15.0 FIBRE FRONTIER

Ngā Urutaunga ki Tua

NOTE: This is a revision to the original Fibre Frontier chapter. The original chapter had a larger proposed network expansion programme over the four-year PQP2 period. As such, much of the commissioned research and some of the economic analysis described throughout the chapter references the larger piece of work.

15.0 Fibre Frontier

This chapter describes our new network extension programme to communities outside the UFB footprint, Fibre Frontier.

15.1 Our proposal

Within PQP2 we are proposing to spend $13.0 million to provide communal fibre infrastructure to a further 6,379 premises. This is part of an investment programme of $37 million that begins in PQP1 and will bring fibre to a total of 10,008 additional premises. Given expected timing of expenditure, the value of commissioned assets in PQP2 associated with this project will be in the region of $24 million.[1]

TABLE 15.1: FIBRE FRONTIER CAPEX (PQP2 PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

	2025	2026	2027	2028	TOTAL PQP2
Fibre Frontier capex	13.0	0.0	0.0	0.0	13.0

This chapter is set out as follows:

- Context on the case for extending fibre coverage
- Determining fibre build costs – our proposed investment
- End-users' willingness to pay for Fibre Frontier network extension
- The appropriate analytical framework for evaluating the proposal
- Application of a workably competitive market test
- Application of a telecommunications networks optimisation test.

The expenditure in this chapter sits within the Extending the Network Augmentation sub-category.

FIBRE FRONTIER CAPEX

We propose a build programme to increase fibre network coverage to 6,379 premises in Aotearoa.

$13m

6,379

15.2 Introduction – context on the case for extending fibre coverage

15.2.1 The end of the UFB programme and role of fibre connectivity

At the end of 2022 we successfully completed the latest phase of the Ultra-Fast Broadband (UFB) rollout in Aotearoa, playing our part in deploying fibre services to 87% of Aotearoa and delivering the project on time and on budget – a highly successful public-private partnership. Over the past decade, UFB has positioned Aotearoa extremely well to support the tremendous growth in data usage that has

[1] The precise value of commissioned assets for this investment will be confirmed during the standard process to set the PQP2 MAR.

come from end-users adopting more and more digital services as well as the shift from traditional media consumption to online video.[2]

Fibre's ability to scale to the needs of end-users was put to the test during the COVID-19 pandemic when digital services became essential for people to live, work, learn and socialise. Chorus' fibre network saw a 34% increase in data usage during the March 2020 lockdown without any congestion or discernible drop in service performance.[3] New digital habits were formed that have continued beyond the lockdowns and now underpin our increasingly digital modern life, particularly the shift to working from home, with many employers reducing office space on the expectation of a more hybrid workforce incorporating both remote and in-office time.[4] In InternetNZ's most recent Internet Insights report they found that around six in ten New Zealanders believe they do the type of job that allows them to work from home. A higher proportion of 78% work remotely some or all of the time, showing the increased flexibility employees have.[5]

AVAILABILITY OF FIBRE

"A country-wide excellent internet connection is essential for Kiwis to excel in today's world. It is as important as roads and electricity."

Stakeholder feedback

15.2.2 So, what's next?

We believe all New Zealanders will need the kind of connectivity that can scale with their needs into the future in the way our fibre network did during the COVID-19 pandemic. Access to the internet is now seen as critical infrastructure for homes and businesses.[6] As our reliance on high-capacity connectivity grows, it is exposing the inequality faced by the 650,000 New Zealanders caught on the wrong side of an ever-growing digital divide.

Given the current capabilities of various technologies, we demonstrate below that fibre is the technology that will best meet New Zealanders' needs over the coming decades, through both providing a fibre-to-the-home (FTTH) service as well as enabling other technologies that support the rural connectivity ecosystem (such as fixed wireless, mobile, and satellite ground stations).

15.2.3 Rural and urban users have the same connectivity needs

The policy challenge of identifying end-users' needs was clearly shown through the government's Rural Broadband Initiative. The original 2010 initiative, with a target peak speed of 5Mbps, was drastically out of step with urban connectivity by the time the programme finished in 2016. While it pursued 5Mbps speeds for rural users, at the same time fibre capable of 1Gbps speeds (200 times faster) was being deployed to urban Aotearoa.[7] A decade later, urban networks now have the capacity for an 8Gbps 'Hyperfibre' product, which required no additional government funding. In contrast, rural programmes are still focused on basic connectivity of around 20Mbps (0.25% of the fastest urban speed) and are likely to require ongoing subsidies for capacity upgrades.

AVAILABILITY OF FIBRE

"Fibre should be available to all NZ regardless of location."

Stakeholder feedback

2 Where Are The Audiences 2021? NZ on Air, https://www.nzonair.govt.nz/research/where-are-audiences-2021/
3 MBNZ Autumn 2020 Report
4 https://www.nzherald.co.nz/nz/back-to-the-office-the-great-hybrid-return-to-work/R6V3XS2WTSWZT5NUME2JC0U4QE/
5 New Zealand's Internet Insights 2022, InternetNZ, https://internetnz.nz/assets/Uploads/Internet-insights-2022.pdf, December 2022.
6 "Stop treating the internet as a luxury it's an essential utility", Andrew Cushen, NZ Herald, https://www.nzherald.co.nz/nz/andrew-cushen-stop-treating-the-internet-as-a-luxury-its-an-essential-utility/NEXGA5KSPFHC5GR672XMXO3YKQ/, 29 July 2022.
7 Chorus' Network Infrastructure Project Agreement required that the network was designed and built to support future growth via an upgrade path to speeds at least 1Gbps.

The line drawn between those within a UFB area and those outside does not reflect the needs of the people on either side of it or how valuable fibre connectivity is to them – it simply reflects the upfront cost to deploy the technology and relative priority calls made by policymakers and governments of the day. Fourteen years ago, the government determined that the majority of the country needed access to high-speed and high-capacity connectivity via the UFB programme. The remaining quarter was not excluded due to a lack of need, but simply because funding at the time did not permit the programme to go further.

As funding became available extensions were made, such as UFB2 and UFB2+ programmes which took fibre coverage to 87% of Aotearoa. Crown Infrastructure Partners (CIP) noted in their most recent request for proposals for the Remote Users Scheme that "preference will be given to technologies that maximise broadband performance and minimise the ongoing costs such as capacity upgrades as broadband demand grows." Their evaluation criteria below shows their preference rankings for different access network solutions, with fibre ranked first, despite the fact the scheme is aimed at remote users.[8]

AVAILABILITY OF FIBRE

"It should be readily available to all areas of New Zealand & all families should be able to access it."

Stakeholder feedback

TABLE 15.2: CIP EVALUATION CRITERIA (SOURCED FROM CIP REQUEST FOR PROPOSALS: REMOTE USERS SCHEME 2023)

EVALUATION CRITERA	CONSIDERATIONS
Government funding (price) criterion	The number of Eligible End Users (EEUs) served and the amount of Government Funding requested per EEU, assessed on a Respondent Area basis
Access network solution	Listed in order of preference: (a) Uncapped UFB (b) Uncapped hybrid (c) Uncapped VDSL (d) Uncapped Wireless Broadband (e) Capped Wireless Broadband

The government's 2022 rural strategy paper 'Lifting Connectivity in Aotearoa' highlighted the growth in urban-fringe areas, and noted that the original footprint for UFB was set a number of years ago and population growth has occurred in and around our towns and cities since that time.[9] It is largely these populations that we are intending to cover as part of our PQP2 network expansion proposal.

8 Request for Proposals: Remote Users Scheme 2023, Crown Infrastructure Partners, April 2023.
9 Lifting Connectivity in Aotearoa, MBIE, December 2022.

15.2.4 The current state of rural connectivity is not meeting end-users' current or future needs

In comparison to their urban counterparts who have access to the UFB network, rural end-users experience inferior speeds, often pay higher prices and can experience congested networks.

Rural connectivity is a patchwork of providers, networks, pricing, and plans available across the country. This results in local monopolies, vertical integration subsidised by government grant funding, and a lack of cohesive policy and regulatory frameworks aimed at delivering high-quality solutions to end-users.

Higher deployment costs to rural end-users mean they are often limited to slower technologies – copper, fixed wireless, and satellite – which provide significantly less capacity than their urban counterparts. In rural areas, not covered by the UFB network, wholesale separation and price controls only apply to the copper network, which has drastically declined in popularity in recent years.[10]

A 2022 Federated Farmers survey provides a useful snapshot of how end-users in our rural communities experience connectivity. The survey found that more than half of the nearly 1,200 farmers who responded to the survey reported internet download speeds at or less than what could be considered a bare minimum (20Mbps).[11] The survey also highlighted the constraints within the current networks – with an increase in farmers reporting that the quality and reliability of their internet connections had deteriorated as local network infrastructure had become over-subscribed, either by increased numbers of end-users or increased demand by those end-users.

This point was also picked up in the government's Lifting Connectivity in Aotearoa strategy which set out the need to continue to improve connectivity:[12]

> *"People in densely populated rural areas, including land surrounding our towns and cities, are experiencing increasing levels of network congestion. Network congestion occurs when the capacity of a network is insufficient to handle the total data transmission demand without degrading the performance to customers.*
>
> *For wireless internet and mobile phone users, congestion can be a reduction in download and upload speeds or complete loss of service due to a lack of capacity available in that area.*
>
> *It is estimated this issue could be affecting around five per cent of New Zealand's population.*
>
> *Typically, the affected areas do not have fibre to the premise, and the wireless coverage that may be available is being outpaced by data demands. This stems from increased demand on the network, for example, larger amounts of internet use per household or business, and additional users moving into the area."*

In our view this illustrates not only the extent to which the capacity available on rural networks is well below what end-users need currently, but also the looming challenge for these technologies to meet future needs.

AVAILABILITY OF FIBRE

"Would love to see it rolled out to smaller communities. It has been affecting our decision of where to move as need it for work but would rather move to a smaller community or more rural."

Stakeholder feedback

AVAILABILITY OF FIBRE

"There has to be a longer-term focus on filling the gaps in coverage in regards to fibre broadband and getting rural NZ off copper and onto quicker more reliable broadband that's unlimited and affordable."

Stakeholder feedback

10 Annual Telecommunications Monitoring Report 2021, Commerce Commission, 17 March 2022, p5.
11 Federated Farmers NZ, *Too many farmers still stuck in connectivity 'slow lane'*, https://fedfarm.org.nz/FFPublic/FFPublic/Media-Releases/2022/Too-many-famers-still-stuck-in-connectivity-slow-lane.aspx
12 *Lifting Connectivity in Aotearoa (LCIA),* Ministry of Business, Innovation, and Employment, December 2022, p21.

In contrast to the capacity challenges and artificial constraints like data caps that feature in the rural wireless market, a quarter of Chorus' fibre end-users have chosen the 1Gbps product. 15% of all fibre end-users currently use more than 1 terabyte of data a month, and the average end-user is now using over half a terabyte a month.

In comparison, the recently released average rural 4G fixed wireless access (FWA) speed at peak time is currently only 25Mbps, with this new information illustrating the poorer performance relative to urban 4G FWA services. In addition to the lower speeds, plans usually come with data caps that would not meet the average usage in a fibre area – and at substantially higher prices.[13]

COVID-19 lockdowns in particular illustrated some of the challenges for FWA networks to meet demand as performance of FWA services dropped 20-25% due to widespread congestion.[14] The government's response to this was to provide an additional $60m of funding for the Rural Capacity Upgrade. As usage continues to increase, it is challenging to see how these services can satisfy end-user needs without ongoing significant further investment.

AVAILABILITY OF FIBRE

"Equity of access is vital for all communities."

Stakeholder feedback

15.2.5 Improving rural connectivity will provide significant economic value

In 2022 we commissioned the New Zealand Institute of Economic Research (NZIER) to estimate the economic benefit of having access to unconstrained connectivity in rural Aotearoa. They found:[15]

> *"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 estimates suggest that the total benefit is in the order of $16.5 billion over ten years."*

The economic and productivity benefits of improved connectivity were also cited by the government in their Lifting Connectivity in Aotearoa strategy: [16]

> *"Various local and international studies have demonstrated greater coverage and access to higher speed broadband leads to economic growth, and ultimately growth in a country's GDP. Organisations such as the World Bank have identified that access to internet-based technologies can help workers carry out tasks more efficiently and to a higher standard, while also providing a greater ability to gain exposure to new markets, find new customers, and access a greater volume and quality of information."*

ECONOMIC BENEFIT OF UNCONSTRAINED CONNECTIVITY IN RURAL AOTEAROA

With incremental benefits for rural households, relative to the status quo, time savings for rural businesses and improved productivity, estimated total benefit over 10 years is estimated to be

$16.5bn

13 Measuring Broadband New Zealand, Spring Report, May 2023, p7., Digital "Rural Fixed Wireless costs three times urban price" and for example One NZ rural plans as accessed on 17 April 2023.
14 Measuring Broadband New Zealand, Autumn Report, May 2020, p4.
15 NZIER. 2022. Rural connectivity: Economic benefits of closing the rural digital divide. A report for Chorus Limited. The total benefit of $16.5 billion represents a present value assuming a discount rate of 5%.
16 LCIA, p33.

This document then specifically recognises the importance of fibre in delivering resilient and high-speed connectivity and sets principles for future action and initiatives including taking a long-term, enduring approach to connectivity with the ability to meet future growth in demand for increased speed and capability. The government also stated that it will support or encourage the extension of fibre, including backhaul, to improve network performance and resilience in areas.[17]

As part of the statement of intent, the government set a goal of Aotearoa being in the top 20% of nations in respect to international connectivity measures.[18] Given the increasing international investment in expanding fibre, we believe Aotearoa will need to continue to invest in growing the fibre footprint in order to meet this target.

The New Zealand Productivity Commission's recent working paper 'Does high-speed internet boost exporting?' found that firms that shifted to fibre broadband in the early years of the UFB rollout in Aotearoa were subsequently more likely than otherwise similar firms to start exporting. It suggested that investments in high-speed broadband such as the UFB initiative in Aotearoa help to set conditions under which firms can access a wider international market.[19]

15.2.6 Improving rural connectivity is in line with international approaches

Internationally, we see growing acceptance of the need for widescale fibre connectivity, including in countries with similar geography to Aotearoa like Japan, which announced in 2022 a target of 99.9% of households to be covered with fibre within six years.[20] Similarly in Europe, the expectation is that countries now need to work towards near-universal gigabit connectivity via the European Commission's 2030 Digital Compass:[21]

> *"Many European countries are now getting at a point in their Fibre to the Premises (FTTP) deployment where the only portions of the territory that remain uncovered are deep rural areas. In initial plans laid out a decade ago, these areas were considered very hard to reach and policy instruments in place aimed at delivering some broadband solution there, but not necessarily FTTP.*
>
> *Now that rural is the last hurdle, policy goals have shifted. Countries like Spain, France or the UK are openly stating that their goal is to have fibre deployed to every premise in the country, and while they admit that it might not be achievable for a very small portion of households for topological reasons (small islands, mountain peaks...) the policy instruments are now in place to deliver this. When 80% or more of the population has access to gigabit broadband capacities at affordable prices, it becomes very hard to argue that rural citizens should be treated as second-class with worse and more expensive broadband."*

There are undoubtably challenges in extending a fixed network in a country with the geography and comparatively sparse population of Aotearoa. However, as the nearly 100% coverage of our copper network illustrates, these challenges are not insurmountable.

AVAILABILITY OF FIBRE

Lack of fibre "stops many from accessing basic needs, such as education and health care. Cost is also a major inhibitor for entry in many places, this continues the cycle of deprivation, and inequality or equity to those services that are going digital, whether central of local government, as well as access to social services and cultural connectivity."

Stakeholder feedback

AVAILABILITY OF FIBRE

"Equity is key. Chorus should make every effort to expand its network into rural areas to facilitate remote working and lower social economic areas to ensure equal access to information/education."

Stakeholder feedback

17 LCIA, p41.
18 LCIA, p37.
19 Lynda Sanderson, Garrick Wright-McNaughton and Naomitsu Yashiro (2022) *Does high- speed internet boost exporting?*, New Zealand Productivity Commission. Working paper 2022/02. Available from www.productivity.govt.nz/research
20 https://english.kyodonews.net/news/2022/06/e450761baecb-japan-to-cover-999-of-households-by-fiber-optic-networks-in-2028.html?phrase=china%20&words=
21 Benoit Felton & Karim Bensassi-Nour, Plum Consulting, Approaches to rural broadband in Europe, 2022.

15.2.7 Improving rural connectivity is in line with government policy

The government recently acknowledged the importance and need for improved connectivity:[22]

> *"The importance of connectivity in our day-to-day lives means we need to keep focusing on improving broadband and mobile coverage, building on the success of the work to date."*

In 2016, when Cabinet considered the new regulatory framework for telecommunications post 2020, it clearly anticipated that the new model would enable what it viewed as necessary additional investment in expansion:[23]

> *"In October 2015, the Government announced a bold new connectivity target for areas outside the current UFB footprint. Under this target virtually all New Zealanders, regardless of where they live or work, will be able to access broadband at peak speeds of at least 50 Mbps. To achieve these goals, it is important that the regulatory regime is predictable, stable,* ***and that network owners have the right incentives to invest and expand their networks****. A regulatory framework that supports efficient private sector investment should decrease dependence on government intervention to drive network upgrades and meet the growing needs of consumers."*

Later in the paper they went on to note that the move to a fibre-only building blocks model:[24]

> *"will provide an incentive for Chorus to expand its fibre footprint (subject to Commission efficiency tests) so that such investment can be included in its fibre RAB, and so that its pre-existing copper services in areas that remain subject to a price cap can be replaced with fibre over time."*

AVAILABILITY OF FIBRE

"As it is just as important as having power with the current global situation, it would be ideal having access to this service in smaller towns/rural areas and having the cost cheaper for those who can't afford but require the connection."

Stakeholder feedback

15.3 Determining fibre build costs – our proposed investment

15.3.1 Our proposed network extension outside the UFB footprint

While we believe that all rural New Zealanders need the capacity and speed that fibre connectivity brings, we do not have the access to the capital to deliver this ambition alone, and we also have competing investment priorities across our network.

We are seeking funding in PQP2 for our first phase of the Fibre Frontier build program, which we forecast to be $13m which will see an additional 6,379 New Zealanders getting access to fibre. This is part of an investment programme of $37 million that begins in PQP1 and will bring fibre to a total of 10,008 additional premises.

While we have ambitions to take fibre further, at this time we are unable to commit to a build programme beyond the first phase of the build. Any spend beyond June 2025 of PQP2 will be conditional upon material shifts in regulatory and policy settings and market outcomes and subject to business casing once these are known. We would present this investment as one or more individual capex proposals.

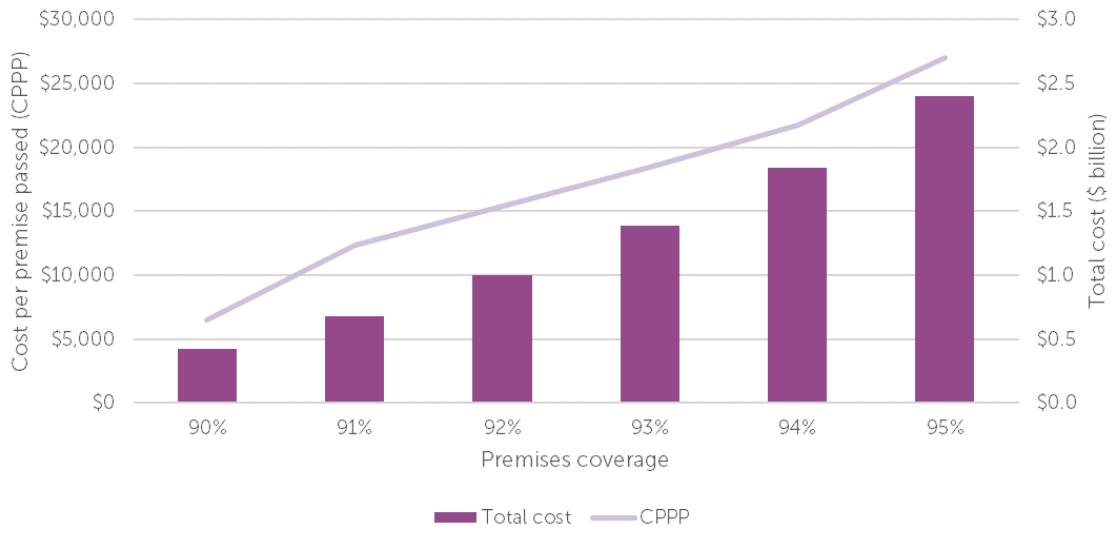
22 Lifting Connectivity in New Zealand, MBIE, December 2022.
23 Review of the Telecommunications Act 2001: Final Policy Decisions for Fixed Line Communications Services, Cabinet Economic Growth and Infrastructure Committee, 7 December 2016 and Cabinet Minute, 14 December 2016.
24 Ibid.

15.3.2 Initial scoping exercise – taking fibre further

We considered proposing extending the network further to a greater proportion of New Zealanders. However, due to the greater distances between properties outside of urban areas, further extending the fibre network to more rural parts of Aotearoa will understandably come at a higher cost per premises passed.

Our initial desktop scoping of a fibre rollout to 95% of the population (an additional 8% of premises) estimates a cost of between $2-2.5 billion as shown in Figure 15.1 below. These costs would increase significantly if the rollout extended past 95-96%, diminishing associated net benefits to New Zealanders.

FIGURE 15.1: INDICATIVE COSTS FOR FIBRE EXTENSION



15.3.3 Approach to costing Network Extension

Throughout the UFB build process we demonstrated our ability to deliver work programmes on time and on budget. We successfully delivered our portion of the government-funded UFB programme and have installed fibre to over 1.2 million premises.

We typically use price (P) x quantity (Q) models to forecast capital expenditure. However, when rolling out fibre into more remote communities, a more bottom-up planning approach is required as every community is slightly different.

We have access to significant amounts of network data and costings information and have leveraged this in our approach to estimating the costs of rolling the network out further. While there is a degree of uncertainty in costing any project like this, much of this programme involves deploying fibre in urban fringe areas and small rural communities similar to those where we have just completed the UFB2+ programme, giving us a solid baseline of data from which we can estimate costings and to determine potential future build areas.

We entered into an agreement with one of our Service Partners in December 2023 to complete the first phase of the Fibre Frontier network extension activity covering the period February 2024 to June 2025. Despite having had cost modelling completed, the actual costs are the best estimates for the potential service company costs for this piece of communal build.

DELIVERY TRACK RECORD

We delivered the UFB programme on time and on time.

15.3.4 Costings to roll out fibre

The table below breaks down the key costings of the Fibre Frontier programme. We have shown the total costs of build ($37m), the PQP2 commissioned assets of $24m (assets that are expected to be commissioned in PQP2) and the proposed PQP2 allowance of $13m, being the spend that occurs in the PQP2 period.:

The table below breaks down the key costings of the Fibre Frontier programme. We have shown the total costs of build ($37m), the PQP2 commissioned assets of $24m (assets that are expected to be commissioned in PQP2) and the proposed PQP2 allowance of $13m, being thespend that occurs in the PQP2 period:

TABLE 15.3: KEY COSTING INPUTS

CATEGORY	PHASE 1 TOTAL SPEND	PQP2 COMMISSIONED ASSETS	PQP2 PROPOSED ALLOWANCE	NOTES
Service company costs	**CCI [ ]**	**CCI [ ]**	**[ ]**	This incorporates actual service company contracted rates for the proposed build.
Materials and Chorus labour	**CCI [ ]**	**CCI [ ]**	**CCI [ ]**	This includes materials, internal Chorus project costs and contingency.
Total spend	**CCI [ ]**	**CCI [ ]**	**CCI [ ]**	

15.3.5 Our programme must be flexible

As part of this network build, we will need to be flexible. The government-coordinated 'candidate area' approach undertaken as part of the UFB programmes no longer exists, so our plans may change if we discover other fibre companies have already built communal fibre networks in an area (noting that any fibre build beyond government-funded programmes is challenging to identify in advance).[25]

As experienced in our UFB build, we may also run into local build challenges, such as local council issues or communities requiring additional consultation and engagement. This will also require a degree of flexibility, and we will look to substitute premises included in the programme as this need arises in order to still see approximately 6,400 premises covered by fibre over PQP2. We will take these from the existing high-level planning we have completed out to 95% of Aotearoa.

15.3.6 Sequencing and deliverability of the programme

Below we summarise our considerations when selecting areas to build. Cost is a key element, but ensuring a strong level of uptake is also critical to deliver economic return on our investment.

25 Overbuilding another fibre company fibre network is not economic, so we would look to reprioritise our fibre build into other areas.

- Cost of delivery – we will focus the programme on delivering the most cost-effective build.
- Levels of community interest – as outlined at the beginning of this chapter there is strong demand for fibre from communities outside the existing fibre footprint and we receive frequent approaches from community leaders seeking fibre extension. Strong local interest should translate into good levels of fibre uptake which will deliver high value to both Chorus and the local communities where we are deploying fibre. Engaged communities should also mean fewer build challenges in an area, meaning we can build with more confidence and meet our timing and cost estimates.
- Likely areas of high population growth – we continue to look to optimise how and where we roll out our core fibre network. If we know an area is likely to experience high population growth in the coming years, building network there will enable a larger number of end-users to benefit.
- Market insights of an area – we performed a desktop review of the build areas that allowed us to identify which areas we would expect to see higher levels of fibre uptake. This included the current broadband uptake we see in an area, along with marketing 'mosaic' profiles which provide insights as to the demographic and property types in an area. Targeting our efforts in areas similar to existing UFB areas where we see high fibre uptake should mean good uptake in new build areas.

TAKE UP

The economic benefit of fibre comes from end-users taking and using the fibre service – not just having it pass their property. We therefore plan to roll-out to areas with expected high levels of uptake first.

The economic benefit of fibre comes from end-users taking and using a fibre service – not just having it pass their property. This analysis of likely uptake is a relevant consideration in determining our priority areas for deployment.

15.4 Chorus Governance process around build extension

Given the nature and potential scale of the network extension, Chorus has applied additional levels of governance to the programme.

Chorus has a cross-functional team with a responsibility to develop and implement our overall strategy for rural connectivity, which includes the work to support fibre extension. This model allows us to leverage expertise from across the business from previous fibre build programmes, as well as consider the extension programme in an end-to-end way in terms of how we will deliver service to end-users.

This programme of work is governed by two layers of challenge process:

- Firstly, a cross functional group of senior managers provide input into and challenge the programme and raise risks and opportunities for the team to manage.
- Secondly, the work programme is overseen by an Executive Steering Group which meets approximately monthly. This currently consists of the Chief Executive, Chief Corporate Officer, Chief Customer Officer, General Manager Customer and Network Operations and Chief Technology Officer.

The above governance bodies have provided input into and challenged the process of building the business case for network extension, along with the area selection process and subsequent refinement.

In addition, our network extension proposal has been subject to the specific governance processes put in place for the PQP2 proposal development and as described in our Governance report in Our Fibre Plans.

15.5 End-users' willingness to pay for Fibre Frontier network extension

The regulatory regime incentivises Chorus to extend the fibre footprint, as it provides the potential to recover the costs from end-users. This of course relies on end-users being both supportive of and willing to pay for the network extension.

End-users' willingness to pay can be thought about from several different angles. We consider three options of end-user willingness to pay below:

- Option 1: end-user pays upfront – the willingness of potential new rural end-users to pay all of, or a contribution towards, their own installation cost at the outset
- Option 2: end-user pays over time – the willingness for the potential new rural end-users to take a fibre connection, and the wholesale portion of this rental cost over time recovering the installation cost and ongoing maintenance costs
- Option 3: cost recovery across existing fibre end-users – the willingness of existing fibre end-users to pay a higher monthly cost to the extent to which costs cannot be met from either option 1 or 2.

WILLINGNESS TO PAY

Our ability to recover costs of extending the network depends on end-users being supportive and willing to pay.

We have explored these options through two key pieces of research we commissioned from Kantar over the past six months.

Kantar's initial research focused on end-users who reside outside the current fibre footprint, i.e. our potential 'rural' end-users.[26] This research had some initial pre-qualification questions where the end-users were required to confirm they resided in areas where fibre is not currently available to them, their likely uptake of fibre, and their willingness to pay installation costs.

Subsequently, as part of our broader consultation on discretionary capex for PQP2, we commissioned Kantar to perform a piece of research asking a wider range of stakeholders about their thoughts on Chorus' investment plans for PQP2, which included the proposed Fibre Frontier investment, the price implications, and options to consider both lower and higher investment cases.[27]

We discuss each of these options of end-user willingness to pay in turn below.

WILLINGNESS TO PAY

"We might even collectively want to pay for a fibre network ourselves so we can finally get off the copper lines."

Stakeholder feedback

15.5.1 End-user pays upfront (Option 1)

NZIER's research demonstrates that the benefit to Aotearoa of improving rural connectivity should significantly outweigh the cost. However, this benefit is to the end-users and rural economy, rather than the builders of the networks.

Given these substantial private benefits, we believe that there may be opportunities for end-user contributions towards their connections. However, end-users have been conditioned to expect connection to telecommunications networks to be free, even where there is a clear value proposition for this connection. For example, Starlink reduced the pricing for its hardware for rural customers from RRP $1040 to $199 in April 2023.[28]

26 Kantar, Rural Opportunities Research 2023.
27 Kantar, Understanding the investment preference of Chorus' key stakeholders, 2023
28 Starlink offers huge hardware discount to rural users (farmersweekly.co.nz).

The Kantar research commissioned by Chorus also found minimal appetite for paying for fibre installations. Whilst there was very strong intention to take up fibre (84%), when respondents were asked about their willingness to contribute towards an installation the response was less positive. The lowest price point asked was if an end-user would contribute $500 towards an install, and at this level only **CCI [ ]** would contribute. This fell to **CCI [ ]** at $1,000 contribution. Many of the comments received as part of the research also referenced the fairness of rural end-users having to pay for installs when their urban counterparts had received fibre for free.

From a build optimisation perspective, agreeing to build individual connections to end-users on request dependent on which end-user is willing to pay is highly inefficient. The economics of fibre deployment support building scale areas, i.e. communal infrastructure for whole streets and communities, not single one-off connections over time.

While shifting this perception is possible, the required engagement and communications would be costly. It could also potentially result in a less efficient model requiring collecting payments and aggregating orders over time until a critical mass of end-users willing to pay was reached (if ever) in a particular area, at which point the network build could be scheduled. We do not believe this represents an efficient way of building fibre network extension. Therefore, we are proposing our expansion-related expenditure should be recovered entirely through monthly service pricing rather than a combination of capital contribution and service pricing. We discuss monthly service pricing further under Option 2 below.

FUND VIA MAR

We propose our expansion-related expenditure should be entirely funded via the MAR, with associated capex added to the RAB.

15.5.2 End-user pays over time (Option 2)

As has been outlined in this chapter, there is strong demand for fibre from end-users and strong evidence about the benefits of high-speed fibre in terms of user experience and potential economic benefit. In particular, we highlight the number of end-users that would be willing to take a fibre service if available.[29] The Kantar research found that 84% of those surveyed were likely to take up fibre once it was available in their area. For those respondents who currently had a Fixed Wireless service, 84% of these surveyed were also likely to take a fibre service. 76% of those surveyed knew about fibre and over half of them had looked into getting fibre installed in their home, noting that both of these measures were higher in urban adjacent areas where we are proposing to build, versus remote rural communities.

This research helped us build the workably competitive market test outlined in detail below. In the modelling, we assumed a more modest 70% uptake rate, which is aligned to our business plan assumptions.

The output of the workably competitive market test showed that the breakeven wholesale price for the proposed PQP2 investment at a 70% uptake would be **CCI [ ]** per connection per month, which is lower than the wholesale price for fibre that Chorus would charge under the currently proposed price path.

WILLINGNESS TO PAY

"We still have pockets of communities that have no fibre & prepared to financially contribute to make things happen."

Stakeholder feedback

29 Kantar, Rural Opportunities Research 2023.

This base case modelling illustrates that end-users that take up fibre via the proposed extension would cover the installation and ongoing costs of their own fibre connection over the life of the asset and not require any cross-subsidisation from other users.

Another factor to consider in terms of likely Fibre Frontier uptake is the availability of alternative equivalent services for these end-users. Low-earth orbit satellites like Starlink (the closest competitor in terms of download speed and lack of constraining data caps) currently have a monthly price nearly twice that of a standard fibre product, with rural wireless products being similarly expensive. This creates a strong incentive for end-users to choose fibre where it is available.

The combination of these factors illustrates the willingness of directly impacted end-users to pay, provided the costs are recovered via the monthly price over the life of the asset rather than requiring full upfront cost recovery as per Option 1.

EQUITY

"Make if more affordable to all New Zealanders no matter where they live."

Stakeholder feedback

15.5.3 Cost recovery across existing fibre end-users (Option 3)

The economic modelling shows that existing customers would be able to fully fund the proposed network extension and not require cross-subsidisation. However, when considering future extension activity, it may be necessary to consider other customers' willingness to contribute to network extension.

If the incremental cost of the proposed network extension investment is not entirely covered by the new end-user base, Chorus' existing end-user base would have to face higher prices over time than they would have if the Fibre Frontier investment did not occur.

We explicitly tested this proposition as part of the second piece of commissioned Kantar research to engage with our customers and end-users to understand their investment preferences. Kantar sought views from a range of stakeholders about Chorus' investment plans for PQP2, focused on areas of 'discretionary capex' where we have options for the level of investment in PQP2. Kantar held workshops and structured interviews to understand the preferences of our end-users and stakeholders, as well as the underlying reasons and drivers behind those preferences.

For Fibre Frontier, the research looked to "test the degree of proactivity that should be undertaken regarding network extension into urban fringe areas," – i.e. our existing end-users' willingness to accept higher costs for rural fibre rollout. The research covered a wide range of consumer types, organisations and groups to ensure a representative audience. Participants were presented with a range of investment options for Chorus over the coming price-quality (PQ) period, with descriptions of the proposed plans, what benefits they would deliver and the required investment (see Table 15.4 below). They were also told how much extra it would cost them each month, and over what time horizon they would have to pay more, in order to fund the investment.[30] We note all of these investment options represented a higher degree of investment than we are putting forward in this proposal.

EQUITY

"Not everybody can afford the same service. But everybody should have access to the same service."

Stakeholder feedback

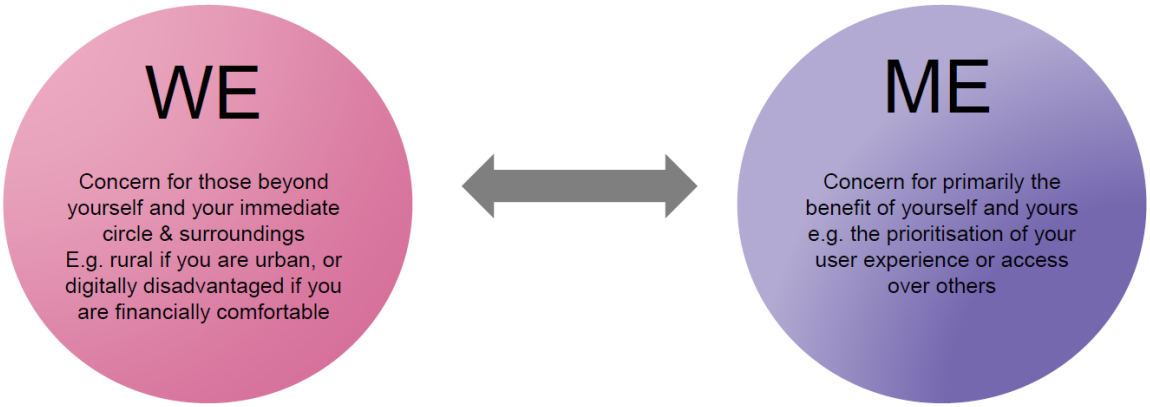
30 We have since undertaken more accurate modelling that indicates the additional cost per premises per month would be in the range of $1.30 - $2.00 (WACC dependent, see sensitivity analysis). We note these price impacts assume the entire Fibre Frontier investment is recovered from all end-users. In practice, the impact on the end-user's bill would be much lower (and possibly close to zero) as our analysis has confirmed – see the workably competitive market (WCM) test discussed in this document and the associated sensitivity analysis – that new end-users connecting to the extended network would most likely almost entirely pay for the investment. Only a potential under-recovery of our Fibre Frontier investment would have to be recovered from the entire end-user base.

TABLE 15.4: FIBRE FRONTIER INVESTMENT OPTIONS PRESENTED TO STAKEHOLDERS

OPTION	DESCRIPTION	REQUIRED $ INVESTMENT	LENGTH OF TIME OF ADDITIONAL COST	ADDITIONAL COST PER PREMISES PER MONTH
Decreased investment	Extend the fibre network to connect 88.8% of households in Aotearoa. More than 29,000 additional households and businesses in rural regions have the option to connect to fibre. Up to $1.2 billion in economic benefits to households and businesses	$117-157m	25 years	$0.67
Current plan	Extend the fibre network to connect 89.3% of households in Aotearoa. Over 41,000 additional households and businesses in rural regions have the option to connect to fibre. Up to $1.6 billion in economic benefits to households and businesses	$181-221m	25 years	$0.98
Increased investment	Extend the fibre network to connect 89.7% of households in Aotearoa. Additional 52,000 additional households and businesses in rural regions have the option to connect to fibre. Up to $2.08 billion in economic benefits to households and businesses	$258-298m	25 years	$1.35

Before going into detail on what the respondents thought of the proposed Fibre Frontier investment, Kantar provided us with some useful insights around New Zealanders, and their views on a tension point between collective and individual benefits:

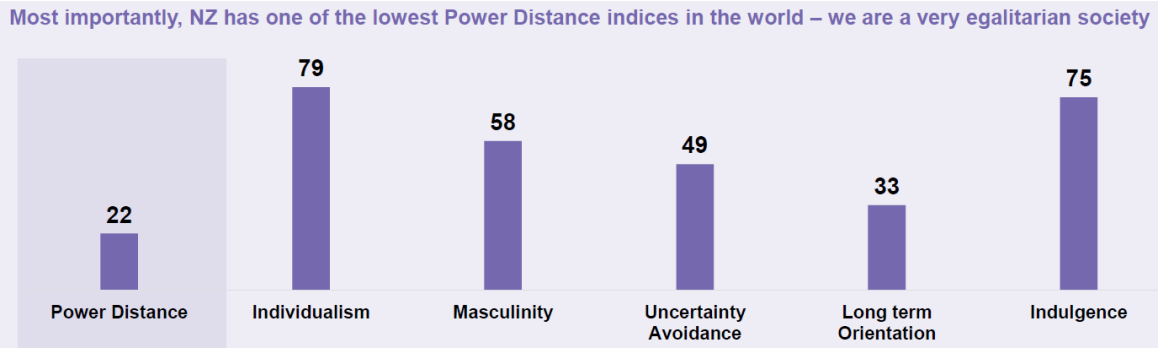
FIGURE 15.2: COLLECTIVE VS. INDIVIDUAL BENEFITS



Kantar outlined that "in global terms, NZ culture is strongly orientated towards the We." They also provided us with useful context and models outlining Hofstede's Power Distance dimension:

"Hofstede's Power Distance dimension deals with the fact that all individuals in societies are not equal - it expresses the attitude of the culture towards these inequalities amongst us. Power Distance is defined as the extent to which the less powerful members of institutions and organisations within a country expect and accept that power is distributed unequally."

FIGURE 15.3: HOFSTEDE'S POWER DISTANCE DIMENSION – NZ



"Cross-subsidisation is a classic We vs. Me example and NZ'ers appear very comfortable with equitable charging.

Cross subsidisation was not an issue across the project except for being mentioned as a possible topical concern by a survey respondent.

NZ'ers responses to pricing and how costs are allocated across groups and across time was all about pure affordability, with our shared responsibility to share the load barely requiring any conversation.

There is some refusal to pay relating to 'is it me or is it a business?' We also heard some concern from another survey respondent regarding some sensitivity between urban high rent retailers subsidising cheaper rural operators, but never does this tension appear between urban & rural consumers."

The Fibre Frontier investment was deemed by participants to "directly address fairness & equity and regional economic growth," and was deemed a high priority investment by the groups surveyed.

There were variations across some business stakeholder groups, but an increased priority for Fibre Frontier was a common theme. Consumer stakeholders did not vary much beyond the view that the Fibre Frontier investment was deemed a high priority investment.

"Rural communities are important to NZ we've got to look after them," and pricing subsidisation is viewed as fair.

Also, that the targeted population for this investment is urban fringe is universally seen as appropriate.

Although equality between urban and rural is important to NZ'ers, there is a limit to the cost/benefit reality – "87% is pretty good and there is some room to extend but we can't get to 100%, it's just not worth it. Starlink will be the best option for isolated areas."

Throughout our engagement processes, we note that Retail Service Provider (RSP) submitters were supportive, but did raise cost concerns and/or noted that the investment should only be funded through regulated revenue where there is an economic benefit. We also note RSPs leaned more towards a "me" versus "we" perspective and did raise some concerns around cross-subsidy risk for urban users.

The views presented through Kantar's results support the views presented in this chapter to date. We acknowledge that extending fibre beyond 90% is unlikely to be possible on a commercial basis for Chorus alone, but the level of support for the proposed build programme in PQP2 as outlined provides us with strong evidence that our existing end-user base would accept a degree of higher costs for rural fibre roll out.

Kantar's approach was designed to gather insight into why the different groups supported network extension and the concerns that were expressed relating to the proposed network extension.

On balance, "the weight of consumer/social preference was towards continuing the current investment strategy." We note that three groups preferred a decreased level of investment, with 10 groups preferring increasing investment and 18 groups preferring we invest as currently planned.

FAIRNESS

Stakeholder feedback deems the proposed Fibre Frontier investment to "directly address fairness and equity and regional economic growth."

Kantar research

OVERALL SUPPORT

Whilst a range of views was obtained from the various stakeholder research, on balance the weight of preference was to continue with our Fibre Frontier investment strategy.

TABLE 15.5: CONSUMER AND SOCIAL GROUPS BY INVESTMENT PREFERENCES[31]

DECREASED INVESTMENT	CURRENT PLANS	INCREASED INVESTMENT
Retail (industry association)	Māori	Council
Large RSP	Sustainable Business Sustainability (industry association)	University
Digital Business	Council (x3)	Farmers (industry association)
	Disabled People (representative body) (x2)	Industry Association
	NZ Homeowners (x2)	Digital Business
	Infrastructure (industry association)	Māori
	University	Small Business RSP
	Digital Business	Rural Consumers
	Small RSP	Infrastructure (industry association)
	Council	Digital Business
	Gamers (industry association)	
	Digital Equity (representative body)	
	Digital Business	

The research provides strong support of existing fibre end-users' willingness to pay higher prices to enable the proposed network extension. As part of the research, consumer representatives were able to clearly see the cost implications – despite this, not only did a significant proportion support the proposed base case, but a number of participants supported an increase to our Fibre Frontier investment, despite that coming at a higher cost.

15.6 Our view on the analytical framework for evaluating the proposal

Because the fibre regulatory regime is relatively new, there is no clear precedent for how the Commission should evaluate the merits of our fibre extension proposal.

The Fibre Input Methodologies require the Commission to evaluate proposed capex by:

- considering whether the proposed capex meets the capital expenditure objective
- considering whether the proposed capex reflects good telecommunications industry practice
- having regard to certain assessment factors.

The capital expenditure objective is met if "the expenditure reflects the efficient costs that a prudent fibre network operator would incur to deliver PQ FFLAS of appropriate quality, during the relevant regulatory period and over the longer term."

31 The options for decreasing or increasing investment relate to Chorus' current business plan levels (as outlined in Table 15.4), not to what we have spent in or proposed for PQP1. Groups have been anonymised for privacy purposes.

Applying these evaluation requirements is relatively straightforward when it comes to assessing the cost side of our proposed network extension, but less clear when it comes to assessing the benefits, and therefore whether costs should be approved. In other words, the input methodologies do not make the appropriate economic test clear.

This contrasts with the regulation of Transpower's grid enhancement and development investments, for which there is a well-established and relatively prescriptive economic test specified in an input methodology.

The lack of specificity in the Fibre Capex IM means the Commission must look to the Telecommunications Act when considering the appropriate economic test. Section 166(2) of the Act requires that the Commission make a decision that it considers "best gives, or is likely to best give, effect-

1. to the purpose of section 163; and
2. to the extent that the [Commission] considers it relevant, to the promotion of workable competition in telecommunications markets for the long-term benefit of end-users of telecommunications services."

INVESTMENT TEST

There is no precedent within the relatively new fibre regulatory regime for how the Commission should evaluate investments of this nature. Different methods can have very different outcomes for investment.

15.6.1 Incremental Revenue from Incremental Customers test is a high threshold to meet

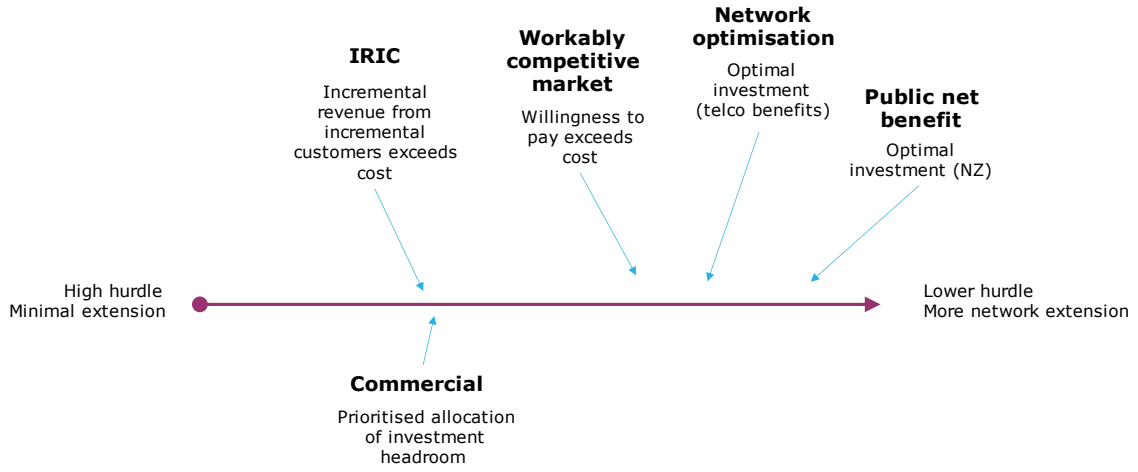
The Commission has previously formed a view on what this implied for the economic test it used to evaluate our proposal to invest in 2023 customer incentives. In that case, the Commission considered it was important to ensure that incentives did not amount to predatory pricing and decided investment would pass the economic test if:

> *"the expected incremental revenue exclusively from the incremental end-users/upgrades that the incentive payments drive outweigh the incremental costs, including the incentive expenditure itself."*[32]

The following diagram illustrates a range of options for an economic test for network extension, with the economic test that the Commission applied for incentives (incremental revenue from incremental customers, or IRIC) near one end of the spectrum.

32 Commerce Commission "Chorus' price-quality path from 1 January 2022 – Final decision: Reasons paper" (16 December 2021), paragraph C63

FIGURE 15.4: ECONOMIC TEST OPTIONS



When considering the test to apply for fibre extension, it is important to recognise that Chorus is required to set geographically consistent pricing (GCP). This means that:

- our pricing is constrained by the anchor price cap, which holds mass market plan prices to a level that may be below consumer willingness to pay
- incremental (rural) end-users will face the same price as existing urban customers, even though they may be willing to pay more than urban end-users if that were necessary to obtain coverage.

These factors mean an IRIC test presents a high hurdle to investment, which would only support minimal network extension – much less than would provide economic benefits in the market for telecommunications services. It also constrains fibre investment relative to competing technologies, which can (and typically do) charge higher prices and deliver lower quality[33] for rural end-users.

The IRIC test is also likely to constrain investment relative to our commercial appetite – possibly for PQP2 and almost certainly for the deeper investment we may propose beyond PQP2. Factors that influence our commercial appetite for investment include:

- our ability to recover costs across our customer base is constrained by the price cap on our anchor service and by competition from other technologies
- our ability under the regulatory settings to recover a consequential under-recovery of the Fibre Frontier investment from the existing end-user base over time. However, as discussed more in the Appendix to this chapter we consider this risk low and the impact, if any, would most likely be minimal
- the benefit arising from the avoided cost of supplying copper services
- our ability to finance new investment – we have limited debt headroom for new investment

GEOGRAPHICALLY CONSISTENT PRICING

Chorus is required to hold our mass market plan prices at the same level, regardless of where an end-user is located.

33 For example, other services typically have some combination of lower speeds, more congestion at busy times, higher latencies, data caps, susceptibility to interference or higher fault rates,

- prioritisation of our investment headroom – because we have limited investment headroom, we must prioritise investment opportunities. We use a range of considerations to allocate available headroom, including insight gained through consumer engagement and other market research.

15.6.2 A Public Net Benefit test is currently out of scope

At the other end of the spectrum is a full public net benefit (PNB) test. This is the type of test a government might apply to its investments (for example, in the UFB programme) and considers the full scope of economic benefits that may accrue to Aotearoa. A PNB test would compare competing investment options (including do nothing, and mixed-technology options) and compare the streams of benefits and costs in net present value terms using a social discount rate. This is the type of test that leads to other countries targeting near 100% fibre availability coverage.

We accept that the PNB option is currently out of scope, because the Commission must limit its analysis to the "long-term benefit of end-users in markets for fibre fixed line access services" (s162) and the "long-term benefit of end-users of telecommunications services" (s166(2)), rather than the benefits of the public as a whole. The Commerce Act applies a similar narrowing of scope when considering electricity lines services, which requires Transpower excluding wider public benefits such as the social cost of carbon emissions and the price of carbon credits.

Given the pervasiveness of telecommunications in modern life, it is not clear if there are economic benefits that we could quantify that would fall outside the scope that can be considered under the Act – but at least in principle we think full PNB is currently not an available economic test for network extension.

15.6.3 Other economic tests

We think this leaves the Commission with two main options, or variations on those options. They are:

- workably competitive market (WCM) test – this would consider whether end-user willingness to pay exceeds the cost of the investment, which is how a supplier in a workably competitive market without regulatory constraints on their investment and pricing would make their decisions. One option for the WCM test would be to modify the IRIC test by assuming Chorus can apply cost-reflective pricing. In other words, test what would happen if GCP did not apply
- telecommunications networks optimisation (TNO) test – the Commission's economic test for Transpower's grid enhancement and development investments resembles the test a network planner would apply to maximise benefits to end-users of electricity services. It only considers electricity sector costs and benefits, and it aims to select the optimal investment path across all available options – albeit in a context where actual generation and demand decisions are not regulated.

Either of these tests would set a higher bar, and likely deliver less network extension, than would be delivered by a (financially unconstrained) government.

Whether the WCM or TNO test would set the highest bar may be situation-specific and sensitive to assumptions, and we think both tests would likely deliver broadly similar outcomes. However, the tests have differing information requirements:

- The WCM test rests on assumptions about uptake rates and levels at differing price points. The test should consider the optimal price path and set

incremental revenue from incremental customers such that our financial capital would be maintained.

- The TNO test rests on assumptions about the economic benefits of fibre, and the comparative costs and benefits of competing technologies.

15.6.4 The tests we have applied

Due to the uncertainty above, we have not relied on a single analysis. Rather, we have:

- commissioned NZIER to estimate the benefit to end-users of telecommunications services of access to unconstrained connectivity. The NZIER report focusses on key quantifiable benefits, and considers a narrower subset of benefits than may be appropriate for a full public benefit test. It is also not technology-specific, meaning we need to adjust the figures if we wish to compare fibre to other high-performance technology options
- conducted commercial testing. This considers the benefit to Chorus of extending the fibre network, including through avoided copper costs. This analysis has been used to prioritise investment opportunities, and essentially frames Chorus' willingness to invest. This testing focuses on shareholder benefit, rather than taking a regulatory justification focus
- applied a WCM test. We think this is a stringent and conservative basis on which the Commission could evaluate our proposed expenditure. This testing determines the willingness to pay that would be needed to justify our proposed investment. It assumes that end-users in the new network areas could pay a different price than end-users in existing coverage areas. As a conservative approach, we have not considered avoided copper costs as part of this test – i.e. this is the test that any supplier without GCP constraints could apply. We also conducted market research that validates that actual willingness to pay is likely considerably higher than needed to obtain a positive outcome for the PQP2 tranche of investment
- trialled a TNO test, on the basis of a potential larger build plan. This provides a cross check on the WCM test. We have evaluated the net benefit to telecommunications users of our proposal and compared this with the net benefit of other technology options – i.e. we have tested whether extending fibre is the optimal solution. We think it would be valid to take avoided copper costs into account in this style of test but have not needed to do so to obtain a positive outcome for the PQP2 tranche of investment.

ECONOMIC TESTS

We have undertaken a range of different analysis to assess the reasonableness of the Fibre Frontier investment.

The basis for the tests is the PQP2 forecast expenditure for the Fibre Frontier programme, as well as the associated expected uptake rate. A slightly larger plan was considered for the TNO test.

15.7 Workably competitive market test

Our WCM test involves four steps:

1. calculate the incremental MAR from the proposed PQP2 investment
1. calculate the incremental MAR per connection if spread across the incremental connections (i.e. assuming no GCP)
2. estimate the required wholesale price at which the investment would breakeven.

3. test that the breakeven price is lower than consumer willingness to pay.

To complement the above, we also calculate the incremental MAR per connection if spread across all Chorus fibre connections (i.e. under real-world GCP conditions).

15.7.1 Incremental MAR from proposed PQP2 investment

We have used a revenue building-blocks approach, consistent with our regulatory settings, to determine the revenue we would need to cover our costs. Modelled costs include:

- Fibre Frontier network extension investment during PQP2
- incremental installation capex during and beyond PQP2, including customer incentive costs
- incremental opex such as reactive maintenance and electricity costs
- lifecycle capex such as ONT upgrades and fibre repair costs.

The incremental MAR calculation then assesses incremental return on and of capital, opex cost recovery and associated tax effects, RAB indexation and within-period MAR smoothing. The following table presents incremental MAR for the first two PQ periods.[34]

TABLE 15.6: INCREMENTAL MAR

PRICE-QUALITY PERIOD	PQP2				PQP3+				
Calendar year	2025	2026	2027	2028	2029	2030	2031	2032	2033
Incremental MAR ($m)	4.2	4.3	4.4	4.4	4.6	4.7	4.8	4.9	5.0

15.7.2 Incremental MAR per incremental connection

Our next step is to spread the incremental MAR across connections to the new network. This provides the hypothetical price we would need to set to recover our costs if those costs were recovered:

- from Fibre Frontier end-users only – i.e. with no cross-subsidy between Fibre Frontier end-users and our existing PQ-FFLAS end-users
- with the same annual profile as our (smoothed within periods) incremental MAR.

34 There will be an incremental MAR for the life of the investment, it will however decline as the new assets depreciate. Ignoring any impact changes in WACC over time can have on MAR, peak MAR is occurring at the end of PQP3 when the growth capex will have concluded and the associated asset value will peak.

TABLE 15.7: INCREMENTAL MAR PER CONNECTION

PRICE-QUALITY PERIOD	PQP2				PQP3+				
Calendar year	2025	2026	2027	2028	2029	2030	2031	2032	2033
Incremental MAR per connection ($ per month)	114	68	57	53	55	56	57	59	60

The monthly MAR is high compared to current wholesale price during the early years of the investment. This reflects the:

- lag between extending the network and gaining end-users – we have assumed a end-user uptake rate at about the same level observed for the UFB network, as discussed below
- MAR profile – this front-loads cost recovery with smoothing only applying within PQ periods.

As the investment depreciates, the monthly MAR will drop and eventually fall behind the wholesale price. We note, whilst they have a different profile over time, the break-even wholesale price discussed below and the monthly MAR are neutral in present value terms over the life of the investment (provided using the same weighted average cost of capital (WACC) estimates).

15.7.3 Breakeven wholesale price

Next, we take a long-term view of the wholesale price we would need to achieve in the Fibre Frontier areas to recover the incremental MAR over the life of the investment. This analysis:

- assumes we set a Fibre Frontier wholesale price in 2025 that increases with inflation each year (i.e. is held flat in real terms)
- compares the present value of revenue to the present value of incremental costs, with our regulatory rate of return as the discount rate
- seeks a breakeven wholesale price that maintains our financial capital.

Applying this analysis, we found a breakeven wholesale price for 2024 would be **CCI [ ]** per connection per month. This compares to our estimated average revenue per user (ARPU) for 2024 of **CCI [ ]**.

15.7.4 Willingness to pay

From the above, our proposed Fibre Frontier investment would have a breakeven wholesale price that is lower than our planned ARPU meaning that the new customers would be fully funding the proposed investment and not require any cross-subsidisation from existing users.

Network extension beyond proposed PQP2 may need us to consider if end-users in Fibre Frontier areas (i.e. rural users) would, given the choice, be willing to pay more per month for fibre connectivity than end-users in UFB areas (i.e. urban users).

If this were true, then it would be rational for a supplier in a workably competitive market to invest in network extension beyond the proposed PQP2 tranche.

This analysis includes the following assumptions:

- We assume that the difference in wholesale price between rural and urban end-users is passed through to retail prices. In practice, retail service providers may:
    - cross-subsidise across their base, creating a lower price difference between rural and urban end-users. Retailers would do this if they found the benefits of a uniform offering outweigh the benefits of cost-reflective pricing. We note that retailers currently offer higher rural prices for FWA services, indicating cost-reflective pass-through is likely
    - factor other input cost differences into their retail pricing, creating a higher price difference between urban and rural end-users. While backhaul costs may be slightly higher for rural end-users, we think it is reasonable to assume input costs otherwise don't vary significantly with geography.
- We assume the uptake rate will be at about the level observed in UFB regions. This seems a reasonable assumption if the price is comfortably below willingness to pay and given that we have assumed ongoing investment in customer incentives. Also, the broadband market has matured, and most end-users will be moving to fibre from higher-priced options with lower performance.
- Uptake rates could be lower if retailers took the opportunity to price up to rural willingness to pay, but we assume retail competition is vigorous enough to prevent this outcome enduring.
- Our analysis compares average prices across a portfolio of residential and business products at differing pricing levels. It is not necessary for this analysis to predict how pricing relativities between products would evolve, but we expect preferences amongst Fibre Frontier users would be similar to our existing base (i.e. many rural end-users would prefer our mainstream plan, while others would prefer our starter or premium plans).

Our assessment is that Fibre Frontier end-users would be prepared to pay a premium if necessary to satisfy a WCM test which showed a need for them to do so. Supporting evidence for this judgement is that:

- research conducted by Kantar[35] found that **CCI**
  [
  ]
- copper connections in rural areas have fallen below 50% of the market.[36] Copper is priced comparably to fibre at a wholesale input level, but is priced higher in the retail market. Both FWA and satellite options used by these end-users are priced at a higher point, implying that end-users are prepared to pay a higher price for their services

35 Kantar, Rural Opportunities Research 2023.
36 Commerce Commission, 2022 Annual Monitoring report

- a relatively low proportion of end-users within the PQP2 Fibre Frontier footprint would have access to 5G FWA as an alternative to fibre in the coming years as any rollout will focus on more urban areas first
- the remaining end-users within the PQP2 Fibre Frontier footprint would likely have access to urban 4G FWA as an alternative, but this is not likely to meet their future needs. We expect these users would be more willing to pay a premium for an uncapped fibre service.

15.7.5 Cost impact with GCP

For completeness, we have also tested the incremental MAR per connection in the real-world conditions where GCP does apply.

TABLE 15.8: INCREMENTAL MAR PER CONNECTION WITH GCP

PRICE-QUALITY PERIOD	PQP2				PQP3+				
Calendar year	2025	2026	2027	2028	2029	2030	2031	2032	2033
Incremental MAR per connection ($ per month)	0.31	0.31	0.31	0.31	0.32	0.32	0.32	0.33	0.33

This modelling is more consistent with how we have described pricing impacts to participants in our consumer panels. For the panels we used a more simplified calculation.

In practice, the pricing impact will not be as modelled above because these price impacts assume the entire Fibre Frontier investment is recovered from all end-users. In practice, there would most likely be no bill impact. Our analysis strongly indicates– see the sensitivity analysis below and in the Appendix to this chapter – that new end-users connecting to the extended network would most likely entirely pay for the investment. Only a potential – but unlikely – under-recovery of our Fibre Frontier investment would have to be recovered from the entire end-user base.

We also do not expect revenues to reach our MAR during PQP2. This means that:

- we expect prices during PQP2 will remain constrained by the anchor price
- any incremental MAR under-recovery associated with the Fibre Frontier investment would wash-up into the future, eventually flowing into pricing at the point where the revenue cap would otherwise have constrained prices below the price cap
- in effect, a potential (but unlikely) MAR under-recovery associated with the Fibre Frontier investment would not manifest itself in higher prices, but rather delay the point when prices would otherwise start to fall in real terms.

How the above dynamics will play out in practice is subject to many factors that are uncertain or outside our control. These include:

- the extent of a potential under-recovery of the incremental Fibre Frontier MAR arising from the constrained wholesale price we achieve from new Fibre Frontier end-users (we expect this to be small or even negative – i.e. there is a

possibility – uptake dependent – that new Fibre Frontier users will pay more than is required for us to recover the Fibre Frontier investment and would hence subsidise existing end-users)

- how much investment is approved for PQP2 and beyond
- how the Commission chooses to profile the PQP2 and subsequent revenue paths
- how (and whether) the anchor cap is applied in future
- our allowable rate of return for PQP2 and beyond
- our actual revenue.

These complexities mean that incremental MAR impact is a useful way to illustrate impact to end-users.

15.7.6 Sensitivity analysis

We have carried out sensitivity analysis to test the robustness of the outputs from the WCM test to changes in key inputs and assumptions, as well as to understand where uncertainty in these inputs and assumptions is most impactful.

In short, the WCM test we applied to demonstrate our Fibre Frontier investment would be break-even at a price below the current wholesale price is most sensitive to changes in:

- the WACC, i.e. the discount rate applied in the discounted cash flow (DCF) modelling
- upfront build costs, as they are the highest costs and we would incur them early
- the fibre uptake rate, because connections drive revenue.

We also tested the impact of connection capex and lifecycle expenditure. These impacts are negligible (lifecycle more than connection capex) because they are comparatively low and occur later in the investment's life cycle, and therefore have a lower time value of money in the DCF analysis.

Like all modelling of future events, our application of the WCM test is uncertain. Our base case models one possible future, which in our view has the highest likelihood of occurring. However, ultimately the future will play out differently from what we have assumed in this base case. Depending on the trajectories of key drivers, revenue from new Fibre Frontier end-users will either:

- exactly (or almost exactly) fund the Fibre Frontier investment. However, this is highly unlikely
- over-recover the Fibre Frontier investment and contribute to recovering our initial UFB build investment, enabling lower prices over time for existing fibre end-users. In our view, this is the most likely outcome due to the conservative WACC (relative to more recent history) and uptake rate assumptions
- partially under-recover the Fibre Frontier investment with cross-subsidisation required from existing fibre end-users to make up the shortfall (for which existing end-users have signalled a certain willingness to pay). We consider this less likely than an over-recovery scenario.

A more detailed discussion on our sensitivity analysis can be found in the Appendix of this chapter.

15.8 Telecommunications networks optimisation test

We think the WCM test provides a stringent and conservative test. However, for completeness (and given the lack of precedent) we have also considered the TNO test. The TNO test outlined below has been modelled on what a potential larger build plan could look like over the PQP2 period, which considers a build to ~40,000 premises and a capital spend of ~$200 million.

15.8.1 Assessing the relative merits of technology choices and their respective costs and benefits

In assessing technology and their costs and benefits, like-for-like comparisons must be used. As discussed earlier in this chapter at 15.2.5, NZIER found substantial benefits to end-users in having access to unconstrained high-capacity networks. It is therefore relevant to consider the extent to which the service is:

- available (i.e. whether it can serve all end-users or only a subset, and whether higher capacity plans are subject to 'stop sells' to prevent congestion for other end-users)
- able to meet current, and growing, capacity requirements from end-users
- sustainable long-term (i.e. whether it will require additional funding sources such as top-up government funding to provide and upgrade the service).

When assessing available options, we have therefore focused on those closest to delivering (or having a potential upgrade path to deliver) high-capacity networks. These are:

- 4G fixed wireless networks provided by mobile network operators (MNOs) and broader wireless offerings from wireless internet service providers (WISPs)
- 5G services as an evolution of fixed wireless solutions
- Low earth orbit (LEO) satellite technology.

We have excluded copper services as speed increases are generally enabled by replacement of copper lengths with fibre rather than improvements to copper itself. We have also excluded geostationary (GEO) satellite services on the basis that their higher latency makes them less attractive from an investment perspective to deliver high-capacity connectivity to end-users, particularly relative to LEO satellite options.

RIGHT TECH FOR THE JOB

"We have to resolve the rural issue, and we have to use the right technology in the right place."

Stakeholder feedback

FIBRE V OTHER TECHNOLOGIES

"It's cheaper, it's better, it's more resilient, it opens opportunities, it's faster. There's not downside."

Stakeholder feedback

Fixed wireless networks provided by MNOs and WISPs

Fixed wireless networks can provide broadband services, but unlike urban iterations of these services, rural plans have had a greater focus on managing capacity. Existing rural offerings (many resulting from government-funded Rural Broadband Initiative programmes) generally have slower maximum download speeds (comparable to original entry-level fibre plans), data caps, and higher prices to end-users (although plan availability and terms are highly dependent on end-users' address).[37]

Designed for more modest use, the government's rural broadband technologies were aimed at primarily 4G FWA provided by MNOs, with some WISPs providing regionally-focused services. It is challenging for some of these services to keep pace with growing demand, with the government recently stating that congestion is impacting five percent of the population of Aotearoa (potentially nearly half of rural users) – reducing download and upload speeds and, in some cases, resulting in complete loss of service.[38]

The challenge of FWA was described in Plum Consulting's report Approaches to rural broadband in Europe:[39]

> *"Fixed wireless access (FWA) is seldom used although some deep rural projects are awarded funding to deploy in remote areas where fibre is unlikely to be available for some time. The issue, according to people in charge of funding schemes in various advanced VHCN [very high-capacity networks] countries is that FWA is constrained by a combination of factors: spectrum availability and household density. Below a certain density, the cost of deployment combined with the cost of the spectrum allocation make the business model non-viable. Above a certain density, because of the shared spectrum resource, performance degrades for all subscribers in the coverage area. Finding the sweet spot between those two is tricky and ultimately makes FWA a hard solution to apply to the rural connectivity problem. A number of countries, like the UK, will only approve funding for FWA solutions if the antennas are directly fibered up, which makes the deployment all the more costly."*

In addition, Plum Consulting's report notes that fixed wireless is predominantly viewed as a temporary solution while long term solutions are deployed.[40] The challenge of these services in meeting growing demand was also referenced by Craig Young, Chief Executive of TUANZ when commenting on capacity of the initial Rural Broadband Initiative:[41]

> *"We're also are keen to hear from Crown Infrastructure Partners on plans to improve the capacity of the original RBI1 programme - what we call the stale donut of broadband coverage."*
>
> *The Tuanz boss says the stats should start to focus less on areas reached, and more on whether it could truly be called fast internet in 2021.*
>
> *"Over time coverage becomes less important than capacity, and over the long run becomes more critical to ensuring rural NZ doesn't get left further behind."*

The financial challenges of fixed wireless were further illustrated with the second phase of the Rural Broadband Initiative from 2018, where the three MNOs (being

FIXED WIRELESS

Fixed wireless networks generally have slower maximum download speeds (comparable to original entry-level fibre plans), data caps, and higher prices to end-users. Costs vs capacity and performance can make deployment costly and tricky.

37 www.broadbandcompare.co.nz provides a sample of these when a rural address is entered.
38 NZ Government, Lifting Connectivity in Aotearoa, December 2022. P21.
39 Benoit Felton & Karim Bensassi-Nour, Plum Consulting, Approaches to rural broadband in Europe, 2022. P16.
40 Ibid. p4
41 *A feast of urban broadband but rural internet a 'stale donut'*, Chris Keall, NZ Herald, 3 August 2021.

Spark, One NZ and 2Degrees) were awarded the majority share of the funding to deliver a network on shared infrastructure. This programme had a use-case-based target of around 20Mbps.[42] The need for a substantial government grant and for all three national MNOs to develop a joint bid incorporating infrastructure-sharing (which is not a feature of the wider urban market) illustrates the greater economic challenges in providing these services in rural Aotearoa.

In addition to these technical challenges, retail pricing for these services can also be significantly more expensive to end-users, as outlined in Table 15.9 below.

5G services as an evolution of fixed wireless solutions

5G networks are being rolled out in urban parts of Aotearoa, and while it appears there will be some expansion into rural parts of Aotearoa,[43] there are additional technical challenges and high costs associated with bringing high capacity 5G to rural communities. These include the topography of rural Aotearoa (i.e. hills, mountains, valleys) and everyday obstacles like growing trees, which can impact the coverage and quality of 5G services. As the government noted in Lifting Connectivity in Aotearoa:[44]

> *"the high frequencies used for most 5G equipment often mean the signals have a shorter broadcast range. These same frequencies are also more prone to being blocked by buildings, trees, hills and other obstacles. This can mean that more towers are required than 3G or 4G to cover a similar land area, which can make building, operating and maintaining a 5G network more expensive (particularly in rural areas where there are greater distances between customers)."*

5G

The geography of Aotearoa and technical challenges of 5G can make building, operating and maintaining a 5G network difficult and therefore more expensive for rural areas.

They then contrast this with urban areas, where "the high number of customers within a small area generally makes it economically feasible to build very small radio transmitters for 5G (sometimes called micro-cells) to overcome the shorter range of 5G, and the blocking effects of buildings."[45] We see this as an implicit acknowledgement that the government does not believe that 5G is currently economically feasible at scale in rural Aotearoa.

This feasibility is also considered against the backdrop of the government's decision to allocate the long-term rights to the 3.5GHz spectrum (the spectrum used in 5G technology) to MNOs in return for some accelerated rollout of 5G services in smaller towns, rather than providing 5G in true rural areas. Assuming the commercial value of the 3.5GHz spectrum is similar to the 700MHz allocation (the predominant 4G spectrum used in rural Aotearoa), this would represent a subsidy to MNOs of at least $320m in today's dollars.[46] This again points to inherent commercial challenges associated with the 5G rollout in rural Aotearoa (in addition to the practical considerations).

This spectrum allocation decision also points to challenges using 5G in a rural setting, with the configuration decided by MBIE confirming that 5G services would have far less reach. As noted by the chair of WISPA (Wireless Internet Service Providers Association) Mike Smith:[47]

> *"…the outcome of the lengthy process [to allocate 3.5GHz spectrum] has led to a situation where the entire band has been structured in a way that*

42 Crown Infrastructure Partners – RBI2/MBSF expansion announcement – Questions and Answers, 18 December 2018.
43 Kiwis to benefit from accelerated 5G roll-out, Minister David Clark, 20 October 2022.
44 Lifting Connectivity in Aotearoa, Ministry of Business, Innovation, and Employment, December 2022, p25.
45 LCIA p25.
46 In 2014 the total revenue received by the Crown for the 700MHz spectrum auctioned was $259m.
47 *Juha Saarinen: Government rush to 5G trips up rural broadband*, NZ Herald, 3 May 2023.

works for the MNOs targeting urban rollouts but drastically reduces its viability in rural/regional areas."

…[the] rules, at what seems to be on the bequest of MNOs, that reduce the maximum cell size to just 9km "effectively makes rural connectivity gains null and void."

In their report for UK Broadband Stakeholder Group on the commercial and technical practicalities of providing broadband coverage to the UK's hardest to reach areas, Analysys Mason concluded that providing 300Mbps speeds required dense networks in rural areas, and that "the extra equipment and new sites made microcell FWA unsuitable for reaching VHtRPs [very hard to reach places]…the lower cell radius (required to provide higher speeds) and low premises density make this option the least viable in almost all areas."[48]

It is difficult to ascertain what the experienced speeds of 5G fixed wireless broadband services will be once the network is deployed and used at scale. Using 4G services as a guide, top speeds cited as it was deployed were up to 150Mbps, while the latest Commerce Commission report shows average peak speeds of 33Mbps, approximately a fifth of that initially cited.[49]

Internationally, data from Ookla found that median 5G download performance was declining in many early launch markets as 5G adoption grows and users in more remote locations access the service. They stated that "declining median download speeds also point to investment and deployment challenges in some markets. At the same time, many of these markets are facing economic headwinds, placing more emphasis than ever on cost control."[50]

Low earth orbit satellite technology

Advancements in Low Earth Orbit (LEO) satellite technology suggest this technology could play an important role for the most remote end-users for whom fibre will not be an economically viable solution, perhaps the last 5% of Aotearoa. The average speed in Aotearoa of Starlink, a subsidiary of SpaceX, is 106Mbps which puts it well above 4G FWA but well below the capability of fibre.[51] As the market is evolving this could change over time, particularly as the service matures. We note that competing offerings are being considered, with Amazon in the process of launching its own satellite programme, Project Kuiper, with broadband services expected to be available in the coming years.[52]

The current LEO satellite offerings are an improvement on existing rural fixed wireless offerings, though have higher monthly charges for end-users and lack the speed and capacity of mass market fibre offerings.

As with fixed wireless services, the performance of Starlink has deteriorated since it was first launched and uptake has grown,[53] and in North America measures have been introduced to manage data usage due to capacity constraints.[54] Companies of the scale of Starlink and Amazon will likely continue to invest to improve this service, but will require significant investment from global multinational companies to sustain and improve performance.

LEO SATELLITE

Low earth orbit satellites could play an important role in the most remote areas of Aotearoa, with performance generally better than fixed wireless alternatives, although still below that of fibre.

48 Matt Yardley, Andrew Daly, Helena Fyles, Research on Very Hard to Reach Premises: technical and commercial analysis, Analysys Mason, 12 August 2021. P15.
49 NZ's big 4G rollout – progress report, NZ Herald, July 2014.
50 Are 5G Networks Meeting Consumers' Expectations? Ookla Insights Articles, February 2023.
51 Ookla Starlink Performance GraphQ2 2022: https://www.ookla.com/s/media/2022/09/ookla_satellite_internet_comparison_oceania_0922-01.png
52 Project Kuiper, https://www.aboutamazon.com/what-we-do/devices-services/project-kuiper, accessed April 2023.
53 Ookla Starlink Performance: https://www.ookla.com/articles/starlink-hughesnet-viasat-performance-q2-2022.
54 Starlink Fair Use Policy: Starlink Fair Use Policy - Starlink

Overall, the performance of LEO satellite services is superior to most fixed wireless solutions, but inferior compared with a fibre to the premises (FTTP) service. Fibre is faster than LEO satellite services, offering speeds of several Gbps, compared to a few hundred Mbps, also has much lower latency (delay), making it more suitable for suitable for applications that require real-time communication, such as online gaming and video conferencing (as outlined in Table 15.9 below).

15.8.2 Pricing and upfront costs for rural end-users of different broadband options

These options have different price points, data caps, and capabilities, as outlined in the below table (current as at April 2023).

TABLE 15.9: CHARACTERISTICS OF VARIOUS BROADBAND TECHNOLOGIES

	URBAN		RURAL				
	Fibre[55]	5G FWA[56]	4G FWA	WISP FWA	Satellite – LEO	Satellite – GEO	Copper (VDSL)
Install cost to end-user	Free	Free	Free	Free	$729 + $34	$1,999	Free
Retail price per month	$80	$80	$155.99	$149	$159	$149	$100
Data use	Unlimited	Fair use	200Gb	Unlimited	Unlimited	Unlimited	Unlimited
Download speed	1Gbps+	100Mbps+	37Mbps	50Mbps	125Mbps	50Mbps	43Mbps
Upload speed	500Mbps+	20Mbps	18Mbps	50Mbps	17Mbps	10Mbps	11Mbps
Latency	5ms	20ms	48ms	21ms	48ms	500ms	20ms

55 Fibre is shown as an urban comparator, as Chorus has a geographically consistent pricing (**GCP**) requirement to provide wholesale inputs at a consistent price nationwide so would see the same price point in rural areas as in urban areas. Presently standard installations do not incur a charge in in urban areas, and we have assumed the same for the proposed extension areas in PQP2.

56 Currently 5G is being rolled out in urban areas, so current urban pricing is shown, we would expect that higher pricing similar to that shown for 4G rural FWA would apply for a rural version of the service in rural Aotearoa. Also noting performances are estimates as 5G rollout continues.

As already outlined, overall rural end-users experience inferior services than their urban counterparts. As the table above shows, rural end-users are subject to higher monthly costs and in most instances some combination of inferior speed and latency, data caps, as well as a need to fund some (or all) of the initial installation costs.

15.8.3 Cumulative net benefit analyses

A wholesale fibre network rollout will deliver an uncongested, high-speed network to the rural community at a more affordable price, providing urban-rural parity, and a clear upgrade path for future connectivity needs. Based on the factors outlined above, we are convinced a fibre solution will yield the highest net benefit to New Zealanders.

In the next section, we discuss the economics of rolling out fibre further beyond its current footprint. Our analysis very strongly supports our proposal to extend the fibre network to the next 3% of Aotearoa (i.e. beyond PQP2 spend), with those New Zealanders having the lowest incremental connection cost. We acknowledge though that at some point the net benefit to New Zealanders of extending our fibre network would become negative. We will continue to refine our analysis to be able to better identify this point and will aim to work with government and other stakeholders to help find a solution for these most remote New Zealanders as well.

BENEFITS

A wholesale fibre network rollout will deliver an uncongested, high-speed network to the rural community at a more affordable price, providing urban-rural parity, and a clear upgrade path for future connectivity needs.

Cost and benefits of deploying fibre to 89.2%

We have modelled the cost to deploy fibre to another 40,506 premises, expanding the fibre footprint of Aotearoa by 2.2% to 89.2% (noting this is beyond the current PQP2 proposed spend).).

We have also compared this to the benefits outlined in the NZIER report 'Economic benefits of closing the rural digital divide' and discussed above. NZIER's assessment of benefits assumes 100% fibre coverage with 100% uptake. As such, we have adjusted the benefits to account for the smaller coverage area and expected lower uptake – we modelled a conservative 70% uptake.[57] This reflects a slightly lower level of uptake than observed in UFB2 areas, which we believe to be a conservative assumption. Uptake will be supported by a range of factors including fewer alternative broadband options available further from main centres and an increasing need for quality broadband over time as work and leisure activities increasingly require quality connectivity.

The table and charts below show the costs, benefits, and cumulative net benefit of extending fibre to 89.2%.

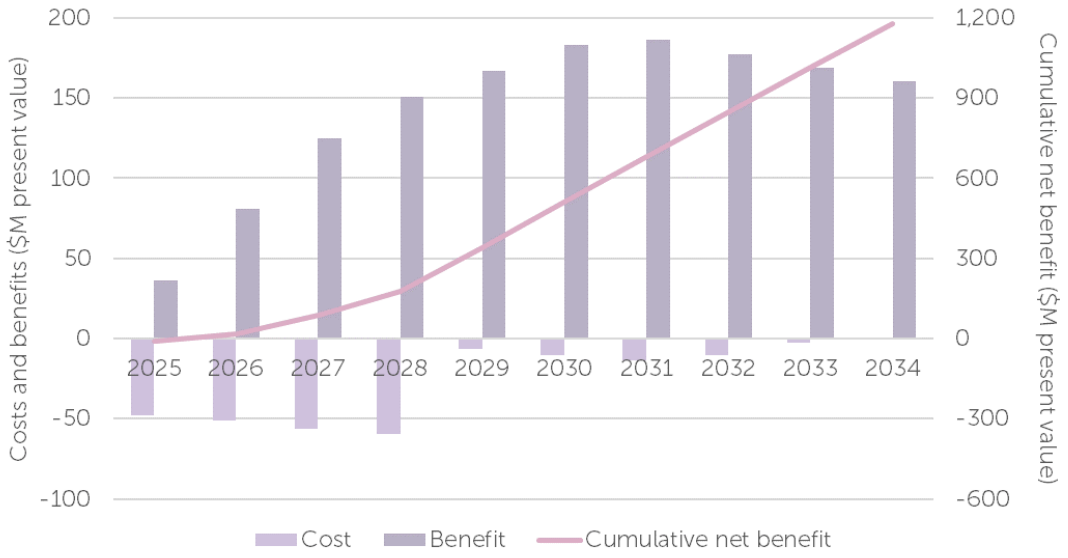
TABLE 15.10: COST BENEFIT ANALYSIS FOR FIBRE TO 89.2% (2022 CONSTANT PRICE TERMS)

FIBRE NET BENEFIT ANALYSIS	2025	2026	2027	2028	10 YEARS
Chorus network build cost	$46.8m	$48.1m	$51.6m	$54.5m	$201.0m
Connect costs	$0.8m	$2.7m	$4.7m	$5.2m	$57.3m
Apportioned NZIER benefits	$39.4m	$88.4m	$134.7m	$161.3m	$1,201.0m
Cumulative net benefit	-$11.1m	$20.0m	$90.2m	$183.3m	$1,196.6m

57 Kantar research commissioned by Chorus outlined **CCI [ ]** of rural users would be likely to take up a fibre service

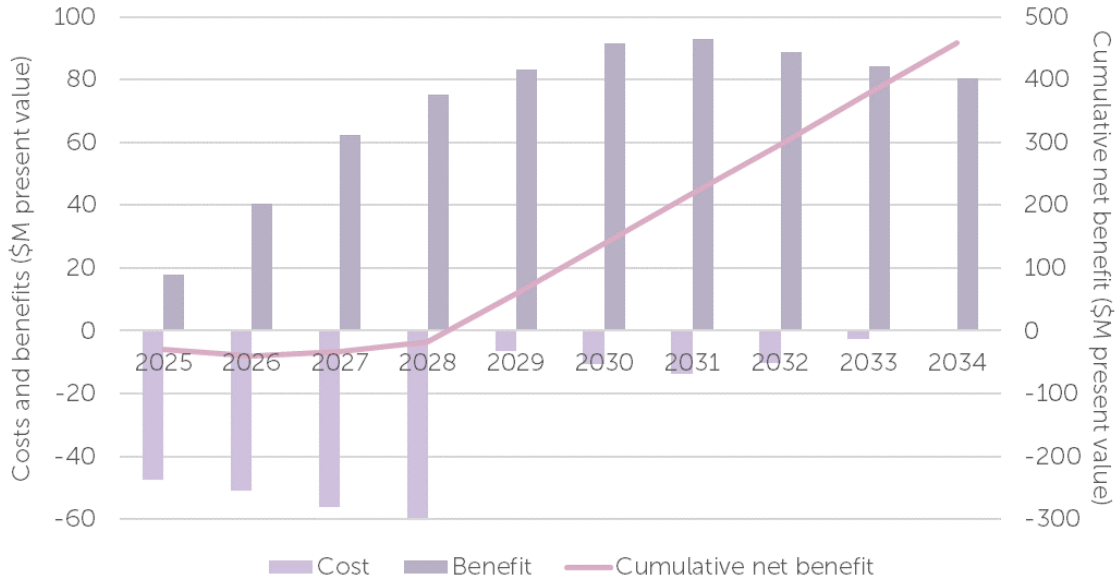
We note that fibre is a long-term investment – physical assets deployed today should still be in use 20+ years from now. Our Layer 2 assets do have a shorter replacement lifecycle, therefore it's likely that additional capex (substantially less than the amounts above) will be required at some point after the period covered by this analysis.

FIGURE 15.5: COST BENEFIT ANALYSIS FOR FIBRE TO 89.2%



As shown by Figure 15.6, even if the benefits are halved while holding costs per the base case, we would still reach a positive net benefit by year 5.

FIGURE 15.6: COST BENEFIT ANALYSIS FOR FIBRE TO 89.2% (SENSITIVITY – 50% OF ORIGINAL BENEFITS)



Costs and benefits of FWA alternative

Chorus' expertise is in building fixed line networks rather than mobile networks, so the following represents a very high-level estimate of the net benefits associated with building a wireless network instead of fibre. We have used the Rural Connectivity Upgrade (RCU) costs as a proxy for the cost to build the network, using the published cost data of $65m for RCU1 and $43m for RCU2 to assume a total of $108m over four years, which we've discounted at 5% per annum in line with the fibre calculations. Given the nature of wireless networks it's likely that further investment will be required to keep up with growing bandwidth demands, therefore we have included a further tranche of investment in year 10 ($16.6m) to cater for this.

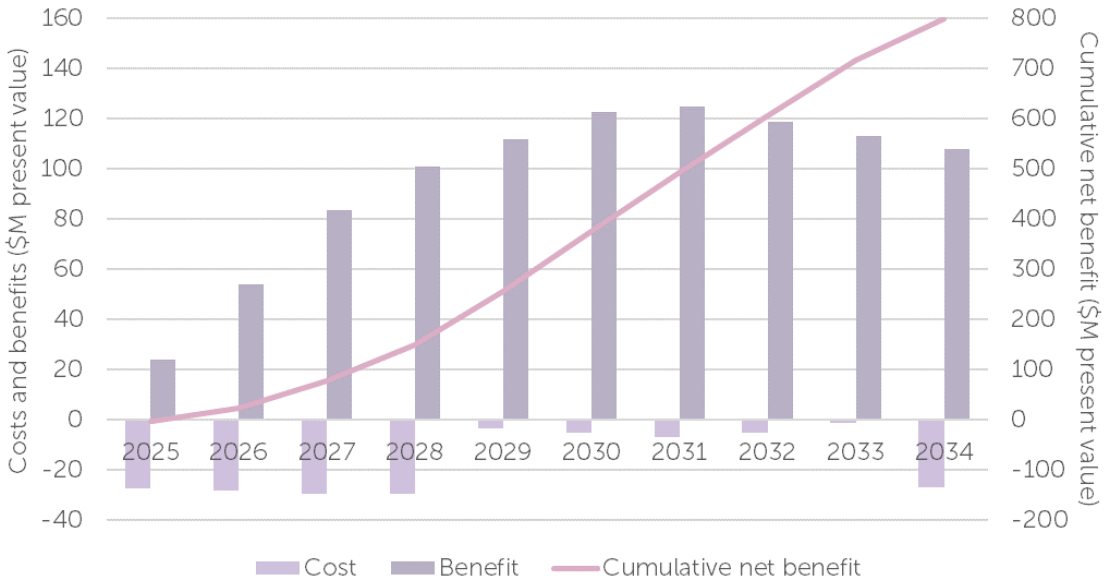
We anticipate that the installation cost for FWA will be somewhat lower than fibre because in some instances it will be possible to courier a modem/router to the end-user's premises. However, some installations will require a site visit in order to install an external aerial. On balance we've assumed that the cost to connect a FWA end-user will be half that of a fibre end-user.

We have used a 66% multiplier on the net benefits (compared to fibre) on the basis that the NZIER report (upon which our analysis is based) assumed an unconstrained network. To achieve this outcome with FWA would require significantly more investment than we have allowed for, likely necessitating building a 5G mmWave radio network with transmitters close to every premises served. The cost to do this would likely be more than that required to deploy fibre to the premises and does not provide a useful comparator.

TABLE 15.11: SUMMARY OF NET BENEFITS OF WIRELESS

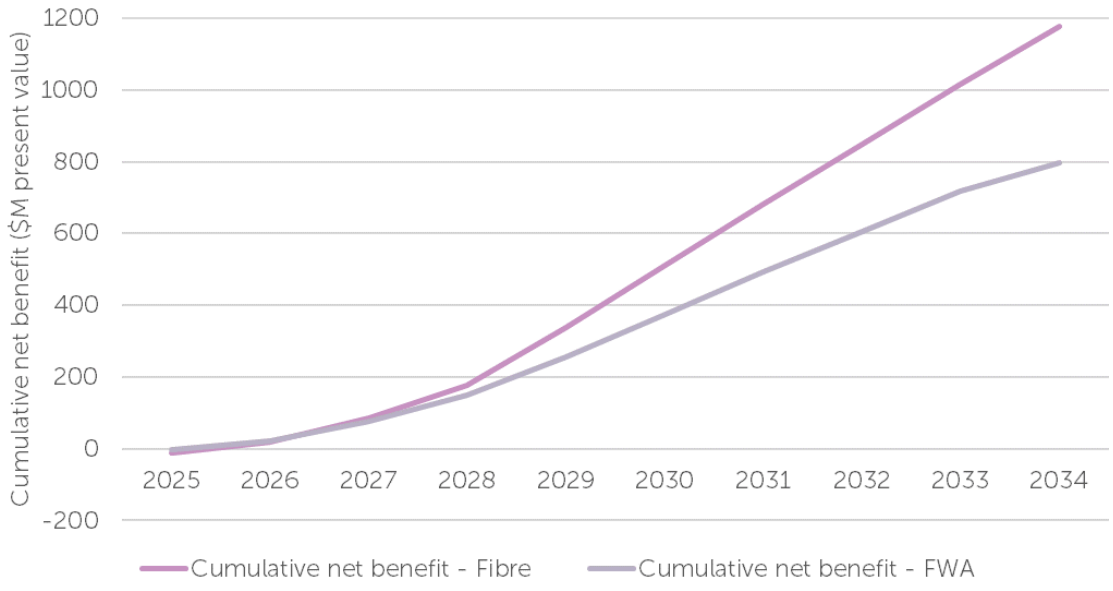
WIRELESS NET BENEFIT ANALYSIS	2025	2026	2027	2028	10 YEARS
Wireless network build cost	$27.0m	$27.0m	$27.0m	$27.0m	$135.0m
Connect cost	$0.4m	$1.4m	$2.4m	$2.6m	$28.7m
Apportioned NZIER benefits	$24.5m	$54.9m	$84.8m	$102.4m	$974.8m
Cumulative Net benefit	-$3.0m	$23.6m	$79.0m	$151.8m	$811.1m

FIGURE 15.7: COST BENEFIT ANALYSIS FOR FWA BUILD



While FWA requires a smaller initial outlay, resulting in slightly stronger net benefits than fibre in the first two years, the reduced achievable benefits due to the constrained nature of FWA connectivity combined with the need for ongoing investment results in a weaker long-term outcome than fibre investment.

FIGURE 15.8: CUMULATIVE NET BENEFIT FOR FIBRE AND FWA



The purpose of this analysis is not to downplay the usefulness of wireless technologies in the rural setting. The Rural Broadband Initiative and subsequent Rural Connectivity Upgrade programmes have not only provided a basic level of broadband to end-users who previously would have had only expensive satellite options, but have also provided critical mobile coverage. The analysis does however illustrate that fibre is a realistic investment option over the medium term,

proving cost competitive compared to wireless and providing a vastly superior user experience with a low-cost future upgrade path.

15.9 Summary of economic tests

15.9.1 PQP2 Fibre extension passes the economic tests

We have demonstrated that our proposed PQP2 investment of $13m (which we expect to represent approximately $24m of commissioned assets) to extend communal fibre to 6,379 premises passes a workably competitive market test which, in the absence of a market benefit or equivalent test in the regulation, is a conservative economic test for fibre network extension for PQP2.[58]

The investment passes the test because the breakeven wholesale price needed to justify investment would not only be competitive with offers from other networks, it would be lower than our likely price path for fibre over the coming years. We also note, that whilst the current geographically consistent pricing obligation should not be taken into account when applying a workably competitive market test, the investment passes regardless.

We found that a wholesale price of **CCI [ ]** per month for Fibre Frontier end-users would be required. This would support retail prices that are lower than competing services with inferior performance and is lower than the willingness to pay indicated by our consumer research.

We have also tested a larger portion of investment against other network options. This is the type of testing that a telecommunications network planner would apply if they were trying to optimise benefits for end-users of telecommunications services, and is analogous to the grid investment test used by Transpower.

We found that extending fibre provides a materially higher net benefit stream than the next best alternative of extending FWA. This reflects the superior performance and scalability of fibre, and the inherent limitation of FWA in a rural setting.

15.9.2 Fibre extension also benefits competition in telecommunications markets

Fibre extension is not only consistent with workably competitive markets, it will also promote competition in telecommunications markets by:

- increasing competition in the retail broadband market, as more RSPs will have the opportunity to compete for broadband users. There are numerous RSPs that only provide fibre services, so where copper broadband is overbuilt by a wholesale fibre network the number of RSPs who can serve end-users in those areas will increase. Similarly, extending fibre coverage into in areas where only fixed wireless broadband or satellite is currently available will increase the pool of RSPs beyond the vertically integrated operators and mobile virtual network operators (MVNOs).
- making a wider range of services available in these areas and expanding the geographic scope of some markets – for example, the market for corporate grade broadband.

58 We propose development of an investment test that assesses investment cost against a wider set of market benefits. Codifying this test, as has been done for other regulated entities, would allow greater predictability, support more effective stakeholder engagement and assist long term investment planning.

15.10 Further opportunities for fibre extension

We believe there is a strong case to continue to extend the network even further than our current plans, with net benefits to Aotearoa beyond the significant investment required to push fibre out further into rural Aotearoa. We have only included phase 1 of Fibre Frontier network build in our PQP2 proposal covering a period to June 2025. Whilst we have ambitions to take fibre further, we are unable to commit to that at this time without additional regulatory and policy certainty. We would look to submit one or more Individual Capex Proposals for any future build plans once we feel the environment supports this investment.

Should the government look to allocate additional funding to support fibre rollout as part of wider rural connectivity work, enabling an opportunity to extend past the above programme, we would look to submit an Individual Capex Proposal for additional funding within PQP2.

15.11 Appendix – Testing the sensitivity of the WCM to changes in its inputs and assumptions

We have carried out sensitivity analysis underpinning our economic modelling with a specific focus on the workably competitive market (WCM) test and its key drivers and outputs.

15.11.1 At a glance

In short, the WCM test we applied to demonstrate our Fibre Frontier investment would be break-even at the current wholesale price is most sensitive to changes in:

- the WACC, i.e. the discount rate applied in the DCF modelling
- upfront build costs, as they are the highest costs and we would incur them early
- the fibre uptake rate, because connections drive revenue.

We also tested the impact of connection capex and lifecycle expenditure. These impacts are negligible (lifecycle more than connection capex) because they are comparatively low and occur later in the investment's life cycle, and therefore have a lower time value of money in the DCF analysis.

Like all modelling of future events, our application of the WCM test is uncertain. Our base case models one possible future, which in our view has the highest likelihood of occurring. However, ultimately the future will play out differently from what we have assumed in this base case. Depending on the trajectories of key drivers, revenue from new Fibre Frontier end-users will either:

- exactly (or almost exactly) fund the Fibre Frontier investment. However, this is highly unlikely
- over-recover the Fibre Frontier investment and contribute to recovering our initial UFB build investment, enabling lower prices over time for existing fibre end-users. In our view, this is the most likely outcome due to the conservative WACC (relative to more recent history) and uptake rate assumptions
- partially under-recover the Fibre Frontier investment with cross-subsidisation required from existing fibre end-users to make up the shortfall (for which existing end-users have signalled a certain willingness to pay). We consider this less likely than an over-recovery scenario.

Immediate price increase vs. delayed MAR-constrained pricing

For clarification, any cross-subsidisation of the Fibre Frontier investment by existing fibre end-users would not mean a rise in prices for them. Rather, it would push out a decline in our MAR and delay lower prices for end-users.

When consulting with end-users, we simplified the regulatory regime and presented scenarios where Chorus would increase prices above current levels to fund the incremental spend. However in reality, Chorus is currently not pricing to the MAR, and is carrying forward allowable revenues into future regulatory periods. End-users would not see an immediate increase on their monthly bills to cover this cost – rather, based on current modelling, CPI price increases may carry on for **CCI [ ]**, at which point Chorus is expected to become MAR-constrained.

Considering end-users were largely supportive of the proposed spend for Fibre Frontier network extension assuming an immediate price impact, if they were to know the actual impact may not be seen until a much later date, it would not be unreasonable to expect they be even more supportive.

To be clear, the Fibre Frontier expenditure we propose the Commission should approve for PQP2 would most likely not require any cross-subsidisation from the existing fibre end-users.

15.11.2 Key sensitivities

Our internal governance processes mean we are acutely aware of where our key sensitivities are for this investment, and we have provided additional modelling to support this sensitivity analysis alongside this document.

The three key sensitivities are:

- WACC
- Upfront build costs
- Fibre uptake rate

WACC

Typically, WACC is the most impactful uncertainty in a financial analysis like the one we have undertaken to determine the incremental MAR impact by the Fibre Fronter investment or the whole price required to be break even.

Our analysis uses our PQP2 WACC estimates, but for comparison we have run a sensitivity using the WACC estimates the Commission used to set our MAR for PQP1, which are significantly lower. The impacts on the modelling outcomes are shown in Table 15.12 below.

TABLE 15.12: SENSITIVITY ANALYSIS - WACC

	PQP1 WACC[59]	PQP2 WACC[60]
Incremental MAR per connection (all connections) @ Vanilla WACC	$0.21	$0.33
Break-even wholesale price per connection (new connections) @ Post-tax WACC	$30	**CCI [ ]**

We note, however, that the regulatory WACC is not the focus of our sensitivity analysis as it will change every time the Commission resets our price path, therefore is not within our control and impossible to forecast accurately over a 43-year asset life. To eliminate the effect of the WACC from our analysis – and to transparently showcase the effect on modelling outcomes from changes in parameters we can influence – we have kept the WACC fixed at our PQP2 estimate over the life of the investment.

What this sensitivity analysis highlights though is that at the current wholesale price we would be able to recover our investment at any WACC rate that sits at or below the relatively high PQP2 estimate. Any Fibre Frontier over-recovery we would make if the WACC were lower than we currently assume for PQP2 would contribute to recovering our cost for the initial UFB build and consequently reduce prices for all end-users in the longer term.

For example, if the WACC were set at the PQP1 estimates, newly connected Fibre Frontier end-users paying for their fibre services at the current wholesale price would generate an over-recovery of $38 million in present value terms ($178 million nominal) over the life of the investment, hence cross-subsidising existing fibre end-users. However, the same logic applies vice versa – if the WACC were significantly above the PQP2 estimate, at the current wholesale price existing fibre end-users would cross-subsidise new Fibre Frontier end-users.

Upfront build cost

A range of outcomes are possible here. To date we have leveraged current service company codes to deliver the build work. We note the current labour market is challenging and high inflation is also adding cost pressures to the ecosystem. However, to counter this, Chorus intends to tender this piece of work as a bundle with other similar work types in order to create a scale project to be delivered by our service partners. As much as cost pressures exist in the market, it should be more cost effective to deliver as a programme of work – so we may see reduced costs on current business-as-usual service company codes. To mitigate this uncertainty and to narrow the range of possible outcomes, we are tendering an initial tranche of build with our service company partners. Tenders closed in September 2023 with an intention to begin build in early 2024.

Uptake rate

The modelling assumes a 70% uptake. We believe this is a conservative assumption, but note this is aligned to our business plan. This rate is lower than what we have seen in our UFB areas and lower than our Kantar research suggests is likely.

59 Commerce Commission WACC determination - 4.72% Vanilla WACC, 4.52 Post-tax WACC
60 Our WACC estimate - 7.82% Vanilla WACC, 7.31 Post-tax WACC

As outlined above, we consider an 80% uptake assumption is possible, so have the sensitivity of the break-even wholesale price to this assumption. At this uptake rate, the break-even wholesale price would drop to $41, **CCI [ ]**. We see uptake levels in UFB areas getting closer to 80%. We also note that once Chorus has completed a fibre roll out in these areas, they become a Specified Fibre Area. When an area becomes a Specified Fibre Area Chorus can stop providing copper services in accordance with the Copper Withdrawal Code. Our experience with copper withdrawal to date shows around 80% of remaining copper end-users choosing a fibre service, and we expect to leverage this mechanism to drive uptake beyond the assumed 70% rate.

15.11.3 Further sensitivities

In addition to the three key sensitivities outlined above, we have run further sensitivities on the remaining expenditure we are likely to incur on top of the initial Fibre Frontier build cost. These expenditures are purely incremental – i.e. we would not incur them unless we go ahead with the initial build. They include our:

- capex (connect) – capex to connect new end-users to the extended fibre network
- capex (lifecycle) – capex incurred when upgrading the network to next generation technology (ONTs, line cards, etc.) and when repairing the fibres for any damages we cannot charge to a causer (e.g. landslides)
- opex – reactive opex and electricity costs.

15.11.4 Break-even wholesale price sensitivity analysis

The below analysis shows the sensitivity of the 2024 break-even wholesale price to changes in the input assumptions discussed above (with the exception of WACC):

- The midpoint (where the lines cross) reflects our base case, which requires a wholesale price of **CCI** [ ] to break even.
- The areas left and right of the vertical line in the centre of the chart reflect changes to the assumptions that underpin our base case (i.e. the area to the left varies the assumptions by up to -50%, and the area to the right varies the assumptions by up to +50%).
- Any upwards movements in the lines from the base case indicate that a higher wholesale price would be needed to recover our investment. For example, if the uptake rate (connections volume) was 20% lower, the break-even wholesale price would have to increase by $7.90 per connection to make up for the revenue shortfall otherwise caused by fewer connections.
- Any downwards movement in the lines from the base case indicate a lower wholesale price would be needed to recover our investment. For example, if the uptake rate were 10% higher the break-even wholesale price could drop by $2.90/connection to account for the revenue increase from more connections.

FIGURE 15.9: SENSITIVITY OF THE 2024 BREAK-EVEN WHOLESALE PRICE TO CHANGES INPUT ASSUMPTIONS (RELATIVE TO BASE CASE OF **CCI [ ]** PER CONNECTION IN 2024)

[ ]

Relative to our base case, the below table shows the changes in the break-even wholesale price for each 10% increment as plotted on the above graph.

TABLE 15.13: CHART OUTPUTS FOR BREAK-EVEN WHOLESALE PRICE SENSITIVITIES ($/MONTH/CONNECTION)

	-50%	-40%	-30%	-20%	-10%	BASE CASE	10%	20%	30%	40%	50%
Capex (build)	-15.7	-12.6	-9.4	-6.3	-3.1	0.0	3.2	6.3	9.4	12.6	15.7
Capex (connect)	-4.2	-3.3	-2.5	-1.7	-0.8	0.0	0.8	1.7	2.5	3.3	4.2
Capex (lifecycle)	-1.4	-1.1	-0.8	-0.6	-0.3	0.0	0.3	0.6	0.8	1.1	1.4
Opex	-1.1	-0.9	-0.6	-0.4	-0.2	0.0	0.2	0.4	0.7	0.9	1.1
Connections	31.8	21.2	13.6	7.9	3.5	0.0	-2.9	-5.3	-7.3	-9.1	-10.6

15.11.5 Over/under-recovery sensitivity analysis

The below analysis shows the sensitivity of the Fibre Frontier investment recovery (in present value terms) to changes in the input assumptions discussed above (with the exception of WACC):

- The midpoint (where the lines cross) reflects our base case, which allows us to fully recover our investment (including WACC) at a wholesale price of **CCI [ ]**. At this point, the net present value over the life of the investment is zero, our financial capital is maintained.
- The areas left and right to the vertical line in the centre of the chart reflect changes to the assumptions that underpin our base case (i.e. the area to the left varies the assumptions by up to -50%, and the area to the right varies the assumptions by up to +50%).
- Any upwards movements in the lines from the base case indicate that we would over-recover our Fibre Frontier investment. For example, a 10% higher uptake rate (connections volume) would result in an over-recovery of $2.9 million in present value terms. Through the over-recovery, new Fibre Frontier end-users would contribute to recovering our initial UFB investment, and prices for existing fibre end-users would be lower in the longer-term than they would be without the Fibre Frontier investment.
- Any downwards movement in the lines from the base case indicate that we would under-recover our Fibre Frontier investment. For example, a 20% lower uptake rate would result in an under-recovery of $5.9 million in present value terms. As the regulatory regime is intended to ensure full cost recovery of our efficient investment, the shortfall in recovery would be recovered from all fibre end-users over the life of the investment. Existing fibre end-users would partially cross-subsidise the Fibre Frontier investment. Our consultation highlighted a general willingness from existing fibre end-users to contribute to building out the network to rural New Zealanders. Whilst we tested an incremental price point of $0.98 per connection, our more precise updated modelling indicates the increase could be between $0.21 and $0.33 per connection (WACC dependent, see above WACC sensitivity). However, these numbers imply the full investment recovery is spread across the end-user base. In reality, the incremental impact on existing end-users would be lower (most likely significantly) as they would only have to make up for a potential shortfall in investment recovery from new Fibre Frontier end-users.

FIGURE 15.10: SENSITIVITY OF THE FIBRE FRONTIER INVESTMENT OVER/UNDER-RECOVERY TO CHANGES IN INPUT ASSUMPTIONS RELATIVE TO BASE CASE AND A WHOLESALE PRICE OF **CCI [ ]** PER CONNECTION (IN PRESENT VALUE TERMS)

[ ]

Relative to our base case, the below table shows the under/over-recovery for each 10% increment as plotted on the above graph.

TABLE 15.14: CHART OUTPUTS FOR FIBRE FRONTIER UNDER/OVER-RECOVERY SENSITIVITIES ($M)

	-50%	-40%	-30%	-20%	-10%	BASE CASE	10%	20%	30%	40%	50%
Capex (build)	14.5	11.6	8.7	5.8	2.9	0.0	-2.9	-5.8	-8.7	-11.6	-14.5
Capex (connect)	3.9	3.1	2.3	1.5	0.8	0.0	-0.8	-1.5	-2.3	-3.1	-3.9
Capex (lifecycle)	1.3	1.0	0.8	0.5	0.3	0.0	-0.3	-0.5	-0.8	-1.0	-1.3
Opex	1.0	0.8	0.6	0.4	0.2	0.0	-0.2	-0.4	-0.6	-0.8	-1.0
Connections	-14.7	-11.7	-8.8	-5.9	-2.9	0.0	2.9	5.9	8.8	11.7	14.7