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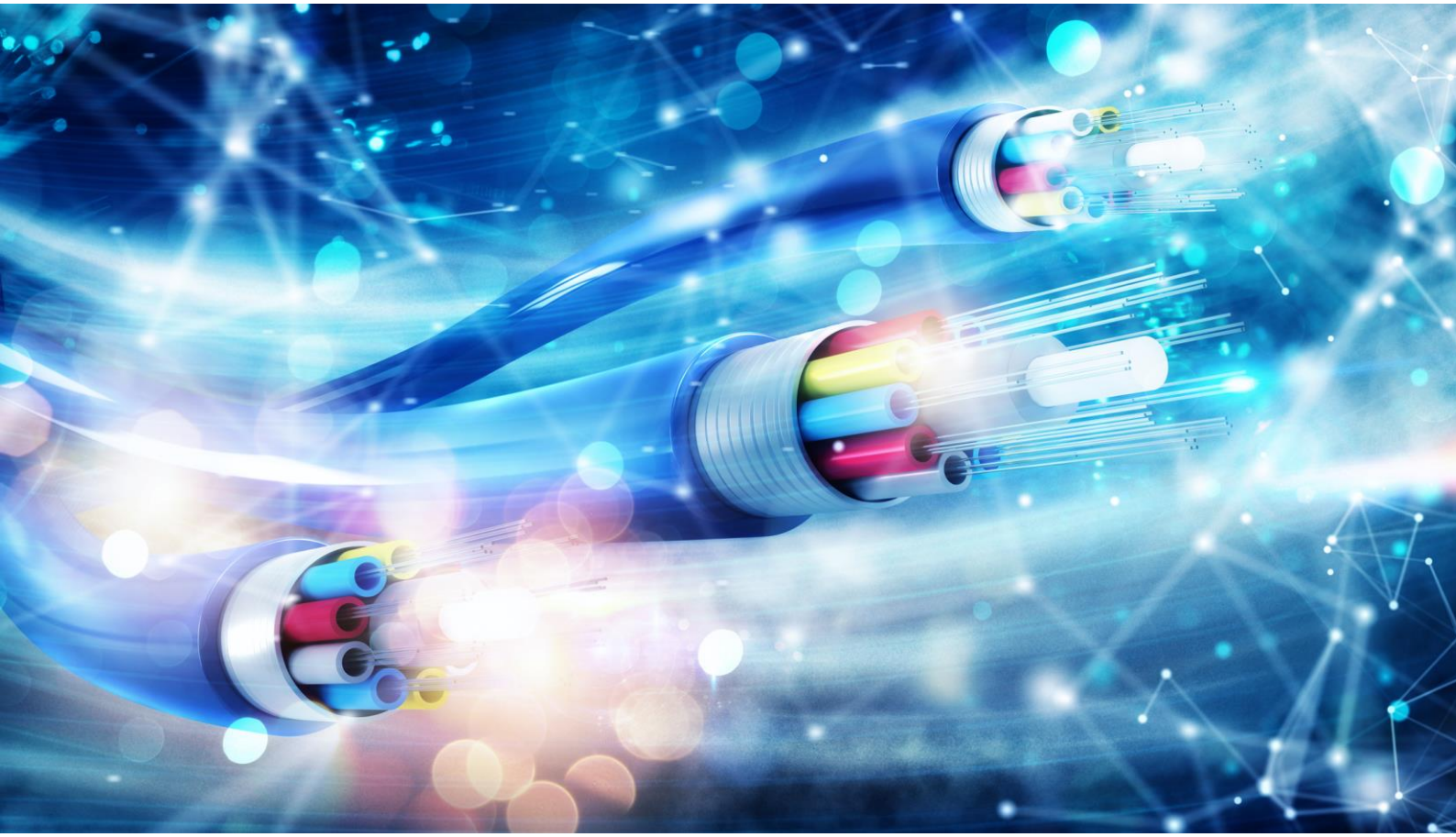

Rural connectivity

Economic benefits of closing the rural digital divide

NZIER report to Chorus Limited

4 November 2022

About NZIER

NZIER is a specialist consulting firm that uses applied economic research and analysis to provide a wide range of strategic advice.

We undertake and make freely available economic research aimed at promoting a better understanding of New Zealand's important economic challenges.

Our long-established Quarterly Survey of Business Opinion and Quarterly Predictions are available to members of NZIER.

We pride ourselves on our reputation for independence and delivering quality analysis in the right form and at the right time. We ensure quality through teamwork on individual projects, critical review at internal seminars, and peer review.

NZIER was established in 1958.

Authorship

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Executive summary

Chorus commissioned NZIER to assess the potential benefits of closing the urban-rural digital divide. For our analysis, we have defined this as the benefits of all households and businesses outside the current fibre footprint having access to the same unconstrained capacity[1] as those within the urban boundary.

We consider how digital technology improves the way people communicate, work, learn and access services and entertainment. The extent of these improvements depends on the degree of access people have to digital technologies and their skills. Those with unfettered access to digital technologies are most able to capture these benefits.

The COVID-19 pandemic has revealed the digital divide, as the acceleration towards online communication, learning, and working revealed inequities in access to and skills to use digital technologies. The government's digital strategy (New Zealand Government 2022b) highlights the importance of ensuring that the national digital network infrastructure delivers permanent, high speed broadband solutions so that there are no constraints on adopting digital technology across New Zealand. Simply having access to digital technology is not enough – constraints on capacity and reliability will discourage their usage and hence the degree to which benefits can be captured.

We estimate the annual incremental benefits for rural households of access to digital connectivity with unconstrained capacity, relative to the status quo, to be $1.79 billion and the annual benefits for time savings for rural businesses to be $344 million. In addition, we estimate that for rural businesses, the improvement in productivity from having access to connectivity with unconstrained capacity increases output each year by at least $189.5 million. These benefits are not directly additive because the models used to estimate the benefits capture different factors and hence are not directly comparable. However, these estimates suggest that the total benefit is in the order of $16.5 billion over ten years[2].

The benefits of closing the urban-rural digital divide span allocative, productive and dynamic efficiency gains. People living in rural areas can access resources and use their skills without having to travel to other areas (allocative efficiency). People and businesses can easily use digital tools and networks in their everyday work to improve their productivity and business output (productive efficiency). Over time, unconstrained access to high capacity digital networks will allow people to build on these benefits, bring innovations to current work practices, and create unidentified opportunities (dynamic efficiency).

As our estimates are based on the current state of the households and businesses in rural areas, we consider them to be conservative. The estimates capture the allocative and productive gains as we estimate the benefits of the role of digital technologies in improving the matching of resources and skills and contributing to time savings for households and businesses. We expect that over time, having access to connectivity with unconstrained capacity would encourage more households and businesses to move to the rural areas and enable better matching of jobs and skills. Access to connectivity with unconstrained capacity would allow the development of innovations we cannot identify and, therefore, cannot quantify at this point.

1 In this paper we use the terminology "unconstrained" or "high" capacity as defined by BEREC in the European Union (BEREC 2020).

2 At an assumed discount rate of 5 percent.

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1 Introduction

> *How we keep pace with changes in digital technologies, and how they are used in our economy and across our communities, will have a strong impact on Aotearoa New Zealand's future prosperity. The potential benefits of using digital ways of doing things are large. They will help improve lives, expand consumer and career choices, and contribute to wider issues, like climate change.*
>
> Te koke ki tētahi Rautaki Matihiko mō Aotearoa Towards a Digital Strategy for Aotearoa, (New Zealand Government 2022a)

Digital technology is often seen as the preserve of big tech firms and their employees. There is an increasing divide between these firms and other parts of the economy, but this model ignores that digital technology is increasingly endogenous to how people communicate, work, learn and access services and entertainment across the world.

Digital connectivity enables individuals, whānau, communities, businesses and other organisations to leverage digital technologies to create social and economic value (Dutta and Lanvin 2021, 26). Over the past twenty years, there has been significant investment in connectivity infrastructure in New Zealand and internationally. This investment supported large parts of the world to pivot to online communication, learning and working when the COVID pandemic struck in early 2020.

The accelerated shift to online exposed more clearly the gaps in access and quality of connectivity. This shift exacerbated the inequalities of access for individuals and households and affected communities and organisations across the business and not-for-profit sectors, particularly small and medium enterprises (SMEs).

The post-COVID 'new normal' appears to be a step up in the digital transformation of the economy as well as increasing online interaction across the board. We can expect an increase in the speeds, devices and budgets required by households and businesses, making connectivity a top priority (World Economic Forum 2020, 3).

The government's digital strategy has set the vision *Enabling Aotearoa New Zealand's people, communities, economy and environment to flourish and prosper in a digital world* (New Zealand Government 2022b). A prerequisite is ensuring that the national digital network infrastructure delivers permanent, high capacity broadband solutions so that there are no constraints on adopting digital technology across New Zealand.

We use 'high capacity' as shorthand for the term 'very high capacity network' as defined in Article 2(2) of the European Electronic Communications Code:

- either an electronic communications network which consists wholly of optical fibre elements at least up to the distribution point at the serving location,
- or an electronic communications network which is capable of delivering, under usual peak-time conditions, similar network performance in terms of available downlink and uplink bandwidth, resilience, error-related parameters, and latency and its variation'. (BEREC 2020; Felten and Bensassi-Nour 2022).

2 Digital transformation

Driven by the development of digital technologies, technological change has been exponential over the past 20 years. Few predicted how developments such as email, the internet, smartphones and cloud computing would transform how people communicate, learn and work. It is equally difficult to predict the impact of technological change over the next 20 years, such as the Internet of Things (IoT), artificial intelligence (AI) and semi-autonomous vehicles.

We have learnt from the past 20 years that digital engagement is increasing across all parts of society and the economy. Digital technology has become foundational to how most people and organisations access and operate a range of activities. Recognising that digital technology and digital platforms underpin how people and organisations communicate, learn and work means that digital connectivity needs to be recognised as a basic utility for everyone. Low capacity and unreliable digital networks or infrastructure are increasingly a constraint on businesses, households and communities.

How we frame the use of digital technology in society and the economy determines how we think about digital transformation and connectivity. In turn, this impacts how policy is framed and implemented. Individuals can choose how and when to engage with digital technology, but many organisations no longer have that choice when they engage with suppliers, customers, the government, banks and other service providers.

There are wider issues that affect how people engage with digital technology. Digital inclusion is a function of several factors commonly collected under the MAST framework: motivation, access (including connectivity), skills and trust (digital.govt.nz 2021). Access to digital networks or connectivity will not in itself resolve issues such as affordability and digital skills, but good connectivity is a requirement for people to be able to engage effectively with digital technology.

There are many opportunities to better develop digital skills and capability across society and the economy, not least by promoting investment in digital technology industries and innovation. These industries focused on developing hardware, software and technology applications are less constrained by location, which overcomes some of the 'tyranny of distance' facing New Zealand exporting businesses.

Although digital connectivity and digitalisation or digital transformation provide the opportunity to develop high-tech businesses, digital skills and capability are required across all parts of society and the economy. Digital technology is integrated into 'business as usual' activities, such as cloud-based accounting and payroll and digital manufacturing systems. In this way, digital technology has the potential to improve business productivity, but only if it is supported by access to high capacity digital network infrastructure.

Framing the economic opportunity from digital technology purely in terms of growing the high-tech sector has also created a narrow location focus for investment. High-tech industries are associated with hubs, such as Silicon Valley in California, and these hubs are traditionally within city boundaries. Focusing on the needs of urban-based tech hubs ignores the need for all businesses, regardless of location, to have access to high capacity networks to support their day-to-day activity and management and encourage innovation.

2.1 COVID-19 and digital transformation

Around the world, measures put in place to manage the COVID-19 pandemic have acted as a major incentive for many people to get online and increase their use of digital technology when 'stay at home' measures moved work, education and shopping online for many people. This has been characterised as a global tipping point in the adoption of technology (Dutta and Lanvin 2021, 14).

At the same time, the stay-at-home measures highlighted the digital divide. Those without reliable access to the internet were unable to move online or found that their ability to work, learn and communicate was constrained.

Ensuring everyone has access to high capacity digital networks and technology has become more pressing. Although people are returning to school, workplaces and community spaces, the acceleration in the uptake of digital tools has given people and businesses more flexibility in how they live and operate.

2.2 Non-urban digital transformation

Rural communities are more likely than urban centres to experience digital exclusion based on limited access to broadband and poor connectivity. Lack of high capacity and reliable connectivity acts as a deterrent to using and benefiting from internet or digital tools (B. Wilson et al. 2018)

Access to digital networks can bring many benefits to rural and semi-rural communities by improving social access, growing local income, opening access to new markets, and overcoming the friction of distance and isolation of markets (Philip and Williams 2019, 306). Although digital technology is not a panacea for regional and rural innovation (Philip and Williams 2019, 308), rural-based communities' access to social support, information and resources, and the delivery of government services can be greatly improved by high capacity internet access.

Digital inclusion traditionally focuses on the needs of individuals and households, but access to high capacity and reliable digital infrastructure is also important to rural based communities and businesses. The rural-urban digital divide potentially reduces the gains and opportunities for innovation and increases the costs of doing business for rural-based businesses.

Increasingly businesses are required to engage with the digital economy by their customers, suppliers and government agencies. They are subject to digital expectations and internal and external business requirements fuelled by a society where internet access, availability and routine use are the norm. Tourism businesses are expected to be online to take bookings and provide internet access to their clients. Low-capacity networks put booking systems at risk and mean visitors don't get the experience they expect.

Benefits that access to digital networks and technology can bring small and medium enterprises (SMEs), micro businesses, home-based businesses and the self-employed in rural areas have been well documented (Philip and Williams 2019, 308). The advantages include, for example:

- enhanced visibility, which attracts new customers and suppliers from beyond the local area
- online identity for advertising, marketing and wider engagement

- online modes of communication with customers and suppliers, between business colleagues and collaborators, and the development of professional networks
- intelligence gathering and skills development
- financial, data management and storage solutions via online platforms
- support for routine administrative tasks.

Rural and semi-rural businesses are characterised by their sectoral diversity. In the United Kingdom, the most important business sectors are agriculture, tourism and arts/creative sector. In New Zealand, the most important sectors are agriculture and tourism (see section 4). A rural business can also have diverse activities, for example, when a farming operation is manufacturing and selling directly to consumers and/or delivering a tourist experience. Non-urban businesses are also characterised by their small size, often being household-run and embedded in place.

2.3 The digital divide and digital parity?

The digital transformation has generated significant structural changes and contributed to the persistence of an urban-rural divide that challenges the capacity of some groups and communities to actively participate in society and the economy (Gallardo, Beaulieu, and Geideman 2021). To ensure that communities have the capacity to participate in a digital society, broadband infrastructure is an essential *built capital asset* that communities must have to be connected. In Europe, including the United Kingdom, *there is a perception that delivering sub-par broadband to rural citizens is no longer an acceptable goal* (Felten and Bensassi-Nour 2022, 5).

Gallardo et al. (2021) introduce the concept of *digital parity*, which refers to the idea that different social and economic outcomes between groups are due, in part, to unequal levels of internet connectivity, as well as digital skills. An uneven digital playing field leads to digital exclusion, which is a clear threat to community and economic development (Gallardo, Beaulieu, and Geideman 2021, 5–6).

When people in rural areas have reliable access to broadband networks, they can have the same benefits as urban users. Gallardo et al. found that when digital parity exists, the urban-rural differences are eliminated. More importantly, they found that *rural households utilise and benefit more from the technology* when digital parity exists (Gallardo, Beaulieu, and Geideman 2021, 13–14).

Here in New Zealand, the attempt to move the surveying of the Census 2018 online highlighted the digital divide, as those without the digital tools to complete the survey were inadvertently excluded. This had widespread implications for the representation of different parts of society in assessing where to allocate resources and services.

3 Digital transformation in Aotearoa New Zealand

Since 2011, billions of dollars have been spent (including investment from both government and private partners) in building a world-class fibre network with unconstrained capacity, available to 87 percent of the New Zealand population. Current take-up rate is about 70 percent (Crown Infrastructure Partners 2022).

Most of the remaining 13 percent of the population outside fibre coverage can access the internet via a range of government funded programmes including rural broadband initiatives, mobile blackspot fund, rural capacity upgrades and the marae digital connectivity programme. To date, the mix of solutions utilised have limited capacity and reliability, which sets a constraint on users in rural locations. In turn, this limits the incentives to adopt new technology and solutions. The rural digital infrastructure is not easily upgraded to meet increasing demand as technology changes.

New Zealand has been among the leaders in the roll-out of digital networks, but it lags in its digital transformation (OECD 2022). In its economic survey of New Zealand in 2022, the OECD focused on the opportunities that digitalisation or digital transformation can provide to society, firms, the economy and the government. It concluded that New Zealand's digital sector and digital innovation have room for growth, but structural bottlenecks hinder this. These bottlenecks include severe shortages of ICT skills in the workforce and a regulatory system that risks constraining digital innovation while not preventing harmful activities. *More intensive use of digital tools is also held back by low availability of high-speed internet connections in rural areas* (OECD 2022, 84).

Despite the ongoing digital transformation, New Zealand (and other OECD economies) are struggling with productivity growth. This is often referred to as the Solow productivity paradox - that we *can see the computer age everywhere but in the productivity statistics* (quoted in Brynjolfsson, Rock, and Syverson 2020). This may be because economic statistics do not fully reflect the benefits of digital technologies, particularly when digital services appear to be free for users. It also reflects the lag between investment in technology and the time it takes for individuals and organisations to learn how to use technology effectively. The accumulation of intangible capital to complement digital technologies includes access to a skilled workforce, (financial) capital, appropriate regulatory settings, and the availability of high-quality digital infrastructure (OECD 2022, 85).

To reap the benefits of digital technology, New Zealanders need to seize the opportunities. Previous research points to New Zealand businesses' slow technology adoption rate, especially SMEs (Grimes, Ren, and Stevens 2009; NZIER 2020). The opportunity for rural-based businesses is currently constrained by the capacity of digital infrastructure in rural areas (KPMG 2022; Federated Farmers of New Zealand 2021; TUANZ 2022).

Farmers and growers increasingly use digital technology to support their businesses, whether using accounting tools or adopting technology solutions for their day-to-day activity, such as automated milking sheds, harvesting equipment or monitoring water quality. The agriculture sector is increasingly marketing itself to promote the integrity of its products to consumers, if not directly selling to consumers. Ag-tech is identified as an opportunity for New Zealand, but its success depends on the digital infrastructure's capacity to support its implementation.

The New Zealand tourism sector is predominantly rural, outside the urban centres. Marketing to international clients and managing their bookings is carried out online. Low capacity and unreliable digital infrastructure can deter possible clients from making bookings, especially if connections are slow. Overseas visitors also expect access to high capacity and reliable networks across all locations.

The provision of high capacity digital infrastructure to the same standard across all of Aotearoa New Zealand means that location is not the primary constraint for business start-ups or home-based businesses. After the experience of COVID-19 lockdowns, people are re-considering their residential location choices, including moving out of urban centres to more rural areas (Cebr 2021). This suggests that preferences are changing, including a preference for remote working, but this depends on access to digital technology.

3.1 The Digital Strategy for Aotearoa

In September 2022, the government issued Te Ruataki Matihiko mō Aotearoa The Digital Strategy for Aotearoa, with the vision *Enabling Aotearoa New Zealand's people, communities, economy and environment to flourish and prosper in a digital world*. The strategy is built around three goals:

- Mahi Tika: Trust
- Mahi Tahi: Inclusion
- Maki Ake: Growth
  (New Zealand Government 2022b, 4).

The strategy identifies the role of digital infrastructure in supporting digital inclusion. One of the measures of success is that *high speed internet is available to all New Zealanders*, although there is no definition of 'high speed'.

Before issuing the Digital Strategy, the government consulted on a draft strategy in 2021. Submitters noted that the strategy potentially fitted with a 'build back better' approach post-COVID and identified that 'digital', in the broad sense, can be a key enabler. Some noted that the strategy could be more ambitious (New Zealand Government 2022a, 5–6). *A core theme that ran through the submissions was a recognition that the application of digital technology and need to keep up with rapid digital technology innovation was a consideration for a wide range of sectors* (New Zealand Government 2022a, 30).

4 Rural New Zealand

Rural-based communities in New Zealand are diverse. New Zealanders tend to think of rural-based households, whānau and businesses as predominantly based in the agriculture sector, but rural New Zealand encompasses the full range of social and economic activity.

The current roll-out of fixed fibre within urban boundaries sets a clear boundary between urban and rural so that one way of defining rural New Zealand is anywhere outside the fibre network. This urban-rural boundary means that many rural households, communities and/or businesses are not necessarily remote or off-grid but are just poorly served by digital networks. The "stale donut" describes those areas that are outside the urban boundary for fibre but are not served well by rural broadband initiatives (TUANZ 2021).

We used Stats NZ's 2022 geographic boundaries of Statistical Area 2 (SA2s) and urban and rural areas to map the urban/rural divide in New Zealand (see Figure 1). Using this urban/rural mapping, we have created an estimate of the resident and working populations outside the urban border (Stats NZ 2022b).

We use Stats NZ's subnational population estimate data and the 2018 Census data (Stats NZ 2018; 2021) and estimate that about 16.3 per cent of the population lived in rural areas as at June 2021, or about 16.7 percent of households in the 2018 Census (Table 2). This aligns with the current targets for the fixed fibre roll-out.

Table 1 Population and households by location type (2021)

Location type	Population	Share of total population	Households	Share of total households
Rural	834,900	16.3%	275,496	16.7%
Urban	4,287,700	83.7%	1,378,296	83.3%
Total	5,122,600		1,653,792	

Source: Stats NZ, NZIER

4.1 The rural economy in New Zealand

New Zealand is a country of small and micro enterprises, particularly in rural and semi-rural areas. Defined as businesses with fewer than 20 employees, 97 percent of businesses are small (Ministry of Business, Innovation & Employment n.d.). These businesses are subject to the same compliance requirements as their urban counterparts. They also have less access to service providers as government agencies and other businesses reduce their physical footprints by closing bricks and mortar outlets.

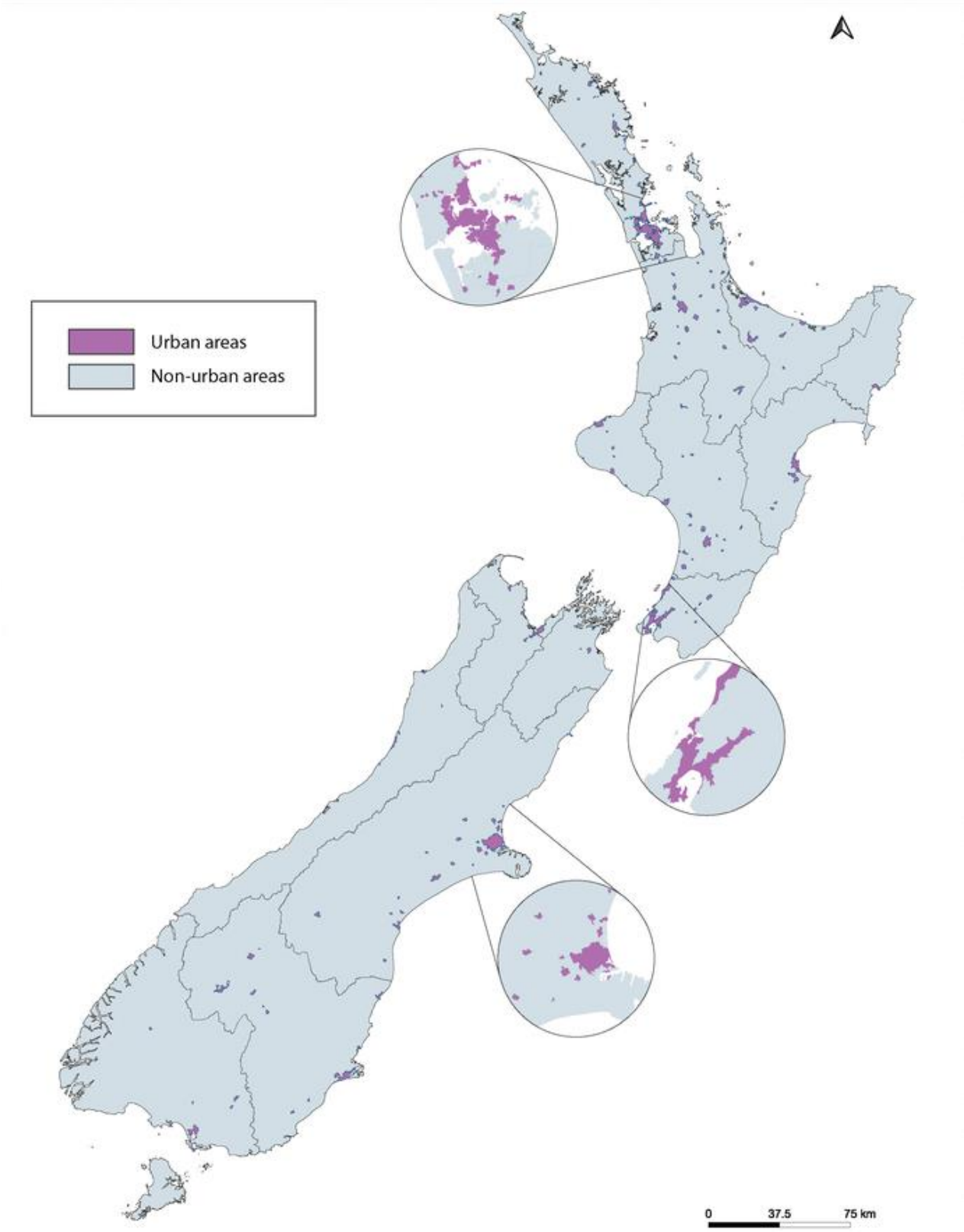
Applying our urban/rural mapping to Stats NZ business demography data, we have identified the number of businesses (and trusts) that are rural-based. We estimate that about 140,028 businesses are in rural areas, making up just under a quarter of all businesses. A similar analysis in the United Kingdom found that about 25 percent of businesses were located in rural areas (B. Wilson et al. 2018, 17).

Table 2 Number of businesses by location type (2021)

Location type	Number	Proportion (%)
Rural	140,028	23.4
Urban	458,382	76.6
Total	**598,410**	

Source: Stats NZ, NZIER

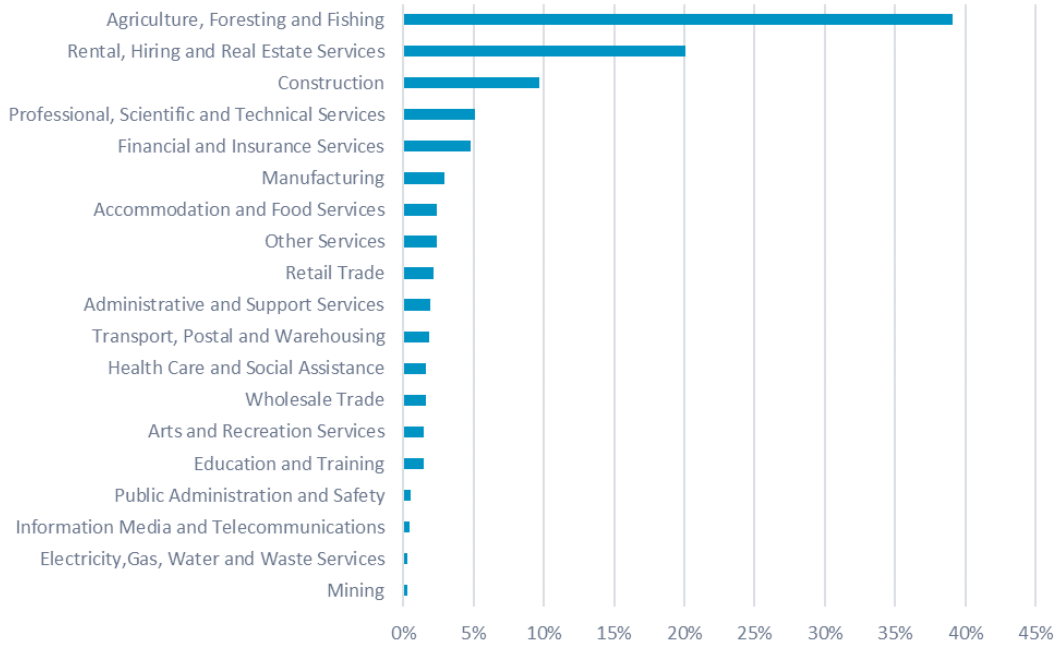
Figure 1 Urban-rural allocation



The rural economy is diverse. There are businesses from across all the industry sectors, and about 40 percent of businesses are in the agriculture, forestry and fishing sectors.

Figure 2 Rural-based businesses by sector

Percentage of rural businesses belonging to each industry



Source: NZIER

From the Stats NZ Business Demography data at the SA2 level, we see that, on average, rural-based businesses in New Zealand are small, with an average employee count of 1.9. Only 11.6 percent of employees are rural-based. The corollary is that the Stats NZ Business Demography data does not capture the self-employed or *owner-operators* unless they are on the payroll and pay PAYE. Farm owners, for example, are unlikely to pay PAYE.

Table 3 Employee count (EC) by location type (2021)

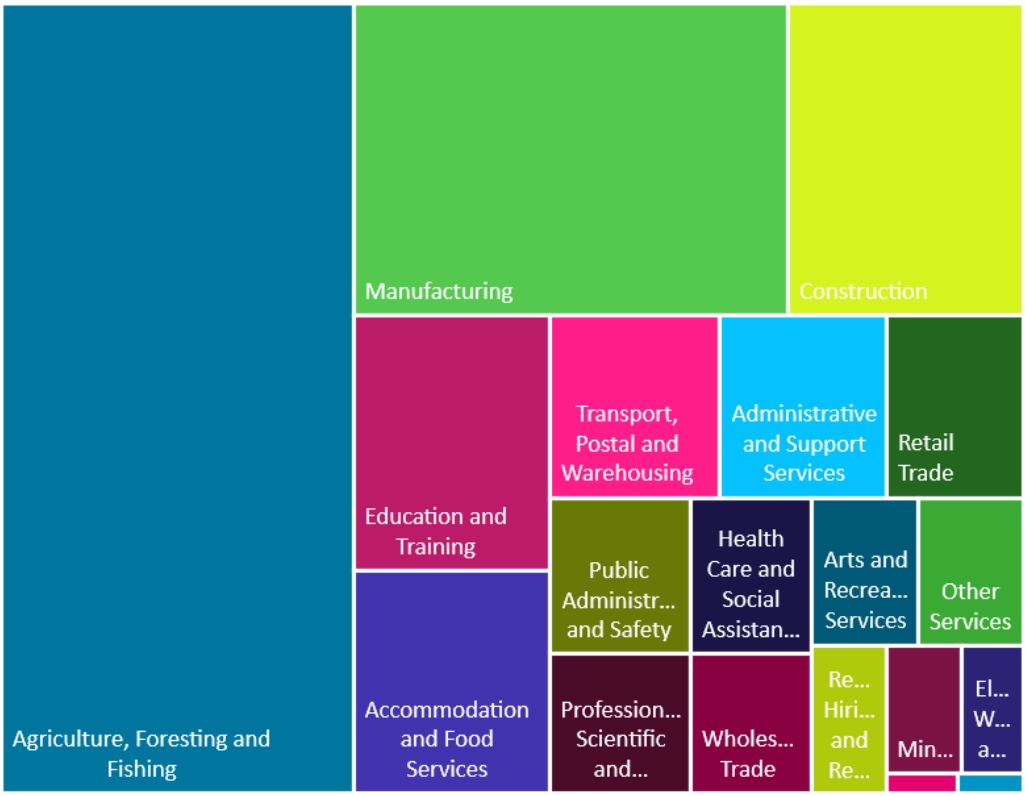
Location type	Number	Proportion (%)	Average EC
Rural	267,535	11.6	1.9
Urban	2,045,865	88.4	4.5
total	2,313,400		3.9

Source: Stats NZ, NZIER

The significant employers are agriculture, forestry and fishing; manufacturing; construction; education; and accommodation and food services. Regarding average employee count, the largest employers are in manufacturing, public administration and safety; mining; education; and energy (see Figure 3).

Migration restrictions have limited employment growth in the agriculture and tourism sectors. With the border re-opening, there is likely to be both an increase in employment and a possible increase in the number of rural-based businesses.

Figure 3 Rural-based employee count by sector



Source: Stats NZ, NZIER

5 The benefits of digital connectivity

The benefits of digital connectivity and access to the internet are manifested at a number of levels across New Zealand: individual, household, whānau and community, and business, culminating in the overarching society and economy-wide (health, education).

5.1 People identify benefits from digital connectivity

New Zealanders surveyed on their internet use report significant benefits of internet access (BNZ 2022; InternetNZ 2021). People agree that the internet helps with:

- teaching yourself to do new things
- connection with family, friends and community
- professional development
- saving time and organising life
- saving money

- finding a job
- connecting with or expressing culture, faith or religion
- managing and improving physical and mental health.

InternetNZ noted a small downward trend in the perceived benefits of using the internet in 2021, including working from home. The exception was an upward trend in people seeing the internet as a way to connect communities (InternetNZ 2021). This may be driven by the increased use of the internet to connect during the COVID lockdowns in 2020–21. Increased use of internet-based communication was reported by Māori whānau and iwi in response to restrictions on face-to-face engagement through the COVID pandemic (Department of Internal Affairs 2020). In addition to the benefits listed above, people value access to a range of online services and apps, such as search engines, email, live streaming of movies and music, maps, shopping, as well as social media. Because access to these services and apps are often free, it is difficult to estimate the benefit (or disbenefits). Research on willingness to pay has identified that people do associate benefits to these services, although the value of the benefits varies by demographic, location and nationality (Brynjolfsson and Collis 2020).

5.2 Benefits to business

In a world where digital technology and applications are now endogenous to how we operate, digital connectivity supports all businesses to improve their production and management processes, marketing and productivity.

At a macro level, the economic impact of investment in high capacity broadband is expected to increase business productivity; create new businesses, especially those that would be more reliant on broadband; attract foreign direct investment; increase employment; and enable people to work more effectively from home and in transit (Deloitte 2015; KPMG 2015; NZIER 2020)

In research commissioned by Amazon in the United Kingdom (B. Wilson et al. 2018), the benefits for rural businesses[3] in taking up digital technology were:

- Assisting remote working
- Improving access to customers and suppliers
- Improving business efficiency
- Improving data storage and security
- Enabling more business flexibility
- Reducing business costs, increasing turnover and improving profitability.

Two factors influenced the extent of business benefits: connectivity and business size. Connectivity was also the major constraint in digital take-up. Slow and unreliable connections contributed to reputational harm, lost time, inability to work flexibly, and lost sales (B. Wilson et al. 2018, 7).

[3] Defined as businesses that are in local authority areas where at least half the population live in settlements containing fewer than 10,000 people, just under 30 percent of United Kingdom local authority areas.

5.3 Health

There are many potential health benefits of digital access, including the ease of online booking for doctor (GP) appointments, searching for medical information online, accessing health records and managing e-prescriptions. During COVID-19, telehealth (health consultations online) was widely used to avoid the risk of infection for patients and health professionals (Geraldine Wilson et al. 2021). The Ministry of Health's Digital Enablement Programme funded 19 providers to test ways of increasing access to services digitally, including a Digital Health Hub, remote health monitoring and GP enrolment (McBeth 2021).

Access to telehealth services should positively affect rural communities with limited access to medical services, who would otherwise have to travel some distance to consult a doctor or other medical specialist. There is a benefit in reduced travel time, although telehealth options will not overcome the need for in-person visits for some conditions.

Research in New Zealand, on the attitude of two rural communities on using online health and wellness services, indicated that these communities were generally positive. Respondents identified risks, especially in seeking help online from non-medical professionals, as well as benefits. They also cited access to technology and cost as a constraint (Babbage et al. 2020).

5.4 Education

The relationship between digital access and education outcomes is complex. In New Zealand, evidence suggests that using digital devices in the classroom can actually harm student learning (Sutcliffe 2021). We know relatively little about the impact of digital devices at home on education outcomes. The Programme for International Student Assessment (PISA) 2018 shows poorer maths, reading and science scores for 15-year-olds who do not have a computer at home to use for schoolwork relative to those who do. However, we cannot attribute this gap to computer ownership or access alone. In assessing global PISA data, the OECD finds a hill-shaped relationship between the use of computers at home and education outcomes, with those using computers least and most frequently having worse scores than those with moderate use (OECD 2015). It is therefore challenging to anticipate the direct education consequences of digital access.

On the other hand, since COVID-19, home digital access has become essential for school attendance, which is a key indicator of education performance. Schools also present an opportunity to deliver digital skills training, which can promote long-term safe internet practices. Given the uncertainty about the future of education in light of COVID-19 and the role technology will play, we do not include estimates for the educational benefits of digital inclusion.

High capacity digital access in rural areas would support a more dispersed delivery of vocational training, including workplace-based training. This would reduce the need for those in rural areas to relocate to access training and development opportunities. Training increases productivity within the workplace and potentially the earnings of those completing the training (NZIER 2021b). This is partly captured in the estimate of the benefit to a household of increased earnings (see Table 11).

5.5 Working from home

In 2019 Cebr estimated the impacts of a nationwide full fibre roll-out in the United Kingdom These were updated in 2021 to account for the COVID-19-driven pivot in work habits. The study found a significant boost in productivity as measured by gross value add (GVA). This was largely driven by an increase in the number of people working from home. The full fibre roll-out meant people could live and work where they chose so that more people would move to rural areas and others could return to the workforce because of the flexibility provided by working from home. In turn, this would reduce the climate impact by reducing commuting (Cebr 2021).

5.6 Disbenefits

People recognise that there are also harms associated with digital access. These harms include cybercrime, social media harm, misinformation and disinformation (Hannah, Hattotuwa, and Taylor 2021, 2).

The Computer Emergency Response Team (CERT NZ) reports that online scams and fraud cost people $4.2 million per quarter or $16.8 million per year (CERT NZ 2022). This is equivalent to $11 per online household. However, this is widely regarded as an underestimate by the agencies and organisations engaged with cyber security in New Zealand. Digital inclusion user insight research identifies a high level of concern about cybercrime, especially for inexperienced users (digital.govt.nz n.d.).

On average, people have an explicit willingness to pay for social media above $0; therefore, many perceive a consumer surplus from using the service for free. However, Allcott et al. (2020) suggest that this consumer surplus may be overstated if users do not understand how social media can be addictive or reduce wellbeing.

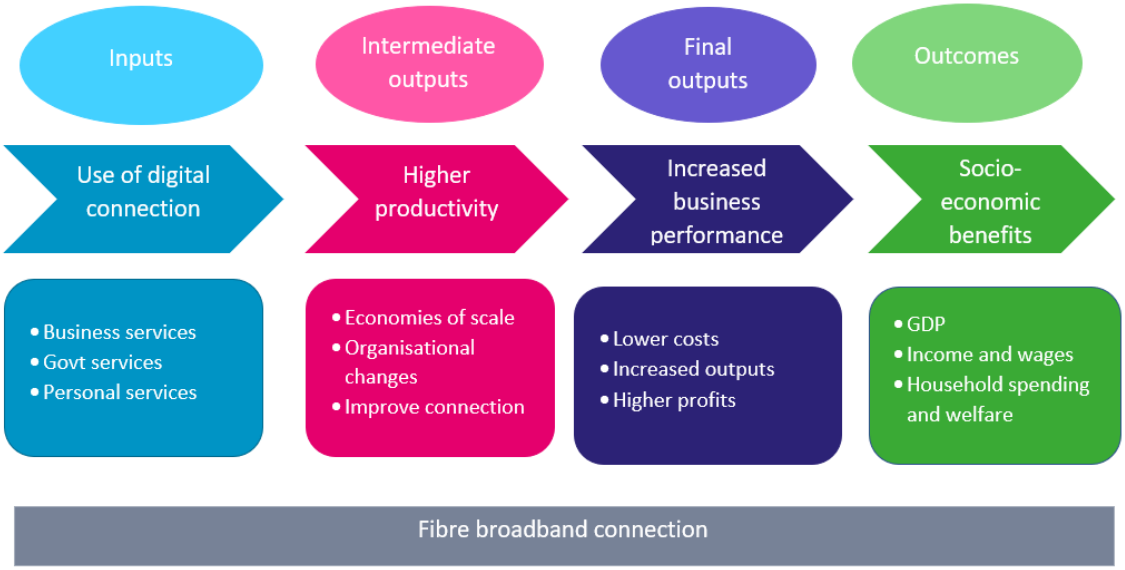
In New Zealand, the Disinformation Project reported a sharp increase in the popularity and intensity of disinformation relating to COVID-19 spread through online channels (Hannah, Hattotuwa, and Taylor 2021). This spread of harmful content threatens health and presents wider threats to democratic processes.

6 Measuring the benefits of digital connectivity

6.1 Our approach

This intervention logic assumes that access to high capacity broadband will increase the use of digital connectivity and digital technologies across both households and businesses. This will deliver benefits to households and lead to higher productivity and improved business performance. A portion of businesses' higher revenue as a result of this improved performance is reallocated toward increased real wages, which leads to higher household spending. As a result, household welfare and New Zealand's GDP will expand (NZIER 2020, 2).

Figure 4 Intervention logic for rural connectivity



Source: Based on NZIER (2020)

We have drawn on previous work on the benefits of digital inclusion and NZIER (2020) to estimate the benefits to rural-based households and businesses of extending high capacity digital infrastructure to all parts of New Zealand. To date, about 70 percent of households that have access to ultra-fast broadband (UFB) have taken it up. In urban areas outside the main metropolitan centres, the uptake rate appears to be higher, with some centres reaching 99 percent (Crown Infrastructure Partners 2022, 6). We have assumed that there would be a high uptake rate of high capacity broadband across rural households and businesses. We have applied the benefits to all households and businesses.

Our estimates of the benefit to rural-based households identify benefits from online transactions with government and banks, reduced travel time, improved earnings from access to wider employment opportunities, telehealth, retail savings and social connection. See Appendix B for a discussion of these benefits. We estimate an annual benefit of approximately $6,505 per household, which would be about $1.8 billion across all rural-based households.

Table 4 Annual benefits to households and time savings for businesses

Benefits	Households	Business
Time saving	$ 378	$ 1,026
Travel time	$ 1,404	$ 1,404
Individual earnings	$ 1,510	
Health	$ 80	
Social connection	$ 2,180	
Retail transactions	$ 952	
Total	**$ 6,504**	**$ 2,457**
Number	275,496 households	140,028 businesses
Rural location total	$ 1,791,963,732	$ 344,048,796

Source: NZIER

Estimating the benefits to rural businesses is more difficult. Access to high capacity fibre networks would support the uptake and utilisation of digital tools, improve communication with urban-based advisors and service providers, improve employment opportunities by giving better access to online recruitment tools and extend the opportunity for work-from-home employees. These developments would increase productivity across rural-based businesses.

The decline in rural services means that rural businesses are more likely to use online services, in part to avoid travel costs, including time. There are also a number of government compliance needs. Estimating the time savings to business alone implies a benefit of $2,457 per annum per business. Applying that to the estimate of rural-based businesses, this is a total benefit of $344 million (see Table 5).

To model the impact on business productivity, we have estimated gross value add by sector, using Stats NZ's Annual Enterprise Survey data for 2021.[4] We have weighted each sector by the rural-based share of the employee count in that sector to provide a proxy for the size of the sector in the rural economy. We have then applied the output growth estimates generated by NZIER(2020).

NZIER (2020) modelled three multi-factor productivity[5] improvement scenarios associated with a 20 percent increase in the uptake of cloud-based business tools. They found that overall industry output would increase by a range of 0.7 to 1.3 percent. We have applied these output growth estimates using their low, central and high estimates.

These estimates suggest that there is at least an overall increase in rural-based value add of $189.5 million in the business sector alone. Noting that NZIER (2020) modelled a 20 percent increase in the uptake of cloud-based business tools, these estimates are arguably low. Many rural businesses are already using cloud-based business tools, but the effectiveness is compromised by low capacity and unreliable digital infrastructure. Based on the uptake of UFB in households in urban areas outside the metropolitan centres, we expect that the

4 https://www.stats.govt.nz/information-releases/annual-enterprise-survey-2021-financial-year-provisional/

5 Multi-factor productivity measures the increase in output that cannot be accounted for by changing all inputs used in the production process. For a fuller discussion see Appendix E in Economic potential of cloud-based business tools (NZIER 2020, 52).

uptake would be high in rural businesses. We also expect that access to high capacity and reliable digital infrastructure would encourage investment in other digital tools and systems.

Table 5 Annual change in rural-based value add by sector

$ millions

	Sector	Low (0.7% output growth)	Central (1.0% output growth)	High (1.3% output growth)	Weight - share of total employee count in rural economy
	All sectors	$210.7	$301.0	$391.2	11.6%
AA	Agriculture, Foresting and Fishing	$24.9	$24.9	$37.4	74.4%
BB	Mining	$1.4	$1.4	$2.0	57.9%
CC	Manufacturing	$31.1	$41.5	$51.9	19.2%
DD	Electricity, Gas, Water and Waste Services	$8.9	$12.5	$15.2	13.3%
EE	Construction	$28.5	$38.0	$50.7	12.6%
FF	Wholesale Trade	$2.5	$3.3	$4.9	4.9%
GH	Retail trade, accommodation and food services	$12.9	$17.2	$23.0	5.9%
II	Transport, Postal and Warehousing	$2.4	$2.4	$3.6	11.4%
JJ	Information Media and Telecommunications	$0.4	$0.5	$0.6	1.5%
KK	Financial and Insurance Services	$3.3	$4.5	$5.7	0.7%
LL	Rental, Hiring and Real Estate Services	$31.0	$44.3	$57.6	10.5%
MN	Professional etc and administrative services	$18.6	$27.9	$35.3	5.5%
OO	Public Administration and Safety	$0.9	$1.3	$1.6	5.1%
PP	Education and Training	$3.2	$4.7	$6.2	8.4%
QQ	Health Care and Social Assistance	$3.9	$5.7	$7.4	2.4%
RS	Arts & recreation and other services	$15.7	$21.4	$28.0	8.5%
	Total	**$189.5**	**$251.4**	**$331.1**	

Source: Stats NZ, NZIER

Over the next ten years, these annual benefits represent an opportunity cost of not having access to connectivity with unconstrained capacity of $13.8 billion for households, $2.7 billion related to time savings for businesses and $1.5 billion in output increases foregone for rural businesses.[6]

Table 6 Ten-year opportunity cost

$ billions

Households	Business (time savings)	Business output
13.8	2.7	1.5

Source: NZIER

As our estimates are based on the current state of the households and businesses in rural areas, we consider them to be conservative. We would expect that over time, having access to connectivity with unconstrained capacity would encourage more households and

[6] At an assumed discount rate of 5 percent.

businesses to move to the rural areas and enable better matching of jobs and skills. Furthermore, having access to connectivity with unconstrained capacity would allow the development of innovations which we cannot identify and, therefore, cannot quantify at this point.

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Appendix A The rural economy in New Zealand

A.1 Business numbers

Applying our urban/rural mapping to Stats NZ business demography data, we have identified the number of businesses (and trusts) that are rural-based. Business demography data does not capture businesses that are not registered for GST, i.e. whose total sales fall below the compulsory GST registration level of $60,000 or are not registered for PAYE. This means that the data underestimates the number of enterprises and the number of those working in these businesses, especially working owners.

Table 7 Number of businesses by location type (2021)

Location type	Number	Proportion (%)
Rural	140,028	23.4
Urban	458,382	76.6
Total	**598,410**	

Source: Stats NZ, NZIER

A.2 Industry sector

The analysis of the business demography data shows that the rural economy is diverse. There are businesses from across all the industry sectors. About 40 percent of businesses are in the agriculture, forestry and fishing sector (see Figure 2).

This urban-rural analysis is for the year ending February 2021, which was impacted by the COVID-19 pandemic. At a national level, there is evidence that although there was not an overall reduction in the number of businesses, there were significant changes in the number of enterprises and employment in sectors that were directly affected by COVID-19 and the decline in international tourism. These include administrative and support services (which includes travel agents), transport (in particular, passenger transport operators), professional services and arts and recreation (NZIER 2021a).

Migration restrictions have limited employment growth in the agriculture and tourism sectors. With the border re-opening, there is likely to be both an increase in employment (see section 3.3) and a possible increase in the number of rural-based businesses.

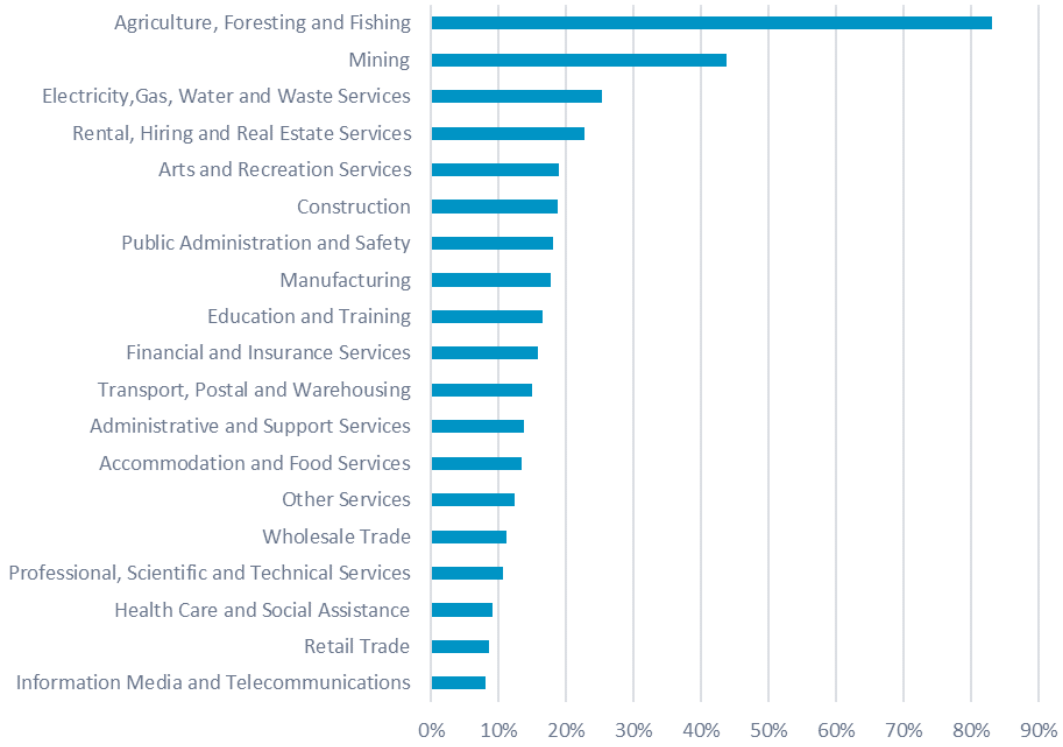
Comparing data for 2019 with the data for 2021, the number of businesses located in rural and urban areas has increased. There has been a decline in the number of rurally located businesses in the agriculture sector, accommodation and food services, and arts and recreation services. The largest increases in rurally located businesses were in information, media and telecommunications, health care, and social assistance.

The employee count has also grown despite a fall in employee count (EC) in agriculture, accommodation and food services, and arts and recreation. There has been an increase in the employee count in sectors such as construction, professional services and education.

There was also an increase in the enterprise death rate in the finance sector, partly due to the closure of bank branches. The rural-based finance businesses appear to be trusts,

especially given the low employee count in the sector (see section 4). The closure of branches of other businesses, such as Post Shops, also contributed to regional enterprise death rates.

Figure 5 Rural-based businesses share of total sector



Source: NZIER

A.3 Rural-based employee numbers

On average, rural businesses in New Zealand are small, with an average employee count of 1.9. Using the business demography data, only 11.6 percent of employees are rural-based. The corollary is that the business demography data does not capture *owner-operators* unless they are on the payroll and pay PAYE. Another factor is that some people living in rural households will work for businesses that are within the urban boundaries.

Table 8 Employee count (EC) by location type (2021)

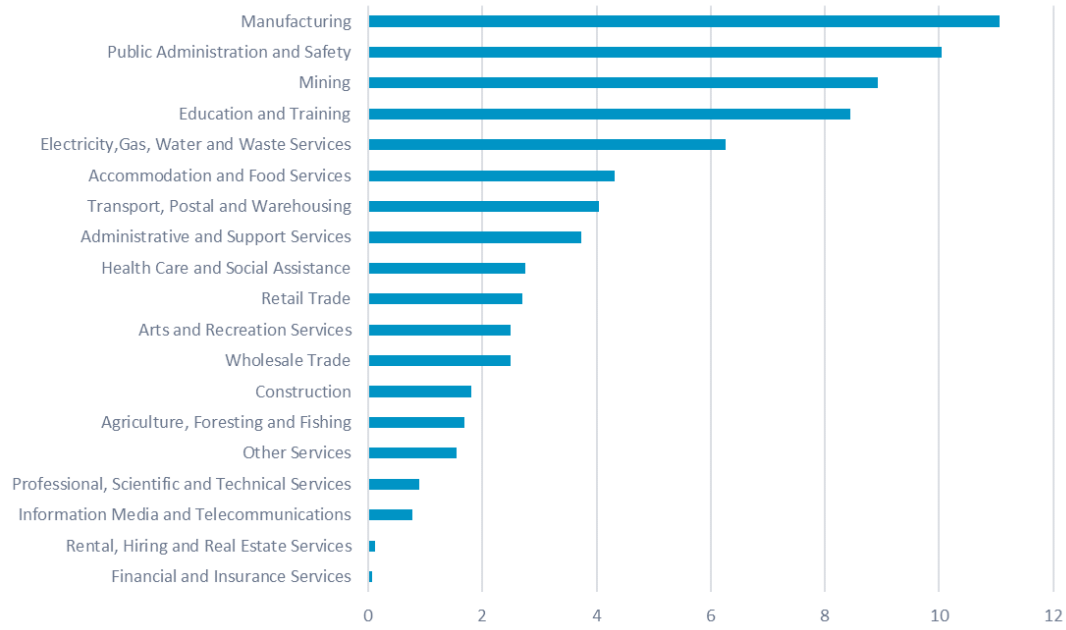
Location type	Number	Proportion (%)	Average EC
Rural	267,535	11.6	1.9
Urban	2,045,865	88.4	4.5
Total	2,313,400		3.9

Source: Stats NZ, NZIER

The total employee count in the business demography data is lower than the estimates of employment reported in the Household Labour Force Survey (Stats NZ 2022a). In June 2021, this was 2,313,400 and 2,775,000, respectively.

Extrapolating from our data for the rural population in June 2021 (see Table 2), we estimate that the rural-based labour force is about 379,880, compared with the rural employee count of 267,535 in Table 9. Allowing for owner-operators and those working in urban areas suggests that unemployment and underutilisation rates are higher among the rural-based working-age population. Increasing access to unconstrained digital infrastructure could increase opportunities for employment in rural areas.

Figure 6 Average rural-based employee count by sector



Source: Stats NZ, NZIER

Appendix B Individual and household benefits

In this section, we summarise the literature on measuring and valuing the benefits to individuals and/or households from digital connectivity.

B.1 Existing cost-benefit analysis estimations

A 2012 study on the benefits of broadband in New Zealand estimated that the investment in UFB and Rural Broadband Initiative (RBI) would contribute $5.5 billion to GDP over 20 years. The same study found that there was a $32.8 billion benefit across health care, education, business and the dairy sector, equivalent then to the value of New Zealand wine exports (Alcatel Lucent 2012).

The Digital Inclusion Research Group (2017) provided an overview of existing attempts to quantify the economic benefits of digital inclusion internationally. They used benefits calculated by PwC (2009) to estimate that the total economic value of digital inclusion was around NZ$1.5 billion per year for households. Under the assumption that 10% of households were not connected or lacked the motivation to be connected, the authors estimated the cost to New Zealand is at least NZ$150 million per year.

B.2 Benefits measured by Cebr (2018)

The Centre for Economics and Business Research (Cebr) has completed two studies on the economic impact of digital inclusion in the United (Cebr 2018). It identified eight benefit channels: time-saving to people, increased individual earnings, enhanced employability, online retail transactions benefits, improved social inclusion, more-efficient health services, greater digitisation of government transactions and reduction in digital skills shortages vacancies. We have used these as the basis for our assessment of the benefits of rural connectivity.

B.2.1 Time savings

Digital devices allow people to access government and other services online. During COVID-19, many government services were available online, for example, booking a vaccine appointment or applying for a wage subsidy. Before COVID-19, many services were already online, like applying for benefits or a visa. Across the literature, researchers tend to use a proxy of 30 minutes saved for each online transaction (Cebr 2018).

B.2.2 Government transactions

The digital services landscape in New Zealand is different to that of the UK. Table 9Table 9 shows the proportion of government interactions undertaken online in July–September 2016. While this shows that about half of everyday government interactions are completed online, many are infrequent interactions; for example, paying for a vehicle licence and filing tax returns are annual events.

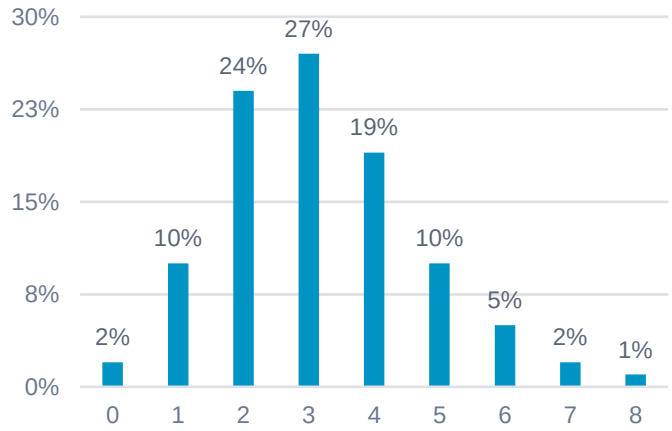
Table 9 Proportion of government interactions completed online

Agency	Service	July–September 2016
Department of Conservation	Book Department of Conservation asset	29.8%
NZ Customs Service	SmartGate	60.6%
Ministry of Business, Innovation & Employment	Apply for visa	30.0%
New Zealand Transport Agency	Pay for vehicle licence	36.6%
New Zealand Police	Pay fine	62.8%
Inland Revenue	File an individual tax return	86.9%
	Pay individual tax	89.4%
	Apply for an IRD number	26.3%
Ministry of Social Development	Apply for financial assistance	47.9%
Department of Internal Affairs	Renew adult passport	48.8%
Total		**51.9%**

Source: Department of Internal Affairs (2018)

We can combine this with the Department of Internal Affairs' research from 2014 that shows the number of interactions with the government per year (Figure 7) when the most common number of government interactions was three.

Figure 7 Number of government interactions per year (2014)



Source: Department of Internal Affairs (2018)

B.2.3 Online banking

The World Internet Project NZ 2021 shows that 46 percent of respondents paid bills online or used e-banking weekly, and 12 percent did so daily (Diaz Andrade et al. 2021, 16). These transactions may be due to ease of use and, increasingly, replace a physical trip to the bank as the number of bank branches declines. The Computers in Homes evaluation found that, of those who participated, 65 percent did internet banking every week, followed by 18 percent every day (20/20 Trust 2018).

B.2.4 Travel time

Rural-based households, communities and businesses are increasingly unable to access services in person unless they are prepared to travel some distance. Banks, government agencies and retailers are closing outlets in rural centres. Based on an analysis of the average distance to travel to hospitals, we have used 2 hours per trip (Brabyn and Skelly 2002). Noting that most trips would include several activities, we have allowed for one trip per fortnight.

B.2.5 Earnings and employability

Digital skills are associated with increased earnings and employability. Cebr (2018) estimates that people who have learned basic digital skills could expect a lifetime increase in average hourly earnings of 2.8 percent and apply this to the lowest wage quartile. The estimated increase of 2.8 percent is in line with OECD recommendations.

Cebr has also undertaken work on the impacts of a nationwide full fibre roll-out in the UK, which was updated in 2021 to account for the COVID-19-driven pivot in work habits. The study found a significant boost in productivity as measured by gross value add (GVA). This was largely driven by an increase in the number of people working from home. The full fibre roll-out meant people could live and work where they chose so that more people would move to rural areas and others could return to the workforce because of the flexibility provided by working from home. In turn, this would reduce the climate impact by reducing commuting (Cebr 2021).

B.2.6 Social connection

The internet provides a way for people to stay connected. Emails, video chat and social media are all ways that whānau and communities can maintain relationships. These channels are particularly important for people who live alone or at a distance from others.

There is little evidence quantifying the relationship between digital access and loneliness. One study focuses on the impact of internet use on loneliness among older adults (Cotten, Anderson and McCullough 2013). The authors find that a 1-point increase in internet use (on a 3-point scale) was associated with a 0.15-point decrease in loneliness scores, also on a 3-point scale.

B.2.7 Retail savings

Online shoppers can make significant savings through access to retail with less overhead costs and a greater ability to shop around. Unsurprisingly, online shopping saw extraordinary growth throughout 2020. Older age groups saw the highest growth in numbers shopping, frequency and spend. The 2021 New Zealand eCommerce review, commissioned by NZ Post, found that shoppers aged 30–44 are most likely to be online shopping (NZ Post 2021).

International research gives some indication of the benefits of online shopping. Dolfen et al. (2019) assess the consumer surplus from e-commerce in the US. The authors estimate that e-commerce gave consumers the equivalent of a 1 percent permanent boost to their consumption or over US$1,000 per household. Rural households are expected to benefit significantly from access to online shopping opportunities by increasing their choice and access to more competitively priced goods.

Table 10 Annual benefits to households and time savings for businesses

Benefits	Description		Reference	Households		Business
Time saving	Time saving from online government transactions, and online banking	28 transactions per annum, 30 minutes each @ $27 an hour	(Department of Internal Affairs 2014)	$ 378	1.5 transactions per week, @ $27 an hour	$ 1,053
	Travel time - 2 hours per trip	1 trip per fortnight	(Brabyn and Skelly 2002)	$ 1,404	1 trip per fortnight	$ 1,404
Individual earnings	Value of increase in earnings from digital access	Increase average income ($53,943) per household by 2.8%	(Cebr 2018)	$ 1,510		
Health	Reduction in GP consultations		(Cebr 2018)	$ 80		
Social connection	Greater social connection, reducing loneliness	1 point increase in internet use (on a 3-point scale) causes 0.15-point decrease in loneliness scores, (3-point scale). 1-point change in loneliness (0–5 scale) scale is worth $7,267. Assume internet shifts loneliness by 0.3 points	(The Treasury 2021)	$ 2,180		
Retail transactions	Savings from shopping online		(Lloyds Bank 2021)	$ 952		
Total				$ 6,505		$ 2,457
Rural location total		275496 households		**$ 1,791,963,732**	140028 businesses	**$ 344,048,796**

Source: NZIER

Appendix C Business benefits

Drawing on the framework in Appendix B, there are six possible benefit channels: time saving to businesses, increased earnings, employment outcomes, online transactions benefits, digitisation of government transactions and potential productivity improvements.

C.1 Time savings

Government transactions

As noted above, digital connectivity allows people to access government services online. Businesses are increasingly required to engage with government agencies online, including: IRD, ACC, Companies Office, Immigration, etc. We have used the proxy of 30 minutes saved for each online transaction (Cebr 2018) every fortnight.

Online banking and other services

Rural businesses will complete most of their interactions with banks and other service providers, such as accountants and lawyers, online. We have included one transaction per week as above.

Travel time

As for rural households, rural businesses increasingly cannot access banking services, professional services, government and local government services, etc., without travelling some distance. Using the estimate above, we have allowed for 12 trips per year.

Employment

Access to reliable digital networks will provide some benefits for rural employers. They can use the internet for online recruitment and, where appropriate, employ people who can work from home.

This has the potential to increase turnover and income.

Online transactions

Rural businesses that have access to reliable digital connections can benefit through access to business-to-business (B2B) and moving to sell online to customers.

Accessing B2B should reduce input costs and ease sales.

Moving to online sales should increase sales and income, given the greater reach of customers

Productivity

Access to digital technology and digital networks provides the opportunity for efficiency gains and innovation within the organisation.