as not regional and remote.
- Low-income Australians n = 646. This group is defined as anyone with a household income of less than $70,000.
- First Nations people n = 92. This group is defined by respondents self-reporting within the survey.

Benchmark:

- Survey indicators are based on the impact of the **nbn** network in a specific year and can be compared year to year to determine if a change has occurred over time.
- Results do not report on improvement compared to a counterfactual, such as pre-**nbn** home internet.
- It is not possible to ask respondents to compare the impact of the **nbn** network with the impact of the internet in their home prior to their connection to the **nbn** network. This is because many households have had a **nbn** network connection for several years and respondents would not accurately be able to differentiate between impacts of the **nbn** and non-**nbn** internet.
- The survey asks respondents to assess their overall satisfaction with life. This question does not attempt to associate the **nbn** network with life satisfaction, but it allows responses to this question to be compared to other surveys of life satisfaction.

Source: **nbn** Social Impact Measurement Approach, Accenture Analysis

Statistical significance of the survey data

Sample size, margin of error and confidence level

The sample size required to achieve statistically significant results is based on two statistical measures:

1. The first is the **confidence level** which is the probability that the estimation of the location of a statistical parameter (e.g., mean) in a sample is true for a population.[1] Confidence levels of 90%, 95% and 99% are commonly used. We established a 95% confidence interval when designing the survey. This means that a result from the survey sample will also be true for the whole population, 95% of the time.
2. The second is **margin of error** which indicates the degree to which real world results may deviate from the result from the survey. It is expressed as a plus or minus around a statistical parameter. If there is a wide margin of error in a survey, there will be less confidence that it matches the 'true' figures for the total population. A margin of error between 3% to 5% is common.[2] In this survey, we have a margin of error of 3%. This means that for all results in the survey, if the survey was repeated the results would fall with in a range of +3% or -3% of the original survey results, 95% of the time (our confidence interval). For example, within our sample, 32% of **nbn** users used job search websites or platforms in the last 12 months. If this was replicated with other **nbn** users and they were asked if they used job search websites or platforms in the last 12 months, 95% of the time the result would be between 29% (32% - 3%) and 35% (32% + 3%).

Based on the selected confidence level and margin of error**, the minimum sample size required to ensure statistically significant results for the overall sample is 1,068.** The sample size achieved in the survey was 1,518. The additional survey responses were collected to ensure the sample had enough of the target groups of interest to NBN Co**.**

The target groups (low-income **nbn** users, regional and remote **nbn** users and First Nations **nbn** users) achieve statistically significant results, with a larger margin of error. We are comfortable with a wider margin of error for these target groups, given that analysis of the overall population was the primary focus of this work. In the future, the **nbn** could consider additional research methods to capture the nuances of these groups in a more detailed measurement approach.

Statistically significant sample at a given level of confidence internal and margin of error

Sample	Proportion of the weighted sample	Confidence interval	Margin of error
Complete Sample	100% (1,518)	95%	+/- 3%
Low income (Less than $70,000 household income)[3]	43% (646)	95%	+/- 4%
Regional and remote *(not Major Cities)*[4]	28% (422)	95%	+/- 5%
First Nations[5]	6% (92)	95%	+/- 10%

1. Statista (n.d.) Definition Confidence level 2. Statista (n.d.) Defining Margin of error 3. Total population who are classified as low-income, adult population, connected to the **nbn** is 6,114,711 based on data from ABS Census 2021 (counting dwellings, place of enumeration; Tablebuilder, HINASD Total Household Income as Stated (weekly). 4. Total population who are classified as regional and remote, adult population, connected to the **nbn** is 4,238,193 based on data from ABS (2023) Regional population, Data cubes: Population estimates by LGA, Significant Urban Area, Remoteness Area and electoral division, 2001 to 2022, Table 3: Estimated resident population, Remoteness Areas, Australia. 5. Total population who are classified as First Nations, adult population, connected to the **nbn** is 487,994 based on data from Census of Population and Housing - Counts of Aboriginal and Torres Strait Islander Australians. Note: The proportion of First Nations people who are connected to the **nbn** network is likely to be less than the national average of 75%. Therefore, the total number is likely to be less than 487,994.

NBN Co economic modelling provides data for the employment & income and education domain, to support survey data

Data source 2: NBN Co economic modelling – jobs, businesses and higher education attainment

Methodology:

- Three models were developed by NBN Co to estimate the impact of broadband on employment (# jobs created), business (# businesses created) and education (# additional individuals graduating with a bachelor degree or higher).
- Impacts have been estimated using econometric models that find a positive, statistically significant relationship between broadband speeds and each metric.
- These models are based on a panel dataset at a detailed location level (SA2) between 2011 and 2020 and findings are inline with international literature. See the technical report appendix for further details.

Data collection period:

- Annual estimates based on average broadband speed in the year.[1]

Target groups:

- Education modelling can be analysed for regional and remote Australians
- Not applicable for other target groups. This could be considered in future iterations of the model, data permitting.

Key metrics:

- Jobs created in FY23 alone due to the benefits of fast home internet via the **nbn** to our economy
- Businesses created in FY23 alone due to the benefits of fast home internet via the **nbn** to our economy
- Additional number of graduates from a bachelor or higher degree due to the benefits of fast home internet via the internet

Benchmark:

- The models estimate the impact on each metric (jobs, businesses, education attainment) based on the increase in broadband speed over the course of the calendar year.
- Results have been adjusted here to be shown on a financial year basis.
- Results are available from 2012 and are also shown on a cumulative basis; representative of the impact since the **nbn** roll out commenced.

1. Economic modelling results adjusted from calendar year to financial year to align with other social impact indicators.

An additional model to estimate the impact of the nbn network on education (bachelor and higher degree completions) was developed

Overview of model specification

To estimate the impact of fast broadband on higher education attainment at an SA2 level the following model specification was developed :

$$\%EDUC\_bachelor\ degrees\ or\ higher_{it} = \beta_1 Broadband.Speed_{it} + \beta_2 Population.Density_{it} + \beta_3 Average.Income_{it} + \beta_4 Unemployment.Rate_{it} + \beta_5 Remoteness_{it} + \epsilon_{it}$$

Where *i* = SA2 and *t* = time period (year, calendar year 2012 to 2019 inclusive)

With the following variables:

- $\%EDUC\_bachelor\ degrees\ or\ higher$ = Proportion with a bachelor degree or higher within an SA2
- $Broadband.Speed_{it}$ = Average broadband speeds, estimated based on **nbn** and non-**nbn** connections, including unconnected households, who are assumed to have a speed of zero.
- $Population.Density_{it}$ = The quotient of the residential population in an SA2 and its area in square kilometres
- $Average.Income_{it}$ = Personal income on an SA2 level
- $Unemployment.Rate_{it}$ =Unemployment rate, by SA2 from Small Area Labour Markets data, by SA2
- $Remoteness_{it}$ = Classification of an SA2 into one of five remoteness categories (major cities, inner regional, outer regional, remote and very remote) based on the Australian Statistical Geography Standard
- ϵ_{it} = *error term*

We applied this model to estimate the implied percentage of people with a bachelors degree or higher in the absence of fast broadband ($\%EDUC\_bachelor\ degrees\ or\ higher\ - \beta_1$ * Increase in broadband speed since 2011 / 100). Our model describes a relationship between total average broadband speeds and number of bachelor and higher degree completions. To fairly represent the impact of the **nbn** network (only one part of the total broadband story in Australia), we then disaggregate this total number of bachelor and higher degree completions impact into **nbn** and non-**nbn** effects. In each year we calculate the weighted impact of the **nbn** network on the all-Australian average broadband speed, accounting for take-up and average speeds, using the following formula:

$$\%Completion\ of\ a\ bachelor\ degree\ or\ higher\ uplift_{nbn} = \left(\frac{Households_{nbn} * Speed_{nbn}}{Households_{total}}\right) / Speed_{All}$$

This fraction increases over time with the **nbn** roll out, from 0.6% in 2012 to close to 90% in 2023. This fraction accounts for the fact the other non-**nbn** technologies exist and these too are providing some of the GDP benefit.

Summary results

Variable	Coefficient	P-value
$Broadband.Speed$	0.0209	0.000
$Population.Density$	0.0025	0.000
$Average.Income$	0.0000451	0.000
$Unemployment.Rate$	-0.0371	0.000
$Remoteness$	0.7894	0.0108

Source: Accenture

NBN Co emissions avoidance modelling builds the evidence base for the environment domain, which is not possible through the survey

Data source 3: NBN Co emissions avoidance modelling

Methodology:

- Measure of emissions avoided through the electricity savings yielded from using **nbn** network fixed-line technologies to download data in comparison to a legacy ADSL-based network (theoretical based on 2011 data and subscriber numbers).
- Note the scope of data does not include the indirect avoided emissions that the **nbn** network fixed-line technologies may enable.
- Terabyte data used as unit of activity.

Data collection period:

- Annually, in financial years

Target groups:

- Not applicable

Key metrics:

- Avoided emissions against legacy ADSL-based network (tCO2-e)

Benchmark:

- Impacts are benchmarked against the circumstances in 2011, when the **nbn** network rollout began.
- For example, changes in broadband speeds between today and 2011.
- Impacts are expressed as the annual net new impact on avoided emissions based on any net change in the efficiency of the network compared to the previous year.

Section 2
Social impact
Detailed Results

How nbn-enabled internet impacts overall wellbeing

Overall impact by domain

Overall wellbeing

Employment & income	77%	of **nbn** users who worked from home or used job search platforms reported the **nbn** network positively impacted their employment outcomes in FY23
Education & skills	82%	of **nbn** users who engaged in formal or informal education from home via the **nbn** reported the **nbn** network positively impacted their education outcomes in FY23
Health	77%	of **nbn** users who accessed telehealth or online medical information, resources or records via the **nbn** network reported the **nbn** positively impacted their health outcomes in FY23
Social & community connection	74%	**nbn** users who connect with family, friends and others or access news or community information online via the **nbn** reported the **nbn** network positively impacted their social and community connectedness in FY23
Environment	85%	of **nbn** users who work, study, access health or other services online reported having fast internet via **nbn** helped them to reduce their emissions in FY23

3 in 4 **nbn** users say having a connection on the **nbn** network at home has had a positive impact on their satisfaction with life

The distribution of results:

- 25% reported a strong positive impact
- 50% reported a moderate positive impact
- 24% reported no impact
- 1% reported a moderate negative impact
- 0% reported a strong negative impact

How nbn-enabled internet impacts employment & income outcomes

Employment & income outcomes | **Impact** | **Overall impact**

nbn Resources, Activities, Outputs

32% of **nbn** users used online job search via the **nbn** in the last 12 months

Of the 32% of nbn users...

- **43%** reported having a better understanding of the job market and job opportunities (+)
- **35%** reported no impact
- **25%** were already employed but were able to find a better job (+)
- **7%** were unemployed but were able to find a job (+)

31% of **nbn** users worked from home via the **nbn** in the last 12 months

Of the 31% of nbn users...

- **53%** reported being better able to balance work with non-work interests and commitments (+)
- **47%** report being more productive at work and therefore more successful (+)
- **43%** reported being able to spend more time to spend with friends and family (+)
- **23%** reported facing lower barriers to participating in the workforce (+)
- **14%** reported feeling more isolated (-)
- **13%** reported that the boundaries between work life and home life were blurred (-)
- **10%** reported feeling less motivated or more distracted when working from home (-)
- **9%** reported no impact

Overall impact: **77%** of **nbn** users who worked from home or used job search platforms reported the **nbn** network positively impacted their employment outcomes in FY23

6,000 jobs created in FY23 alone due to the benefits of fast internet via **nbn** to our economy, contributing to an aggregate impact of 140,100 additional jobs since 2011[1]

6,900 businesses created in FY23 alone due to the benefits of fast internet via **nbn** to our economy, contributing to an aggregate of 74,100 additional businesses since 2011[1]

Source: **nbn** Social Impact Measurement Approach, Accenture Analysis

How nbn-enabled internet impacts education & skills outcomes

Education & skills outcomes → **Impact** → **Overall impact**

nbn Resources, Activities, Outputs

12% of **nbn** users engaged in formal education via the **nbn** in the last 12 months

Of the 12% of nbn users...

- **58%** reported they were able to study more effectively from home (+)
- **44%** reported that the reduced their travel time and more flexible learning from studying online allowed them to do more paid work, leisure or study (+)
- **38%** reported they were able to access courses which are not offered near where they live (+)
- **14%** reported that they were not able to study as effectively from home (-)
- **12%** reported that they felt less connected to teachers and other students (-)
- **3%** reported no impact

17% of **nbn** users engaged in informal education via the **nbn** in the last 12 months

Of the 17% of nbn users...

- **57%** reported that they were able to study more effectively online (+)
- **46%** reported that they were able to access informal education which are not offered near where they live related to work, study or areas of interest (+)
- **44%** reported reduced travel time and more flexible learning from studying online allowed them to do more paid work, leisure or study (+)
- **8%** reported they felt less connected to others who are engaged in informal education (-)
- **6%** reported no impact
- **5%** were not able to study as effectively from online (-)

Overall impact: **82%** of **nbn** users who engaged in formal or informal education from home via the **nbn** reported the **nbn** network positively impacted their education outcomes in FY23

13,500 additional individuals graduating with a bachelor degree or above in FY23 alone due to the benefits of fast internet via **nbn** on education, contributing to the aggregate impact of 208,600 additional degrees since 2011[1]

Source: **nbn** Social Impact Measurement Approach, Accenture Analysis

How nbn-enabled internet impacts health outcomes

Health outcomes → **Impact** → **Overall impact**

nbn Resources, Activities, Outputs

34% of **nbn** users accessed telehealth services via the **nbn** in the last 12 months

Of the 34% of nbn users...

- **40%** able to see a health professional or access a health service more regularly and/or quickly as telehealth is more convenient for them (+)
- **38%** reported that they did not have to travel to access health services because can access them online, so had more time to do other things (work, study or leisure) (+)
- **25%** reported being able to access a wider range of health professionals or health services through telehealth than they could in person (+)
- **18%** reported that they found it hard to receive a diagnosis or receive a satisfactory outcome via telehealth (-)
- **17%** reported that they used telehealth, but still needed to see a health professional in person which wasted time and money (-)
- **11%** reported no impact

52% of **nbn** users accesses medical information, resources and records via the **nbn** in the last 12 months

Of the 52% of nbn users...

- **50%** reported being able to access medical records more quickly and easily (+)
- **34%** reported they were able to learn more about their own health and how to live a healthy lifestyle (+)
- **26%** reported being able to learn more about when to seek medical care from a health professional (+)
- **15%** reported no impact
- **13%** were concerned with confidentiality and security of personal health data (-)
- **8%** were confused by the wide range of information available and the existence of contradicting medical advice online (-)

Overall impact

77% of **nbn** users who accessed telehealth or online medical information, resources or records via the **nbn** reported the **nbn** network positively impacted their health outcomes in FY23

Source: **nbn** Social Impact Measurement Approach, Accenture Analysis

How nbn-enabled internet impacts social & community connection outcomes

	Social & community connection outcomes	Impact	Overall impact

nbn Resources, Activities, Outputs

88% of **nbn** users connect with friends and family via communications platforms

53% of **nbn** users use their **nbn** connection to engage in online activities with friends or family

47% of **nbn** users use their **nbn** connection to connect with new people or interest groups online

78% of **nbn** users use their **nbn** connection to access news or community information

Of the nbn users who connected with friends, family, new people or interest groups…

- **52%** felt more connected to friends or family (+)
- **28%** reported no impact
- **26%** felt more connected to a community (+)
- **18%** felt less lonely or isolated (+)
- **6%** felt less connected to friends and family due to the online format of communication (-)
- **5%** reported experiencing online harm (-)
- **3%** reported that they felt frustrated because of the reliance on online communication to connect to friends and family (-)
- **2%** reported experiencing cyberbullying (-)

Of the 78% of nbn users…

- **52%** reported feeling more informed and therefore more connected to a community (+)
- **37%** reported no impact
- **17%** reported that they felt less lonely or isolated (+)
- **5%** reported experiencing online harm (-)

74% **nbn** users who connect with family, friends and others or access news or community information online via **nbn** reported that the **nbn** network positively impacted their social and community connectedness in FY23

Source: **nbn** Social Impact Measurement Approach, Accenture Analysis

How nbn-enabled internet impacts environmental outcomes

Environmental outcomes | **Impact** | **Overall impact**

nbn
Resources, Activities, Outputs

72% of **nbn** users who studied from home reported they travelled less because they were able to study from home via the **nbn** (+)

68% of **nbn** users who worked from home reported they travelled less because they were able to work from home via the **nbn** (+)

66% of **nbn** users who accessed telehealth reported they traveledl less because they use the **nbn** to access services from home (+)

42% of **nbn** users reported they were able to travel less due to accessing other services online via the **nbn** (+)

Reduced emissions from less travel

297,118 tCO2-e avoided through the electricity savings yielded from using **nbn**® network fixed-line technologies to download data in comparison to a legacy ADSL-based network[1] (+)

85% of **nbn** users who work, study, access healthcare or other services online reported having fast internet via **nbn** network helped them to reduce their emissions in FY23

Source: **nbn** Social Impact Measurement Approach, Accenture Analysis

About Accenture

Accenture is a leading global professional services company that helps the world's leading businesses, governments and other organizations build their digital core, optimize their operations, accelerate revenue growth and enhance citizen services—creating tangible value at speed and scale. We are a talent and innovation led company with 738,000 people serving clients in more than 120 countries. Technology is at the core of change today, and we are one of the world's leaders in helping drive that change, with strong ecosystem relationships. We combine our strength in technology with unmatched industry experience, functional expertise and global delivery capability. We are uniquely able to deliver tangible outcomes because of our broad range of services, solutions and assets across Strategy & Consulting, Technology, Operations, Industry X and Accenture Song. These capabilities, together with our culture of shared success and commitment to creating 360° value, enable us to help our clients succeed and build trusted, lasting relationships. We measure our success by the 360° value we create for our clients, each other, our shareholders, partners and communities. Visit us at www.accenture.com.

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