CHORUS

OUR FIBRE ASSETS

Ā tātau rawa

This document provides details of our regulatory proposal for investment in fibre services during PQP2, the four-year price-quality regulatory period starting January 2025. The document includes a key component of our 2023 Integrated Fibre Plan - our investment report, which details investment plans and expenditure forecasts.

OUR FIBRE ASSETS

Ā tātau whakaritenga

CONTENTS

1.0 INTRODUCTION

Kupu Whakataki

1.0 Introduction

This chapter introduces the purpose and structure of this document and explains key conventions.

1.1 Purpose

Our Fibre Assets provides detailed information on our investment plans for fibre for our second price-quality path (PQP2), being the four years from 1 January 2025.

Our Fibre Assets is accompanied by a document, called Our Fibre Plans. These documents are the key parts of our PQP2 proposal and together they comprise our Integrated Fibre Plan for 2023.[1] Our Fibre Assets also includes a chapter on connection capex, which forms a key component of our connection capex proposal for PQP2.[2]

The purpose of Our Fibre Assets is to help stakeholders understand and assess the merits of our proposed investment in our fibre network by providing information on network assets, asset management, and forecast expenditure.

INTEGRATED FIBRE PLAN

Together, Our Fibre Plans and Our Fibre Assets make up our Integrated Fibre Plan (IFP).

The connection capex chapter provides connection capex proposal information.

1.2 Structure

We have structured this document to provide an overview of our investment plans, plus a systematic breakdown by investment area, then a summary of special topics.

The first part of the document provides overview information:

- introduction – introduces the purpose and structure of the document and explains key conventions
- proposal insights – explains the overall makeup of our proposal and key relationships between expenditure areas and with investment outcomes
- asset management – provides context on how we manage our assets and our progress and plans for improving asset management capability
- our network – provides more detail on our fibre network and the makeup and state of our network assets.

The second part of the document then steps through each expenditure area, providing information on forecasts and how they reflect good telecommunications industry practice and prudent and efficient investment. We break forecast expenditure into categories consistent with regulatory requirements:

1 Integrated Fibre Plan requirements are set out at clause 3.7.7 of the Fibre Input Methodologies determination. Our Fibre Assets provides the Investment Report requirements at 3.7.7(1)(d).
2 Connection capex baseline proposal requirements are set out at clause 3.7.14 of the Fibre Input Methodologies determination.

- **Extending the Network** – includes greenfield extensions (new property development) and augmentation work to add infill capacity (infill) or extend the network to more of Aotearoa (extension)
- **Installations** – work to physically connect individual premises or other end points to nearby communal network. This category also includes customer incentives investment to stimulate demand for fibre services
- **Network Sustain and Enhance** – investment in physical network assets. Includes adding diverse routes (resilience), accommodating other infrastructure work (relocations), and investing in the condition and capability of network buildings (site sustain) or in-field assets (field sustain)
- **Network Capacity** – investment in network electronics and associated management platforms aimed at ensuring reliability and cost-effectively meeting growing demand for bandwidth
- **IT and Support** – investment in IT systems that enable customer, network, and business operations, plus investment in offices and other corporate facilities
- **Connection Capex** – a subset of installations investment that is subject to a regulatory 'true-up' mechanism that mitigates over- or under-recovery risks associated with uncertainty in forecasting demand for new installations
- **Operating Expenditure** – recurring costs across customer, network, and support activities. Includes mix of internal and outsourced labour, plus operating costs such as electricity and fuel.

The third part of the document provides information on special topics:

- **ONT deployment strategy** – a more in-depth presentation of the analysis that supports our intended approach to managing the transition from GPON to XGS-PON access equipment
- **Fibre Frontier** – a more in-depth discussion of the rationale and economic justification for our proposal to extend network coverage to 89% of Aotearoa during PQP2.

THREE PARTS

First, we provide an overview. Then we step through each expenditure area. Finally, we cover special topics.

OPEX

We provide operating cost information that goes beyond IFP requirements and rounds out our PQP2 proposal.

1.3 Key conventions

Unless stated otherwise we present expenditure based on the following conventions:

- **calendar year** – all information is on a calendar year basis. This means figures will not match our financial reporting (which uses a June year-end) but do match information disclosures and other regulatory reporting
- **2022 base year** – all prices are expressed in constant price terms using 2022-dollar values
- **real historical** – historical figures are expressed in real terms, with Consumer Price Index (CPI) adjustments to bring values up to 2022-dollar equivalent values

- **constant price forecasts** – forecast figures do not have CPI or real price effects (see below) added. This allows us to show expenditure trends independent of economy-wide movements in input costs or dollar values
- **real price effects** – forecast figures exclude real price effects. In our regulatory templates we separately forecast movement in the real price of key inputs. Real price effect forecasts are locked into our allowances by the Commission but we expect CPI impacts will be adjusted for actual outturn inflation
- **capex forecasts** – capex is presented excluding Interest During Construction (IDC). In our regulatory templates we separately model IDC and the timing shift for converting capex to Value of Commissioned Assets (VCA). We expect VCA will be used for revenue setting
- **historical capex** - historical expenditure (from January 2016 to December 2022) is consistent with previous regulatory disclosures. Figures for 2023 are built up from historical figures for the first six months and forecast figures for the second six months
- **fibre access costs** – our proposal is for Fibre Fixed Line Access Services that are subject to price-quality regulation (PQ FFLAS) only. All our figures are consistent with applicable (for each period) scope of PQ FFLAS and allocation of shared costs. This includes consistency with the final determination of the opening value of our Regulated Asset Base (RAB) and consistency with allocation changes made as part of our 2022 information disclosures
- **lease costs** – we present lease costs consistent with our accounting treatment at the time:
    - lease costs are shown as capex from July 2017, which is when we adopted NZ IFRS 16. This presentation differs from our PQP1 proposal, where we presented forecast lease costs using a cashflow (opex) view
    - for earlier periods, we show operating leases as opex and finance leases are as capex, consistent with NZ IAS 17
- **narrative categories** – we present forecast and historical expenditure using narrative categories agreed with the Commerce Commission.

Our Modelling and Cost Allocation Report contains more information on our financial conventions, including modelling and forecasting.

REGULATORY ACCOUNTING

We present financial figures using regulatory conventions that support a focus on underlying long-term trends.

2.0 PROPOSAL INSIGHTS

Ngā Whakakitenga

2.0 Proposal insights

This chapter introduces the overall makeup of our PQP2 proposal, including key relationships between expenditure areas and with investment outcomes.

2.1 Introduction

This chapter presents information that helps build an understanding of our PQP2 proposal:

- **overall trends** – how we expect the level and makeup of our expenditure to change as we enter PQP2
- **updates and changes** – how our Integrated Fibre Plan has changed since the edition we published in 2020 as part of our PQP1 proposal
- **linkages** – connections between types of expenditure, and with our business and asset management strategy
- **competition** – parts of our proposal that have a notable impact on competitive dynamics or outcomes
- **legislative obligations** – programmes of work that have a notable link to legislative drivers
- **efficiency** – our efficiency efforts and the assumptions built into our forecasts
- **resilience** – how and where resilience expenditure features in our plans.

Each section addresses one or more requirements of the fibre input methodology (IM) or PQP2 Section 221 information notice issued to Chorus by the Commerce Commission in February 2023.

2.2 Overall trends

2.2.1 Capex

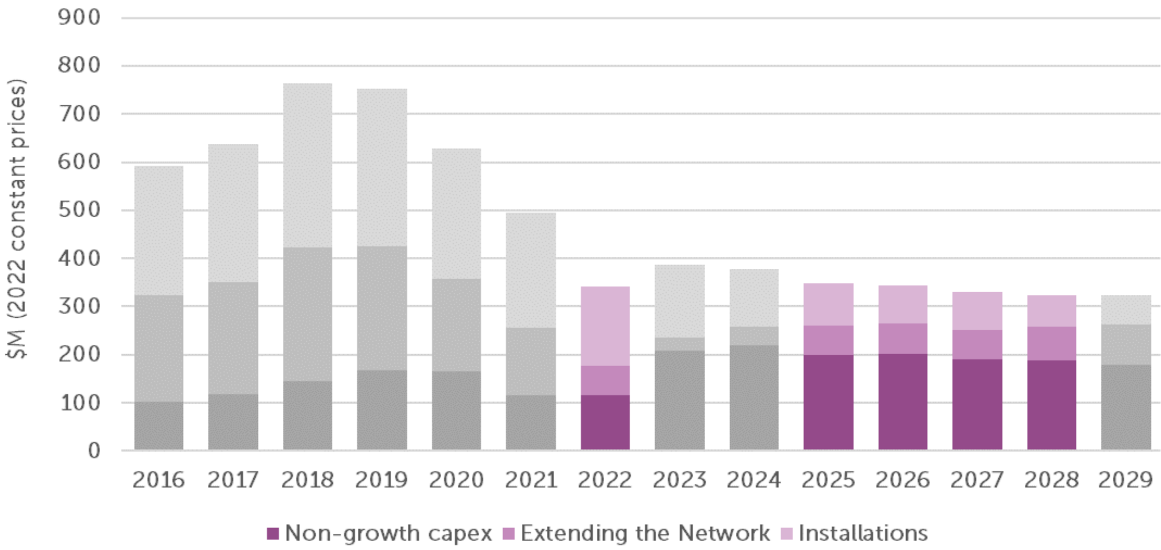
During PQP2 we plan to invest $1.34 billion of capex.

PQP2 CAPEX

We plan to invest $1.34bn of capex.

$1.34bn

FIGURE 2.1: HISTORICAL AND FORECAST CAPEX (PQ FFLAS)



In relation to Figure 2.1 above we highlight the following about historical and forecast investment:

- the Ultra-Fast Broadband (UFB) programmes extended fibre coverage to 87% of the population, with Chorus investing more than $4 billion over 11 years as our part of the programme
- fibre coverage prompts demand-led installation investment that enables individual premises to access fibre services. By the end of 2022 we completed our part of the UFB rollout, making fibre available to more than 1.3 million homes and businesses, and we had around 1 million fibre connections
- extension and installation investment peaked in 2018 and dominated investment from 2016 to 2022
- with the UFB programmes behind us, we have greater discretion to direct investment to enhancing or extending the network. If the Commerce Commission approves our proposal, we plan to extend fibre to another 40,500 premises (taking coverage to 89% of Aotearoa) over PQP2.

'Non-growth capex' includes all work on:

- sustaining the condition of field and site assets
- optimising network electronics, including to accommodate bandwidth growth and manage obsolescence, cost, and capability
- maintaining and evolving IT systems, including to enhance business to business processes, deliver improved end-user experiences, meet evolving compliance obligations, manage obsolescence, support asset management activities, and deliver efficiency improvements
- investing to improve resilience, or otherwise reducing network risk.

UFB DELIVERED

Having delivered our contribution to the UFB programmes, our planned investment is smaller and more balanced.

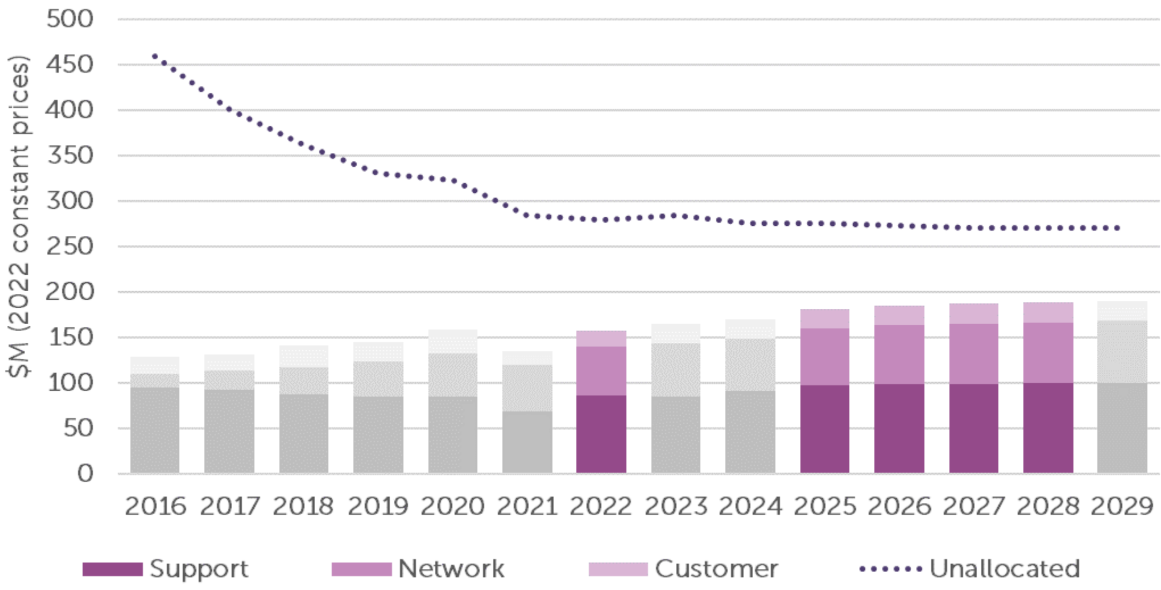
Observations regarding this non-growth expenditure include that:

- some is directly driven by the UFB programmes – including adding capacity to keep the network congestion free as usage grows and developing and enhancing systems for interfacing with retail and in-field service providers. These investments supported the positive end-user experiences and active retail community that have stimulated growth in fibre market share. To meet contractual obligations, we've also added resilient links as connection numbers have grown
- another major programme up until now has been separating our IT systems from Spark following our separation from Telecom (now Spark) in 2011. This investment has allowed each business to tailor systems to its needs
- we have kept the balance of our investment over that period as low as possible, consistent with managing cashflow and financing through the network build phase. From 2023, there is a step up in the volume of non-growth work – both in absolute terms and as a share of total capex
- we propose increased investment to improve network resilience. We discuss this further in section 2.8 below.

2.2.2 Opex

During PQP2, we forecast average opex of $185 million per annum. In Figure 2.2 below, we have shown the growth in opex allocated to fibre and the trend in unallocated opex (i.e. all direct and shared opex).

FIGURE 2.2: HISTORICAL AND FORECAST OPEX (UNALLOCATED AND PQ FFLAS)



This highlights key trends:

- FFLAS network opex has grown as we have built out more fibre network. This reflects the growth in direct fibre costs, the increasing allocation of shared costs and the impact of declining aggregate work volumes and inflationary pressures
- we have steadily reduced total (unallocated) opex. This reflects the transition from copper (with comparatively high operating costs) to fibre, plus our efforts to improve efficiency over time. In addition, we have adopted new accounting standards as they have been released, which have had the effect of increasing capitalisation over time. This includes costs relating to customer acquisition and certain lease costs.

PQP2 OPEX

We forecast opex of $185m per year.

$185m

2.2.3 Non-growth capex per connection

To complement the above views, it is useful to examine how non-growth cost per connection has trended over time.

FIGURE 2.3: HISTORICAL AND FORECAST NON-GROWTH CAPEX (TOTAL AND PER CONNECTION) (PQ FFLAS)

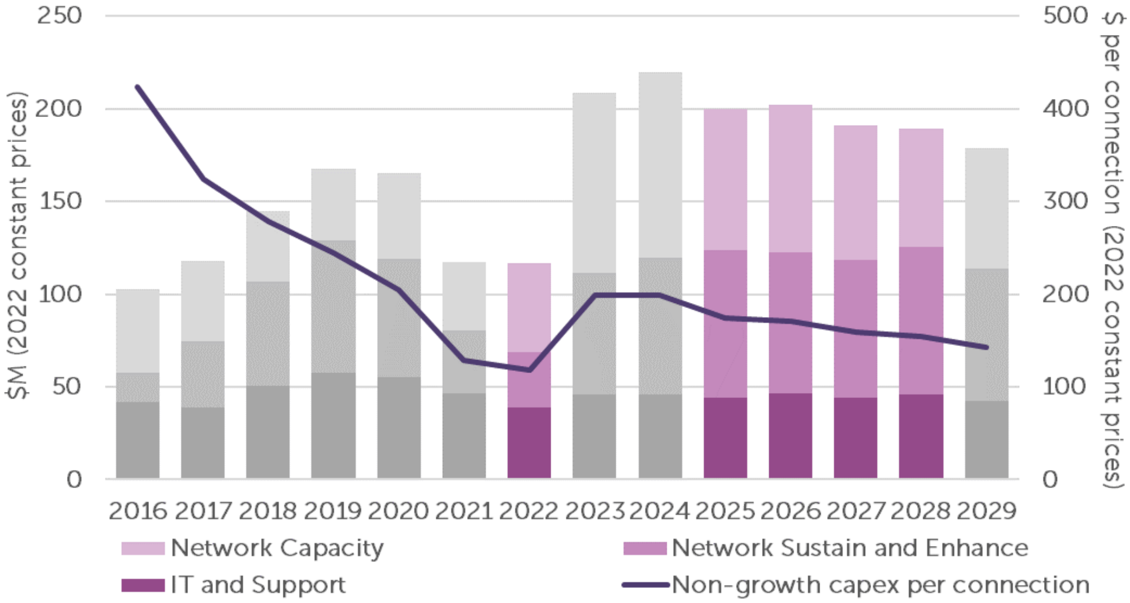


Figure 2.3 above shows the trend in 'non-growth capex' per fibre connection. We observe that:

- non-growth capex includes expenditure in the Network Sustain and Enhance, Network Capacity, and IT and Support narrative categories (i.e. all capex excluding that in the Extending the Network, and Installations categories)
- non-growth capex per fibre connection reduced materially up until 2022 as connection numbers grew and we sought to minimise discretionary and deferrable investment[3]
- the forecast includes investment that is somewhat one-off in nature, including:
    - resilience, which adds new network elements
    - seismic upgrades, which improves the robustness of exchanges
- noting the above, we forecast that non-growth capex per connection will increase in 2023 as we:
    - catch up on deferred work from 2021 and 2022 including investment in network assets, such as exchange building weathertightness and monitoring
    - progress the one-off investments mentioned above
    - begin or scale up proactive investments, such as pole and fibre replacements
    - enable more widespread adoption of Hyperfibre services through deployment of XGS-PON line cards
    - address lifecycle investment in aggregation and transport electronics
    - progress a one-off programme to exit Huawei transport electronics
- beyond 2023, we forecast resumption of a downward trend in non-growth capex per fibre connection.

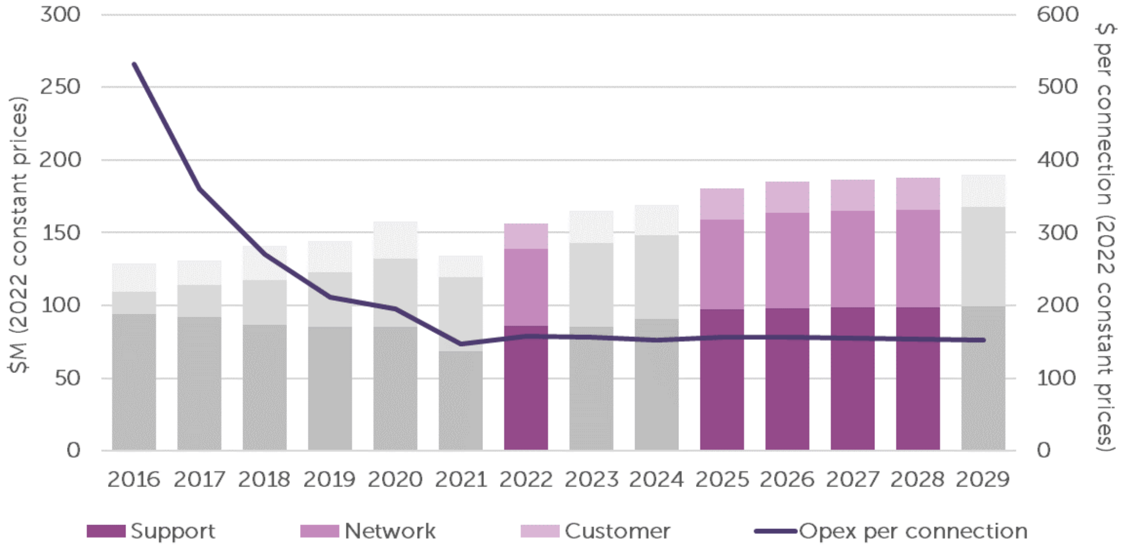
PRUDENT REINVESTMENT

End-user growth has lowered the cost per connection, enabling prudent investment in resilience and proactive asset management.

3 The combination of COVID restrictions in 2021, service company reset (2022) and labour market conditions (and shortage of technicians) during 2021 and 2022 led to a notable reduction in less-time sensitive capex to allow prioritisation of time sensitive and customer impacting activities such as installations, new property development and service restoration.

2.2.4 Opex per connection

FIGURE 2.4: HISTORICAL AND FORECAST OPEX (TOTAL AND PER CONNECTION) (PQ FFLAS)



The presentation above shows the trend in opex per fibre connection. Observations are that:

- as with non-growth capex, opex per fibre connection has reduced materially as we have added connections – from over $530 per connection in 2016 to less than $150 in 2021. This reflects the economies of scale from expanding fibre connections (even as shared costs are increasingly allocated to fibre) and changes in the accounting treatment of leases and acquisition costs
- 2021 costs were low, as activities were impacted by COVID-19 disruptions
- we forecast opex per fibre connection will stabilise at $155-$160 per annum, reflecting a balance between declining economies of scope (i.e. as copper services cover a declining portion of shared costs) and increasing economies of scale for fibre plus other benefits
- we re-tendered field services contracts in 2022, which has helped contain cost pressures from declining volumes of field work (including due to winding down of build and install activity, and declining copper connections). Overall volumes will continue to decline across PQP2, providing an ongoing source of pressure on unit costs.

OPEX EFFICIENCY

We forecast opex per connection will stabilise.

2.2.5 Assumptions and uncertainties

Our forecasts adopt common assumptions regarding:

- **connection and bandwidth growth** – we maintain a central forecast of demand growth, which rests on assumptions regarding population and housing growth, fibre market share, and usage per connection[4]
- **cost allocation** – we apply cost allocation centrally to ensure consistency. Allocations are audited and comply with the Cost Allocation IM[5]
- **cost escalation** – we forecast in constant price terms, then add consistent central forecast of movements in key input costs and overall inflation[6]
- **field services costs** – we use common field services resources across most maintenance and in-field capital expenditure activities. We adopt common assumptions across these activities for changes in job rates at contract reset events.[7]

CONSISTENCY

We use a core set of common assumptions across our capex and opex forecasts.

Key uncertainties across our proposal include:

- **input cost escalation** – our allowances will adjust for general inflation but not for departures from forecast movement in input costs
- **project cost estimates** – the scope, phasing and cost of large projects are uncertain. Uncertainty is higher if the planned works are further into the future, if they involve civil works, if they involve modifying existing buildings, or if they involve novel work. We are in the process of using market testing to help reduce uncertainty for Fibre Frontier[8] and resilience programmes. Other notable large projects include our seismic upgrade and exchange relocation programmes, and our trouble management system replacement programme
- **programme efficiency gains** – we are forecasting significant cost reductions as we scale and mature our smart locations installation programme. The demand for smart locations installation is uncertain, as is the scope for associated efficiency gains
- **IT investment makeup** – while we are confident regarding the overall level of investment in IT systems, the nature of IT investment is that prioritisation and scoping is continuously refined and is uncertain when projecting into future years.

4 Refer to Demand chapter of Our Fibre Plans for more information.
5 Refer to Modelling and Cost Allocation Report for more information.
6 Refer to Modelling and Cost Allocation Report for more information.
7 Refer to Delivery chapter of Our Fibre Plans for more information.
8 Fibre Frontier is the name we have given our network extension programme. You can find more information on this programme in chapter 15.0.

2.3 Updates and changes

We published our first Integrated Fibre Plan in 2020 as part of our PQP1 proposal, and this document is part of our first Integrated Fibre Plan update.

We published the 2020 plan before key parts of the regulatory regime for fibre had been settled. Notably, our 2020 plan:

- presented historical expenditure on an unallocated basis only. This was because allocation methodologies remained market sensitive due to their impact on our yet-to-be-determined regulatory asset base (RAB) value. We now have a settled approach to allocation, after the starting RAB determination published in October 2022, and can present allocated historical data which provides better insight into trends over time
- presented PQP1 forecasts on an allocated basis using our view at the time of the scope of PQ FFLAS and appropriate allocations
- did not provide a view of forecast expenditure beyond PQP1. Our business planning at the time had a five-year horizon for expenditure build-ups, so for 2025 and 2026 we were only able to provide high-level extrapolations on a confidential basis.

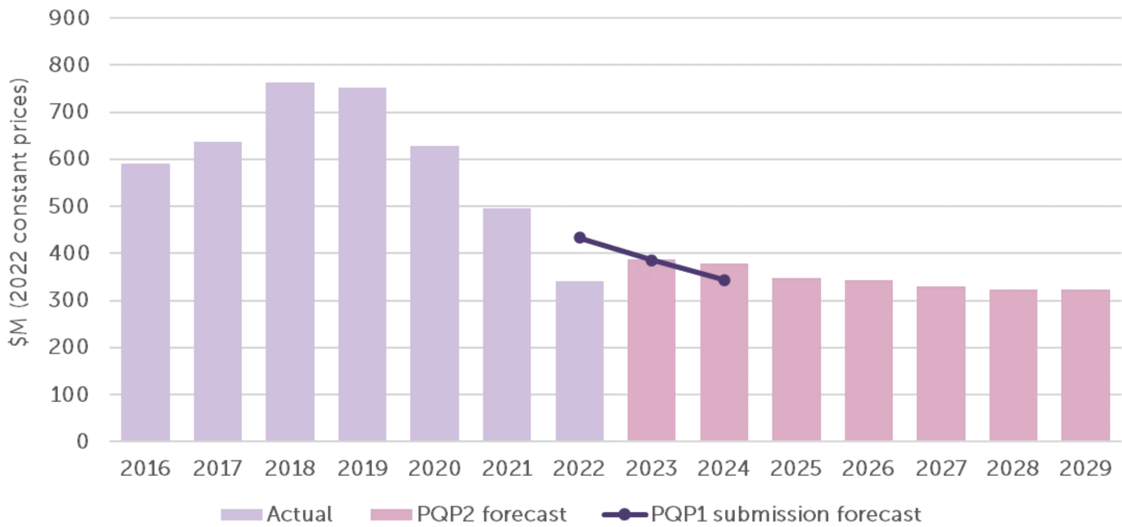
IMPROVEMENT

This is only our second Integrated Fibre Plan. We have made updates since 2020 to improve this 2023 edition.

Below we present a comparison between forecasts from our 2020 plan, and the historical and forecast information in this plan.

2.3.1 Capex

FIGURE 2.5: HISTORICAL AND FORECAST CAPEX COMPARISON WITH PQP1 SUBMISSION FORECAST (PQ FFLAS)



Key observations are:

- actual fibre capex for 2022 was lower than the PQP1 submission forecast (noting that our final PQP1 allowance approved by the Commerce Commission was lower and closer to our 2022 actuals). Key drivers for this outcome are:

- prioritisation of time sensitive and end-user impacting activities such as end-user installations, fault response and new property developments (NPD)
- significantly higher NPD demand than assumed in the PQP1 submission forecast. The netting off of NPD revenue from capex allowances and actuals reduced reported capex by $33 million (i.e. 8%) in 2022)[9]
- pause or deferral of some non-time sensitive investment, for example, our managed migrations programme[10] and the refurbishment of the Courtenay Place exchange

- our forecasts for 2023 and 2024 are now materially in line with our PQP1 submission forecast but materially higher than our PQP1 allowance. Key drivers for this outcome are:
  - the first stage of Fibre Frontier programme commencing 2024, which will extend fibre to an additional 40,500 premises by the end of PQP2
  - refinement and expansion of our seismic upgrade programme, which is needed to achieve compliance with earthquake prone building legislation
  - introduction of our solar upgrade programme, which will reduce costs long-term by reducing electricity requirements
  - introduction of work to proactively provision more XGS-PON equipment into key exchanges to support Hyperfibre uptake
  - refinement of the scope, phasing and costing of work to address the condition of our exchange buildings, with a focus on weathertightness and safety
  - refinement of the scope, phasing, and cost of proactive programmes across poles, slotted core fibre, and fibre flexibility points
  - refinement of the scope, phasing and cost of lifecycle and growth investment in aggregation and transport equipment
  - the basis of preparation – specifically, reported actuals and forecasts account for the final starting RAB decision, cost allocation actuals, changes to allocators and higher than expected inflation (which the submission forecasts do not).

We are working to prioritise capex in 2023 and 2024. We expect this will reduce capex for 2023 and 2024 respectively but that we will exceed PQP1 allowances in both years.

NEW PLANS

While 2022 investment was close to our 2020 forecast, we have developed our plans for 2023 and beyond.

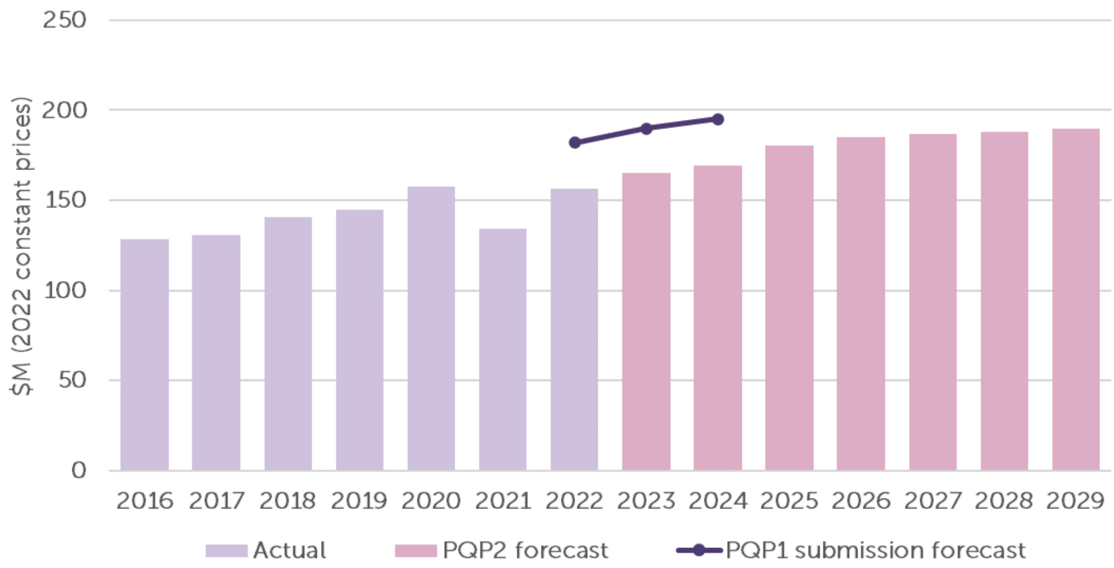
NEW OUTCOMES

Our new plans include more network extension, resilience, renewal, sustainability, and technology enhancements.

9 Refer 2022 Information Disclosure CEO cover letter, page 2, note 1: chorus-fibre-information-disclosure-dy22-ceo-cover-letter.pdf (ctfassets.net)
10 A programme designed to increase our FFLAS end-users and migrate customers away from copper services

2.3.2 Opex

FIGURE 2.6: HISTORICAL AND FORECAST OPEX COMPARISON WITH PQP1 SUBMISSION FORECAST (PQ FFLAS)



Key observations are that 2021 and 2022 were affected by:

- COVID-19 restrictions and release of a holiday pay provision
- restructuring and renewal of field services contracts with change of provider in some areas had a small but noticeable effect on operating expenditure in the second quarter of 2022
- a constrained labour market and reopening borders in Aotearoa contributed to a technician shortage during 2022 (and 2023) with a small but noticeable impact on operating expenditure in 2022 (with a more pronounced impact on capex)
- curtailment of marketing expenditure in 2022 due to technician shortages and the transitory difficulty meeting demand for new installations.

While inflationary pressures built through 2022, the timing of contract changes and staff compensation muted the impact in 2022 (the full impacts are being felt in 2023, along with the cost of meeting new price-quality and information disclosure compliance requirements).

2.3.3 Other changes

We have also evolved our approach to forecasting and asset management, with key changes being that we:

- adopted a base-step-trend approach to forecasting opex, as is common for regulated businesses

BST FORECAST

We have revamped our approach to forecasting long-term operating costs – adopting the base-step-trend (BST) approach commonly used by regulated businesses.

- conducted a strategic study to test the optimal approach to manage lifecycle and technology evolution objectives for our optical network terminals (ONTs)
- developed a new portfolio asset management plan (PAMP) for poles, as a forerunner to refreshing all our PAMPs. This new pole PAMP applies survivor curve analysis, which is an advance on our previous practice
- enhanced our approach to stakeholder engagement, making extensive use of stakeholder research. This included research that informed a strategy refresh in 2022, and further research during 2023 to test specific investment choices for PQP2
- extended the forecast horizon for our business plan expenditure build-up to 10 years.

Finally, we have updated how we present the Integrated Fibre Plan. Key changes are:

- this chapter replaces the Investment Summary from Our Fibre Plans, which reduces duplication between Our Fibre Plans and Our Fibre Assets. We have also used this chapter to address aspects of matters such as efficiency that are best addressed at a proposal-wide level (rather than in each expenditure chapter)
- we have centralised discussion of network assets into the Our Network chapter in this document
- the Demand chapter in Our Fibre Plans is significantly enhanced and provides richer information on how we develop demand forecasts
- we developed a new Asset Management chapter for this document
- we have adopted a more programme-based and less asset-centric approach to most expenditure chapters in this document. This provides a more coherent and accessible explanation of the drivers for investment.

STREAMLINING

We have reduced duplication between Our Fibre Plans and Assets, pulled asset information into one place, and taken a more programme-based approach to explaining our forecasts.

2.4 Linkages

Notable linkages and trade-offs between opex, base capex and connection capex, quality and other outcomes are summarised below:

- marketing (opex) and customer incentives (base or individual capex) support demand for fibre services, and for new products
- network capacity investment (base capex) is based on an optimised plan that solves for multiple outcomes. One of those outcomes is achievement of the performance quality standard
- reactive maintenance expenditure (opex) is essential for achieving availability quality standards
- our proactive pole replacement and our pit and manhole inspection and replacement programmes (base capex) have strong public safety drivers
- we expect that a subset of our IT benefits investments (base capex) will support opex reductions (e.g. by automating processes)

COHERENCY

The component parts of our expenditure and quality proposal fit together as a coherent whole.

- we expect a portion of our IT investment (base capex) and opex will support improved asset information and asset management more generally. This will influence the makeup for future capex and opex plans
- our resilience and seismic upgrade programmes (base capex) will reduce network vulnerability to severe events.

Our proposal is consistent with our business strategy. Notable features that demonstrate this consistency are:

- we aim to grow demand for fibre services, including through product development, marketing, and customer incentives. Growing connections reduces cost per connection, helps pay down losses from the network build phase, and creates options to consider discretionary investment
- we recognise that our fibre network is an important asset for Aotearoa, and we have a responsibility to ensure it delivers value. This is reflected in our investment in next generation (XGS-PON) services, our low-cost starter product, enhancing resilience, extending coverage to more New Zealanders, and our category marketing efforts
- we have a cautious approach to discretionary investment because we are wary of over-investing and impairing the competitiveness of fibre services. We are also constrained by access to finance. This caution is evidenced in our approach to minimising lifecycle investment, and sizing and testing resilience and Fibre Frontier programmes
- notwithstanding the above, we recognise that good asset management can involve proactive interventions with longer-term payback periods. This is evident in our solar programme and fibre flexibility point rehabilitation programme
- we also recognise that good asset management can involve investing in information, decision frameworks and analytics that improve prioritisation. This is demonstrated in our refreshed PAMP for poles, and our ONT strategy.

ALIGNMENT

Our proposal aligns with our business strategy.

2.5 Competition

Our services both enable and compete with other telecommunication providers and associated services (for example contestable infrastructure for new property developments).

Our services:

- enable and compete with other technologies – fibre competes with copper, fixed wireless, and satellite broadband
- support retail competition – we supply fibre services as a wholesaler only. This supports competition amongst retailers, including fibre-only retailers and retailers offering multiple technologies
- are designed and built to support Layer 2 contestability – access seekers can elect to take our Layer 1 services and provide their own Layer 2 services.

We also compete with other fibre companies to extend fibre coverage.

Areas of proposed expenditure with a strong link to competitive dynamics or outcomes are:

- **Fibre Frontier** – extending the network brings technology competition to new locations and expands the size of the fibre retail market. Network extension beyond the level planned for PQP2 could also increase the average cost per connection of fibre services
- **marketing and customer incentives** – promoting the fibre category and fibre products helps fibre compete with other technologies and helps grow the fibre retail market. In addition, customer incentives stimulate demand by reducing barriers to uptake
- **customer IT** – investment in customer systems help improve retailer and end-user experiences, which supports retail competition and helps fibre compete with other technologies.

COMPETITIVE

Where fibre is available, it competes with other technologies and supports vibrant retail competition.

In addition to the above, the overall competitiveness of fibre is impacted by the price-quality balance that we maintain. In particular:

- the lower our expenditure, the more competitively we can price our services longer-term, and the better fibre will compete with other technologies
- investments that prevent congestion, improve resilience and reliability, offer new products, and reduce carbon intensity improve the attractiveness of fibre and enhances its ability to compete with other technologies.

2.6 Legislative obligations

We carry out all our work in compliance with applicable laws, including safety, environmental, and employment laws. Also, we offer our services and set prices in compliance with specific telecommunications laws and general commercial and consumer laws.

Programmes of work with notable legislative drivers are:

- **seismic upgrades** – we plan to upgrade exchanges as required to comply with earthquake prone building legislation
- **relocations** – local government, roading and railway legislation govern our obligations and cost recovery arrangements for work to accommodate roading and rail maintenance and improvements.

We are also adapting our business to efficiently comply with new price-quality, information disclosure and climate regulation through a combination of business system, process and operational changes. We propose a small opex increase to meet the external assurance costs necessary for compliance, and to support execution of our asset management development roadmap.

2.7 Efficiency

Our proposal adopts a 'revealed costs' approach to efficiency. This means that forecasts carry forward costs observed in 2022, without applying adjustments for prospective or speculative efficiency improvements.

This is consistent with our understanding of the Commerce Commission's approach to other regulated utilities. We understand this approach is effective because it results in sharing of efficiency gains between suppliers and end-users over time, which in turn encourages suppliers to pursue (and reveal) efficiency gains.

In contrast, building prospective efficiency gains into regulatory allowances risks under-funding efficient costs and encourages suppliers to hold back on pursuing or realising efficiency initiatives.

The revealed costs approach is appropriate for Chorus because our operating environment has consistently favoured a cost minimisation approach. In particular:

- copper price resets early in our corporate history imposed a revenue shock that stimulated aggressive cost management
- the UFB programmes were structured to reward outperformance. Financing the programmes was also challenging and required minimisation of discretionary or deferrable costs
- Chorus is a listed entity, with investor scrutiny that focusses on efficiency, capital discipline and revenue growth
- as fibre competes with other technologies, we have a fundamental strategic incentive to ensure we sustain a competitive balance between cost and quality
- from 2022, we have been subject to revenue control arrangements that reinforce incentives to outperform cost forecasts.

Our efforts to ensure we operate efficiently are demonstrated by initiatives such as:

- extensive re-use of legacy assets for delivery of fibre services
- careful testing of the optimal ONT replacement strategy, which resulted in rejecting proactive replacement options
- bringing forward reconfiguration of field service contracts to contain cost pressures associated with declining in-field work volumes
- deferral of non-essential investment in exchange buildings
- programmes to reduce exposure to Spark costs associated with shared IT systems, exchange space and engineering services
- testing whether end-user ONT self-installs could avoid truck roll costs.

PRINCIPLED

We have a principled approach to efficiency that ensures we have incentives to pursue gains and share those gains with end-users.

Exceptions to our approach of using 2022 revealed costs are:

- **IT benefits** – we anticipate that a portion of overall benefits-driven IT investment will deliver opex reduction benefits and we have forecast the associated opex reductions accordingly. This approach overcomes limitations in our expenditure incentive settings while also ensuring we do not over-recover the cost of these investments[11]
- **electricity cost reductions** – we anticipate that investment in solar systems will reduce electricity costs at exchanges and have forecast opex reductions accordingly. As above, this approach overcomes incentive setting limitations
- **smart location installation costs** – as this activity is relatively new and small scale, we anticipate there may be considerable scope for cost reduction as delivery scales and matures. We have factored this into our demand forecasts and, as such, we have elected to build potential cost reductions into our expenditure forecasts.

BUILT-IN GAINS

As well as building-in all gains achieved to date, we have projected efficiency gains in three areas – IT benefits, electricity costs, and smart location installations.

2.8 Resilience

Some of our proposed expenditure is directed at improving the resilience of our network, which was strongly supported by end-users in our PQP2 consultations.

Material programmes of work with this objective are:

- **route diversity** – we plan to continue to build geographically diverse fibre routes to ensure that no single element failure impacts more than 3,000 premises (as required by our architecture standards). Dual path routes reduce the likelihood of outages by ensuring that the network can still operate even if certain parts fail.
- **functional limits** – based on our resilience standards (as well as our risk appetite and brand protection goals), we impose functional limits on our network sites – i.e. limiting the number of connections relying on any one site, based on the functions performed by that site. We plan to continue to expand other sites so that we can move traffic away from sites that are approaching their functional limits.
- **seismic upgrades**[12] – in accordance with the Building (Earthquake Prone Buildings) Amendments Act 2016, we have reassessed the importance level (IL) of our network sites and upgraded our Core and Mesh buildings from IL3 to IL4. This is the required standard for buildings that support services that must be available following an earthquake. As such, these buildings must now meet higher seismic standards. Following our detailed seismic assessments, we plan to start remediation work on two sites during PQP2.

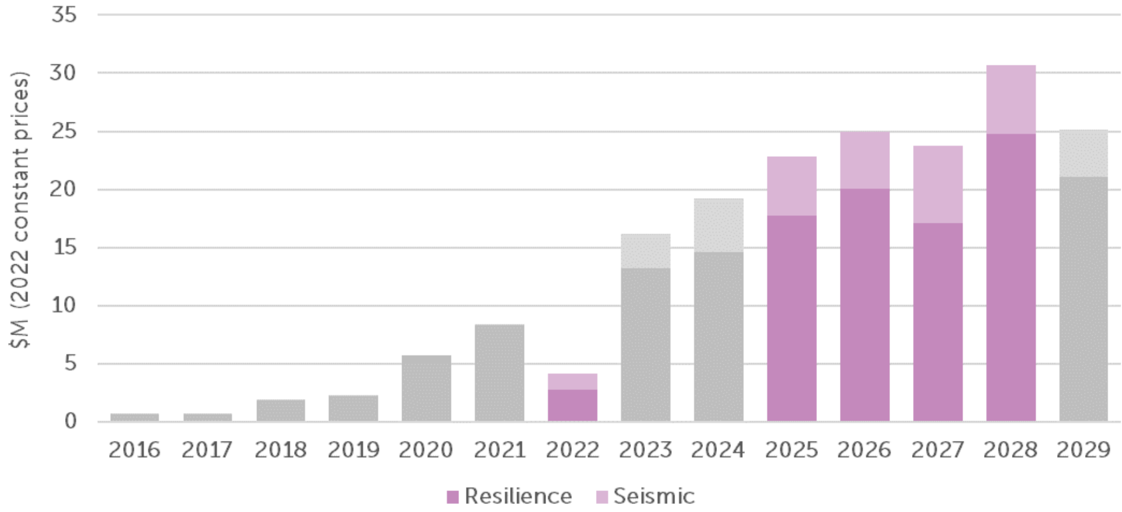
RESILIENCE

Resilience is woven into how we plan and operate, plus we have specific resilience-focused programmes of work.

In aggregate, these areas account for $103 million across PQP2, which is 8% of proposed capex. The profile of this expenditure is shown below.

11 If expenditure incentives were complete, then we would not need to forecast this class of capex as it would be self-funded through the associated opex savings.
12 Seismic upgrade work forms part of our Site Sustain expenditure sub-category within Network Sustain & Enhance.

FIGURE 2.7: HISTORICAL AND FORECAST RESILIENCE CAPEX (INCLUDES SEISMIC UPGRADES) (PQ FFLAS)



Note that in Figure 2.7:

- the Resilience expenditure sub-category includes forecast expenditure on route diversity and functional limits,
- from 2016 to 2022, Resilience includes fibre growth. From 2023 we have categorised fibre growth as Field Sustain investment, reflecting that resilience is typically a by-product rather than a driver for this investment
- seismic investment (which is within our Site Sustain expenditure sub-category) does not include new buildings (such as the proposed building at Gore), but seismic risk can be one of the key drivers for such projects
- similarly, seismic does not include the incremental cost of seismic strengthening carried out as part of the Courtenay Place refurbishment. The Courtenay Place project has multiple drivers and elements
- Resilience does not include the incremental cost of diversity that was built into the network as part of network extension.

STRENGTHENING

We are planning major investment into route diversity, functional limits, and seismic upgrades.

$103m

Key observations are:

- we are proposing significant growth in investment in standalone diversity projects, consistent with end-user preferences
- we expect our compliance-driven programme of seismic upgrades to grow in PQP2.

In addition to the investment shown (and mentioned) above, improved resilience is one of the outcomes for other expenditure areas, most notably:

- **network capacity** – resilience is one of the outcomes we consider as we develop optimised plans for responding to bandwidth growth, lifecycle renewal and new product set drivers. For example, by balancing load across switches we can make the network more resilient to equipment failure, and by carrying critical spares we can reduce restoration times

- **solar** – solar photovoltaic systems can extend the running time of backup power arrangements at exchanges.

We have not attempted to break out the portion of this expenditure that could be considered attributable to resilience. We have not proposed any opex uplift specifically aimed at improving resilience.

3.0 ASSET MANAGEMENT

Whakahaere Rawa

3.0 Asset management

This chapter introduces our approach to asset management and our roadmap for capability improvements.

3.1 Asset management context

Our fibre network:

- provides an increasingly essential service
- competes with other networks from other providers, and is displacing our legacy copper network
- provides world-class performance supporting uncapped, congestion-free service
- relies on a mix of old assets (notably buildings) and new assets (notably fibre and electronics) located across Aotearoa
- uses a mix of long and short-lived assets, with a mix of replacement drivers across age, physical condition, capacity, and obsolescence.

As an asset manager, Chorus:

- has engineering and commercial know-how that builds on Telecom's long history as a voice and broadband provider, and our more recent success delivering the Ultra-Fast Broadband (UFB) programmes
- endured a formative financial shock after copper prices were revised down in a 2012 regulatory determination, and enduring financial constraints while investing in the UFB programmes and building fibre revenue
- remains financially constrained, with fibre revenue tracking below allowable revenues
- retains a strategic imperative to invest at a level that sustains a competitive service, with an attractive (to end-users) balance of price and outcomes (including quality)
- has needed to prioritise capabilities that support UFB delivery, customer acquisition and cost containment
- has recognised the need to shift its priorities with completion of UFB build, maturing of uptake, ageing of assets, and entry into new regulatory arrangements
- has identified what we need to do to improve our asset management capability.

FIBRE

We are managing a new fibre network with both new and repurposed assets, providing services in a highly competitive environment.

This context has some similarities and many contrasts to the utilities traditionally subject to price-quality regulation. As such, it is important for us to evolve our asset management in a way that:

- preserves existing strengths, where these remain valuable
- builds new strengths in the areas where they will be most valuable
- tailors approaches to our context
- meshes effectively with our corporate priorities and culture.

EVOLUTION

Our asset management priorities are evolving as our activity mix changes.

3.2 Asset management roadmaps

In August 2020, we commissioned a leading asset management consultancy to review and benchmark our asset management capabilities. The review found that:

- our asset management capability was similar to other organisations undertaking their first reviews, but behind leading practice
- we had strengths oriented toward lifecycle delivery, which fits with our focus on the UFB rollout.

At the same time, we were putting together our first regulatory proposal (PQP1) and engaging with the Commerce Commission on input methodologies and regulatory asset base valuation. Through these processes we:

- extended our expenditure forecast horizons, and introduced regulatory forecasting techniques (such as real price effects)
- developed methodologies for forecasting cost allocation outcomes
- prepared extensive new documentation, covering matters such as demand forecasting, capital governance, delivery, asset populations, and lifecycle management approaches
- began the process of understanding the nature and extent of testing and justification needed to support regulatory approval processes.

Following resolution of our PQP1 revenue path, we prepared a series of asset management roadmaps to chart the next steps for:

- cost estimation
- asset data
- improving our asset management capability.

ROADMAPS

We prepared three roadmaps in 2022 to guide our capability development efforts.

The roadmaps built on the benchmark report and our PQP1 proposal experience, and aimed to:

- establish a small 'centre of excellence' team to guide development of asset management policies, strategies, and plans to enhance capability (including through delivery of the roadmaps)

- deliver early wins that would demonstrate tangible progress ahead of our PQP2 submission, and provide lessons and a template for wider progress
- traverse priority components of our asset management system, including direction-setting (policies, objectives and strategies), planning, analytics, and people.

In August this year, we provided the Commerce Commission with an update on our roadmaps. Highlights include that we:

- have established a centre of excellence, as planned
- have completed an updated portfolio asset management plan (PAMP) for poles, which included implementation of survivor curve analysis. This provides a forerunner for other PAMP updates and has directly benefited our PQP2 proposal
- completed a strategic study of our optical network terminal (ONT) assets. This brought new rigour to our testing and documentation of asset strategies. It has informed our PQP2 proposal, will inform a future update of the ONT PAMP and acts as a forerunner for future strategic studies
- completed updates of our Asset Management Policy and Strategic Asset Management Plan, which included developing a future value framework. These are key documents for aligning asset management with our strategic objectives
- progressed development of four technology sub-strategies, covering software lifecycle management, hybrid cloud and security, congestion free network, and network availability
- have formed an asset management leadership team to review and approve initiatives recommended by the centre of excellence.

PROGRESS

We have made good progress against our roadmaps, laying foundations for further improvement.

We have completed these initiatives in parallel with many other activities, including:

- transitioning to new facilities management and field services contracts
- managing through COVID-19-related workforce and materials disruptions
- implementing an agile-based resourcing model for IT delivery, and adaptive practices more widely
- finalising our regulated asset base (RAB), implementing new systems for business planning and cost allocation, preparing an individual capex proposal for customer incentives, and publishing our first information disclosure under new rules
- conducting extensive proposal-focused stakeholder engagement designed to test prioritisation across key discretionary investment areas
- preparing our second (PQP2) regulatory proposal, which has included an intensive independent verification process.

Based on our progress and thinking to date we have refined and updated our roadmaps. We are pleased with our progress to date but recognise we have much left to do, noting:

- closing out the PQP2 process will free up resource, including to progress work on cost estimation that we re-phased to accommodate other priorities and to gain the benefit of lessons from the independent verification process
- we will need additional dedicated resource, and longer term we will need to evolve our operating model and capability
- we appreciate regulatory processes demand development of review-friendly documentation and models, and greater application of systematic and repeatable planning processes and analytics
- while we can learn from other sectors, we also need to tailor approaches to our network. For example, many of our assets suit a run-to-failure strategy or are managed through co-optimisation of condition, obsolescence (technical and economic) and capacity.

REFINEMENT

We have refined and updated our roadmaps, as set out in updates prepared earlier this year.

3.3 Asset management system

Our proposal provides extensive information on aspects of asset management:

- **demand** – the Our Fibre Plans Demand chapter explains how we forecast relevant types of demand, and how these forecasts link through to investment planning and delivery management
- **delivery** – the Our Fibre Plans Delivery chapters explains our resourcing and operating models for delivering our asset management plans
- **governance** – the Our Fibre Plans Governance chapter provides an overview of our overall corporate governance and proposal governance, plus governance arrangements across product, asset, financial, and risk management
- **engagement** – the Our Fibre Plans Engagement chapter explains how we work to understand information on retailer and end-user preferences and reflect that understanding into our product and wider planning
- **quality** – the Our Fibre Plans Quality chapter explains how we set quality targets as a key driver of our asset management activities
- **assets** – the second part of this document provides more information on management by expenditure areas. This includes information on the drivers for expenditure in each area.

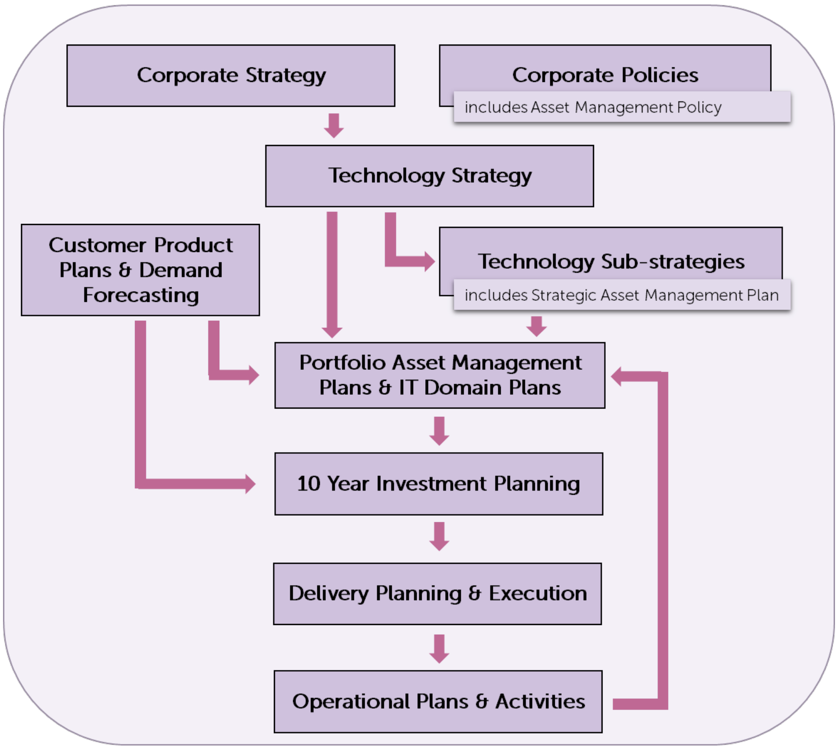
Schedule 13 of our price-quality information disclosures also provide an update on the status of our asset management capabilities and plans for future progress.[13]

The proposal information complements and aligns with the information provided in our recently updated Strategic Asset Management Plan (SAMP).

13 Our first annual disclosure can be found here: chorus-fibre-information-disclosure-schedule-1-13.pdf (ctfassets.net)

The SAMP is one of ten technology sub-strategies, some of which are still in development.

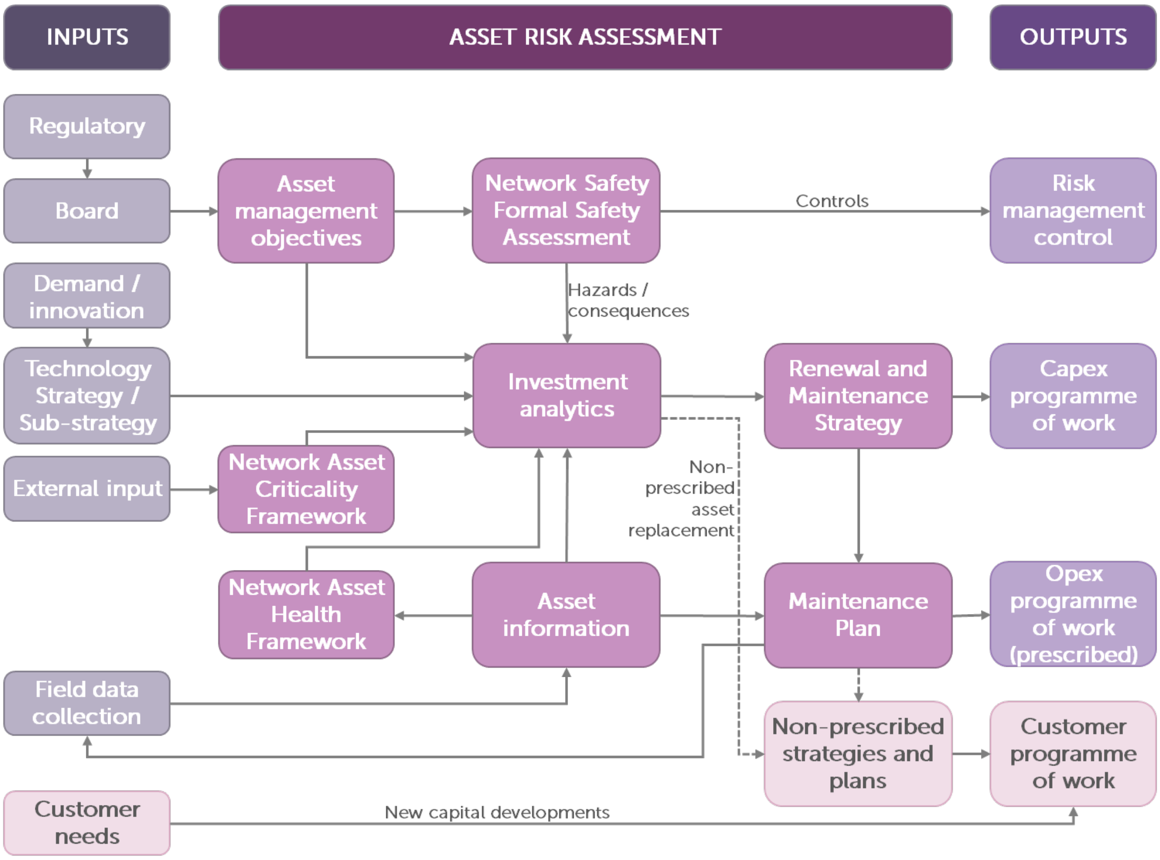
FIGURE 3.1: OUR SAMP IS ONE OF 10 TECHNOLOGY SUB-STRATEGIES



We have begun the work of evolving our portfolio asset management plans (PAMPs) and IT Domain Plans (ITDPs) as a vehicle for documenting, testing, and enhancing our asset lifecycle management. We prioritised poles for our first PAMP review and will apply lessons from that exercise to other asset types.

Alongside this asset-specific work, we plan to progress development or enhancement of the components of our recently developed value framework.

FIGURE 3.2: OUR UPDATED SAMP INCLUDES A NEW VALUE FRAMEWORK



These include our approaches to asset criticality and health, and asset information, as well as the analytics we use to bring these dimensions together into prioritised programmes of work.

These initiatives will improve the rigour, transparency and consistency of our asset management practices to ensure we:

- identify and realise optimisation opportunities, such as exchange consolidation
- identify and plan for efficient proactive interventions, such as planned replacement programmes
- refine our prioritisation across disparate asset risks and opportunities
- improve our early identification and planning for risks and uncertainties that exist later in the regulatory planning horizon
- produce expenditure justifications and explanations that are more readily reviewable and able to satisfy increasingly rigorous regulatory requirements.

4.0 OUR NETWORK

Te Aka Matua

4.0 Our network

This chapter introduces our network, its functional layers and the assets at each layer.

4.1 Introduction

This section describes our fibre network in terms of its history, geographical coverage, functional layers and the assets at each layer.

Our fibre network consists of a large interconnected system of fibre cables that carry digital information in the form of optical pulses across the country. Most of these fibre cables were installed as part of the Ultra-Fast Broadband (UFB) rollout that started in 2011.

As well as these cables, we own supporting assets that join and protect the cables and connect the fibre from the main network to homes and businesses, as well as network electronic devices that decode and aggregate the optical pulses. While not strictly part of our fibre network, we also have IT assets (used to plan, monitor, provision and manage the network), and corporate assets (in the form of accommodation, office equipment and other corporate investments).

While many of our fibre assets are reasonably new because they were installed as part of the UFB rollout, we also have some older long-life assets previously used for our copper network, such as cabinets, ducts, poles, and network buildings, that are also used to support the newer fibre network.

UFB

Chorus was formed in 2011 to take part in the government's UFB initiative. We completed our part of the rollout in 2022, making fibre available to more than 1.3 million homes and businesses.

1.3m

4.2 History of our fibre network

Chorus was formed as a standalone company to deliver UFB in partnership with the government. A public-private partnership was established between the government and Telecom New Zealand (Telecom), where Chorus was a business unit. Following our demerger from Telecom in late 2011, Chorus became a stand-alone listed company.

Our assets and how we manage them has evolved since we were established. At first our priority was building the fibre network. While we continue to extend our network and connect new customers our focus is increasingly weighted toward operating and maintaining our networks.

4.2.1 The UFB programmes

The UFB initiative was announced in 2011 by the government.

The UFB contract was administered for the government by Crown Infrastructure Partners (CIP). We were the largest of four co-investment partners in the government's UFB initiative to make fibre broadband available to approximately 87% of the New Zealanders.

Our UFB build commitment was to install fibre network infrastructure past a defined number of properties as outlined in our Network Infrastructure Project Agreement (NIPA) with CIP. The UFB programme was funded and contracted in two phases called UFB1 and UFB2/2+.

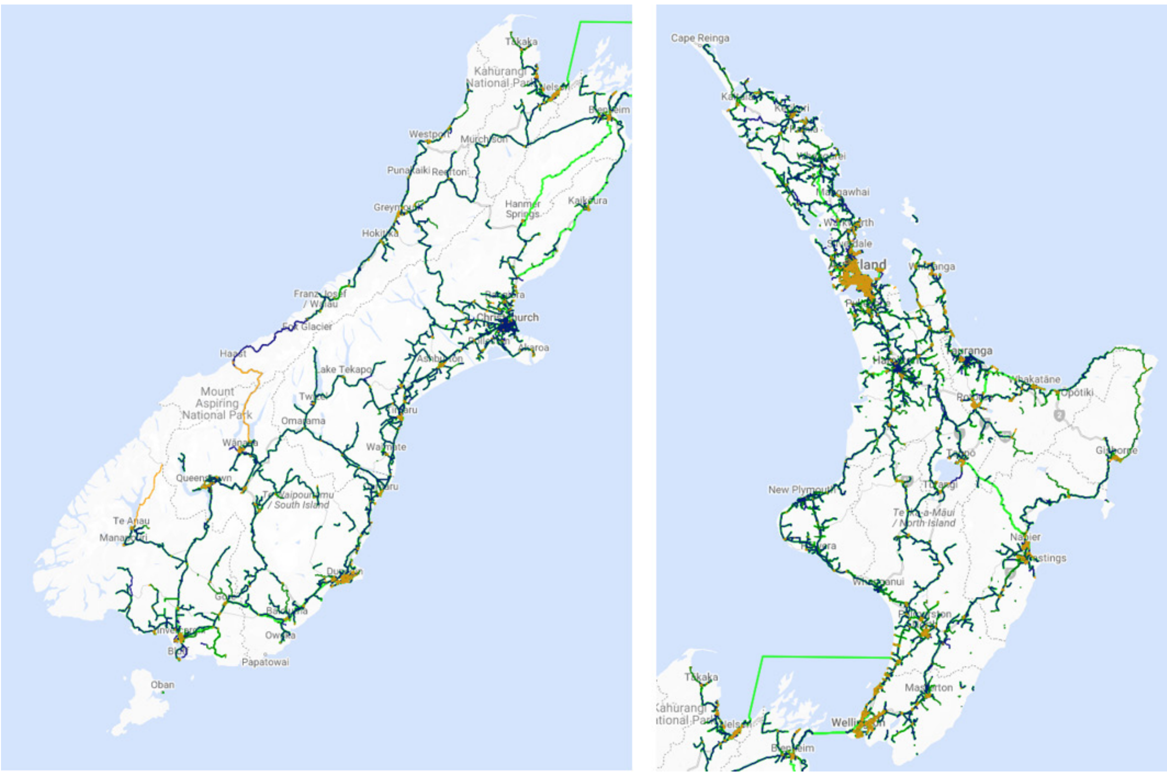
The first phase of the UFB programme, UFB1, was completed in November 2019 and brought fibre to 79% of the country. As part of the UFB1 rollout, Chorus brought fibre to around 1.1 million premises in 28 towns and cities across the country.

In January 2017, the Government expanded the UFB1 programme to include additional areas. The second phase of the UFB rollout, UFB2/2+ extended Chorus' UFB rollout to around 300 areas across the country and was completed at the end of 2022. This made fibre available to an additional 200,000-plus homes and businesses beyond the 1.1 million customers in Chorus' UFB1 rollout areas.

4.3 Geographic coverage of our fibre network

Chorus is the largest fixed line communications infrastructure provider in Aotearoa. We operate as a single business managing a portfolio of assets that includes both our fibre network and an older copper network. Our fibre network now extends across Aotearoa (as shown below in Figure 4.1).

FIGURE 4.1: OUR FIBRE NETWORK

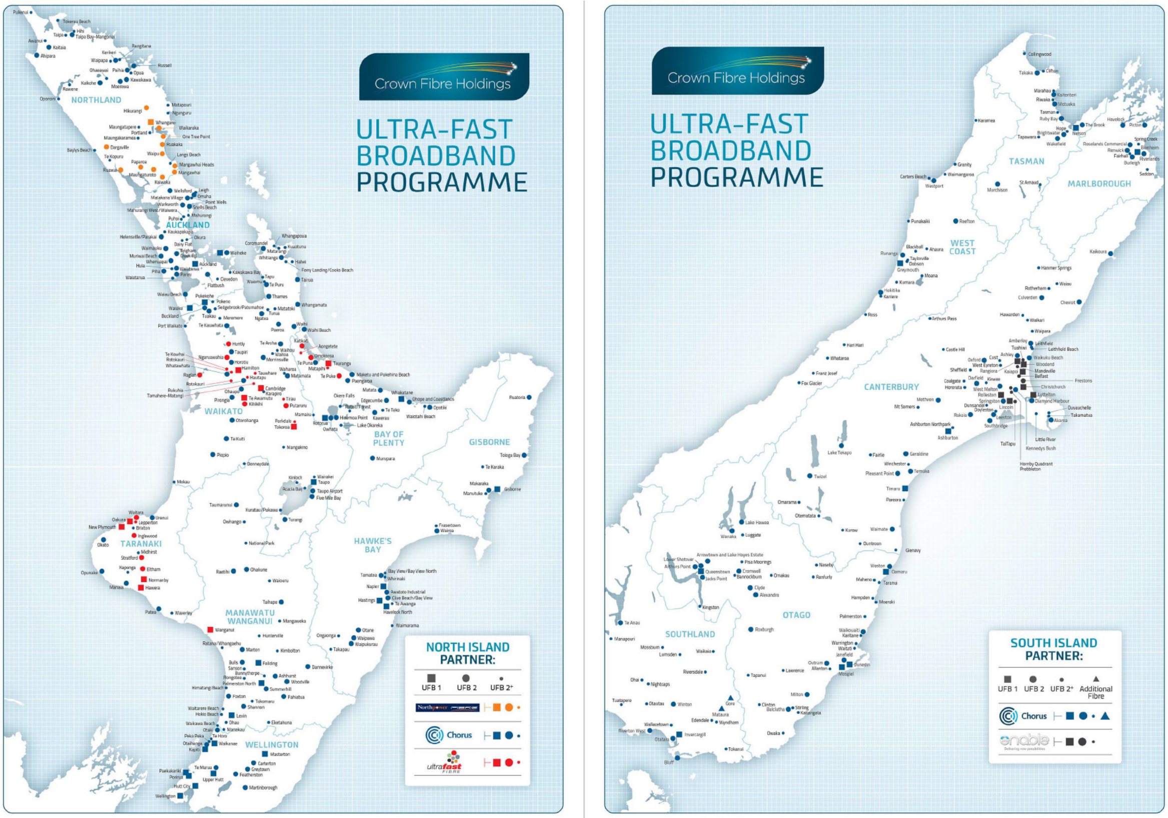


4.3.1 Scope of regulated fibre network

This proposal covers Fibre Fixed Line Access Services (FFLAS) in areas where we are subject to price-quality (PQ) regulation. Our FFLAS services are subject to price-quality regulation everywhere except where local fibre companies (LFC) (i.e. the other three co-investment partners in the UFB rollout) have installed fibre networks under the UFB initiative. Where a LFC has installed fibre networks under the UFB initiative, our FFLAS services are subject to information disclosure (ID) requirements, but not price-quality regulation.

Figure 4.2 below, shows where Chorus (in blue) and each of the LFCs have installed fibre under the UFB initiative.

FIGURE 4.2: UFB1 AND UFB2/2+ FIBRE ROLLOUT[14]



The areas in which our FFLAS services are only subject to information disclosure requirements (because an LFC has installed fibre networks under the UFB initiative) include parts of:

- Northland
- Taranaki
- Waikato
- Bay of Plenty

14 Note that Ultrafast is now Tuatahi First Fibre.

- Manawatu-Whanganui
- Canterbury.

4.4 Functional layers

We classify our network assets into three layers:

- Layer 1 assets – elements of the network that carry digital information in the form of optical pulses. These include:
  - fibre cables
  - joints, termination equipment and splitters (used to connect cables)
- Layer 2 assets – network electronic devices that decode and aggregate these optical pulses. These include:
  - access electronics
  - aggregation electronics
  - transport electronics
  - element management platforms
- Layer 0 assets – supporting infrastructure that houses fibre cables, connectors or network electronics. These include:
  - ducts (provide an enclosed protective passage for cables)
  - manholes (used to access ducts buried underground)
  - poles (used to mount ducts aboveground)
  - network buildings and cabinets (house fibre connectors and electronic devices)
  - engineering services.

LAYERS

Our fibres (Layer 1) carry optical pulses (Layer 2) and are supported by physical assets (Layer 0).

While not strictly part of our fibre network, we also have IT assets (that are used to plan, monitor, provision and manage the network) and corporate assets.

Our network was built using Fibre to the Home (FTTH) architecture, the infrastructure needed to provide network services. In this section we describe at a high level the assets that are created when we build and extend the network.

As shown in Table 4.1 below, the capital expenditure relating to these assets is allocated to various capex narrative categories.

DATA

Unless noted otherwise, asset information aligns with our 2022 information disclosures and covers PQ FFLAS assets only.

TABLE 4.1: MAPPING ASSETS TO CAPEX NARRATIVE CATEGORIES

ASSET	EXTENDING THE NETWORK	INSTALLATIONS	NETWORK SUSTAIN AND ENHANCE	NETWORK CAPACITY	IT AND SUPPORT
Layer 1 assets					
Fibre cables	*	*	*		
Joints	*	*	*		
Termination equipment	*		*		
Splitters	*		*		
Cabinets	*		*		
Layer 2 assets					
Access	*	*		*	
Aggregation	*			*	
Transport	*			*	
Layer 0 assets					
Ducts	*	*	*		
Manholes	*		*		
Poles	*		*		
Network buildings	*		*		
Engineering services	*		*		
Other assets					
IT assets					*
Corporate assets					*

Below we provide more detail on the assets at each functional layer. For Layers 1, 2 and 0 we refer to asset numbers included in our Information Disclosures as at December 2022, covering PQ FFLAS assets only (unless otherwise specified).

4.5 Layer 1 assets

4.5.1 Fibre cables

A fibre cable is an assembly of one or more optical fibres. A cable provides passive optical connectivity between fibre end points that are connected to network electronic devices. The electronic devices send light signals carrying information through the connected fibre cables. Fibre cables have a very large bandwidth, and relative to copper cables can carry large amounts of information at faster speeds and over longer distances.

We have:

- 131,000 km of fibre service leads – the fibre that connects individual premises to the FTTH shared infrastructure
- 54,000 km of FTTH fibre.

The lengths above are the "sheath length" as opposed to route length (shorter) or strand length (longer).

Cables are mainly installed outside, so must be able to withstand temperature changes, wind and earthquakes. Optical fibre strands are individually covered with an acrylate polymer coating or cladding, that provide the fibres with mechanical and optical protection. The construction of our cables follows one of two methods:

- slotted core – older cables that have a central strength member and a support form with cavities or slots that carry a group of fibres
- loose tube – where several fibre strands are housed inside a support tube, one or more tubes make up a cable. Our service leads and most of our FTTH network uses newer loose tube fibre cables.

FIBRE

Most of our fibre is relatively new, having been built as part of the UFB rollout or installations. We do have older fibre, some of which is reaching end of life.

We classify our FTTH cables or routes depending on how critical the fibre is (i.e. how many consumers it serves):

- core fibres – the most critical routes laid between large urban areas and where traffic is expected to increase. All core routes have dual paths (i.e. where two physically separate fibre cables are used independently of each other) to increase resilience
- regional fibres – laid between network buildings. Regional fibres also have dual paths
- access fibres – laid between local network buildings and consumer premises to enable connections.

In practice, a cable will often include multiple categories of fibre, but they are often separated into different tubes within the cable.

Fibre cables are laid passed every premises in UFB areas, and between population hubs. This is done in a few different ways:

- **directly buried underground** – cables are laid directly in the ground. The cable must have a strong outer sheath to protect the fibres, and replacing direct buried cable or increasing the number of fibres requires a whole new lay (e.g. digging a new trench)
- **ducted underground** – cables are blown, pulled, or inserted through the duct which is buried in the ground. This method allows relatively easy replacement or augmentation, and the outer sheath does not need to be as strong as direct buried cable because the duct provides additional protection
- **submarine** – cables are laid underwater on the seabed. The cable must have a strong outer sheath to protect the fibres
- **aerial** – attached to poles above the ground, often those owned by electricity distribution businesses (EDBs). The sheath protects the fibres so must be able to withstand wind loadings, span tension and snow loading, and be UV protected
- **internal** – installed in equipment rooms within network buildings or consumer premises. In network buildings, specialised trunking is used to manage the large volume of internal cables. In consumer buildings, internal fibre is installed in risers and ceiling spaces
- **lead-ins** – fibre cable extends from FTTH infrastructure and terminates in a premise. In residential areas these usually have no more than eight fibre strands but will have a higher fibre count if they terminate in a large building with multiple drop off points.

When installed, we expect fibre cables to have a 20-year life expectancy.

In 2018 we undertook an exercise to assess the age of the assets in our portfolio. As we move to the manage phase, we are planning on improving our asset management capabilities, which includes a plan for updating our asset information.

Most of our fibre cables were installed as part of the UFB rollout and are relatively young. Fibre lead ins are built as part of the installations process and are less than ten years old. Our slotted core fibre is coming to the end of life and accounts for most of the fibre over 25 years old.

The condition of fibre cable is determined by its age, type of construction and the degree to which the cable trench has impacted the cable (tight bends in the cable, stretching, crushing, moisture, land movement, etc.). The quality of the installation, ground conditions and the maintenance of the fibre route influences the operational life of a fibre cable. The ageing process generally shows up as fibre cuts or increasing optical loss over time along the fibres. We identify faults in fibre cables using element management platforms (Layer 2 assets), which monitor fibre performance and trigger an alarm if a fibre is cut.

4.5.2 Joints

We use joints to connect two fibres together. A joint is a plastic enclosure with fibre management trays that join individual fibre strands, and support and seal the cable covering. The physical size of the enclosure depends on the number and size of the fibre cables to be connected.

We use different types of joints depending on the age, the use and the number of cables being joined.

- **fusion joint** – the ends of the individual fibre strands are aligned in a machine, cleaned, and then melted/fused together. Fusion joints are permanent and result in little optical loss. We use fusion joints in long haul fibre situations.
- **mechanical or connector joint** – an optical connector is attached to the end of each fibre strand to be jointed. The strands are then aligned and held together by the connector. Mechanical splicing is quick and easy, and the joint can be disconnected and re-connected. This joint results in higher optical loss and must be kept clean.

JOINTS

We use plastic enclosures to house joints between individual fibre strands.

A fibre joint enclosure allows two or more cable sheaths to be joined. They organise the fibre and allow the fibre sheaths to enter the joint itself via a sealed gland arrangement in the base. A fibre tray supports a group of fibre strands to allow easy fusion of fibres. All the fibres inside this closure are referred to as a joint. A dome-style sealable lid protects the joint assembly from environment and physical damage.

Our fibre joint assets are largely new and experience few faults, benefitting from the low-touch status of the network. Joints don't appear to degrade with age, though they can be vulnerable to damage when a technician is working on the joint tray.

4.5.3 Termination equipment

We use termination equipment to separate individual fibres from cables in a way which protects the fibres. The equipment has evolved over time and has become smaller, better performing and cheaper. It comes in various shapes and sizes but can generally be grouped into three categories:

- Optical Fibre Distribution Frame (OFDF)
- Fibre Flexibility Points (FFP)
- Fibre Access Terminals (FAT).

TERMINATION EQUIPMENT

Our OFDFs, FFPs and FATs protect individual fibre strands where they are separated from cables.

OFDFs present individual fibre strands for joining or connecting. They provide the connection point between the outside underground/aerial fibre cables and the internal fibre cables that connect to network electronic devices. We have over 2,300 PQ FFLAS OFDFs.

FFPs are termination enclosures that also house the splitters that transition the fibre lead-ins to be delivered to premises. Cabinet-based FFPs were installed during the first three years of the UFB rollout. From year three we started installing Air Blown Fibre Flexibility Points (ABFFPs) which are FFPs located in underground pits. This transition resulted in build cost savings by reducing the total distance of 26-way micro-duct. We subsequently moved to a waterproof underground model, using a 1 to 16 splitter.

FATs terminate fibre cables within the access distribution network and extend fibre lead-ins to consumer premises. A fibre cable extends from a FFP to the FAT and provides the connection interface for several fibre lead-ins. The difference between a FFP and a FAT is that the latter does not house a splitter.

Our termination equipment is relatively young and is in good condition. There are limited exceptions where the quality of build practice associated with running cables between OFDF trays or subsequent disturbance results in a fault, from the movement of the trays due to technicians working on the trays, through to traffic vibrations. We pursue good practice through technician training courses, standards, accreditation of field service providers and quality management. This has seen a 38% reduction in these faults between 2020 and 2022, even though we have had an increase in connections of 25%.

4.5.4 Splitters

Splitters take a signal from an optical line terminal (OLT) in a building or cabinet and separate it into multiple paths so it can be extended to each consumer. They are located in access sites and FFPs.

Splitters can create 32, 16, 8, 4 or 2-way splits (referred to as the split ratio). A splitter introduces loss in the optical path, and the greater the split ratio the greater the loss between the incoming and outgoing signal. In the first three years of the UFB build, we mainly installed one to 32-way splitters in passive FFP above ground cabinets. In year four we moved to a more distributed splitter arrangement using a one to 16-way splitter housed in ABFFP enclosures located underground. We have over 106,000 PQ FFLAS splitters in total.

Most of our splitters are relatively new as they were installed as part of the UFB build. There are no known condition issues with splitters.

SPLITTERS

Splitters join one fibre to multiple fibres, sending signals along multiple paths.

>100,000

4.5.5 Cabinets

Cabinets are usually found by the side of the road. They house termination equipment, splitters and network electronic devices. There are two classes of cabinets:

- **active cabinets** have AC power and engineering services. We have approximately 290 PQ FFLAS active cabinets[15]
- **passive cabinets** are unpowered. We have approximately 2,000 PQ FFLAS passive cabinets.

Cabinets are a long-life asset. Most of our cabinets supporting PQ FFLAS services have a metal casing and are in reasonable condition.

CABINETS

Cabinets provide secure roadside enclosures for our equipment.

>2000

15 Some of our cabinets house equipment that serves the copper network or are shared assets that provide both copper and fibre services. We manage these assets together. The expenditure planned for these assets to support FFLAS is addressed through cost allocation. For more information see our Modelling and Cost Allocation Report.

4.6 Layer 2 assets

Our network electronic devices decode, and aggregate optical signals sent through fibre cables. We categorise those electronics into three types: access, aggregation, and transport. Within each of those types there is a further distinction between optical network electronics, and element management platforms:

- **chassis/shelves** are the physical enclosures mounted into an equipment rack in the exchange into which other components are installed
- **controller cards** are installed into chassis/shelf slots and determine what functions can be supported
- **line cards** are installed into chassis/shelf slots to provide ports for capacity and/or specific functions
- **pluggable optics** are the interface between fibre and network electronics. They convert electrical signals from the port in the line card into an optical signal
- **element management platforms** are software systems that communicate with electronic devices in the network. They manage the devices allowing services to be provided to consumers and monitor network operation. They also hold a live inventory of the existing network.

The access network also includes a device located at the customer site called the optical network terminal (ONT), which provides a demarcation between the Chorus Layer 2 service and where retail service providers (RSPs) or end-users can connect their devices (e.g. Wi-Fi router).

The relationships between the different types of network electronics, and how they interact with IT capex and Installations capex are shown in Figure 4.3 below.

ELECTRONICS

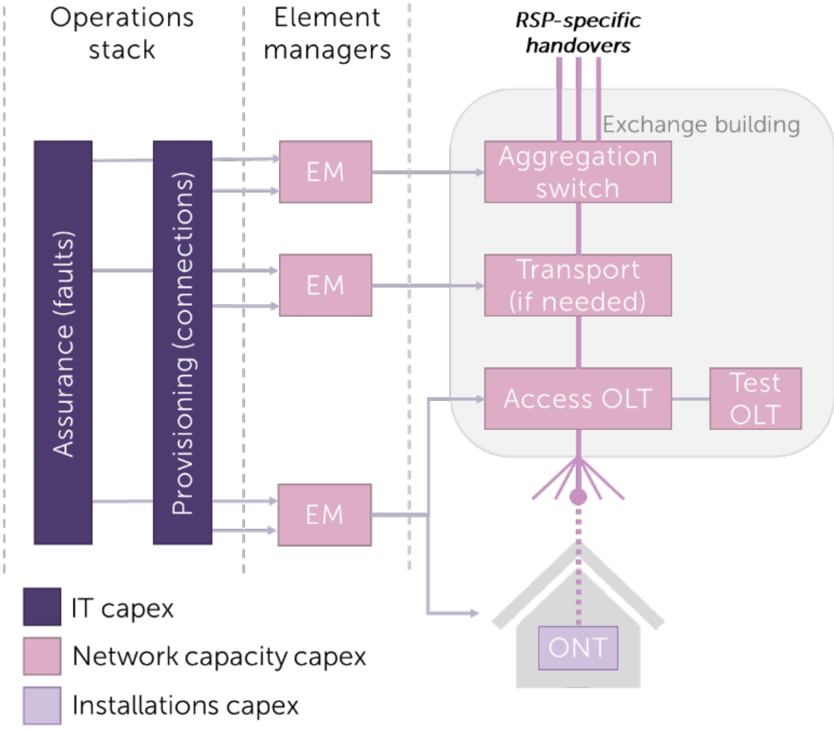
We have Layer 2 assets in our network buildings, and in end-user premises (including homes). Obsolescence is a key driver for replacements.

ONTS

We have around 1.1m ONTs installed in end-user premises, including homes and businesses.

1.1m

FIGURE 4.3: RELATIONSHIPS BETWEEN IT, NETWORK CAPACITY AND INSTALLATIONS CAPEX



4.6.1 Access

Access electronics deliver fibre broadband services to consumers. The electronics required to deliver these services are:

- optical network terminals (ONTs)
- optical line terminals (OLTs)

ONTs are the devices in end-user premises that provide a connection between the fibre network and the end-user's premises. We have over 1,100,000 PQ FFLAS ONTs deployed and expect their lives to exceed 10 years.

OLTs are located in network buildings or roadside cabinets and provide connectivity to end-users over the fibre access network using Gigabit-enabled Passive Optical Network (GPON) ports. We have over 1,240 PQ FFLAS OLT devices (i.e. chassis).

We tend to replace our network electronics before they break because of the pace of change in technology. Chassis have the longest lifespans (around 8-12 years), whereas controller cards (5 years) and line cards (5-8 years) tend to need to be replaced once during the life of their respective chassis. The lifespan of our pluggable optics is usually dictated by compatibility with line cards.

OLTS

We have over 1,240 OLT chassis in our buildings, housing OLT controller and line cards that provide connectivity to end-user premises.

1,240

4.6.2 Aggregation

The aggregation network provides connection between OLTs and handover links to RSPs. It comprises switches (rack-mounted equipment with interface cards) and the links between them.

We have 301 PQ FFLAS aggregation switches (i.e. chassis).

The lifespan of aggregation hardware is aligned with the lifespans of access and transport hardware. Functional obsolescence may shorten the useful life of aggregation hardware in situations where it is not able to support forecast growth rates (so replacement with more higher capacity equipment is required).

SWITCHES

We have 301 aggregation switches that connect OLTs to RSP handover links.

301

4.6.3 Transport

Transport equipment provides high-capacity connectivity over long distances between aggregation nodes and OLTs. It comprises rack-mounted equipment supporting transmission links over core, transport and access cables. The transmission link is usually built with spare channels which remain available to provide additional capacity as needed. We use transport technology that is highly scalable, so it provides significant data capacity while maintaining low latency and bit error rates.

We have deployed nearly 600 transport chassis, with lifespans that align with that of access and aggregation hardware.

4.7 Layer 0 assets

4.7.1 Ducts

Our ducts provide an enclosed, protective passage for cables. Ducts can be underground or embedded in or attached to structures (like bridges or buildings). Once installed, ducts allow cables to be placed without additional excavation. Ducts may also be attached to poles to provide protection where there is a transition between underground and aerial routes.

We install ducts in areas where capacity is likely to grow, or fibre cables are high-risk and warrant extra protection.

We have more than 93,000km[16] of PQ FFLAS ducting, with diameters ranging from 3mm-200mm. This includes numerous types of ducts, such as:

- earthenware ducts that were deployed between 1900 and 1940
- cast iron ducts that were deployed between 1940 and 1950
- cement fibre ducts that were deployed between 1940 and 1960
- PVC ducts that were used from the late 1960s, became common in the 1970s, and are still used today
- galvanised steel trunking systems (Unistrut) that were used from late 1980 and are still used today

DUCTS

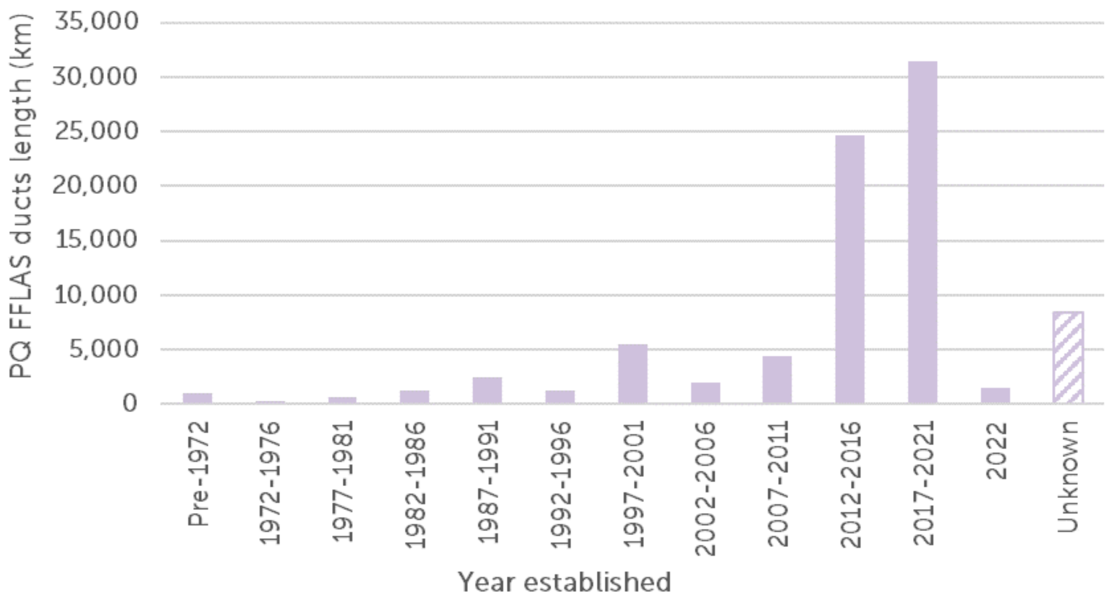
We have more than 90,000km of ducting used to protect fibre, most of which we installed as part of the UFB programme.

93,000km

16 Note that this figure is longer than the route length, as it separately counts the length of each duct where there are multiple ducts installed on the same route (i.e. in the same trench).

- microduct that is a key component of our fibre build. Microduct can be configured to allow us to optimise the network capacity in different locations. Our microduct population ranges from 1-way (which fits a single fibre cable and is used for lead-ins) up to 26-way (which fits 26 fibre cables), with these two types making up nearly 80% of the population.

FIGURE 4.4: DUCTS AGES



We have limited data on the age for ducts installed before 2000. We used microduct extensively during the UFB rollout, and it makes up the majority of duct installed from 2010.

Ducts are long life assets. They are mostly installed underground, and we expect them to last indefinitely if not disturbed. Ducts attached to poles have a shorter life expectancy because they are exposed to the elements and are at greater risk of disturbance and vandalism. We tend to replace them when poles are upgraded as damage during removal makes them unsuitable for reuse.

Duct faults tend to be identified when we reuse a duct to add or remove fibre. The number of faults detected increased between 2009-2015 during the fibre-to-the-node (FTTN) build project and the first three years of UFB1 when fibre was installed into commercial areas using existing duct infrastructure. This was due to increased activity around the ducts and the requirement to use ducts that had latent damage. This damage needed to be repaired to enable the network rollout.

4.7.2 Manholes

Manholes are covered openings that provide access to buried ducts, cables and joints. We install manholes in places where access to fibre is likely to be needed because manholes are more cost effective than repeated excavation.

Manholes have two components, a pit and a lid.

- Pits vary in size from small plastic enclosures centimetres deep to large concrete chambers meters below ground.
- Lids provide access to pits. Older cast iron manhole lids can be a slip hazard, so we make our manholes safe by replacing or repairing them when problems are identified.

We build manholes to two strength standards – a roadway standard and a footway standard. Damage can be caused to manholes built to footway standards when they are driven over by a vehicle. We treat repair or renewal of broken manholes as urgent due to health and safety implications and the risk of lids dropping onto cables in the manhole. When we are notified of an urgent fault a technician is dispatched to the field within two hours.

Roadway strength manhole designs are certified by a registered civil engineer. This ensures that the designs comply with roading authority and local council standards. All new roadway rated manholes have aluminium pits. To reduce the cost and risks associated with accessing them (for example, working on roads) we prefer to place manholes in the berm.

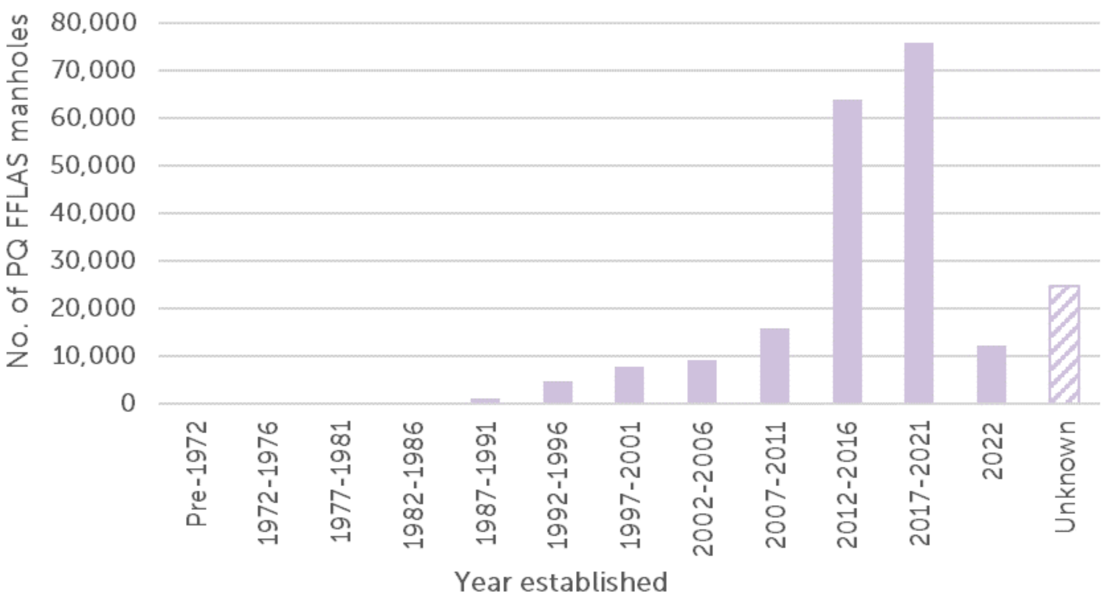
Footway rated manholes are either plastic or aluminium, and range in size from small hand holes with single joints to larger pits that house cable joint enclosures. The frames on new manholes can be adjusted up/down within a limited, pre-specified range.

MANHOLES

We have almost 260,000 manholes providing access to buried equipment, most of which we installed as part of the UFB programme.

259,000

FIGURE 4.5: MANHOLES AGES



We installed thousands of manholes as part of the UFB rollout, which are therefore less than twelve years old. We do not know the age of almost 25,000 of our PQ FFLAS manhole assets because the data was not populated in our geographic information system (NetMAP) when the physical plans were digitised. Most of them are buried direct distribution (BDD) or chambers, and we believe they were installed pre-1990.

We have approximately 259,000 PQ FFLAS manholes in our network.

In a recent field audit of the condition of manholes we identified that 18% of manholes had issues and required remediation. To address this, we are implementing a condition assessment programme where each manhole is inspected every 10 years. We intend to use a proactive maintenance approach to faults we identify.

4.7.3 Poles

Poles are designed to carry cables above ground, mostly to carry a lead-in from a fibre access terminal to the consumer's premises. Most of our poles were installed in urban areas for the copper network, so our poles are shared assets carrying both copper and fibre cables. We use poles as it is cheaper to add new fibre cables to existing poles than to build new underground routes.

In some areas we share poles with electricity distribution businesses (EDBs), entering lease arrangements. In these cases, some shared poles are owned by Chorus and others are owned by the EDB.

We have approximately 115,000 PQ FFLAS poles, approximately 70% of which are made from locally sourced softwood.[17] However, our pole population is reducing overtime as we underground cables. This is mainly driven by EDBs in areas where we share poles, but we may also underground cables in response to customer requests or as a cost-effective solution when poles need replacing.

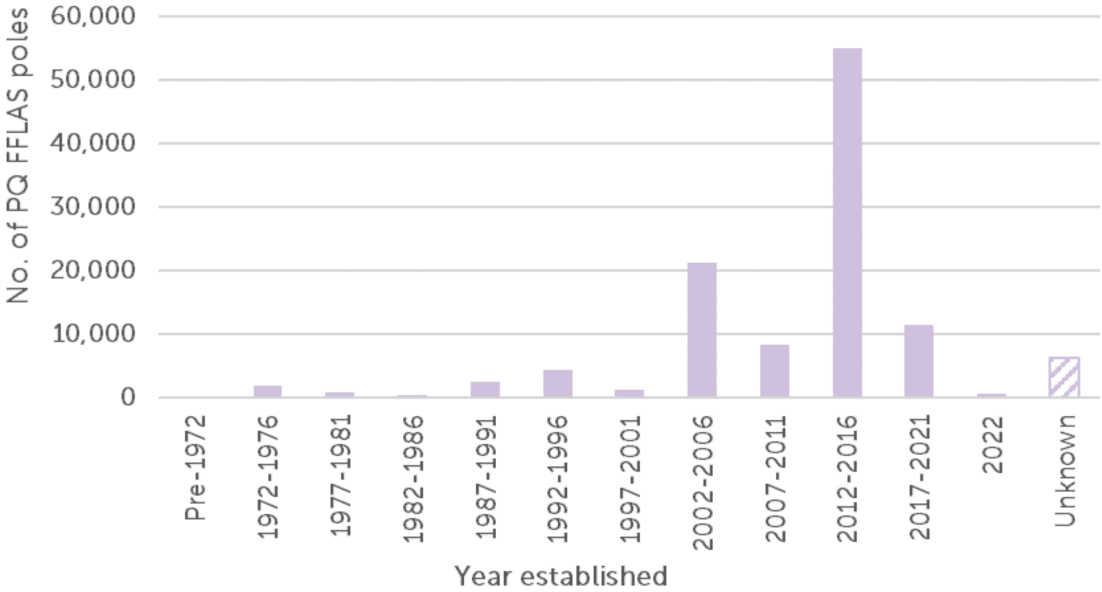
POLES

We have around 115,000 poles supporting overhead fibre, most of which we installed as part of the UFB programme.

115,000

17 The asset information relating to our population of poles is improving as we gather information as part of our poles test and tag programme.

FIGURE 4.6: POLES AGES



Pole condition is related to age and the degree of exposure to the elements. Historically we inspected our poles but did not keep consistent condition data. To address this, we started a test and tag programme in July 2017, with our first round of the programme being completed in early 2023.

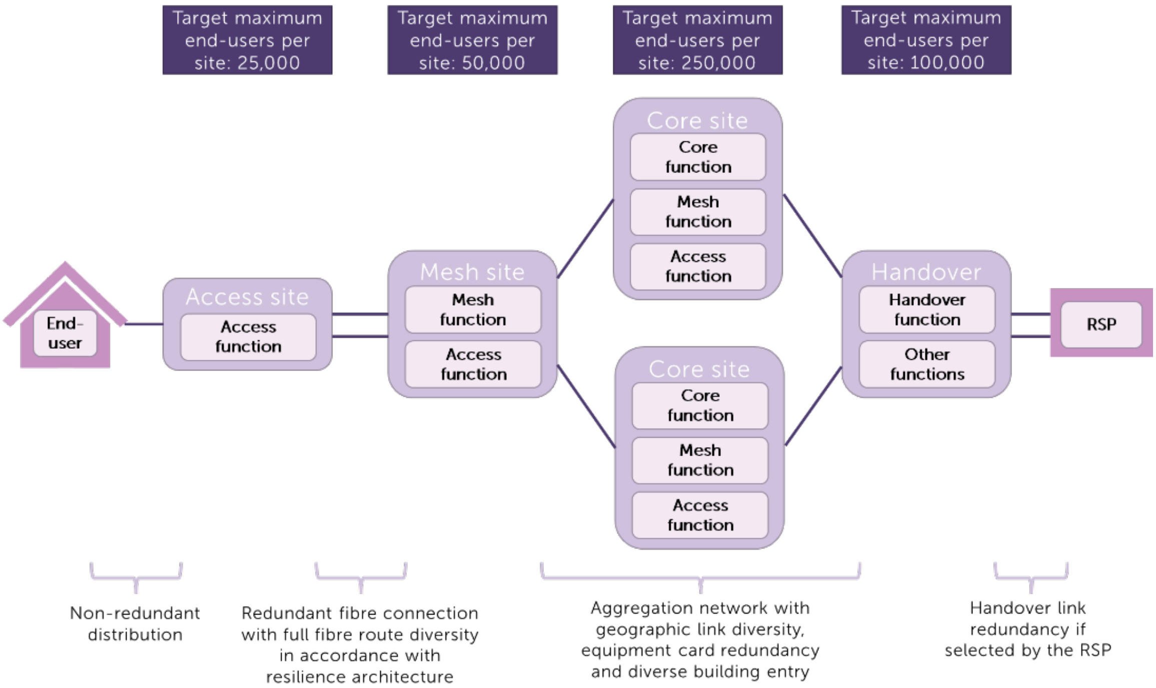
Our test and tag programme uses a colour coding system. Red poles have reached the end of their life – about 6% of our poles are categorised as red and are scheduled for replacement. Any poles deemed a fall risk are scheduled for replacement within seven days. A yellow tag means a pole is approaching end of life - around 9% of our poles are yellow and are scheduled for retest in two years. A green tag means the poles are expected to have significant remaining life and will be retested at five-year intervals until they reach the yellow criteria.

Our hardwood pole population has the largest proportion of red tags. This is unsurprising given the whole population is over 50 years of age. Despite this, more than 30% of our hardwood poles were found to have significant remaining life (i.e. green tagged). About 95% of our concrete and steel poles also have significant remaining life, because they are generally younger and have a longer life expectancy.

4.7.4 Network buildings

We manage 506 PQ FFLAS network sites that house the electronic equipment needed to run our fibre network.

FIGURE 4.7: FIBRE-TO-THE-HOME ARCHITECTURE SHOWING REDUNDANCY LEVELS FOR NETWORK ELEMENTS



Our network buildings or sites have different functions and purposes, and we classify a site according to the highest-order function that it serves (see Figure 4.7).

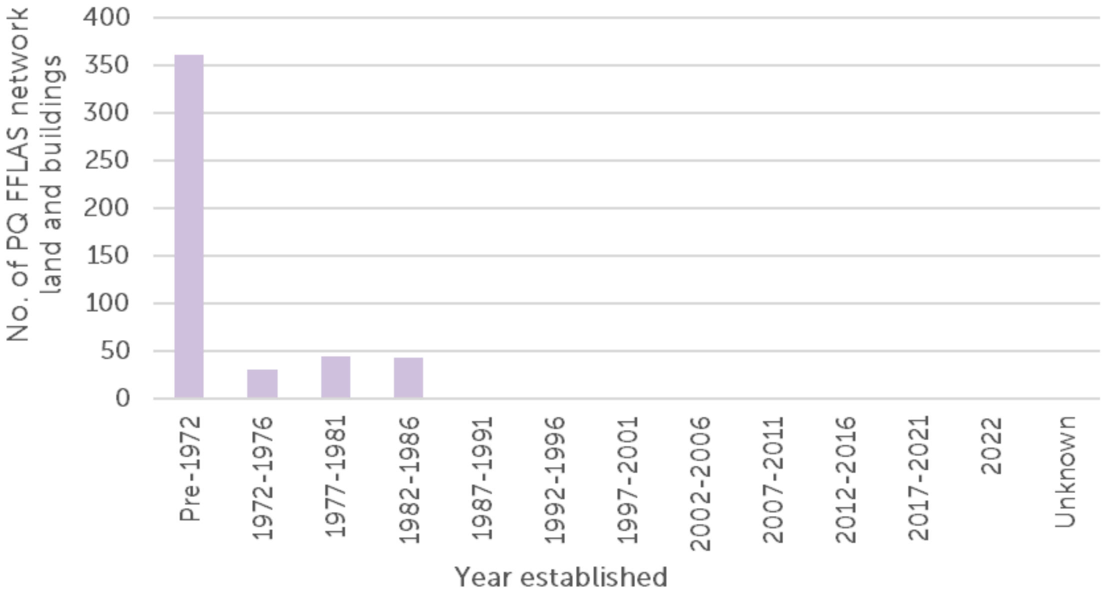
- access sites – host equipment used to connect end-users to the network, such as OLTs. This is the broadest category and captures all our network buildings
- mesh sites – concentrate traffic from multiple access sites (as well as being directly connected to some access customers themselves and containing access functions). The number of access consumers dependent on a mesh site is limited to 50,000 in a region
- core sites – concentrate traffic from multiple mesh sites. They house the large-capacity switches and the equipment for national transport. They can serve up to 250,000 customers, but all core sites are one of a pair to protect against a single core aggregation switch failure. Core sites will also contain mesh and access functions
- handover sites – hand over data traffic to RSPs. Up to 100,000 consumers are dependent on each handover site. A handover always occurs in a building with a core or mesh function.

BUILDINGS

We have over 500 PQ FFLAS network sites that house the electronic equipment needed to run our fibre network.

>500

FIGURE 4.8: NETWORK BUILDINGS AGES



Our network buildings portfolio includes the assets contained within our buildings, including systems to protect our staff, contractors and the network, for example:

- **security** – our larger buildings are monitored by our Security Operations Centre (SOC). We monitor access points across our 506 PQ FFLAS sites through electronic and manual means
- **fire** – we protect our network and staff by installing fire alarms. The annual Building Warrants of Fitness (BWoF) require that we keep fire systems current. Most of our sites comply with this requirement, however there are a few older fire alarm systems that are obsolete and require replacement.

FIRE AND SECURITY

Building services include security and fire monitoring and alarm systems.

4.7.5 Engineering services

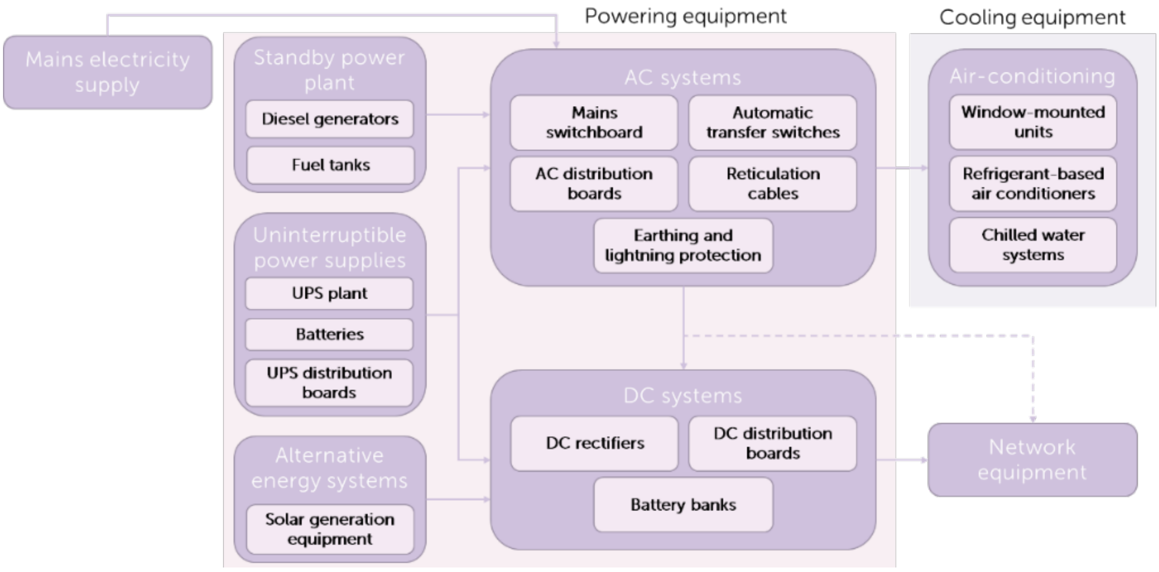
Engineering services are the equipment that power network equipment and maintain environmental conditions within acceptable limits. Our engineering services equipment is located in network buildings and cabinets. It supports both the fibre and copper networks, so since fibre assets require less power and air-conditioning, we expect our expenditure in this area to fall as we migrate our customers from copper to fibre services.

Figure 4.9 below shows a high-level overview of the power flows between the powering and cooling equipment, as well as between the alternating current (AC) and direct current (DC) systems. In reality, the systems are more complex than depicted, with more elements, more complex and flexible relationships, and across diverse locations.

POWER AND COOLING

Engineering services provide power to network equipment and maintain environmental conditions within acceptable limits.

FIGURE 4.9: POWERING AND COOLING EQUIPMENT



Our engineering services portfolio includes the following equipment used to power network equipment:

- AC systems – this refers to the equipment used to manage the power supply from the local line companies. AC power is the main energy source for our network, powering the electrical equipment critical to our systems. AC power system infrastructure comprises of mains switchboard, AC distribution boards and reticulation cables, automatic transfer switches, and earthing and lightning protection. Electricity from these AC systems is usually converted to DC electricity to power our network equipment. However, a small but growing number of our network electronics are powered on AC electricity directly.

- DC systems – these are used to convert AC power to the DC that powers most of the network equipment, and to charge and maintain the energy stored in the DC plant backup battery systems which keep the network running during a mains outage. DC power systems also monitor and control the power output to the equipment, and trigger alarms when necessary. The DC power systems comprise DC rectifiers, battery banks, and primary and secondary DC distribution boards.

- Standby power plant – these provide the AC power required to keep the network and air conditioning running when AC mains power is not available. They include diesel generators (although may include other generation technologies in the future) and fuel tanks.

- Uninterruptible power supplies (UPS) – these systems provide instantaneous emergency AC and DC power in the case of an outage, which allows time for the standby power plant to start up. UPS systems include the UPS plant, batteries and distribution boards.

POWER SUPPLY

We manage AC and DC power systems, standby power plant, uninterruptible power supplies, and alternative energy systems.

- **Alternative energy systems** – these newer investments aim to reduce our electricity costs and carbon emissions by generating our own renewable electricity from solar energy. These systems include solar generation panels and associated equipment. They tend to feed into the DC systems, although in some cases excess electricity will be converted to AC electricity and injected back into the grid.

Our management systems control and monitor the building's mechanical and electrical equipment, including ventilation, power systems, cooling systems, fire systems and security systems. These comprise our:

- **Trouble Management System** – owned by Spark and used by Chorus to monitor alarms. The system is from 1980 and stopped being manufactured in 2000, so is now at end-of-life, but it is still used in all our network buildings
- **records systems** – various systems that store network asset information.

4.8 IT assets

We define an IT asset as any information, software or hardware we use for our business activities. We have over a hundred IT systems that enable us to deliver network services and manage our day-to-day business activities. Our IT systems are broken down into domains that serve either:

- **network and customer** – systems and platforms that help us run the network and interact with our customers
- **business** – systems and platforms needed for our day-to-day business activities.

IT SYSTEMS

We have over 100 IT systems that enable us to deliver network services and manage day-to-day activities.

>100

4.9 Corporate assets

Our corporate assets include accommodation, office equipment and other corporate investments.

Our accommodation assets are our portfolio of leased corporate office locations across Aotearoa. There are four main office buildings (Auckland, Hamilton, Wellington, and Christchurch) as well as a customer experience lab in Auckland. The leases for these sites have remaining terms ranging from two to seven years depending on whether renewal options are taken.

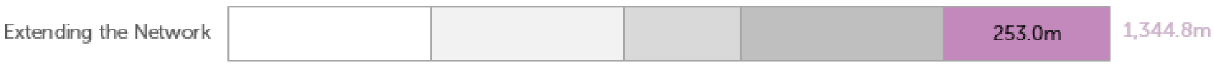
We also accommodate a small number of staff (<30) in smaller regional satellite offices. These offices are located within our network buildings or space leased within a Spark exchange.

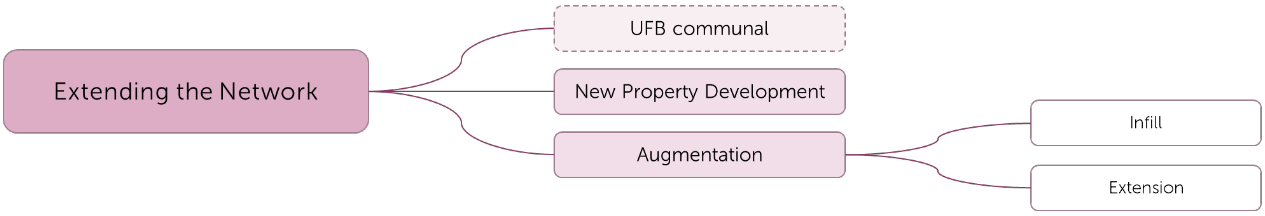
5.0 EXTENDING THE NETWORK

Te Whakawhānui Aka Matua

5.0 Extending the Network

This chapter describes the Extending the Network capital expenditure (capex) category. It covers work to extend communal infrastructure to new streets or developments, and to infill the network to accommodate address growth.





5.1 Introduction

This chapter describes the Extending the Network capital expenditure (capex) category, which is part of our growth capex. It describes the one-off types of costs incurred to establish fibre access for new end points both through extending communal infrastructure and infill to accommodate address growth.

Extending the Network involves installing fibre in a street or property development, establishing a connection back to a local exchange, and providing enough splitters, access ports, aggregation and transport capacity to begin serving connection demand.

Our Extending the Network capex category has three sub-categories:

- **UFB communal** – building the Ultra-Fast Broadband (UFB) network as contracted with the government under the Network Infrastructure Project Agreement (NIPA). We completed the remaining part of the UFB 2/2+ build in 2022, and as such there is no further expenditure in this category for PQP2 or beyond.
- **New property development** – laying fibre as part of new property developments (NPD).
- **Augmentation** – adding to the UFB communal network. This includes infill work (augmenting the network for unforeseen growth within the existing UFB footprint) and extending the fibre network to towns or communities beyond our current fibre network footprint as part of our Fibre Frontier programme.

EXTENDING THE NETWORK

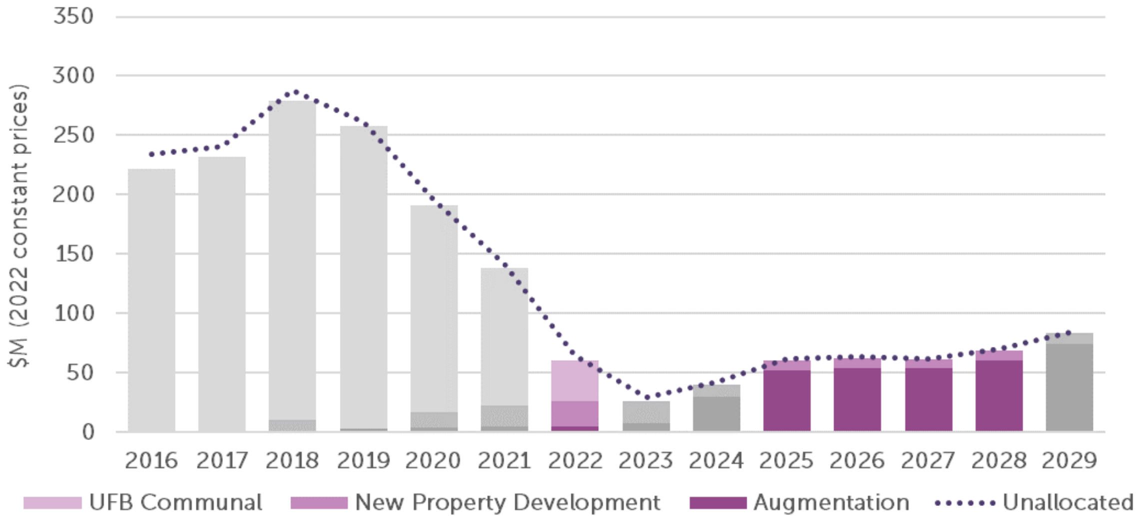
We will invest to extend fibre network coverage and accommodate address growth within the existing network footprint.

$253m

5.2 Forecast overview

For PQP2, our total forecast capex for the Extending the Network capex category is $253m, representing 19% of our total forecast capex. Thereof, the majority relates to our proposal to extend the network from 87% to 89% of premises in Aotearoa, contributing $221m (87%) to our forecast Extending the Network capex.

FIGURE 5.1: EXTENDING THE NETWORK CAPEX (UNALLOCATED AND PQ FFLAS)



The table below shows the forecast capex by regulatory year, broken down into sub-categories.

TABLE 5.1: EXTENDING THE NETWORK CAPEX (PQP2 PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

	2025	2026	2027	2028	TOTAL PQP2
UFB Communal	0.0	0.0	0.0	0.0	0.0
New Property Development	8.0	9.0	6.9	8.5	32.4
Augmentation – infill	5.0	4.9	4.8	4.8	19.5
Augmentation – extension	47.1	48.7	49.4	55.9	201.1
EXTENDING THE NETWORK TOTAL	60.1	62.6	61.1	69.2	253.0

Having completed the contracted UFB 2/2+ build in 2022, forecast network extension capex is significantly lower in total and, for the UFB communal capex, is nil for PQP2 or beyond.

However, we do propose Augmentation capex to extend our fibre network beyond the UFB2/2+ footprint. This proposal reflects strong stakeholder and end-user support for extending access to fibre services to more premises in Aotearoa. The modest level of investment relative to the economic benefits reflects both stakeholder feedback and our own careful prioritisation of discretionary expenditure in a constrained funding environment.

Included in our PQP2 proposal is $201m capex that will increase the fibre footprint in Aotearoa by 2.2% and give access to fibre services to a further 40,506 premises in Aotearoa. We estimate net benefits to New Zealanders of $1.2 billion will arise from this investment over a ten-year period. This expenditure falls within the Extending the Network capex category (as a subset of the Augmentation sub-category), but we discuss it in more detail in the Fibre Frontier chapter later in this document.

Aside from our funding need to extend the network beyond its current footprint, most of our forecast extending the network capex discussed in this chapter relates to our activities to extend the fibre network into NPDs. To a lesser extent, we also forecast some network augmentation of $20m arising from expected address growth within the existing network (referred to as infill capex).

TRENDS

Historically, UFB investment has dominated expenditure. We plan to continue with infill and servicing new property developments and have proposed a 'Fibre Frontier' programme to extend fibre coverage further.

5.3 Strategic objectives

Extending the network makes fibre available to new end-users, which supports our vision of connecting Aotearoa so that we can all live, learn, work and play. In doing so, we build a network that meets the standards reflected in the existing UFB network. These expectations are also captured by the quality standards we propose for PQP2.

Extending the network also is a strategic initiative. When we extend the network, we ensure the network can accommodate high uptake. This allows us to grow active connections which, in return, lowers the cost per connection.

Ultimately, this supports a virtuous circle of reducing the MAR (and therefore price) per connection, strengthening our price-quality balance and consumer value proposition, further supporting connection growth and retention. This virtuous circle helps to lower the risk profile for our regulated business and enable future sustaining and discretionary value-adding investment. This remains important and valuable even as the rate of new connections slows, as more and more end-users connect to the new fibre network.

On average, the Cost Per Premises Passed (CPPP) in the NPD/Infill programmes will be less than the CPPP of the UFB programme, so have the effect of reducing the average cost per premises passed.[18]

5.4 UFB Communal

Due to the completion of the UFB2/2+ build, our forecast capex for UFB Communal in PQP2 is nil. Forecast drivers, methodologies and assumptions are therefore not covered for this sub-category.

18 The lower relative cost profile of NPD/infill work is due to developers laying our communal duct into trenches they build for all utilities (power, water, gas etc.).

5.4.1 Historical expenditure

Our UFB build commitment was to install fibre network infrastructure past a defined number of properties as outlined in our agreement with Crown Infrastructure Partners (CIP). The UFB programme was funded and contracted in two stages called UFB1 and UFB2/2+. All stages are now complete, with UFB2/2+ completed in 2022, making fibre broadband available to 87% of the country.

Four telecommunications network companies and their contractors have put more than 45 million work hours into laying the fibre cables over the past decade, finishing an extended section of the rollout on time and in budget to bring the overall project to a close.

We consider the rollout has been an enormous success and team effort between CIP, fibre companies and the retail service providers (RSPs) who worked with us to bring the fibre broadband connections into homes and businesses around the country.

Chorus alone laid 98,000 kilometres of fibre cable in the two stages, with the UFB partnership companies together completing the first 79 per cent of the country in 2019, and the last eight per cent delivered as an extension of the project over the last three years.

Opononi, Waitaki, Moeraki, Allantown and Tuatapere were the last towns to join the national fibre network, alongside more than 400 other towns and cities from Kaitaia to Bluff.

As a result, internet usage has jumped in Aotearoa as the rollout neared completion, with the data traversing our network increasing exponentially.

UFB

We completed our part of the successful UFB initiative in 2022. The programme has made fibre broadband available to 87% of the country.

87%

SOME QUICK CHORUS UFB ROLLOUT FACTS:

45 million – total number of work hours logged as part of our 11-year rollout.

98,000 kilometres – the amount of fibre cable we have laid in Aotearoa, enough to go around the world more than twice.

992,000 kilometres – the total length of all the individual fibre used in our network, further than the distance to the moon and back.

412 – number of towns and cities across Aotearoa that can now connect to ultra-fast broadband.

90% – fibre customers on 300 megabits per second (Mbps) or faster plans on our network.

25% – expected compounding rate of data growth per year.

1,000 gigabytes (GB) – or one terabyte (TB), the forecast average monthly data usage per household by 2025.

10 Mbps – average broadband speed in 2011, alongside average data usage of 10 GB per month.

357 Mbps – average broadband speed in 2022, alongside an average data usage of 518 GB per month (a 50-fold increase).

5.4.2 Future expenditure

There are currently no government initiatives underway to extend the UFB initiative beyond its current footprint and accordingly we have not included any Extending the Network capex related to UFB communal build in this proposal.

However, now that fibre is subject to price-quality regulation, there is the possibility of funding further extension as regulated expenditure if we are able to fund this investment and can show that the benefit to end-users from such an extension would exceed the associated cost.[19] Such expenditure would be categorised as Augmentation (extension) capex rather than UFB Communal capex.

FIBRE FRONTIER

We cover our proposed 'Fibre Frontier' investment to extend the network in a dedicated chapter.

5.5 New Property Development

Our forecast capex for NPD in PQP2 is $32m. The expenditure included in our proposal is net of any capital contributions we forecast to receive from developers.

TABLE 5.2: NEW PROPERTY DEVELOPMENT CAPEX (GROSS AND NET OF CAPITAL CONTRIBUTIONS) (PQP2 PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

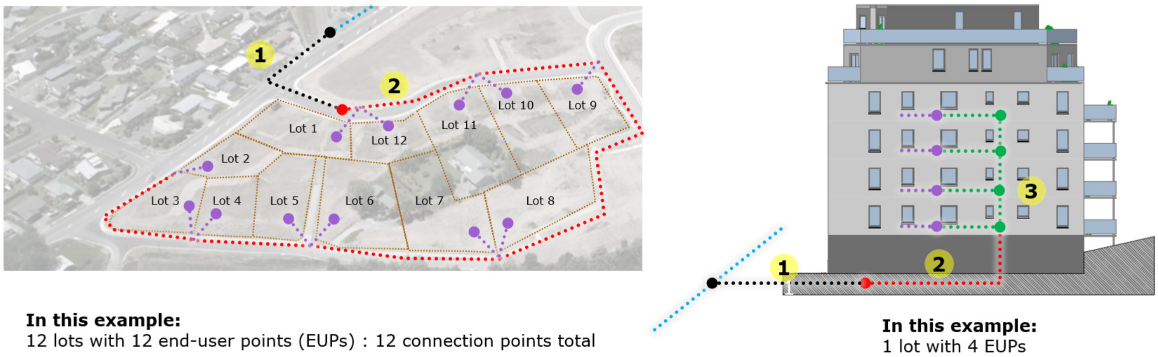
	2025	2026	2027	2028	TOTAL PQP2
New Property Development – gross	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]
Capital contributions	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]
New Property Development – net	8.0	9.0	6.9	8.5	32.4

Extensions to new property developments involve several different types of fibre reticulation. As shown by the diagram below, the exact configuration will depend on the type of development, including whether the property is a single-dwelling unit (SDU) or a multi-dwelling unit (MDU).

19 The possibility of funding extension as regulated expenditure does not preclude the possibility of full or partial Crown funding (or direct customer funding). Crown (or levy) funding would shift the cost burden from end-users of regulated fibre to taxpayers (or levy payers). While there is substantial overlap between these groups, tax and levy payers are broader funding sources and are less likely to incur affordability issues.

FIGURE 5.2: TYPES OF NEW PROPERTY DEVELOPMENT

SDU Developments (Horizontal) | **MDU Developments (Vertical)**



In this example:
12 lots with 12 end-user points (EUPs) : 12 connection points total

In this example:
1 lot with 4 EUPs

Legend

- Communal network (existing)
- 1 Feeder component
- 2 Lot reticulation
- 3 Unit reticulation
- Consumers connection (Installations capex)

5.5.1 Drivers

The main driver for NPD expenditure is demand from NPD activity and our success at winning contracts.

We actively compete with other Local Fibre Companies (LFCs) to lay fibre in NPDs near our existing network.

NPDs or subdivisions are an opportunity for us to increase the number of premises served by our fibre network and there is competition for subdivision contracts in all fibre areas.

NPD

We compete to lay fibre in new property developments near our existing network.

$32.5m

5.5.2 Forecasting methodology

We forecast this expenditure using a volumetric price (P) x quantity (Q) model.

We have a business team that forecasts different types of demand growth, as demand is a key driver of our work plans and the resulting expenditure forecasts (to various degrees). One output from our demand forecasting is the number of new connections within NPDs, which becomes an input in our forecasting methodology (i.e. the ‘Q’ in our P x Q model).

In particular, we use six specific inputs, i.e. both the SDU and MDU connection volumes forecasted separately for our UFB areas, LFC areas and rest of New Zealand (RONZ) areas.

Please refer to Demand chapter of Our Fibre Plans for more information on our demand forecasting methodology.

To forecast prices (or unit costs), we assume that an average of historical NPD costs is an appropriate indication of future unit costs. In particular, we use a historical 12-month average, offset by three months to ensure all associated costs for the completed work are captured within our financial systems.

Using a 12-month historical average is preferable to referring back to our latest actual costs, as this approach better ensures the impact of less frequently performed works (e.g. for unusual zone/dwelling combinations) is captured in the forecast unit costs. Also, the 12-month horizon is sufficiently long to ensure all works are captured, as typically most works do not remain as work in progress (WIP) longer than nine months before they are closed out.

Capital contributions

We usually request capital contributions from developers for extending the network to NPDs. The charge varies depending on the complexity of the work involved, the size of the development based on the number of possible consumer connections and whether the development is in a UFB1 or UFB2/2+ area.[20] Our government contracts stipulate price caps for these charges for projects within the UFB2/2+ footprint.[21]

Our approach to forecasting capital contributions for NPDs is consistent with how we forecast NPD capex – i.e. using a P x Q methodology with forecast quantities being the number of new connections within NPDs as provided by our demand forecasting function.

The prices we charge developers to connect NPDs are either priced on application for atypical works or standardised (see Table 5.3 below). On a case-by-case basis, however, we sometimes adjust the prices we charge in response to specific market conditions. On average though, capital contributions make up around two-thirds of our gross NPD capex, driven by the aforementioned government-set price caps and competitive pressures.

To forecast the prices we charge developers we generally use historical averages, and package those up for the expected zone/dwelling combinations.

We note that we are intending to undertake a pricing review focusing on our NPD pricing holistically across all geographies and dwelling types. CCI [ ].

CAPITAL CONTRIBUTIONS

Up-front capital contributions cover around two-thirds of gross NPD capex, leaving one-third funded as regulatory expenditure.

1/3

TABLE 5.3: NPD CHARGES BY DEVELOPMENT TYPE FOR UFB AREAS

	CHORUS UFB1	CHORUS UFB2	LFC/RONZ
SDU >4	$1,200	$1,200	Price on application
SDU ≤4	$1,200	$0	
MDU >4	$500	$500	
MDU ≤4	$500	$0	

20 Any cost related to subsequent orders for installations and connections from new property developments are captured within installations expenditure.
21 There are no price caps obligations in place anymore for UFB1 areas.

Key assumptions, uncertainties and risks

Forecasting price and quantity both carry risk, but differences between our actual capex and our forecasts are more likely to come from the quantity side of the equation. This is because the 'quantity' of NPDs (i.e. the number of NPDs we anticipate we will extend our network to) is demand-driven and actual demand will (almost) always be different to what we have forecast.

However, forecasting risk is materially mitigated through capital contributions from developers when our fibre network is extended to NPDs. As discussed above, these typically cover around two-thirds of our gross NPD capex, with our forecast being net of these contributions.[22]

Volumes are dependent on many factors, including our contract win-rate and market factors such as rates of population growth and volumes of building consents.

There is also a forecasting risk related to forecast unit costs and arises from uncertainty in the combination of area/dwelling type we use to package up unit costs. Change over time in these combinations can lead to significant movements in our unit costs.

5.5.3 Historical expenditure

Historically, NPD activity has been linked to the same economic cycles that drive other construction work. On the back of strong win rates of NPD contracts, our NPD-related capex peaked in 2022. The more recent downwards trend in NPD capex is predominantly the result of a change in the mix of dwelling type/area defining our NPD works, which we expect will intensify further over the forecasting period (more detail below).

5.5.4 Future expenditure

Our forecast for NPD capex – net of capital contributions – is coming off a demand-led spike in 2022 and is forecast to average $10m per annum over the coming decade.

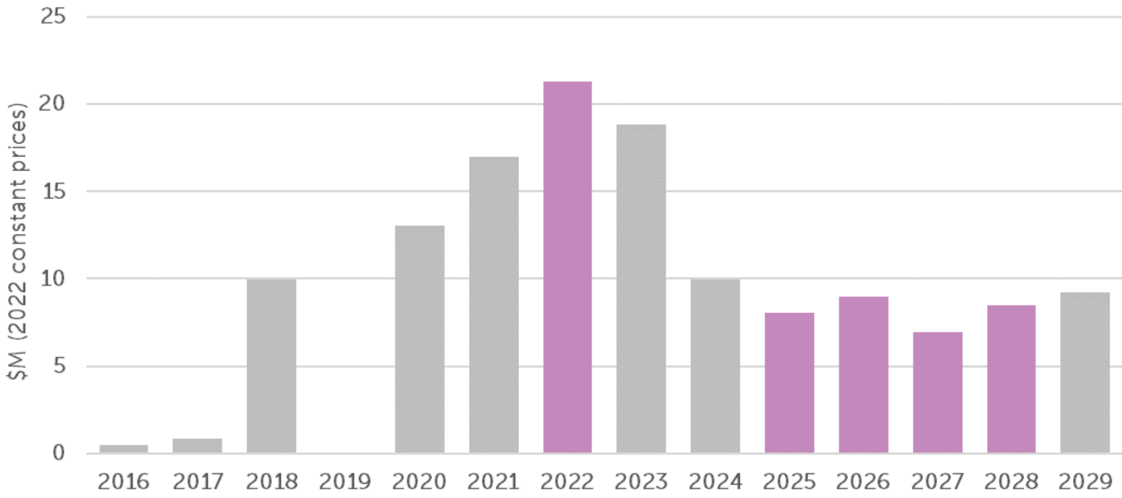
SPIKE

There was a demand-led spike in NPD investment in 2022, which has since subsided.

2022

22 We note that forecasting capital contributions for NPDs bears risk in itself. As with forecasting gross NPD capex, the more significant uncertainty is related to our demand forecast, with the residual risk being driven by uncertainty in the forecast combination of dwellings and areas we use to package up our forecast charges for capital contributions.

FIGURE 5.3: NEW PROPERTY DEVELOPMENT CAPEX (PQ FFLAS)[23]



Coming off the demand-led spike in 2022, we expect to see reduced demand for NPD-related works, resulting in lower forecast NPD capex in PQP2. The volume-driven reduction is further impacted by a change in the average dwelling/area mix over the PQP2 period (more detail on this in the 'Forecasting methodology' section in this chapter):

- The volume impact is expected to be reinforced by a changing trend regarding the areas in which NPD work is expected to be carried out. Historically almost all requests for NPD-related works came from within UFB areas. Going forward, this is anticipated to increasingly shift towards LFC[24] and RONZ[25] areas (from currently 1% to up to **CCI [ ]** in PQP2).[26] This will drive our average unit cost down, as NPDs in LFC/RONZ areas have a higher connection count per development than within UFB areas, and developments with more connections provide economies of scale.

- The volume impact will be partially offset by a changing trend in the predominant dwelling type we expect to lay fibre to in NPDs. SDUs currently make up 70% of the mix, with the remainder being MDUs. Our expectation is that by 2028 more than 90% of the dwellings we lay fibre to will be SDUs, driving up our costs as SDUs only provide for one connection each, removing economies of scale from our unit cost forecast.

Post PQP2, whilst we expect the above-mentioned unit cost impacts to persist, we anticipate the falling trend in demand for NPD-related work will reverse, arresting the decline in overall NPD capex.

SOFTENING

We forecast a decline in volumes and offsetting trends in cost per premise – with more connections per development (lower cost) but fewer multi-dwelling units (higher cost).

23 For clarification, while this chart does not show any spend in 2019, we did carry out NPD that year. However, because we receive capital contributions up front and the NPD build time can be delayed by up to 12 months, this can create timing issues when showing the net spend.
24 UFB areas for which fibre companies other than Chorus won the UFB contract with the government.
25 The geographical area not covered by the UFB areas.
26 This is because the UFB areas have fixed boundaries and urban areas are expanding primarily at their fringes.

5.5.5 How we deliver our NPD

Delivery of NPDs are prompted by a customer request from a developer or a homeowner subdividing their property. This starts a process, which involves activities throughout our business.

Our Customer and Network Operations (CNO) team manage the process of network extensions. They initiate the work using our IT systems, which share information about the status of the work between our teams and the field service provider (FSP). FSPs work closely with developers to complete the build work for NPDs – developers usually carry out the civil component of the build, while the FSPs perform the technical tasks for fibre and duct.[27]

When the build work is complete, we update the information in NetMap relating to our assets and the new addresses which the network serves.

COORDINATED

We coordinate NPD delivery with developers.

5.6 Augmentation

Our forecast capex for Augmentation in PQP2 is $221m, comprising forecast capex of $20m for infill works and $201m of forecast capex relating to our proposal to extend the network out beyond its current footprint, known as our 'Fibre Frontier' programme.

TABLE 5.4: AUGMENTATION CAPEX (PQP2 PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

	2025	2026	2027	2028	TOTAL PQP2
Augmentation – infill	5.0	4.9	4.8	4.8	19.5
Augmentation – extension	47.1	48.7	49.4	55.9	201.1
AUGMENTATION TOTAL	52.1	53.6	54.2	60.7	220.6

We currently complete two types of augmentation activity: infill and network extensions to non-UFB communities.

- Infill work includes augmenting the network for unforeseen (at the time of network build) growth within the existing UFB footprint.
- Network extension work includes extending the network to towns or communities that did not meet the threshold for the UFB 2/2+ contract.

As previously mentioned, our forecast Augmentation (extension) capex is discussed in the Fibre Frontier chapter later in this document. As such, the below section refers to our forecast for infill-related capex only.

A list of the types of infill are described in the below table.

27 We perform all consumer installations to the communal network. This work is described in the Installations chapter.

TABLE 5.5: TYPES OF INFILL

INFILL TYPE	DESCRIPTION	EXAMPLE
Unserved	Address points did not exist or were not detectable when the communal network was deployed	
Orphaned	The capacity allocated to an address point has been used for another premises	
Third-party	Third-party pole changes require construction of new assets to create communal pathways	
Consumption	The existing connections have consumed the available capacity and the network needs to be extended to serve growth areas.	

5.6.1 Drivers

New address creation within our existing fibre network is the main driver for infill growth. This occurs when new properties are developed after the communal network was deployed, requiring incremental network capacity to accommodate the address growth.

Serving new addresses created is the responsibility of the LFC or Chorus – whoever owns the local fibre network. There is no competitive market for infill works. Where the need to undertake infill work arises, it will always be carried out by the relevant LFC or Chorus.

INFILL

We invest within our existing network footprint to accommodate address growth.

$19.5m

5.6.2 Forecasting methodology

Forecast infill expenditure is calculated using a volumetric P x Q methodology.

Our approach to forecasting infill volumes is linked to how we currently respond to unforeseen growth in the network.

When we identify unforeseen growth within our fibre network we essentially have three options:

1. **Do not respond.** We do not consider this a credible option, as the new addresses that are typically driving the unexpected growth would remain unserved and impacted end-users would most likely invest in other network technologies that possibly offer an inferior price-quality balance to them.
2. **Provide additional network capacity reactively – i.e. sort out network capacity issues when we find them.** This is our current practice, which has the advantage that we can tailor our approach exactly to the situation ahead of us. On the other hand, this approach makes it difficult to predict future infill volumes, resulting in forecasting challenges. This is amplified by the low volume of infill related works each year (around 400 a year in minor works[28]) and general unpredictability around where and when this work will emerge (hence the application of a run-rate).
3. **Build incremental capacity proactively using probabilistic analysis and corresponding modelling techniques.** We currently do not possess sufficient capability to undertake this approach. Whilst we see potential benefits from this approach, it would be too risky (in terms of potential over-build) to introduce probabilistic methodologies until fibre uptake stabilises and we have sufficient planning information and models.

In contrast to our NPD forecasting methodology described in this chapter, the forecast infill volume is not an output from our demand forecasting function.

Instead, for minor works, we forecast infill volume within our forecast capex model, using historical averages as an indicator for future infill volume. We then sense check it against our NPD forecast and adjust it when necessary to ensure consistency between the two volume forecasts. In short, future infill volumes for minor works correlate with NPD growth expectations – i.e. more NPD equals more infill and vice versa.

This rather blunt forecasting approach is appropriate at this point. Unpredictability in terms of where unexpected growth in the network will occur leaves history as the best indicator for future volumes we currently have at our disposal.

For higher value infill projects, later referred to as 'named work' projects, we rely on assessments by our urban planners.

Our urban planners perform area studies and undertake route assessments. Performing these tasks gives our planners working knowledge they draw upon to assess which cables and terminals are at risk of experiencing a capacity deficit. When undertaking these tasks, urban planners draw on their professional experience within a planning area with regards to:

- details of local property developments, specifically their locations in relation to available capacity

CORRELATION

Our forecasting assumes that infill volumes correlate with NPD volumes.

28 Minor works are explained further in the 'Future Expenditure' section below

- the likelihood of demand arising for new smart locations such as billboards and traffic lights
- whether other projects will rearrange the network (e.g. RSP site exits or roadworks relocations).

After considering these factors, if a cable route or element is still considered to be at risk of capacity deficit, the planners will create an infill project in our internal systems.

To forecast prices (or unit costs), we apply the same methodology as for NPD unit costs, assuming an average of historical infill costs is an appropriate indication for future unit costs. In practice, we use a historical 12-month average, offset by three months to ensure all associated costs for the completed work are captured within our financial systems.

Using a 12-month historical average is preferable to referring back to our latest actual costs, as this approach better ensures the impact of less frequently performed works is captured in the forecast unit costs. Also, the 12-month horizon is sufficiently long to ensure all works are captured, as typically most works do not remain as WIP longer than nine months before they are closed out.

UNIT COSTS

We use costs from a recent historical 12-month period as the basis for forecast unit costs.

Key assumptions, uncertainties and risks

Considering the modest value of our forecast infill expenditure, the risk of uncertainties around the key assumptions impacting our total Extending the Network capex forecast is small. However, for completeness we note that infill activities can be quite different in scope, adding risk to our forecast unit costs because of variations in:

- the presence of other utilities like gas/power/water
- ground conditions (soil types, presence of rock, etc.)
- surface reinstatement types (asphalt, concrete, grass)
- the availability of existing aerial infrastructure (and conditions for accessing that infrastructure)
- how much of our pre-UFB infrastructure could be reused
- traffic management
- council fees.

However, we at least partially mitigate these risks through our unit cost forecasting approach, which relies on a historical 12-month average. This normalises (some) of the volatility in scope of work we are faced with when undertaking infill activity.

5.6.3 Historical expenditure

Infill work increased as the UFB build neared completion and capacity of the communal network was over-allocated in some areas. More recently, as the network has been filling up, the feeder fibre serving growth areas have required, and will continue to require, additional capacity to be able to serve the associated address growth in these areas.

FILLING UP

Infill investment has grown over time as the network has 'filled up'.

5.6.4 Future expenditure

Our forecast for infill capex is modest ($20m in total) and averages at $4.9m per annum over PQP2.

We will continue to complete infill work when requested to ensure consumers can connect to the network and benefit from fibre services.

We expect as demand for NPD returns from historically high levels to steady state levels it will temper future infill activity. However, overall we expect infill capex to be slightly elevated from what we have seen over recent years. This is because our urban planners (Chorus staff undertaking planning work for urban areas) have identified a number of urban areas where feeder capacities are forecast to reach capacity. These areas within the network will require incremental capacity to support infill growth and avoid situations where incremental capacity is provided reactively, which would create a negative customer experience.

Whilst we have a solid historical cost base for similar types of projects already performed, the frequency at which we will undertake such infill-related capacity work is uncertain and we refer to historical data to forecast future volumes.

Broadly speaking, infill work we forecast for PQP2 falls into three categories:

- **Named work projects** – these are works that exceed $50,000 (and average around $102,000 in PQP2) in capex, and involve build of feeder cables to get capacity from the exchange out to the joint enclosures in the network. To estimate this expenditure our urban planners exercise professional judgment to estimate the volume of such feeder related capacity projects in their respective areas with respect to historical trends (as discussed in section 5.6.2). In the short term, we assume that we will average 24 named work projects per annum, coming off what we consider to be a spike of 42 named work projects in 2023.[29] Named work projects make up roughly 48% of our infill capex forecast.
- **Minor works projects that average around $7,000 each** – these are works that introduce capacity on the communal network itself to accommodate a connection request. On average, we undertake approximately 360 of these projects per annum. These minor works projects make up roughly 48% of our infill capex forecast.
- **Minor works projects that average around $14,000 each** – these are works that build the racks/rows inside the exchange needed to hold our new fibre cables. On average, we undertake approximately 36 of these

MIX

We expect the mix of infill work to change as the network fills up, with a growing share of higher-cost project types.

29 We performed 20 named work projects in 2022. We do not have a long history of infill work to draw on given our fibre network is still young and the need for larger capacity driven infill works has only been arising relatively recently. In the context of 20 and 42 named works projects over the last two years we consider our forecast of 24 projects per annum over PQP2 is conservative.

projects per annum. These minor works projects make up roughly 4-5% of our infill capex forecast.

The increase in our forecast infill capex relative to the early 2020 years is due to additional scope in the type of work we will have to undertake when doing infill work in the future. Whilst our forecast unit costs are based on actuals and only increase with inflation, the work mix is changing and creating upwards pressure on the average unit cost and the resulting capex over PQP2. This increase is because in the past, infill work did not require significant incremental capacity to be built as the fibre network was relatively lightly utilised, meaning small adjustments to the network were necessary to redirect/reallocate existing capacity.

Going forward we expect more costly capacity-related infill work will be necessary. As the fibre network begins to fill up, incremental capacity becomes more expensive to provide because new network elements like cables and terminals need to be created. Smaller adjustments and reassignments can no longer be used, because capacity once available is now gone.

Simply put, achieving the same outcomes (i.e. infill growth) has become and will continue to become more costly, driving total infill capex up despite unchanged unit cost at an individual work level and demand for infill work being flat over time.

5.6.5 How we deliver infill

As with NPD, infill development is prompted by a customer request. Our CNO team then commissions the work using our IT systems which share information about the status of the work between our teams and the FSP. FSPs carry out the design and build work required for infills.

When the build work is complete, we update the information in NetMap relating to our assets and the new addresses which the network serves.

5.7 Links and synergies

5.7.1 Other expenditure areas

Augmentation links to other expenditure areas:

- Installations capex and Customer opex flow as new premises are ready to connect. Augmentation (extension) capex links to all Installation cost groups
- Network Capacity investment is needed as new connections contribute to bandwidth demand growth, and network extension alters the geographic distribution of demand growth. Network extension build also establishes new access and aggregation electronics that need ongoing lifecycle investment regardless of bandwidth growth
- Network extension allows new property development to occur as developments near our fibre network gain the opportunity for greenfield fibre build that can be more cost-effectively tied back to an existing network

- Augmentation (infill) investment is needed as address growth exhausts the initial capacity of the network
- Network Sustain and Enhance capex and Network opex flow as newly built assets add to the populations of physical network assets for us to manage and operate.

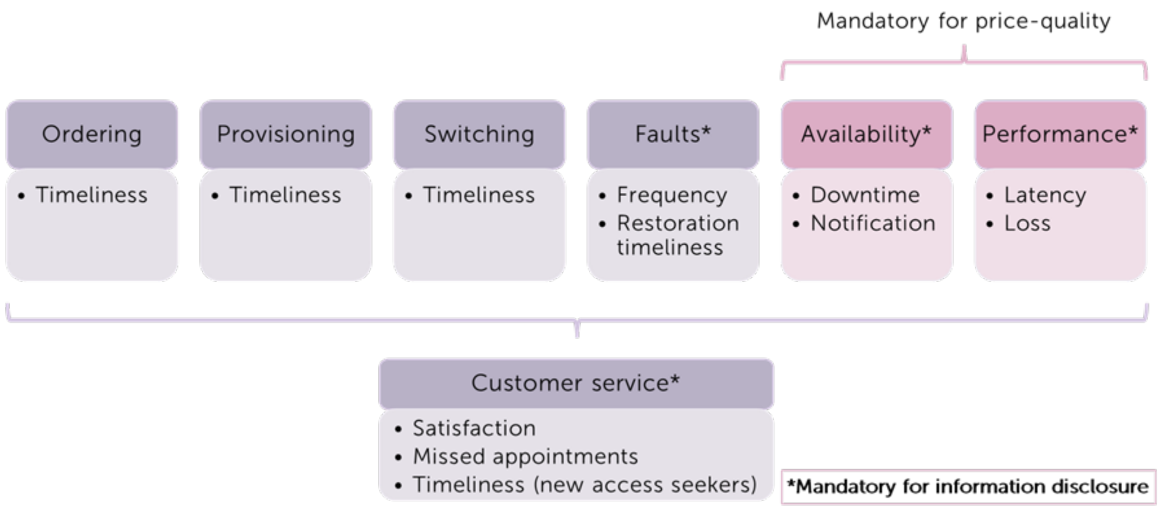
New property development work links to other expenditure areas:

- Installations capex and Customer opex flow as lots are built out and new premises are ready to connect. New Property Development capex links to connection cost groups 1, 7, 8, and 10
- Network Capacity investment is needed as new connections contribute to bandwidth demand growth, and network extension alters the geographic distribution of demand growth
- Network Sustain and Enhance capex and Network opex flow as newly built assets add to the populations of physical network assets for us to manage and operate.

5.7.2 Quality dimensions

The Fibre IMs define six lifecycle-based quality dimensions and one over-arching customer service quality dimension. Two quality dimensions are mandatory for PQ regulation, meaning they must have associated quality standards. Four dimensions (including the two PQ dimensions) are mandatory for information disclosure.

FIGURE 5.4: QUALITY DIMENSIONS AS DEFINED IN THE FIBRE IMS



Each discussion of linkages between expenditure and these quality dimensions includes a summary with simple icons to depict the strength and pace of each linkage. The icons provide a broad characterisation, rather than a precise assessment. Note, this discussion only focuses on quality dimensions for which there is a link to the 'Extending the Network' capex category.

TABLE 5.6: LINKS BETWEEN EXTENDING THE NETWORK CAPEX AND OUR QUALITY DIMENSIONS

Linkage strength:
How direct is the relationship between spend and quality?

▲ One of several drivers
△ A key driver
△ Direct link

Linkage pace:
How quickly would a change in spend materially alter quality?

● Beyond PQP2
● By the end of PQP2
○ Within 12 months

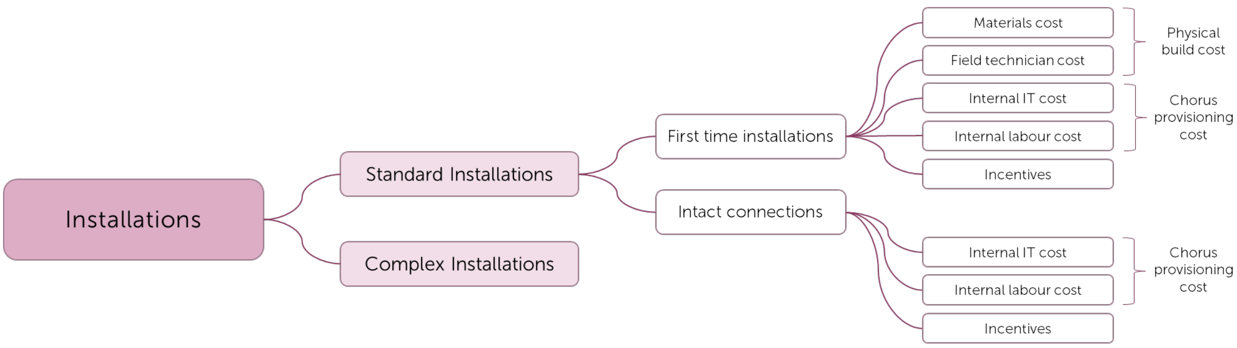
DIMENSION(S)	EXPENDITURE SUB-CATEGORY	STRENGTH	PACE
Availability and faults	All sub-categories The initial build quality of our network will influence Layer 1 reliability over coming decades. Additionally, without overbuilding the network, some planned downtime is required for short periods when growing the footprint of our network	▲▲△	●○○
Customer service	All sub-categories Installs and extensions are when we have our most direct interaction with customers.	▲▲▲	●●●
Provisioning	Augmentation Sometimes provisioning involves infill work to expand network coverage and capacity to accommodate organic growth in premises passed.	▲▲△	●●●

6.0 INSTALLATIONS

Tāutatanga

6.0 Installations

This chapter describes the Installations capital expenditure (capex) category. It covers work to establish the physical link between the communal network and an Optical Network Terminal (ONT) at an end point. It includes associated provisioning and incentive costs. This expenditure category includes both base and connection capex.



6.1 Introduction

This chapter describes the Installations capital expenditure (capex) category, being part of our growth capex that predominantly comprises one-off types of capex to establish the physical link between the communal fibre network and an Optical Network Terminal (ONT), typically at an end-user's premise.

In addition to the physical build cost associated with an installation, this chapter also covers:

- our internal IT and labour cost that we incur when we provision fibre services, which happens either when we complete an installation or when an end-user requests a connection where an installation has already been competed (i.e. an 'intact' connection, where we have already installed a fibre lead-in)
- our expenditure to attract new end-users or to incentivise existing end-users to upgrade to faster services (referred to as 'Customer Incentives').

INSTALLATIONS

Installation capex establishes a link between an end-user's premises and the communal network. It includes fibre lead-ins, ONTs and customer incentives.

An installation is prompted by a connection request from an end-user, business or our managed migration or copper withdrawal programme. The process has several steps and involves activity throughout our business, starting with an order either by a Retail Service Provider (RSP) or Chorus.

- RSP order (around 75% in PQP2) – where an end-user requests a broadband connection at an address which is in a fibre-ready area but requires an installation to their premise before their broadband service can be activated. Most of these orders occur in addresses which have historically had a copper service available, but some also take place in new property developments where the developer has not had fibre installed during the development phase.

- Chorus order (around 25% in PQP2) – where fibre is installed to the house without an RSP order. The end-user is subsequently required to place an intact order to an RSP to activate a broadband service. There are two drivers of Chorus orders:
  - Pre-built Fibre (PBF) – where a property developer requests the houses in their subdivision to have installations established as part of the build
  - Migrations – where Chorus campaigns in an area that is fibre-ready to encourage end-users to have fibre installed.

Installations capex arises from end-users wanting to connect to the fibre network either via standard or more complex installations. These types of installations make up our two installations sub-categories:

- Standard Installations – connections to residential and business end-users. Standard installations break down further into:
  - first-time installations, which cover building fibre lead-ins that join the Fibre to the Home (FTTH) network infrastructure to the premises, the cost of installing an ONT in the premises, and subsequent provisioning of the associated network service for the end-user. There are several types of first-time installations – single dwelling units (SDUs), multi-dwelling units (MDUs), rights of way (ROWs), and fibre access extensions such as CCTVs (we call these 'smart locations')
  - intact connections, which cover the costs we incur when an end-user requests a connection where we have already installed a fibre lead-in (comprising predominantly our internal network provisioning cost)
- Complex Installations – connections where additional design and planning is required to facilitate the installation. We use this categorisation because these types of installation are managed differently from standard installations. Typically, these would be connections to businesses.

This chapter also discusses expenditure incurred to incentivise RSPs to attract new end-users. This capex is allocated to standard installations (both first-time installations and intact connections), so is not an installations sub-category per se, but we discuss it separately due to the distinct way it is managed:

- Customer Incentives – this expenditure captures our incentive payments we pay to RSPs leveraging their product design and marketing capabilities to attract new end-users to our fibre network and to upgrade end-users to faster fibre services where that is right for them. Such incentives have been well established for a number of years and help us to quickly grow our fibre connections and increase the utilisation of the network, which is

DEMAND-DRIVEN

Around three-quarters of installations are prompted by an end-user asking their RSP for fibre. The balance are prompted by developers, or Chorus migration campaigns.

STANDARD AND COMPLEX

'Complex' installations, typically for businesses, involve additional design, planning, and management. Most of our investment is in simpler 'standard' installations.

in the interest of end-users (as the Commerce Commission has confirmed in its recent decision to allow for more incentive payments within PQP1).[30]

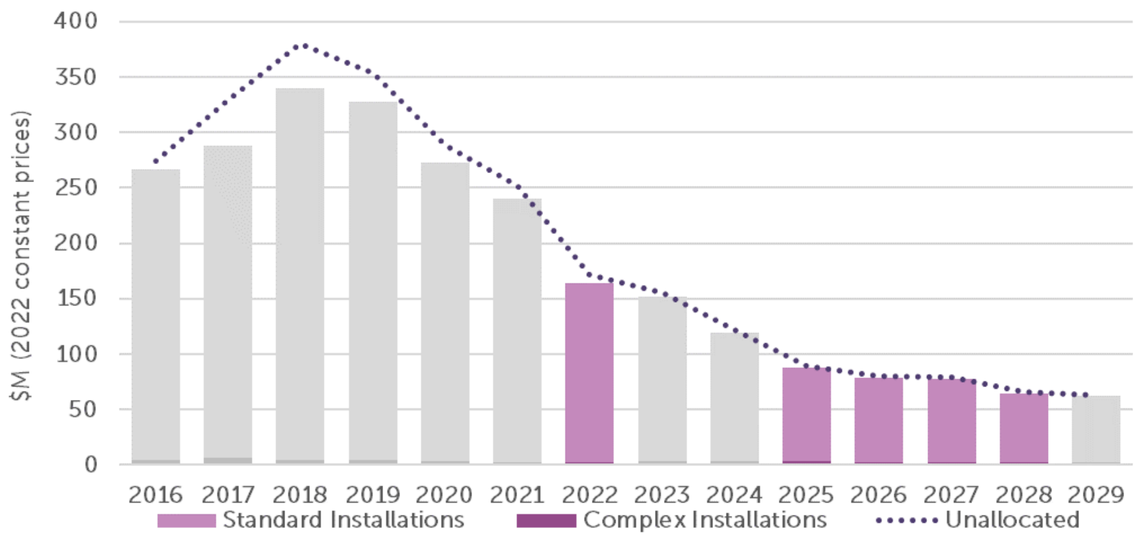
The Installations category and associated sub-categories were created for our first regulatory proposal based on our expenditure forecasting approach. The terms have different definitions from the same terms as used in the Network Infrastructure Project Agreement (NIPA).

See the ONT Strategy chapter in this document for details on the Installations forecast that is driven by ONT expenditure, as well as the ONT type we will be deploying. Note that our ONT Strategy discusses all instances where we install an ONT in the network, covering first-time installations (captured in the Installations capex category) but also for instances where we upgrade the current ONT to a next generation ONT (captured in the Network Capacity capex category).

6.2 Forecast overview

For PQP2, our total forecast capex for the Installations category is $310m, representing 23% of our total forecast capex. Thereof, the majority relates to Standard Installations $298m (96%), with Complex Installations contributing $12m (4%).

FIGURE 6.1: INSTALLATIONS CAPEX (UNALLOCATED AND PQ FFLAS)



30 Refer to Commerce Commission's Determination of Chorus' individual capex allowance for customer incentives 2023, available at: https://comcom.govt.nz/__data/assets/pdf_file/0023/301577/5B20225D-NZCC-39-Determination-of-ChorusE28099-individual-capex-allowance-for-customer-incentives-2023-13-December-2022.pdf and the Reasons paper: https://comcom.govt.nz/__data/assets/pdf_file/0024/301578/ChorusE28099-individual-capex-proposal-for-customer-incentives-2023-Final-Decision-Reasons-paper-13-December-2022.pdf

The below table shows the forecast capex by regulatory year, also broken down into sub-categories and separating out Customer Incentives capex.

TABLE 6.1: INSTALLATIONS CAPEX (PQP2 PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

	2025	2026	2027	2028	TOTAL PQP2
Standard installations (excluding Customer Incentives)	71.2	65.5	61.6	52.7	251.0
Customer Incentives payments[31]	13.6	10.4	13.6	9.3	47.0
Complex installations	3.0	2.9	2.8	2.8	11.5
INSTALLATIONS TOTAL	87.8	78.9	78.1	64.8	309.6

Our spend on installations increased year on year as we built the fibre network and demand for installations grew. Installation numbers peaked in 2020 and have been falling over time as migration to fibre services reaches saturation.

Over PQP2, however, we expect this decline in Installation capex to be arrested. While we will see a continuing decline in new installations within the footprint of the Ultra-Fast Broadband (UFB) programmes, we still forecast some baseload demand for first-time installations in these areas. Predominantly, though, we expect this decline to be offset by demand for installations from new property developments and, to a slightly lesser extent, from end-users located within the footprint of our network extension plans.

As indicated in our PQP1 proposal, further offsetting the demand decline from end-users within the UFB footprint is an expected increase in demand for smart locations, which we expect will peak within the PQP2 planning horizon. These smart locations include non-premise connections where high bandwidth and reliable connectivity is critical – such as traffic lights, CCTV, public WiFi, visual boards, ATMs and self-service kiosks.

Overall, although Installations capex is declining, installations will remain a large capex spend area during PQP2.

INSTALLATIONS

We forecast investment of $309.6m across Standard and Complex Installations.

$309.6m

31 Incentive payments are a subset of the Standard Installations capex sub-category.

6.3 Strategic objectives

An installation is the work needed to take fibre from the network to an end-user, supporting our vision of connecting Aotearoa so that we can all live, learn, work and play. This has implications for our forecasts for standard and complex installations, as we aim to carry out as many installations as possible, making fibre available to every New Zealander who wants to connect.

By early 2023, we achieved our interim goal to connect one million end-users. In PQP2, we will continue to promote fibre through our marketing activities, using incentives for late adopters and promoting upgrades to higher speed services. We are using our Migrations Programme to promote the benefits of the fibre network and encourage uptake in Specified Fibre Areas (SFAs).[32] Our aim is to turn off copper services in these areas using the Copper Withdrawal Code.

Connecting as many end-users as possible is a strategic initiative. It allows us to grow active connections which, in return, lowers the cost per connection. Ultimately, this supports a virtuous circle of reducing the maximum allowable revenue (MAR) (and therefore price) per connection, strengthening our price-quality balance and end-user value proposition, further supporting connection growth and retention, lowering the risk profile for our regulated business and enabling discretionary value-adding investment. This remains important and valuable even as the rate of new connections slows.

In addition to increasing end-user benefit, maximising the number of connections also has important benefits to our business:

- Operating two networks (copper and fibre) is expensive. As we migrate customers from copper to fibre, we will be able to turn off parts of the copper network and reduce our overall operating costs.
- Building the fibre network was a significant investment and we only receive actual revenue when end-users connect to the network. The incremental revenue that we earn from each new connection contributes toward recovery of our costs, including losses from the UFB build period and prospective operating and investment.
- One of our key business objectives is to continue to grow our business in core fibre and to seek out new fibre revenue opportunities. Connecting increasingly more smart locations is a significant UFB network extension opportunity, particularly in light of increasing competitive pressure from nationwide investment into fixed-wireless 5G upgrade technology. To accelerate the momentum, and to bring our strategy to life, we will commit to further partnering with smart location and managed service providers as well as RSPs.

GROWTH

Installations enable connection growth, which lowers the cost per connection on our network.

32 Under amendments to the Telecommunications Act 2001, the Commerce Commission is required to carry out an annual assessment to determine the geographic areas in which specified fibre services are available to end-users. These geographic areas will be known as specified fibre areas (SFAs). The assessment and notification of SFAs is an essential prerequisite to enabling Chorus to withdraw supply of copper services to end-users within those SFAs.

6.4 Standard Installations

Our forecast capex for Standard Installations in PQP2 is $298m. This includes $251m (84%) of expenditure on standard installations with the remaining $47m (16%) relating to incentive payments, which is discussed separately in the 'Customer Incentives' section below.

TABLE 6.2: STANDARD INSTALLATIONS CAPEX (PQP2 PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

	2025	2026	2027	2028	TOTAL PQP2
Standard installations (excluding Customer Incentives)	71.2	65.5	61.6	52.7	251.0
Customer Incentives payments[33]	13.6	10.4	13.6	9.3	47.0
STANDARD INSTALLATIONS TOTAL	84.8	75.9	75.2	62.0	298.0

Leaving the incentives payments aside, the remaining Standard Installation capex comprises broadly two types of expenditure:

- Physical build cost – this comprises:
  - field technician cost – rates agreed in our contracts with our Field Service Providers (FSPs) for building the fibre lead-in, travel to the premise, installation of the ONT, etc.
  - materials cost – the cost of the physical assets required for a connection, being the fibre, duct, cables and ONTs.
- Chorus internal provisioning costs[34] – the costs required to provide service to new end-users connecting to existing fibre service leads, i.e. where an intact connection exists at a property and there is either a new end-user, a change in RSP or a change in plan. Our IT systems automate a substantial part of these processes, but many orders still require some sort of intervention from our personnel to ensure the connection is successful. Our internal provisioning cost comprises the below two subtypes:
  - internal IT cost – an allocation of our internal IT cost for systems involved in the order processing
  - internal labour cost – the internal labour cost required to connect end-users and manage orders using our IT processes. This may involve a service desk person dealing with system or service exceptions (e.g. a missing ONT power cable) and liaising with RSPs, end-users and occasionally our service providers, who would send a technician to the property to successfully activate the service.

STANDARD INSTALLATIONS (EXCL. INCENTIVES)

We forecast investment of $298m in Standard Installations. The incentives component is covered elsewhere in this chapter, so here we focus on the balance, which is $251m.

$251m

33 Incentive payments are a subset of the Standard Installations capex sub-category.
34 The costs are capitalised under Generally Accepted Accounting Practice (GAAP), and specifically IFRS15, which requires the capitalisation and amortisation of costs relating to customer contracts and are subject to external audit each year.

6.4.1 Drivers

Within our fibre network footprint we actively promote fibre uptake through our Migration Programme (which we expect to wind down substantially in PQP2) and the incentives we continue to pay out to RSPs to attract new fibre end-users.

The main overarching driver of our Standard Installations capex is growth in fibre end-users as a share of the overall broadband market.

More specifically, the key volume drivers of our forecast Standard Installations capex are in regards to new end-users connecting to our fibre network due to:

- some of the remaining premises within the UFB areas connecting to our existing fibre network
- fibre we lay to new property developments
- extending our fibre network further beyond its current footprint.

A secondary driver for our provisioning-related capex is demand from intact connections that require some form of Chorus intervention – when either there is a new end-user, a change in RSP or change in plan.

As indicated in our PQP1 proposal, we also expect demand for fibre from new smart locations will become an important capex driver in PQP2, triggered by increasing business to business demand for 'internet of things' solutions.

PARTS AND LABOUR

Setting aside Customer Incentives, standard Installations capex covers lead-ins, ONTs, field labour and internal provisioning costs.

6.4.2 Forecasting methodology

Physical build cost

For physical build costs, we use a volumetric price (P) x quantity (Q) model for Standard Installations, where price is the unit cost of new installations and quantity is the associated forecast volume.

We have a business team that forecasts different types of demand growth as demand is a driver of our work plans as well as the resulting expenditure forecasts (to various degrees).

The key demand forecasting output for installations are growth in fibre end-users as a share of the overall broadband market and how this translates into new connections. The associated forecast volume of new connections for standard installations becomes an input in our forecasting methodology (i.e. is the 'Q' in our P x Q model).

We separately model forecast growth in smart locations, which is also an input into our capex forecasting.

More detail on our approach to demand forecasting can be found in the Demand chapter of the Our Fibre Plans.

To forecast prices (or unit costs) for the different standard installations jobs, we use an average of the actual costs for the current financial year.

This is an appropriate approach to forecasting unit costs, as volatility for standard installation costs is low. This is because roughly 70% of the cost mix is in relation to works carried out by our FSPs, with whom we have fixed price

DEMAND

Installations are demand-driven, so forecast quantities align with our central demand forecasts.

rate cards for different types of deployment. The vast majority of deployment types are within 200m of the communal fibre network (for which the same fixed price rate card under the FSA applies), further removing uncertainty from our forecast standard installations unit cost. In the very rare instances where a fibre installation is made to a premise more than 200m from the communal network, we recover the entirety of the incremental cost from the relevant end-user. This means that for our PQP2 standard installations forecast, all our unit costs are effectively the fixed price for deployment within 200m.

The average of the actual costs from the current financial year is weighted by the deployment type mix from the same period for the various installations jobs we have done. The key corresponding assumption we make is that future standard installation jobs will comprise the same deployment mix. This is prudent as we have no evidence that would suggest assuming a different deployment mix for future installation jobs is more reasonable.

For our smart location installations capex forecast, we forecast unit costs in the same way. However, as we ramp up our efforts to meet demand from new smart location operators, we expect to achieve economies of scale. This will be predominantly due to expected delivery process improvements as our market share is expected to grow from currently around 3% to potentially up to **CCI [ ].** For example, delivery of smart location installations is likely to become more efficient as we intend to:

- take a more proactive engagement approach with smart location operators, **CCI [ ]**
- engage more heavily with councils and utilities providers to better understand their pipeline of work, **CCI [ ]**
- pursue more co-build opportunities with customers **CCI [ ]**
- pursue a clear regional strategy, **CCI [ ]**

The scale of efficiencies achievable through these initiatives is uncertain and will take time to fully realise. While this creates a risk of under-recovery for us, it also provides a strong incentive to pursue and realise the efficiencies outlined above (and others where available).

Chorus provisioning cost

The forecasting methodology for the IT costs required in the provisioning process is a P x Q approach modified, if relevant, for future system needs.

Broadly speaking, we forecast IT provisioning costs based on our latest actual costs, adjusted for inflation expectations or contracted growth rates (price increases built into contracts with providers) where relevant. If applicable, we adjust it further considering future system needs – we identify expenditure associated with the systems used in the provisioning process and use these as the basis for our forecasting approach.

LEAD-INS

Most installations involve lead-in of less than 200m. Where lead-ins exceed 200m, we recover the incremental cost from the end-user and do not need to forecast that cost here.

200m

EFFICIENCIES

In departure from our standard practice, we have built prospective efficiency gains into our forecast for smart location costs.

We capitalise the proportion of the IT cost relating to provisioning systems in accordance with GAAP and then allocate to Installations capex based on the number/mix of orders we forecast for new connections and intact connections – with reference to the demand forecast we also use to forecast physical build cost.

The forecasting methodology for labour costs is a P x Q approach, modified for team activity.

The forecast labour cost is based on our latest actual cost (i.e. actual headcount and labour rates), which are linked to the number of service desk staff currently involved in the provisioning process, for both first-time installations and intact connections, and adjusted for future staff needs with reference to future order volume forecasts generated by our demand forecasting. Judgement is required here because the number of service desk staff does not change in a linear fashion with orders, and takes into account factors such as maintaining service levels and appropriate staffing for operational hours. Labour rates relevant for the career level of the role for each financial year are then applied to the forecast number of staff.

In order to allocate service desk costs between first-time installations and intact connections, the order volume forecast is combined with a high-level view of team activity to allocate the labour and related overhead costs – consistent with the demand forecast we also use to forecast physical build cost – between connection types.

PROVISIONING

Provisioning costs include internal labour and an allocation of IT system costs.

Key assumptions, uncertainties and risks

Forecasting price and quantity both have some uncertainty, introducing risk to the standard installations capex forecast. However, differences in our actual capex compared to our forecasts are more likely to be driven by the quantity side of the equation. This is because:

- ultimately, all installation volumes are demand driven, but actual end-user demand is inherently unknown and will (almost) always be different from what we had forecast
- the key driver for new installations is from expected new address growth as well as our aspirations to extend the UFB network beyond its current footprint. Whilst we can forecast the scale and timing sufficiently accurately, there remains some delivery-related uncertainty
- installation volumes are dependent on previous installation rates for premises passed by the network in and prior to PQP2. Faster uptake and more installations during PQP1 would reduce the pool of remaining premises to be connected during PQP2.

DEMAND UNCERTAINTY

Connection capex is designed to mitigate demand uncertainty by 'truing up' our allowances for actual installation volumes.

As a result, risk arising from installation volume uncertainty should continue to be isolated, because it is demand-dependent and outside our control. If such risk was not isolated, then:

- if volumes turn out to be lower than our forecast, we could recover materially more than our actual costs. This would flow through to higher prices over time
- if volumes turn out to be higher than our forecast, we would need to slow down or turn away installations to ensure we do not face a material funding shortfall.

To avoid these undesirable outcomes, we have designed our proposal to use the connection capex mechanism provided in the fibre input methodologies (IMs) by including the forecast expenditure in the connection capex allowance. This is consistent with the Commerce Commission's approach for PQP1. We consider this prudent, because our forecast capex for new installations remains material, and managing the consequential risk to our base capex allowance from the demand uncertainty would not be within our control.

In contrast, it is appropriate that any risk to our forecast arising from uncertainty around the cost per installation should rest with us, because we are the party best able to manage this risk.

There is some unit cost uncertainty as well. As discussed above, we assume the historical deployment mix of installation jobs is a valid indication of what the mix will be in the future, which informs the average installation costs we use in our P x Q model. However, there is uncertainty of where demand for fibre installations will come from. Ultimately, our actual installations capex will be a result of the actual addresses and premises connected, specifying the installation type and deployment mix required. Consequently, the average installation cost will change over time due to change in the deployment mix, but we do not have enough insight to forecast the change in trend appropriately.

For smart locations:

- volume uncertainty is material, CCI [ ]
- unit cost uncertainty introduces risk to our capex forecast in a similar fashion. CCI [ ]

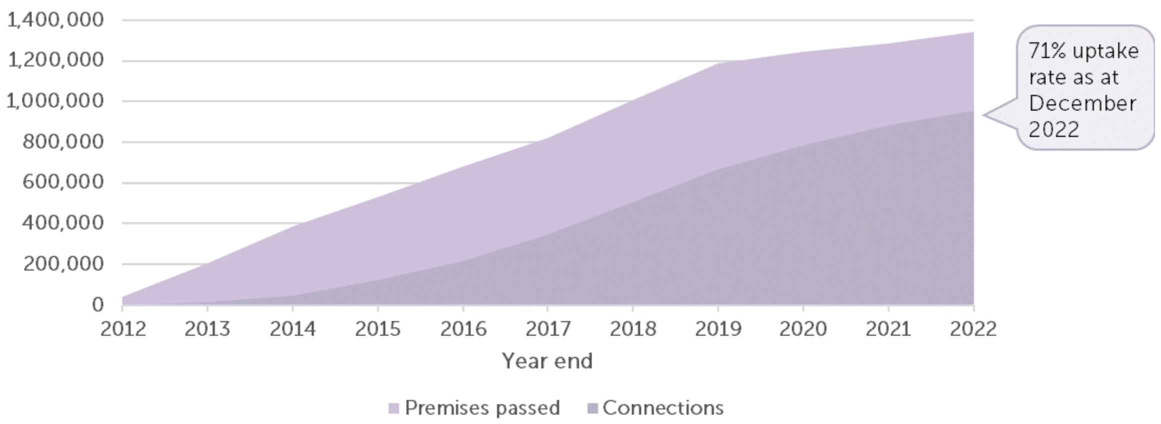
COST UNCERTAINTY

In contrast, uncertainty regarding unit costs rests with us because we are best placed to manage this risk.

6.4.3 Historical expenditure

As part of the UFB rollout, we have built FTTH network infrastructure to over a million premises. Each premise passed is a potential connection to the fibre network. We began completing fibre installations in 2013 and by December 2022 had installed a fibre lead-in to over 70% of end-users served by the network.

FIGURE 6.2: FIBRE UPTAKE



So far, albeit with a time delay, standard installation work has closely followed our UFB build – as we extended our network out further, more end-users have chosen to have an installation to be able to connect to our network.

Installation activity peaked over 2019/2020, and the spend (in nominal terms) has been roughly $2 billion since 2013, making installations capex one of our most material spend areas.

To improve customer experience, over time we have made several improvements to process delivery, comprising initiatives such as 'Fibre in a Day' and new improved deployment methods (e.g. surface mount). The impact of these are now reflected in our actual unit costs, also flowing through to the forecast capex discussed in this chapter.

SCALE

Historically, installations were a major expenditure area with roughly $2bn (nominal) invested to date.

$2bn

6.4.4 Future expenditure

When all premises in UFB areas have had fibre installations, the only remaining sources of new installations will either be the result of:

- extending the fibre network, through either new property developments or augmentation activities
- providing new fibre access to smart locations.

We expect new installations within existing UFB areas to make up 44% of all new standard installations to SDUs (the predominant type of installation), with the remaining share being driven by demand from new property developments 44% and 12% from other augmentation activities.[35]

On average, during PQP2 we expect to carry out 38,000 first-time standard installations per year, which is less than what we expect to complete in PQP1. We note this decline is slightly offset by an uplift in expected installations for smart locations, CCI [ ].[36]

35 In the same way we have seen time lags in end-users wanting to have an installations to the UFB area network, we are anticipating installation-activity time lags associated with the incremental network build we are proposing.

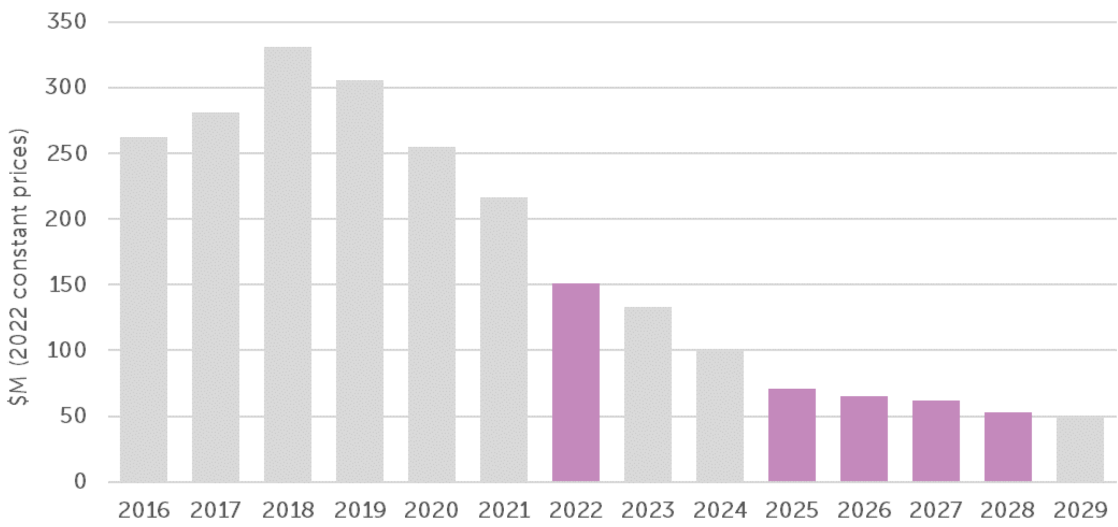
36 CCI [ ].

TABLE 6.3: FORECAST INSTALLATIONS BY TYPE

	2024	2025	2026	2027	2028	2029
SDU installations	60,022	37,871	33,902	34,272	29,128	29,136
NPD	18,034	18,014	14,619	15,219	12,045	14,026
Fibre Frontier	598	2,041	3,762	4,514	5,986	9,843
Migrations	11,173	2,375	0	0	0	0
Other	30,217	15,441	15,521	14,539	11,097	5,268
MDU installations	655	486	403	416	406	405
ROW installations	1,000	742	615	534	491	490
Fibre Access	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]
Smart locations	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]
Other	370	379	387	392	396	400

Having now completed the UFB build, we forecast standard installation capex (across both first-time installations and intact connections) will continue to trend downwards, averaging **CCI [ ]** (excluding Customer Incentives) annually in PQP2. It will remain a key area of spend for us, but will no longer be our most material spend area as it was in PQP1.

FIGURE 6.3: STANDARD INSTALLATIONS CAPEX (EXCLUDING CUSTOMER INCENTIVES) (PQ FFLAS)



The declining trend in installations capex (driven by fewer end-users from current UFB areas needing a fibre lead) in is partially offset by capex to:

- connect new end-users in areas where we propose to extend the network
- connect smart locations to the network.

The majority of our forecast Installations capex over PQP2 relates to connecting end-users in new property developments, which overall has the lowest unit cost per installation so further contributes to the decrease in total installations capex. However, this is partially offset by incremental installations we expect to be making as a result of our network extension activities, for which we forecast higher unit costs due to the more expensive anticipated mix of deployment.

However, the overall impact of movements in unit costs on forecast installation capex is negligible relative to the impact from any forecast changes in volume. This is because our unit costs for the physical build are almost entirely driven off commercially agreed rate cards with our service company providers.

For our internal provisioning costs, we expect to see slight upwards pressure on our forecast capex (over and above inflation). This is because as fibre uptake peaks, declining provisioning capex associated with fewer first-time installations will be more than offset by increasing provisioning capex from a higher existing end-user base. Such increasing end-user activity associated with more intact connections (i.e. as opposed to first-time installations) can have a range of drivers, such as end-users wanting to upgrade or amend their services. Whilst individually these activities costs less than provisioning services for a first-time installation, the higher volume of intact connection-related activity will mean higher provisioning capex overall.

This overall increasing trend in provisioning cost is slightly impacted further by downwards trends in IT and labour unit costs that in total make up our provisioning cost.

As we allude to in the section on forecasting methodology, forecast IT and labour unit cost are predominantly driven by our latest actual costs, however, are adjusted where necessary:

- IT-related provisioning unit costs are broadly stable over PQP2 except for one lifecycle exit, where capability is being built internally (associated capex is included in our IT capex proposal), which will reduce provisioning costs in 2025 when comparing year on year
- Labour-related provisioning unit cost for first-time installations do not drop as sharply as forecast installation volumes. This is because staffing requirements do not have a 1:1 relationship with installation volumes and there is typically a delay before staffing volumes catch up. Also, in anticipation of more intact connection-related end-user requests, we are maintaining a base staffing level in order to retain the capability needed as we move from a build to an operate business model. We are particularly aware of the complexity of new tasks to be performed and we are committed to providing a customer experience that meets expectations and is carried out in a timely manner.

MATURING

With uptake levels maturing across the network, installation volumes declined through PQP1, and we expect them to decline further through PQP2.

6.4.5 How we deliver standard installations

Installation activity is prompted by an end-user requesting to connect to the network or by the managed migrations programme. The process has several steps and involves activity throughout our business, starting with an end-user ordering fibre broadband from their choice of RSP.

The order request is logged on our IT system, which informs our customer and network operations (CNO) team who manage the installation process. The system tracks the order through various stages and triggers several automatic activities that share information on the status of the order with the RSP and the FSP carrying out the installation work.

A scoping visit may be required to determine the type of installation that is required (SDU, MDU or RoW). If a network extension is required, we organise the necessary consent, design and build work in partnership with the FSPs.

If fibre is available at the address, the FSP assigns a technician who follows the following 'ABC' process:

- Agree – meet with the end-user to describe the connection process and agree an install plan
- Build – build the fibre lead-in from the from the network to the boundary of the property and install an ONT
- Connect – meet with the end-user and complete the internal work and ensure that the network service is working.

FIBRE IN A DAY

We use IT systems to track and coordinate our provisioning processes. For simpler installations we can complete all on-site activities in a single day.

To speed up our installations and improve our customer service we have instigated a Fibre in a Day process. For simpler installations, the ABC process is completed in a single visit for Fibre in a Day installations.

When the build is complete, we update NetMap (our internal fibre record system) with information about the new assets.

If an ONT is already in place, our CNO team can connect the end-user without visiting the property.

Finally, our IT systems automatically invoice the RSP for any one-off installation charges (although this is unusual for standard installations) and the recurring billing for the monthly rental begins.

6.5 Complex Installations

We design and build complex installations for specific business requirements.

Complex installations solutions are common for cell sites, hospitals, schools, banks and large office complexes that need a dedicated connection. They can involve extensive design, cable hauling and traffic management activities.

Our forecast capex for complex installations in PQP2 is $12m.

COMPLEX INSTALLATIONS

We forecast investment of $11.5m in complex installations.

$11.5m

TABLE 6.4: PQP2 COMPLEX INSTALLATIONS EXPENDITURE ($M IN 2022 CONSTANT PRICES)

	2025	2026	2027	2028	TOTAL PQP2
Complex installations	3.0	2.9	2.8	2.8	11.5

6.5.1 Drivers

The main driver of complex installations capex is the same as for standard installations capex (i.e. growth in fibre end-users as a share of the overall broadband market, and growth in the overall broadband market), but to the extent that the resulting installations require additional design and planning due to their more complex nature. Typically, this is the case when we do first-time installations to businesses rather than residential premises.

A smaller driver of our expenditure on complex installations involves working with customers such as the Rural Connectivity Group or RSPs to build fibre routes to cellular base stations.

6.5.2 Forecasting methodology

We use a volumetric P x Q model for complex installations, where price is the cost of new complex installations and quantity is the volume of new complex installations.

We forecast volume for complex installations within our forecast capex model, using a historical average to forecast future volumes. We then sense check it against our demand forecast for new fibre connections and adjust it appropriately to ensure consistency with the connections forecast. In short, future complex installations volumes correlate with connection growth expectations – i.e. more fibre connections equals more installations and vice versa.

To forecast prices (or unit costs), we assume an average of historical complex installations costs is an appropriate indication for future unit costs. In particular, we use a historical 12-month average, offset by three months to ensure all associated costs for the completed work are captured within our financial systems.

Using a 12-month historical average is preferable to referring back to our latest actual costs, as this approach better ensures the impact of less frequently performed works is captured in the forecast unit costs. Also, the 12-month horizon is sufficiently long to ensure all works are captured, as typically most works do not remain as work in progress (WIP) longer than nine months before they are closed out.

COMPLEXITY

Complex installations cover less routine installation projects, such as for large businesses sites or cellular base stations.

Key assumptions, uncertainties and risks

There is a small level of risk in the forecast expenditure for complex installations related to uncertainty in our volume and unit cost assumptions.

There is uncertainty in our unit costs for complex installations as our historical expenditure on very high-cost installation types has been volatile. However, as our volumes are low, our exposure to forecasting risk in our total capex forecast is small.

Lower-cost business fibre installations are more stable and higher volume, which reduces the risk of a few very high-cost projects increasing in total programme cost.

Our exposure to risk is further mitigated as we sometimes ask for a contribution toward the costs of complex installations based on the scale of the work required. The level of expenditure presented in our proposal is net of these capital contributions.

When we ask for a capital contribution, the value of the contributions is variable, depending on the area where a complex installation is requested (UFB/non-UFB) and which products and or services are provided. For expensive complex installations, they can cover up to 90% of the total costs required.

CONTRIBUTIONS

Up-front capital contributions from the requesting end-user can cover up to 90% of the cost of a complex installation project.

6.5.3 Historical expenditure

Complex installations have been increasing on the back of the UFB build. However, more recently, we have seen a drop in requests for complex installations, primarily as:

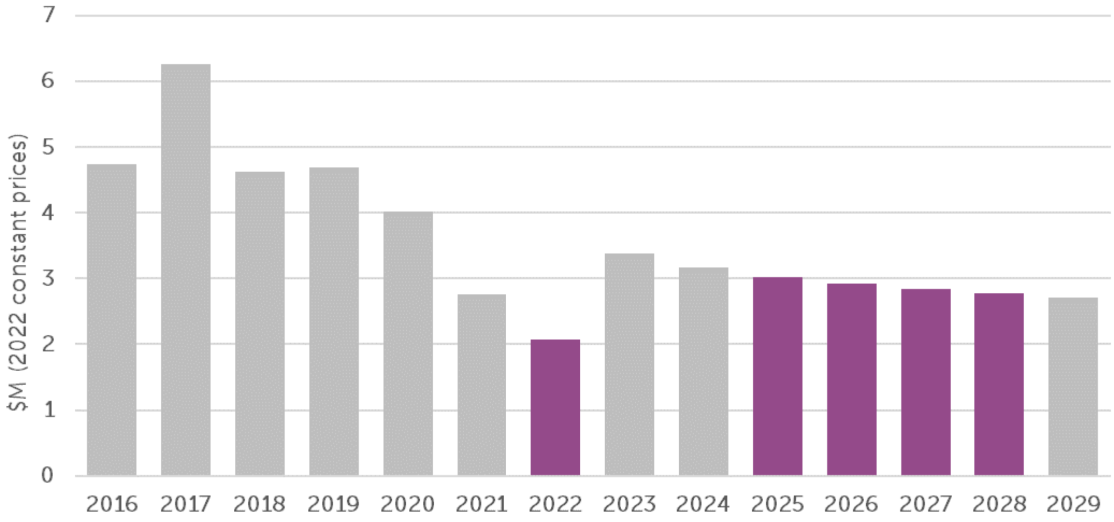
- the UFB build was completed and the volume of complex installations nears a saturation point
- businesses have increasingly opted to just have standard installations. Previously, businesses typically requested complex installations, as these typically provide for a class and level of service above that provided through a standard installation.[37]

6.5.4 Future plans and expectations

Coming off the UFB build, our spend on complex installations has averaged around $4-6m per annum in the recent years and is forecast to be steady over PQP2, averaging at $3m per annum.

37 For example, complex installations can provide for more reliable and/or resilient services through adding incremental redundancy to the installation, typically requested by business customers such as banks, but also hospitals, police stations, etc.

FIGURE 6.4: COMPLEX INSTALLATIONS CAPEX (PQ FFLAS)



Complex installations capex is a relatively low-value expenditure category with moderate volatility. As discussed further below, we consider the recent past demand for complex installations to be the best indicator for what we are likely to see in the future – i.e. to determine our capex forecast, we assume zero volume growth (only very slightly adjusted for a small number of new connections we expect to be doing for some RSPs).

In combination with our assumption that unit costs will remain flat going forward, this results in a relatively flat capex forecast.

6.5.5 How we deliver complex installations

Our approach to delivering complex installations is much the same as our approach to delivering standard installations (see 6.4.5) as they share the same general structure and format of a standard installation.

The key difference is the requirement for additional work due to site or location-specific factors, typically requiring extra cable pathway construction, consent or extension of the communal network.

In turn, each stage of the delivery process – agreeing, building and connecting – will likely involve more time and work than for simple installations, and therefore be more costly.

We consequently charge end-users for complex installations through our automated billing system, which invoices the RSP for any one-off installation charges before the recurring billing for the monthly rental begins.

6.6 Customer Incentives

Customer Incentives capex covers payments we make to RSPs to incentivise acquisition of new end-users to our fibre service or upgrades of existing end-users to new services. These payments are capitalised under GAAP and therefore come within the Standard Installations capex category.

MATURING

As with standard installations, we expect complex installation volumes to decline as uptake matures across the network.

INCENTIVES

We forecast investment of $47m in Customer Incentives, which play a core role in attracting end-users to fibre.

$47m

Our forecast capex for Customer Incentives capex in PQP2 is $47m – around 16% of total Standard Installations Capex.

TABLE 6.5: CUSTOMER INCENTIVES CAPEX (PQP2 PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

EXPENDITURE SUB-CATEGORY	2025	2026	2027	2028	TOTAL PQP2
Standard Installations - Customer Incentives	13.6	10.4	13.6	9.3	47.0

6.6.1 Benefits and objectives

Our goal is to attract end-users to connect to our fibre network and use Fibre Fixed Line Access Services (FFLAS). Our marketing and customer incentives aim to:

- encourage migration to fibre
- encourage offnet households to connect to our network
- optimise consumer experience by moving end-users up the portfolio of fibre plans
- retain end-users on our network, given the availability of alternative services.

Our customer incentives programmes are a core element of our strategy to attract end-users to fibre and retain them on our network, as well as promoting moves to higher-speed fibre where that meets end-users' needs.

The customer incentives programmes complement our marketing, market research and branding activities. They are designed to leverage RSP product design and support active participation by a wide range of RSPs.

Our customer incentives programmes are effective because they enable us to work with RSPs to reduce consumer inertia, including by reducing the cost barrier to fibre uptake or upgrades. More broadly, incentives support connection growth and improve end-user retention and service quality. They are a core part of our commercial offering. Consultation feedback from smaller RSPs and end-users support the continuation of incentives as they improve competition in retail broadband markets and help overcome cost barriers to uptake.[38]

We are not a traditional monopoly utility and consumers have other choices for broadband services. As such, the incentives we provide to retailers are critical to supporting greater awareness of the benefits of fibre and maintaining a level playing field for more diverse and effective retail competition. This benefits consumers through better retail offers and choice, and, as more consumers connect to fibre, secures the sustainability of the fibre network and supports continued growth and development of fibre and fibre products so we retain a world class fibre network.

BENEFITS OF INCENTIVES

"Fibre incentives are fundamental to operating in this segment of the market to acquire customers, grow fibre uptake and to compete against the growing strength of the MNOs."

RSP feedback

38 A more extensive discussion of the benefits of Customer Incentives capex is in Section 1 of Chorus' Incentives Individual Capex Proposal for 2023. These benefits remain current. The proposal is available here: https://comcom.govt.nz/__data/assets/pdf_file/0031/295069/Chorus-ICP-customer-incentives-proposal-Public-30-June-2022.pdf

The costs of our fibre network are largely fixed and sunk. Therefore, providing incentives which result in an expansion of demand (relative to a counterfactual of offering no incentives) is efficient, so long as the incremental revenue from the incentive exceeds the cost of the incentive. This is because:

- our allowed FFLAS revenues (i.e. our MAR) are set based on our costs
- where the fibre network is already built, adding end-users or upgrading them to higher speeds doesn't lead to us incurring material extra costs, because we don't have to build major new assets to connect or upgrade them
- adding extra end-users to our existing network would lead to lower prices over time, because the number of new connections is higher than the extra cost.

We invest in customer incentives in this way to provide a net positive return on investment. Fibre adoption generates consumer surplus over and above our return and also promotes cost savings related to our copper network, but our investment case does not rely on these factors.

Chorus is not alone in providing wholesale customer incentives. In Australia NBN have provided multiple incentives[39] with similar objectives to Chorus'. Locally, Enable[40] and Tuatahi First Fibre[41] have also provided incentives.

6.6.2 Previous assessment of Customer Incentives capex

For PQP1, the Commission approved our proposed Customer Incentives capex only for the initial year (2022) and decided that individual capex proposals (ICPs) would be needed for Customer Incentives capex in 2023 and 2024. We subsequently made an application for Customer Incentives capex for 2023, where the Commission approved the majority of the proposed capex. The Commission concluded that:

- Chorus' "incentive payments can promote competition, accelerate uptake, and can drive cost efficiencies."[42]
- "we are satisfied Chorus' proposed expenditure meets the capital expenditure objective and reflects good telecommunications industry practice"[43] (noting there were a few exceptions where expenditure was excluded in the final decision).

We chose not to make an ICP for Customer Incentives capex for 2024, as we did not want to distract our or the Commission's attention from this expenditure proposal.

BENEFITS OF INCENTIVES

"Incentive payments can promote competition, accelerate uptake, and can drive cost efficiencies."

Commerce Commission

39 See https://www.nbnco.com.au/content/dam/nbn/documents/sell/other-agreements/2023/sfaa-letter-agreement-smp-interim-agreement-take-three-rebate-20230509.pdf.coredownload.pdf, https://www.nbnco.com.au/content/dam/nbn/documents/sell/wba/2022/sfaa-take-two-rebate-letter-agreement-20220901.pdf.coredownload.pdf and https://www.nbnco.com.au/content/dam/nbn/documents/sell/wba/2023/sfaa-wba-nbn-ethernet-dcr-annexure-20230301.pdf
40 See https://www.enable.net.nz/assets/RSP-agreement-Enable-upgrade-to-fibre-offer-Sept-Nov-2019-final.pdf
41 See https://tuatahi.cdn.prismic.io/tuatahi/d4a4b364-fa88-4e37-88fb-0a2ac02cbac3_Digital+Equity+Offer+-+1+July+2022.pdf
42 Commerce Commission, Chorus' individual capex proposal for customer incentives 2023 – Final decision – Reasons paper, 13 December 2022, paragraph 3.10.
43 Commerce Commission, Chorus' individual capex proposal for customer incentives 2023 – Final decision – Reasons paper, 13 December 2022, paragraph 3.57.

6.6.3 Our customer incentives will continue to meet the PQP1 tests

Over the course of the Commission's decisions on our PQP1 expenditure and Chorus' 2023 Incentives ICP, the key tests for approving Customer Incentives capex have become clear:

- the expenditure must be capex
- the economic test must be passed (i.e. incremental revenue from the additional end-users gained by offering incentives must exceed the cost of the incentive payments)
- the incentives need to be consistent with Chorus' geographically consistent pricing (GCP) and non-discrimination obligations
- the incentives must meet the tests set out in sections 162 and 166(2) of the Telecommunications Act 2001 (the Act).

Our customer incentives remain capex. The payments are core fibre assets because they can be, and are, recognised as assets in accordance with GAAP and are acquired in connection with and to support the provision of FFLAS. Chorus is continuing to capitalise the investments under GAAP and will continue this practice in PQP2.

In terms of the economic test, the Commission has previously concluded:

> *"incentive payments are consistent with the behaviour we expect in workably competitive markets as they can be pro-competitive and benefit end-users provided they are not excessive or overstated and provided the recoupment strategy is not to recover the cost of the incentive payments from the whole of the customer base"*[44]

We agree. The Customer Incentives capex put forward for PQP2 is not excessive, with an annual forecast expenditure that is similar to prior years and shows a declining trend over time. Our proposed Customer Incentives capex is in the interest of end-users, because the expected incremental revenues from customer incentives across PQP2 exceed the expected incremental costs, and this holds true across a range of reasonable sensitivity tests.

In terms of the core legal tests, Chorus' process for ensuing our incentives are compliant with our legal obligations, including GCP and non-discrimination, was outlined in section 4.1 of our 2023 Incentives ICP. These processes have not changed and we continue to ensure that our incentive offers are compliant by way of legal review and advice. We are confident that our incentive offers currently in the market are compliant with all relevant legal obligations, and we will continue to ensure that any new incentive offers are similarly compliant.

In addition, our detailed information disclosure requirements relating to customer incentives give the Commission timely information on any new incentives. These disclosures provide additional assurance that the incentives will be compliant and that any concerns regarding compliance can be readily addressed.

INCENTIVES ARE IN THE INTERESTS OF END-USERS

"Any adverse change to the Chorus incentive framework will mean that retailers are most likely to pass on the change by way of higher prices to end user."

RSP feedback

44 Commerce Commission, Chorus' individual capex proposal for customer incentives 2023 – Final decision – Reasons paper, 13 December 2022, paragraph 3.43.

In terms of broader competition effects, it is clear that incentives are important to our customers. They help RSPs to achieve their customer acquisition ambitions, which is critical for vigorous retail competition. Relevant to section 166(2) considerations, our incentives are particularly important in helping non-mobile network operator (MNO) RSPs compete with vertically integrated MNOs.

We also refer the Commission to the NERA report we have provided previously[45] and the discussion of the competition effects of Customer Incentives capex in section 4.2 of our 2023 Incentives ICP. The rationale and analysis remains consistent.

TARGETING

We allocate customer incentive investment across consumer and business segments, and across new connections and upgrades.

6.6.4 Proposed PQP2 expenditure

For PQP2, we propose to invest $47m over four years on Customer Incentives capex (excluding clawback). This includes $30m on incentives to connect new end-users to the network and $25m on incentives to upgrade existing fibre users to faster speed plans, less $7m total clawback.

TABLE 6.6: FORECAST CUSTOMER INCENTIVES CAPEX (PQ FFLAS) ($000 IN 2022 CONSTANT PRICES)

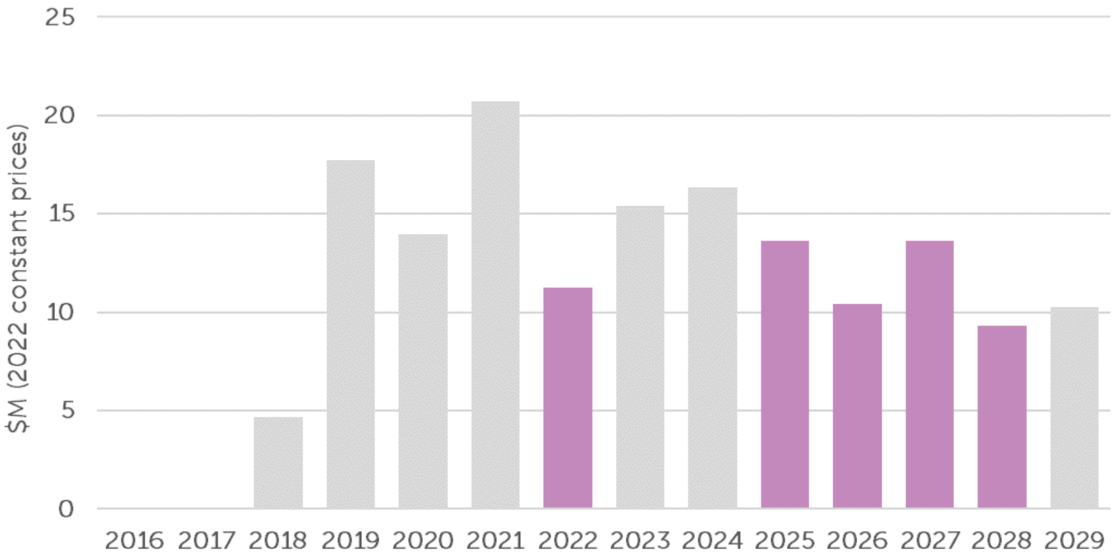
CATEGORY	2024	2025	2026	2027	2028	2029	PQP2 TOTAL
Consumer connect	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]
Consumer connect clawback	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]
Consumer upgrade	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]
Consumer upgrade clawback	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]
Consumer total	14,552	11,978	8,839	12,315	8,374	9,407	41,506
Business connect	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]
Business connect clawback	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]
Business upgrade	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]
Business upgrade clawback	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]
Business total	1,792	1,637	1,571	1,316	958	849	5,481

45 Customer incentive payments and the long-term benefit of end-users, 7 July 2021

CATEGORY	2024	2025	2026	2027	2028	2029	PQP2 TOTAL
GRAND TOTAL	16,343	**13,615**	**10,410**	**13,630**	**9,331**	10,256	46,987

Our proposed Customer Incentives capex for the first year of PQP2 is relatively high. We plan to increase Customer Incentives capex in 2024 as part of a refresh of our incentive offerings, reflecting the increased costs[46] of attracting customers to fibre given competing technologies and the nature of late adopters. We then forecast a generally declining trend of Customer Incentives capex over time – the step up in 2027 reflects an expected acceleration in CCI [ ] in that year.

FIGURE 6.5: CUSTOMER INCENTIVES CAPEX (PQ FFLAS)



6.6.5 Forecasting methodology

Our forecasting approach for Customer Incentives capex remains similar to the approach used for the PQP1 expenditure proposal and our 2023 Incentives ICP. Customer Incentives capex is forecast as part of our yearly planning process, subject to company-wide governance.

When we forecast uptake and upgrade incentives capex we forecast the dollar amount, not the quantity of incentives paid – as we do not plan campaign activity in detail until closer to the campaign launch. We include as much detail as possible about the incentives in our forecasting – when developing our incentive forecasts we forecast customer segments for connection and upgrade incentives. When individual incentives are going through our internal governance process a business case is prepared and a forecast of how many incentives will be paid under the incentive is included.

DEMAND LINKAGES

Our connection demand forecast assumes we will continue to use incentives to drive demand growth.

46 These costs include increased cost for RSPs in encouraging late adopters to move to fibre, such as more resource-intensive sales activity such as 'door to door'.

The general structure of the expenditure calculation is P x Q, where price is the average forecast gross credit per net new connection and quantity is net new connections.

The methodology for our net new connections forecast is described in the Demand chapter of this proposal. It provides an overview of how market conditions (including address growth, penetration rates, and competitor market share) are combined with product manager portfolio knowledge to develop a FFLAS connections forecast. For the nearer-term view of this forecast, latest 'actual' connection volumes (and how they are tracking against previous forecasts) are used to inform model settings.

For consumer new connect incentive payments, our forecast of unit cost per connection **CCI [** **]**.

For consumer upgrade incentive payments, we assume **CCI [** **]**. Our unit cost forecasts are based on 6 months of prior year data. We noted the previous Commission view that this is insufficient, but we consider that using 6 months of data is suitable given the rate of change in uptake of incentives offers and because our Home Fibre Starter offer only began in April 2022, which meant a full year's worth of data (at the time of our business planning decisions) would not have properly reflected growth rates in that product.

For business incentive payments, our forecast of unit cost per connection is based on 12 months of prior year data. **CCI [** **]** so we base our forecast on previous incentive payments and trend rates.

The proposed expenditure is net of clawback. Clawback is recovery of incentive payments made for connections that disconnect within 12 months. We claw back a pro-rated amount, based on the number of months the end-user remains connected to fibre. Our clawback forecast applies historical clawback rates phased across the 12 months following payment. Since the 2023 Incentives ICP, we have updated the calculation of the historical clawback rate to reflect more recent data and address Commission concerns – i.e. we have used data that is consistent with the information provided to the Commission through the ICP process.[48]

Similarly, we have looked to improve the explanation of our connection forecasting methodology, which is set out in the Demand chapter of this proposal. The use of incentives is built into our connections forecast as our forecasts of connection growth and upgrades assume incentives will be applied.

CLAWBACK

If a customer disconnects within 12 months, we 'claw back' the associated incentive payment made to the RSP. Our forecast is net of forecast clawback.

47 For example, **CCI [** **]**

48 See 2023 Incentives ICP RFI 4 response.

6.6.6 Economic analysis

The proposed incentives continue to be economically efficient and consistent with outcomes that would be expected in workably competitive markets. In its final price-quality determination, the Commission concluded that incentives can improve efficiency and be pro-competitive. The Commission approved the Customer Incentives capex for 2022 on the grounds that it met the economic test "since the expected incremental revenues from incremental end-users outweighs the incremental costs. Therefore, in the aggregate and on balance, it is likely to improve efficiency and be pro-competitive."[49] The Commission confirmed this position for our 2023 Incentives ICP.

Our assessment is that our proposed Customer Incentives capex for PQP2 similarly meets the economic test as the expected incremental revenues from incremental end-users outweighs the incremental costs. We have provided scenarios which show that under a range of conditions our incentives are consistent with workably competitive markets. Therefore, there is a strong case that the proposed incentives for PQP2 are beneficial to end-users, improve efficiency and support competition.

Details of the economic test

We have updated our economic test to reflect recent data and business cases. The test calculates the net benefit over eight years to account for the four-year customer life at the end of PQP2.[50] In this test we have estimated that both connection and upgrade expenditure provide an incremental revenue:

- For new connection offers, we estimate a net benefit of **CCI [** **]**. This is based on incremental revenue from moving end-users from off-network (e.g. cable) to fibre, and from copper to fibre, which would provide an average revenue per user (ARPU) uplift that is greater than the incremental costs from the incentive credits provided and new lead-ins.
- For upgrade offers, we estimate a net benefit of **CCI [** **]**. This is based on the ARPU uplift provided by current incentives being greater than the incremental costs from the credit and new ONTs (where end-users upgrade to Hyperfibre).
- For both incentive types, positive results hold under a range of scenarios.

Our new connection credit results are conservative since we limit the revenue benefit of copper customers moving to fibre to the uplift in average revenue per user (ARPU) between copper and fibre. This makes sense from a whole-of-Chorus perspective but is conservative when testing relative to section 162 of the Act, which is focused on markets for fixed fibre line access services and therefore implies that the full fibre ARPU should be taken into account.

A simplified table of calculations is below.

PRO-COMPETITIVE

"Chorus' ability to incentivise all RSPs gives challenger RSP brands, who don't stand to realise the same commercial upside as MNOs, the ability to genuinely compete while offering a superior performing product."

Stakeholder feedback

NET BENEFICIAL

We have assessed that the customer incentive programmes with generate incremental revenue in excess of the incremental cost.

49 PQ final decision, C5.2 & C5.3.
50 This is consistent with our approach for PQP1. The customer retention benefit for any incentive paid is assumed to be 4 years. The test calculates the benefit over 8 years because a benefit is calculated for each year of PQP2.

TABLE 6.7: INPUTS FOR ECONOMIC TEST CALCULATION

ITEM	CONNECT OFFERS	UPGRADE OFFERS
Incremental revenue	Sum of: • Fibre revenue from incremental connections • Incremental revenue from connections moving from copper to fibre • Effect of higher plan mix from RSPs signed to offers	Revenue from ARPU increase on incremental upgrades
Clawbacks	As per business plan	As per business plan
Incremental cost	Sum of: • Credit payments • Additional lead-in cost • Additional ONT cost	Sum of: • Credit payments • Additional ONT cost where Hyperfibre is installed
Taxable income	Tax depreciation for credits in year Tax depreciation for lead-ins and ONTs use diminishing value	Tax depreciation for credits in year Tax depreciation for ONTs use diminishing value

Sensitivity analysis

We have tested the key parameters in the model we have provided, which show that our results are robust and that there is little uncertainty around whether they are consistent with workably competitive markets. Our model shows the effect of +/- 10% changes to key parameters, and to combinations of parameters, and in each case the results are net present value (NPV) positive – even for the most sensitive parameters. This is further highlighted in the two tables below, which show the breakeven value for each parameter.

TABLE 6.8: BREAKEVEN VALUES - MODEM (NEW CONNECTION) CREDITS

PARAMETER	START VALUE	BREAKEVEN VALUE	NOTE
Fibre ARPU	CCI [ ]	CCI [ ]	CCI [ ]
Copper ARPU	CCI [ ]	CCI [ ]	CCI [ ]
Average credit - new connection	CCI [ ]	CCI [ ]	CCI [ ]

PARAMETER	START VALUE	BREAKEVEN VALUE	NOTE
Installation cost	CCI [ ]	CCI [ ]	CCI [ ]
Lead-in proportion	CCI [ ]	CCI [ ]	CCI [ ]
New connection uplift	CCI [ ]	CCI [ ]	CCI [ ]
BAU proportion of new connection uplift	CCI [ ]	CCI [ ]	CCI [ ]
Copper to fibre %	CCI [ ]	CCI [ ]	CCI [ ]
WACC (post-tax)	CCI [ ]	CCI [ ]	CCI [ ]

TABLE 6.9: BREAKEVEN VALUES - UPGRADE CREDITS

PARAMETER	START VALUE	BREAKEVEN VALUE	NOTE
Upgrade ARPU increase	CCI [ ]	CCI [ ]	CCI [ ]
Average credit - upgrade	CCI [ ]	CCI [ ]	CCI [ ]
ONT cost	CCI [ ]	CCI [ ]	CCI [ ]
Incremental upgrade percent	CCI [ ]	CCI [ ]	CCI [ ]
Hyperfibre portion of upgrades	CCI [ ]	CCI [ ]	CCI [ ]
WACC (post-tax)	CCI [ ]	CCI [ ]	CCI [ ]

Additional benefits excluded from our modelling

Our economic analysis excludes some benefits from providing customer incentives. These benefits are those that we have considered, but currently do not have sufficient quantifiable estimates to support our analysis. The benefits excluded fall into four categories:

- **Benefits that would improve the effectiveness of the offers but are not modelled** – our modelling is conservative in that it excludes the benefit of improved customer retention. Our incremental connection parameters are based on increased orders and as such don't include the benefit to Chorus that results from both the lower probability that a fibre user churns to other technologies (when compared to copper) and the lower probability that a fibre user churns to other technologies when they are on higher speed plans. Research shows that users have higher satisfaction on fibre services and at higher speeds so we expect this to translate into increased retention.
- **Operational benefits** – additional operational benefits, such as reducing end-user inertia resulting in better fibre installations through bulk processes, have also been excluded. Customer incentive offers make it easier for us to connect users in batches, which provides productive efficiencies due to consistent installation volumes.
- **Long-run benefits** – we did not quantify the reduced risk of fibre network asset stranding or the reduced long-run costs due to shutting down the copper network, which are significant factors in Chorus' decision making.
- **Other economic benefits**
  - Improved allocative efficiency – greater uptake of premium (high-speed) products by willing end-users reduces the residual MAR per connection across other users. This also flows through to lower prices over time, which itself may support further uptake longer-term, including by households otherwise unable to afford fibre services.
  - Market competition benefits – including benefits that flow from challenger RSPs exerting pressure on incumbent MNOs to innovate, improve efficiency, sharpen prices, and improve service quality. All of this is driven by a healthy pressure to deliver value for end-users of telecommunications services.
  - Non-monetised end-user benefits – these include benefits due to the superior performance and attractive pricing of fibre services relative to alternatives. The COVID-19 pandemic has demonstrated the value of fibre to households and businesses, as people can work from home and stay connected during times of disruption. Incentives grow these benefits by helping overcome consumer inertia, meaning more consumers begin enjoying these benefits earlier than would otherwise occur.

CONSERVATIVE

Our economic modelling is conservative, because we have not attempted to quantify all benefits.

6.6.7 Alternative approaches considered

Given the unusual market structure in Aotearoa, in which fibre products compete with inferior products provided by our competitors, who are also our primary customers, it is essential for Chorus to continue to be an active wholesaler and promote fibre because we cannot rely on the largest RSPs to actively market our products.

Incentives are one part of our active wholesaler programme. They complement our marketing, market research and branding activities that raise awareness of the availability and benefits of fibre and inform end-users of the best options for their needs. They are designed to leverage RSP product design and marketing capabilities and support active participation by a wide range of RSPs.

As such, the alternative to continuing to invest into customer incentives is to switch or rebalance the expenditure to other activities such as marketing. Our view is that incentives work best alongside marketing, rather than investing in just one type of fibre promotion. We intend to continue our customer incentives programmes, although with a broadly declining expenditure amount as new connection numbers fall.

MARKET DYNAMICS

Our primary customers are also competitors, with their own vertically integrated broadband services.

6.6.8 Summary of current incentive offers

Due to market changes, in particular the end of the UFB deployment, a renewed focus on those last remaining customers who have not moved to fibre, and the growth of fixed wireless competition, we have reviewed and simplified our consumer incentive offers since our 2023 Incentives ICP.

Compared to the six types of customer incentive offers we described in our 2023 Incentives ICP,[51] for FY24 Chorus is offering the incentives summarised in the table, where we also provide links to the offer documents with details of each offer:

TABLE 6.10: FY24 CUSTOMER INCENTIVES OFFERED

INCENTIVE	DESCRIPTION
Residential consumer incentive (Pure Fibre) https://sp.chorus.co.nz/product-offer/pure-fibre-consumer-offer-july-2023	This offer replaced our main consumer incentive package, 'Mix it Up', on 1 July 2023. Over the last few years 'Mix it Up' (MiU) has been the primary consumer incentive programme. While the programme was initially effective in driving a higher product mix and therefore increasing ARPU, recent iterations have performed less well – connection volumes have been lower than planned and RSP feedback, notably from the larger RSPs, has been that MiU was not effective in influencing their actions. In particular, we heard MiU thresholds created complexity and focused on promoting 1 gigabit connections, which did not align to encouraging non-fibre users to connect to fibre. The proposed new consumer incentive has been developed to address the customer insight and better deliver our objectives, by: • being simpler, supporting increased RSP engagement and having fewer internal resources to support

51 Promoting fibre and supporting broadband competition: Chorus' individual capex proposal for customer incentives, 30 June 2022, Tables 1 and 2.

INCENTIVE	DESCRIPTION
	• recognising and rewarding fibre connection growth as well as upgrades. Feedback from RSPs on this new consumer incentive structure has been positive. For example CCI [[redacted]] At the time of preparing this expenditure proposal, CCI [[redacted]]
Business Incentive (FLASH) https://sp.chorus.co.nz/product-offer/flash-business-offer	This package of incentives applies to business plans, encouraging off-net end-users to move to fibre, and particularly encouraging upgrades to Hyperfibre and our fastest/high value Next Generation Access (NGA) premium plans. It is the successor to the CHOICE incentive offer in FY23 (the name of our business incentive offer changes each year). Changes from previous business incentives are incremental. They include moderate changes to the incentive unit rates paid and more credits to encourage small businesses which may be on consumer plans to move to business fibre plans.
Hyperfibre CPE https://sp.chorus.co.nz/product-offer/hyperfibre-cpe-credit-july-2023	Feedback from RSPs has been that the higher cost of a Hyperfibre capable modem is a barrier to uptake (and, as a Hyperfibre capable modem will deliver the best experience on Hyperfibre, also affects service quality). We have introduced a $300 credit to help overcome this barrier and ensure end-users have the best possible experience on Hyperfibre. At present, this offer is scheduled to end after 2024 so we are not seeking funding for this in the PQP2 proposal. In our 2023 Incentives ICP, we discussed our 'Hyperfibre fee waiver', where we applied a one-off credit for new Hyperfibre connections to cover the up-front cost of installing a new ONT at the premises. The Hyperfibre ONT fee was reduced to zero from 1 October 2023, so there is no need for the fee waiver to continue to apply.
Point-to-Point (P2P) Migration Offer https://sp.chorus.co.nz/product-offer/point-point-migration-offer	This package of incentives is designed to help customers move from NGA Business Premium & HSNS Premium connections to other Chorus business products. The P2P offer gives customers nominal credits when moving to Business Premium, or High Priority Access – as well as credits to ensure free installation when moving to any Business Fibre plan. In addition, this offer provides free Fibre Project Management and free Hot Cutover services.

52 CCI [[redacted]]

While these incentives are currently in place, and represent the best available information about our likely future offers, we reiterate the need for flexibility when considering our future incentive mix.

We routinely monitor and assess incentive performance, including whether there is a better strategy to increase connections. Committing to incentives too far in advance is less likely to result in incentives that are optimised for the maximum number of new connections and upgrades, especially given the fast-moving nature of the market and the need to respond to market dynamics. Also, the mix of incentives may change and individual credits, thresholds, eligibility criteria and incentive amounts may also change within each incentive, as we monitor performance of specific incentives and make adjustments accordingly.

6.6.9 Proposal to approve Customer Incentives capex as part of connection capex or as a standalone fund

As noted above, Customer Incentives capex is inherently uncertain. Chorus needs to retain flexibility to change our offers quickly in response to market circumstances. We can discuss current offers in the market but it is very challenging to forecast what will be required towards the end of PQP2, as competitive conditions in the telecommunications market may be quite different. The total amount of Customer Incentives capex will vary depending on the rate of new connections, the rate of upgrades and the extent of participation by RSPs – all of these are highly variable elements.

For PQP1, the Commission sought to address this uncertainty by approving Customer Incentives capex for 2022 only and requiring ICPs for 2023 and 2024. The experience of the 2023 incentives programme is that an ICP does not materially reduce the level of uncertainty associated with a Customer Incentives capex forecast, relative to a full expenditure proposal. In practice, an ICP has to be provided to the Commission at least six months prior to the start of the relevant regulatory year, and there is scope for significant changes to demand and incentive offers between the date of the application and the end of the year in which the incentives are paid.

While this expenditure proposal has been developed in accordance with the fibre IMs, as required, we do not believe it is optimal to continue to include Customer Incentives capex in the base capex category. We recommend the Commission amend the fibre IMs (through the IM amendment process we understand it will carry out early in 2024) to provide a more fit-for-purpose method for reviewing and approving Customer Incentives capex. Either of these options would be reasonable and a material improvement on current settings:

- **Including Customer Incentives capex in the connection capex category, such that there is a connection capex variable adjustment to apply to incentives** – this would be beneficial because the Commission could specify an efficient unit rate up front, which can be confirmed as being lower than the expected incremental revenues per added connection. Chorus then bears the commercial risk of any need to spend more than that amount per connection, but the volumes are washed-up – removing the risk associated with forecasting incentives uptake. This is Chorus' preferred option and we provide recommended drafting to create this IM amendment in the Regulatory Settings chapter of Our Fibre Plans.

REGULATORY SETTINGS

We recommend the Commission mitigates uncertainty by treating customer incentives as connection capex, or as a ring-fenced 'use-it-or-lose-it' fund.

- **Specifying a ring-fenced 'use-it-or-lose-it' fund at the start of PQP2, where the fund may only be used for Customer Incentives capex** – Chorus could then draw down on the fund to the extent that it is efficient for us to do so, but the Commission does not risk approving more funding than will be spent.

6.6.10 Other factors

Risk and uncertainty

There is always some uncertainty regarding performance and uptake of new incentive offers. Chorus has sought to ensure the new consumer incentive works as expected by going through a thorough consultation process with RSPs (discussed below) to:

- gain insights on RSP drivers and how they relate to the function of incentives
- seek views on the new framework, which the RSPs confirmed they supported.

In terms of managing ongoing uncertainty with the programme, we note the following risks and mitigations:

- **RSP Participation** – our decision to remove thresholds will make the programme more accessible to more RSPs and mitigate the risk of the under-participation that occurred in 2022 (detailed in our 2023 incentives ICP application)
- **Recognising incremental behaviour versus BAU** – through positive engagement with RSPs and the relative value of the incentive, feedback has been that the incentive offer is strong enough to encourage RSPs to drive more fibre growth
- **Eligibility of reconnections** – under the new Pure Fibre offer, payments are only made for new connections where the end-user has been disconnected for at least 90 days (this requirement was one month under MiU). Extending the eligibility period will help to ensure we are rewarding actual new connections.

We will monitor the performance of the programme and any variance will be investigated to understand what is happening and how best to address (this would be include further consultation with RSPs).

We do not see any uncertainty related to the need for the proposed Customer Incentives capex – given the competitive environment in the broadband market, we must continue to be an active wholesaler in order to achieve increased fibre connections and upgrades, ensuring end-users have full opportunities to access the fibre services they need. There is no material uncertainty related to the timing of the capex, other than the general uncertainty relating to connection forecasts, as incentive payments are made on the basis of connections and upgrades over the course of each year.

Uncertainties related to the economic case are discussed in the economic analysis section.

RISK MITIGATION

We have modified threshold and eligibility settings to mitigate participation and effectiveness risks.

End-user engagement

As discussed in the 2023 Incentives ICP, Chorus has considered seeking views on the incentive programme from end-users and other stakeholders. However, assuming they work as intended, the ultimate effect of incentives is that more connections are added to the network, sharing costs across more end-users and thus reducing average prices. This outcome is clearly desirable, so there is limited value in seeking views from end-users on whether they support it.

In 2022, as part of the ICP preparation, we therefore engaged Kantar to test the value of incentives by seeking views on the reasons why end-users have not signed up to fibre or upgraded to higher-speed fibre plans. As discussed in the 2023 Incentives ICP, the results showed that cost was the largest barrier to uptake or upgrade for those end-users who have access to fibre and are dissatisfied with their current service.[53] Our incentives are designed to help overcome this cost barrier.

We note the Commission did not comment on this end-user engagement in its decision on our 2023 Incentives ICP. We consider the results of the previous survey remain valid (if anything, cost is likely to have increased in importance given recent cost of living pressures) and have not re-run our 2022 consultation for this proposal.

As noted above, and in the Engagement chapter of Our Fibre Plans, we engaged closely with RSPs on the design of our 2024 incentive offers, particularly Pure Fibre, the new incentive aimed at residential end-user connections.

Delivery

Customer Incentives capex does not face the deliverability challenges associated with most capex projects, such as finding a suitably qualified and resourced contractor to deliver the project on time and on budget. Delivery of Customer Incentives capex involves making payments to RSPs for meeting specified criteria related to end-user acquisition and upgrades. The systems and processes for doing this are well-established and functional. The RSPs who accept an incentive offer are loaded into our customer management system (CMT) as eligible for the relevant incentives, which are then automatically calculated on the basis of connections and upgrades, and paid out (generally monthly once eligibility criteria are met).

The only material concern regarding deliverability is the risk that uptake of customer incentives is lower than expected and, as such, Customer Incentives capex will be lower than forecast. This occurred in 2022, but the new Pure Fibre incentive offer has been designed to encourage participation, including by the larger RSPs, and we have had RSP feedback that the new incentives should be effective in ensuring uptake.

BENEFICIAL

Assuming incentives work as intended, they are beneficial to all end-users (and do not involve a price-quality trade-off).

53 More information from this research can be found in section 6 of our 2023 ICP submission: comcom.govt.nz/__data/assets/pdf_file/0031/295069/Chorus-ICP-customer-incentives-proposal-Public-30-June-2022.pdf

6.7 Links and synergies

6.7.1 Other expenditure areas

Standard Installations work links to other expenditure areas:

- Extending the Network capex stimulates installation work by increasing coverage, and some installation requests prompt infill work
- Customer opex includes Product, Sales and Marketing activities that drive installations, and Customer Operations work that supports installation activity. Customer opex is net of costs capitalised as part of installation provisioning
- Network Capacity investment responds as new installations contribute to bandwidth demand growth. New installations also add to the population of ONTs that will require replacement as they age or that need upgrading as end-users adopt new technologies
- Network and Customer IT capex and related Technology opex fund systems to support efficient installation activity. Technology opex is net of costs capitalised as part of installation provisioning
- Network Sustain and Enhance capex and Network opex responds as newly built assets add to the populations of physical network assets for us to manage and operate

Complex Installations work links to other expenditure areas in the same way as standard installations, except provisioning costs are a lower proportion of installation costs and provisioning is less automated.

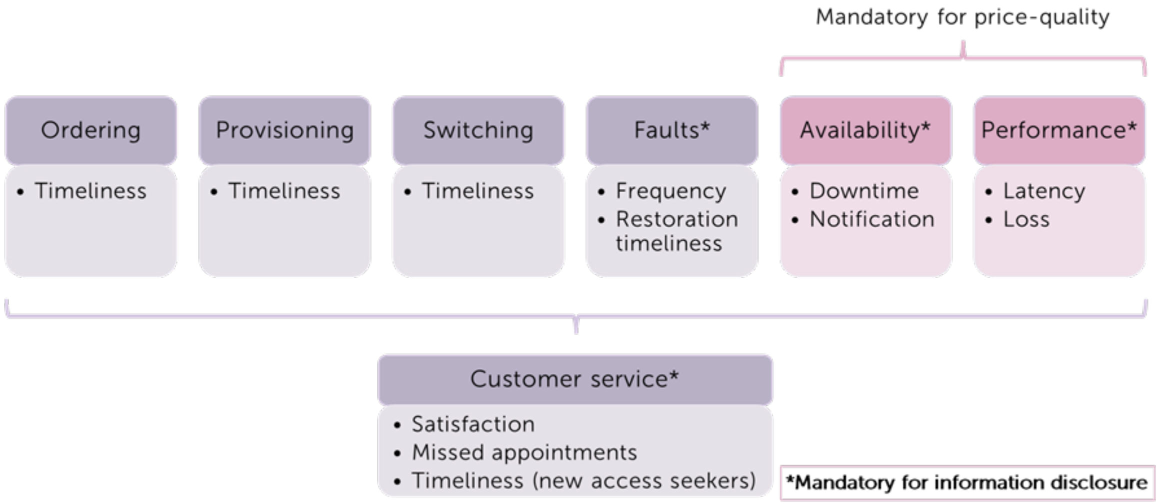
Customer Incentives capex links to other expenditure areas:

- Customer Incentives capex drives Extending the Network, Customer Operations and Network Capacity work by stimulating demand for fibre installations
- Customer opex includes Product, Sales and Marketing activities related to customer incentives payments
- Network and Customer IT capex and related Technology opex funds systems to support efficient payment of incentives. Technology opex is net of costs capitalised as part of installation provisioning.

6.7.2 Quality dimensions

The Fibre Input Methodologies define six lifecycle-based quality dimensions and one over-arching customer service quality dimension. Two quality dimensions are mandatory for PQ regulation, meaning they must have associated quality standards. Four dimensions (including the two PQ dimensions) are mandatory for information disclosure.

FIGURE 6.6: QUALITY DIMENSIONS AS DEFINED IN THE FIBRE IMS

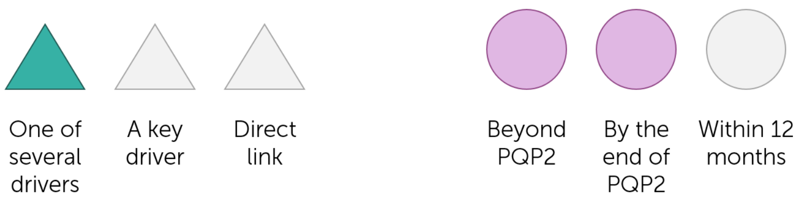


Each discussion of linkages between expenditure and these quality dimensions includes a summary with simple icons to depict the strength and pace of each linkage. The icons provide a broad characterisation, rather than a precise assessment. Note, this discussion only focuses on quality dimensions for which there is a link to the Installations capex category.

TABLE 6.11: LINKS BETWEEN INSTALLATIONS CAPEX AND OUR QUALITY DIMENSIONS

Linkage strength:
How direct is the relationship between spend and quality?

Linkage pace:
How quickly would a change in spend materially alter quality?



DIMENSION(S)	EXPENDITURE SUB-CATEGORY	STRENGTH	PACE
Availability and faults	All sub-categories The initial build quality of our network will influence Layer 1 reliability over coming decades. Additionally, without overbuilding the network, some planned downtime is required for short periods when growing the footprint of our network	▲▲△	●○○
Customer service	All sub-categories Installs make up a declining portion of connection activity. Installs and extensions are when we have our most direct interaction with customers.	▲▲▲	●●●
Provisioning	All sub-categories The most complex provisioning activities involve establishing new installations or installing new ONT capability.	▲▲▲	●●●

As the Commission has previously acknowledged, incentive payments do not affect PQ FFLAS quality.[54]

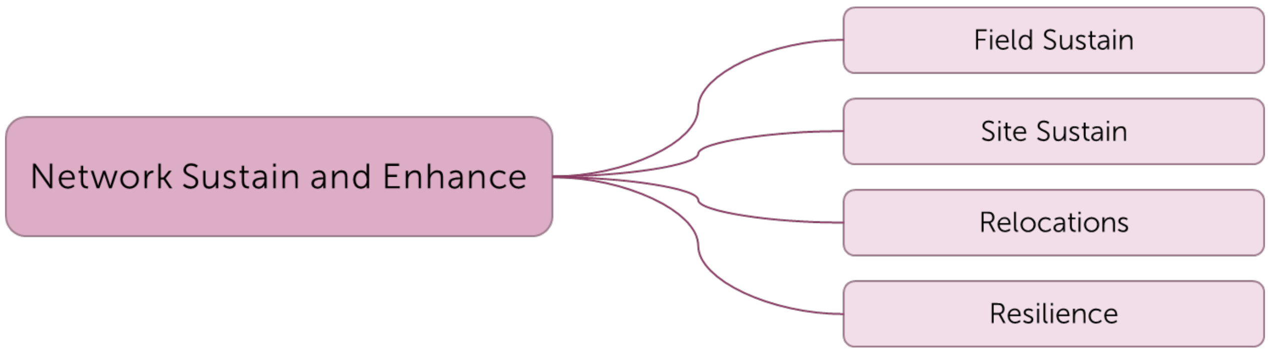
54 Commerce Commission, Chorus' individual capex proposal for customer incentives 2023 – Final decision – Reasons paper, 13 December 2022, paragraph 3.7.3.

7.0 NETWORK SUSTAIN AND ENHANCE

Te Tautīnei Aka Matua

7.0 Network Sustain and Enhance

This chapter describes the Network Sustain and Enhance capital expenditure (capex) category, which covers ongoing investment in physical network assets.



7.1 Introduction

Network Sustain and Enhance capex covers investment in the physical network across four expenditure sub-categories:

- **Field Sustain** – work to replace or enhance in-field assets to maintain their function, maintain compliance, or manage lifecycle costs
- **Site Sustain** – work to replace or enhance building and engineering services to maintain their function, maintain compliance or manage lifecycle costs
- **Relocations** – relocating assets to accommodate roading or other work
- **Resilience** – specific programmes of work to enhance resilience.

NS&E CAPEX

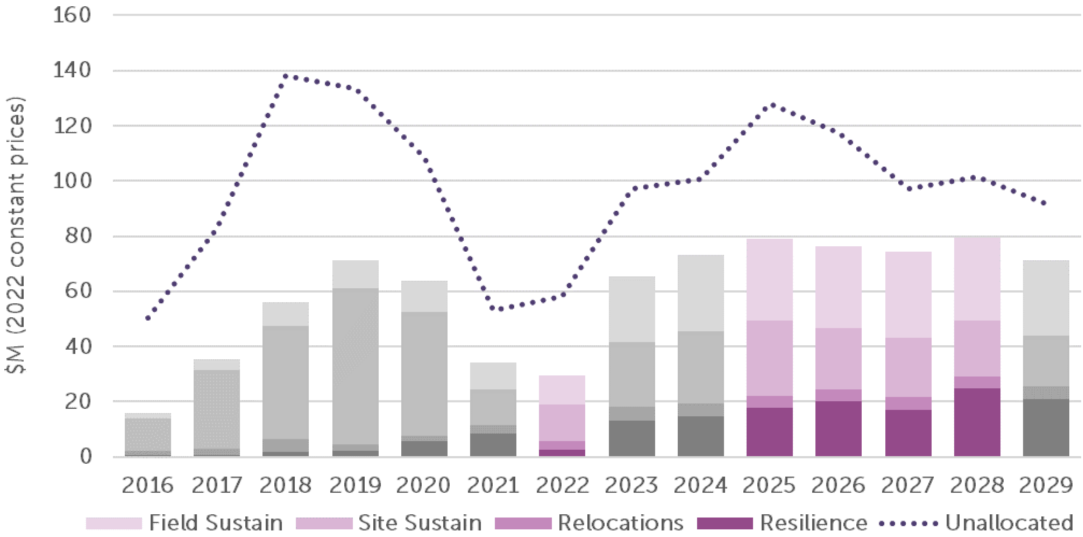
We will invest to ensure field and site physical assets remain fit for purpose and to add resilience.

$310m

7.2 Forecast overview

During PQP2 we plan to invest $309.5 million in Network Sustain and Enhance, which represents 23% of proposed capex.

FIGURE 7.1: NETWORK SUSTAIN AND ENHANCE CAPEX (UNALLOCATED AND PQ FFLAS)



In the presentation above, we have shown both unallocated and allocated capex. This helps highlight key trends:

- the portion of Network Sustain and Enhance capex allocated to fibre has been steadily growing. This reflects growth in direct fibre expenditure (as we've built more fibre assets that we now need to maintain) and growth in the portion of shared costs allocated to fibre
- during 2016 to 2019 we prioritised build of the Ultra-Fast Broadband (UFB) programmes and aimed to minimise network sustain and enhance investment.[55] Network build also displaces some sustain and enhance investment (e.g. where assets are replaced or remediated, and resilience is added as a by-product of network build)
- since 2019 we have scoped and scaled up various programmes of work aimed at addressing compliance, enhancing resilience, or managing lifecycle risks. These include route diversity (Resilience), proactive pole and fibre replacements (Field Sustain), seismic strengthening and roof replacements (Site Sustain)
- we are also planning a solar installation programme. This adds up-front capital costs (shown here) and long-term operating cost savings (shown in Network opex). The lifetime impact is a net cost saving, plus associated sustainability, and resilience benefits
- we have experienced some COVID-19-related disruption, including to delivery in 2021 of seismic upgrade work, and to prices for construction materials and labour
- we are planning for investment to peak across 2025 and 2026, largely due to the planned profile of our investment in resilience

NS&E TRENDS

We plan to increase investment in physical assets, including to add resilience, expand solar generation and progress seismic upgrades.

55 Note that this trend is not apparent in the chart because it includes capitalised leases, which significantly impact 2017 to 2020 figures.

- Relocations capex has grown over time as the network has grown but remains relatively modest because a large portion of costs are recovered from roading authorities.

Below we summarise proposed PQP2 expenditure by sub-category, and the balance of this chapter examines each sub-category in turn.

TABLE 7.1: NETWORK SUSTAIN AND ENHANCE CAPEX (PQP2 PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

	2025	2026	2027	2028	TOTAL PQP2
Field Sustain	29.7	29.4	31.4	30.0	120.5
Site Sustain	27.2	22.3	21.4	20.2	91.1
Relocations	4.6	4.5	4.6	4.5	18.2
Resilience	17.7	20.0	17.1	24.8	79.7
Network Sustain and Enhance total	79.2	76.2	74.5	79.5	309.5

7.3 Field Sustain

Field Sustain covers routine investment to replace or rehabilitate in-field physical assets. Overall, we plan to invest $120.5 million in Field Sustain during PQP2.

FIGURE 7.2: FIELD SUSTAIN CAPEX (UNALLOCATED AND PQ FFLAS)

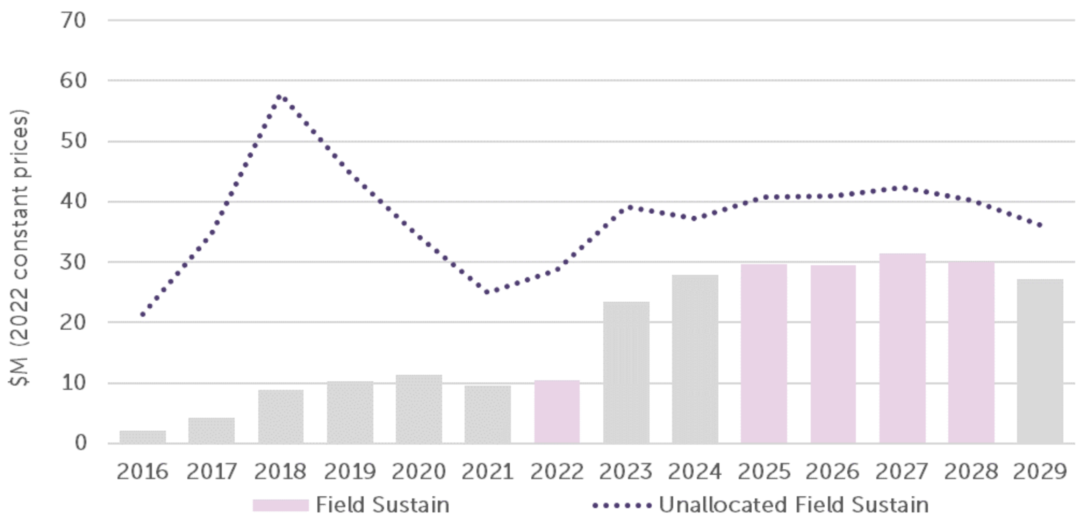


TABLE 7.2: FIELD SUSTAIN CAPEX (PQP2 PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

	2025	2026	2027	2028	TOTAL PQP2
Field Sustain	29.7	29.4	31.4	30.0	120.5

Field Sustain investment covers:

- **fibre growth** – new inter-exchange fibres, typically driven by data growth
- **proactive replacement** – planned replacement of ageing poles and cables
- **rehabilitation** – targeted remediation of faulty fibre flexibility points
- **reactive** – replacement of failed assets, and pit and manhole inspections
- **capability** – vehicles, digitisation, and testing new components.

FIELD SUSTAIN

Replacing, rehabilitating, and modifying poles, fibres, pits, and other in-field assets to optimise their lifetime costs.

$120.5m

Our overall aim with this investment is to optimise the lifetime cost of the physical assets that support the network, while ensuring we safeguard public and worker safety and meet other obligations.

We forecast higher investment compared to historical levels for Field Sustain because we plan to scale up proactive investment in ageing fibre and pole assets.

Our Field Sustain forecast in this area is risk-based in the sense that:

- we have developed a 'balanced' forecast across a large stream of activities that have underlying uncertainties in terms of costs, volumes, scope and phasing and that encompass reactive and planned work. We expect overs and unders to occur, and if costs trend higher than forecast in aggregate then we have options to reprioritise or re-phase within Field Sustain and across other expenditure areas
- our proactive replacement and rehabilitation programmes target key risk areas
- our reactive programmes reflect a risk-based judgement on the impacts of asset failures versus the cost of premature replacement.

Below we examine each expenditure area in more detail.

7.3.1 Fibre growth

Drivers

As bandwidth demand grows, we need to add fibre to inter-exchange transport routes to support capacity growth. Transport routes may be cross-city in larger urban areas, or inter-regional. The rate of investment in fibre is low relative to electronics, as each fibre can accommodate significant growth.

This investment supports network performance and supports connection growth by addressing potential bottlenecks. It can also add resilience in the process.

We plan to invest $2.8 million on fibre growth during PQP2.

We note that, prior to January 2023, we categorised this investment as 'resilience'. This was consistent with a project to lay fibre between Fox Glacier and Haast, which enhanced resilience by adding a second route to the West Coast, dominating transport fibre investment prior to 2023. However, most projects in this area offer resilience as a by-product rather than it being the primary aim of the investment, hence the reclassification of future expenditure.

FIBRE GROWTH

New inter-regional transport fibre accommodates data growth and can add resilience.

$2.8m

Expenditure and forecasting methodology

Our forecast is informed by:

- current fibre utilisation
- inter-exchange traffic forecasts, which are in turn informed by bandwidth demand forecasts and network capacity planning.

We use this information to form a view of the volume of fibre installation work and apply observed unit rates to this volume.

7.3.2 Proactive replacement

Drivers

There are two field asset classes for which it is prudent to proactively replace assets before they fail in service:

- poles – as poles are large structures located along roadsides and in other public spaces, a run-to-fail strategy would present an unacceptable public (and worker) hazard, both from a legislative compliance and reputational perspective
- fibre – as fibre deteriorates with age, its performance can degrade to the point where it is no longer able to carry traffic. This can result in prolonged outages, with loss of resilience or loss of service. As such, a run-to-fail strategy would present an unacceptable reliability risk, including risking breaching the availability quality standard

PROACTIVE

Proactive pole and fibre replacements support public safety and reliability (respectively).

$93.5m

In addition, we proactively create new fibre assets where this is a prudent and efficient approach to lifecycle management – e.g. for end-of-life copper equipment.

We plan to invest $93.5 million during PQP2 in these proactive replacement programmes.

Poles expenditure and forecasting methodology

For poles, our $23.8 million replacement programme is informed by:

- routine inspection and condition testing that identifies end-of-life poles, with five-year inspection intervals for poles in good (green) condition and two-year intervals for poles nearing end of life (yellow)

- inspection of poles reported by the public as defective.

We replace end-of-life poles, plus a small volume of poles damaged through third-party incidents (typically vehicle collisions).

We forecast our proactive poles replacement capex using a price (P) x quantity (Q) approach.

Overall, we forecast replacement of 8,800 poles during PQP2, which is approximately 5% of the population of around 180,000 fibre poles located in UFB areas.

This volume estimate is determined through survivor curve analysis applied to population information obtained through our pole 'test and tag' programme. We completed a nationwide programme of initial inspections in 2020, and now operate a routine re-inspection programme.

POLES

We have tested poles nationwide, and plan to replace 8,800 in UFB areas during PQP2.

8,800

We use softwood poles for replacements, which have an expected life of around 40 years. Replacement costs include the cost of the pole, its installation, provision of pole hardware, and reconnection of supported services. We have forecast costs based on current contracted rates, which were determined through a competitive tender process.

We have tested the efficiency of our approach by comparing with alternative strategies:

- replacement based on asset age would be less targeted, resulting in premature replacement of some poles and late replacement (and hence elevated risk) of others
- extending pole life through staking would produce a higher lifetime cost. Staking has a similar cost to replacement but achieves only a 15-year life extension.

Fibre expenditure and forecasting methodology

For fibre, we are planning to invest $64.0 million to progressively replace earlier 'slotted core' fibre, which was laid 30 to 40 years ago and is reaching end of life.

Over time, the individual fibres within this type of cable are retracting and delaminating, causing gradual and increasing optical loss and eventual failure. The delamination is caused by coating deterioration and the retraction is caused by movement. Some damage has also been caused by lightning strikes on the metal member built into the cables to provide strength for pulling and handling.

FIBRE

Our oldest 'slotted core' fibre is 30 to 40 years old and reaching end of life. We plan to replace 400km during PQP2.

400km

Our newer fibres, including UFB fibre, uses loose tube, gel-filled fibre construction, which has a non-metallic strength member and revised cladding. We do not expect to see the same end-of-life issues with these newer fibres.

Overall, we have around 7,000km of fibre that we have assessed as being in worst (H1) condition. We have developed a 10-year programme for replacing the highest risk fibre:

- we have tagged slotted core fibre cables as asset condition H1 and H2 to indicate we plan proactive replacement within the 10-year programme

- within the H1 category, we have prioritised cables that:
  - we share with Spark, as these are for our core and regional transport systems. The cost of these replacements is shared with Spark, and prioritisation is coordinated with Spark
  - support regional DWDM (dense-wave division multiplexing) systems, because these are high traffic routes and have a bigger impact if they fail
  - have a history of operational problems
- we have been replacing slotted core fibre cables for many years in a semi-reactive way. We started the current prioritised proactive condition-based replacement programme in 2019 and had replaced around 350km by the end of 2022.

Based on this prioritisation approach, we plan to proactively replace 400km of early slotted core fibre during PQP2.

While reliability is the primary driver of this work, it will also deliver:

- higher capacity replacement fibres, with more growth headroom
- more cost-effective delivery, because work is delivered as a planned programme
- opportunities to cost-effectively add laterals along replacement routes, bringing fibre services to more locations.

To forecast the cost of this programme, we have individually costed each replacement project. Costings at this stage are high-level and based on observed rates from similar historical work.

FIBRE

We have developed a prioritised replacement plan the delivers multiple delivery and network benefits.

7.3.3 Rehabilitation

Drivers

We have determined that it is prudent to proactively remediate fibre flexibility points (FFPs) that:

- generate higher reactive fault volumes, and
- are no longer regularly accessed to add new installations (i.e. because uptake has matured).

This approach delivers dual benefits of:

- improving reliability – remediated FFPs generate fewer faults
- reducing cost – it is more cost-effective to proactively remediate high-fault rate FFPs than to incur ongoing higher reactive fault response costs.

We tested this approach through an 18-month trial across 250 FFPs, which found that:

- rehabilitation costs are in the order of $1,000 per FFP, compared to $374 per reactive fault, and are 70% effective at reducing faults in year one (reducing to 9% effective by year six)
- based on these figures, it is cost-effective to rehabilitate FFPs that have had more than five faults in a 24-month period.

REHABILITATION

Our plan to remediate 4,000 fibre flexibility points will deliver cost savings and fewer faults.

$4.8m

Expenditure and forecasting methodology

Our forecast expenditure on this programme during PQP2 is $4.8 million.

Our plan takes deliverability into account, as we will need to scale up rehabilitation resources. As such, we plan to deliver 4,000 FFP rehabilitations during PQP2, with volumes scaling up across the period. We will target "Flash 9 ABFFPs" (fibre aggregation closures for FFLAS – Air Blown Fibre Flexibility Point) with high fault rates and at least 90% utilisation. The total population of ABFFPs is over 26,000. We will also look at expanding this programme to all FFPs, of which we have more than 100,000.

7.3.4 Reactive

Drivers

Other than the proactive programme covered above, it is generally prudent to adopt a run-to-failure strategy for in-field fibre assets. This expenditure area covers two streams of work:

- pits and manholes inspection programme – to manage public safety risk, we have started an inspection programme to capture condition information
- asset replacement – where faulty assets cannot be repaired, we replace them to maintain service.

A reactive replacement approach is appropriate for these workstreams as:

- the health and safety risks are relatively low (i.e. compared to pole failures) so we are not required by legislation to prevent asset failures to avoid risk to the public – remedying these failures once they have occurred is sufficient
- predicting when and which of these assets will fail is difficult, so a proactive approach would not be efficient (i.e. assets would be replaced or remediated when they were not at risk of failing, and vice versa)
- a failure of these assets is unlikely to affect a large number of end-users' service levels and can typically be remediated quickly, so the impact of such a failure on our quality standards is low
- a proactive approach would not provide any cost efficiencies by reducing the whole-of-life costs.

REACTIVE

We replace assets that cannot be cost-effectively repaired and run a nationwide inspection programme for pits and manholes.

$16.2m

Our forecast expenditure on these workstreams is $16.2m over the course of PQP2.

Pits and manholes inspection programme expenditure and forecasting methodology

We have a population of around 259,000 PQ FFLAS pits and manholes, with a 10-year inspection interval. The inspection programme gathers condition information, which is used to manage public safety risk from slippery or loose manhole lids in footpaths or other public spaces.

We completed a trial inspection programme in 2022 that covered around 1,800 pits and manholes in areas with high safety risk. The programme included developing an electronic information capture tool and has refined our inspection methodology and generated cost information.

During PQP2 we plan to inspect 10% of the population annually, consistent with the 10-year inspection interval. Over PQP2 this will amount to 102,520 pits and manholes.

This activity will generate a database of condition information and is therefore classed as capital expenditure. The programme will:

- identify pits and lids that need immediate remediation or replacement, and deliver those remediations and replacements
- generate information to inform renewal planning, including providing baseline condition information for each manhole
- deliver benefits by mitigating public safety risks and providing information that will support future optimisation.

Our forecast is based on cost information gathered through the trial programme, applied to the volume identified above.

PITS & MANHOLES

Inspecting over 100,00 pits and manholes will generate valuable information and preserve public safety.

102,520

Asset replacement expenditure and forecasting methodology

When assets fail in service or are identified through line surveys as in imminent danger of failing, we must either repair them or replace them to restore services or ensure proper function. Line surveys, fault response and repairs are classed as Network opex (specifically Maintenance opex), whereas replacement is classed as capex.

We replace failed assets when they are unable to be repaired to a satisfactory state. Replacement is either essential to restore function, or cost-effective compared to a repair option that would not deliver satisfactory performance. This assessment is governed through a defect referral process that allows engineering judgement to be applied and refined over time and with experience.

Our fibre network uses a mix of repurposed long-life assets (including poles and some ducts) and newly built long-life assets. As such, our forecast assumes no underlying change in reactive asset replacement rates.

Consistent with the above, our forecast is based on historical run rate adjusted for network growth. This leads to a reduction in unallocated capex and increase in FFLAS capex.

7.3.5 Capability

To support effective management of physical assets, we invest in:

- vehicles for Chorus staff whose roles include in-field activities, such as oversight of projects and operations
- digitisation of legacy paper-based drawings and other records
- investigation of new equipment, materials, or technologies that could be incorporated into the network.

Across these areas we plan to invest $3.2 million during PQP2:

- vehicles – $1.3 million across a fleet of 41 vehicles with specifications suitable for safe field operation. Our forecast is consistent with our existing fleet management approach
- digitisation – $1.8 million to continue a programme of progressively digitising legacy records. This programme improves accessibility of asset and engineering information, including as-built records
- investigation – $40,000 for development and introduction of new technologies, such as new jointing systems or fibre cable types.

CAPABILITY

Field vehicles, digitised records and equipment investigations support management of physical assets.

$3.2m

7.4 Site Sustain

Site Sustain covers ongoing investment in our exchange buildings (including building services), and the engineering services that provide power and cooling for network equipment. Overall, we plan to invest $91.1 million in Site Sustain during PQP2.

FIGURE 7.3: SITE SUSTAIN CAPEX (UNALLOCATED AND PQ FFLAS)

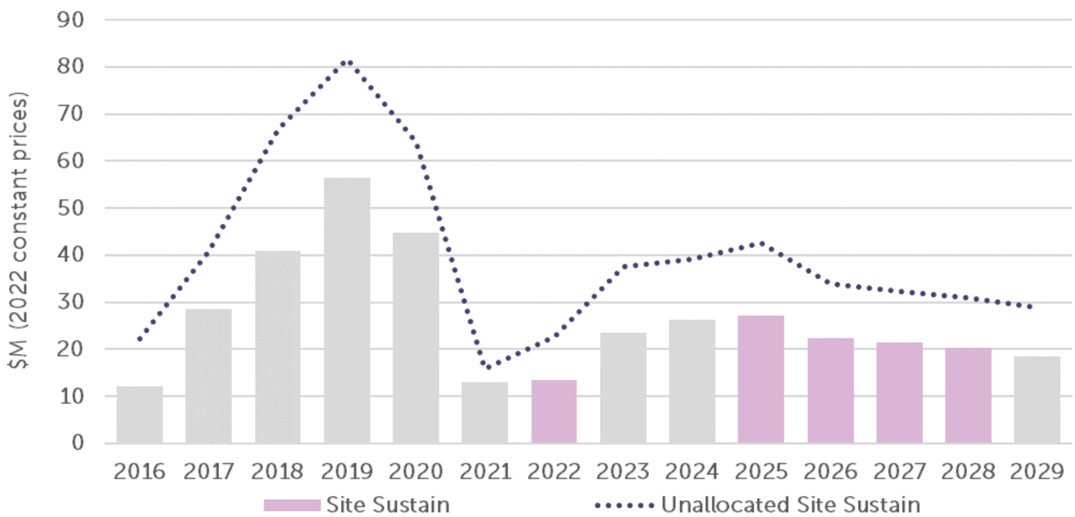


TABLE 7.3: SITE SUSTAIN CAPEX (PQP2 PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

	2025	2026	2027	2028	TOTAL PQP2
Site Sustain	27.2	22.3	21.4	20.2	91.1

Site Sustain investment covers:

- building sustain – investment to keep buildings, services, and grounds in a fit state
- seismic upgrades – compliance-driven programmes to strengthen key exchanges
- services sustain – investment to keep engineering services in a fit state
- solar upgrades – programme to add solar panels to exchanges
- leases – capitalised leases for network buildings, poles, and other network assets
- exchange modifications – work to reconfigure or add space to our exchanges.

SITE SUSTAIN

Replacing, rehabilitating, and modifying buildings, power supplies, air-conditioning and other site assets.

$91.1m

Our overall aim with the expenditure is to maintain a suitable operating environment for network equipment, and ensure we meet our safety obligations as building owners.

Our planned investment during PQP2 is higher than preceding years. This reflects that:

- prior to 2020 we prioritised UFB delivery and endeavoured to keep Site Sustain investment at a minimum.[56] Because we have a large fleet of long-lived building assets, this strategy is possible for years at a time but not sustainable long-term
- from 2020 we started three major programmes of work – refurbishment of the large Courtenay Place exchange in Wellington, seismic strengthening of the Miramar exchange, and our 'alternative sites' programme to reduce the footprint of space leased from Spark. The programmes were disrupted due to COVID-19-related impacts on the construction sector, resulting in relatively low expenditure in 2021 and 2022. The Courtenay Place refurbishment will extend into PQP2 and is large relative to overall Site Sustain expenditure
- during PQP2 we will be executing a wider compliance-driven seismic upgrade programme, a solar programme that delivers on sustainability goals and lifetime cost reductions, and relocation of the Gore exchange that cost-effectively improve resilience while avoiding major renewal costs

56 Note that this trend is not apparent in the chart because it includes capitalised leases, which significantly impact 2017 to 2020 figures.

- in addition, we will be pursuing essential weathertightness, safety and Building Act 2004 compliance programmes of work during PQP2.

Below we examine each area in more detail.

7.4.1 Building sustain

Drivers

We have a large portfolio of network buildings, with an average age of over 50 years, plus associated property rights (such as freehold land, leases, and easements). The buildings were built to house copper network equipment and have been adapted to house fibre equipment, which provided a more efficient solution than building new fibre exchanges.

Fibre networks are less demanding than copper. In particular:

- fibre equipment is more compact, needing less floor area per connection
- fibre is more energy efficient, with lower electricity demand per connection[57]
- each exchange can serve a larger area, with a higher limit on the maximum distance from exchange to end-user.

In addition, environmental hazards (or understanding of hazards) have evolved since our buildings were built. Most notably:

- climate change is altering risk profiles for coastal inundation and rainfall events
- structural loading codes have evolved as Aotearoa has learnt from major earthquakes and ongoing research.

Given this context, the key drivers of building sustain investment are:

- to maintain buildings, building services and grounds in a fit state. This includes ensuring buildings are weathertight, structurally sound, safe to enter, powered and secure. For the first three items the Building Act 2004 applies compliance obligations that reinforce the need for these outcomes
- as opportunities present, managing long-term costs by optimising our exchanges. These opportunities will increase as we withdraw the copper network and will typically be prompted by major lifecycle investment events
- upgrading buildings as required to mitigate environmental risks. We note that seismic retrofit projects are covered separately in section 7.4.2 below.

BUILDING SUSTAIN

Sustaining compliant, weathertight, and fit-for-purpose buildings to house network equipment.

$15.7m

57 There are two parts to this. Fibre networks consumer less energy overall, and some of that energy is supplied at the end-user premises.

Works covered by this investment are:

- building fabric and site assets – end-of-life replacement of assets including roofing, ceilings, doors, cladding, floor coverings, fences, and tracks across relevant sites in our portfolio of 506 PQ FFLAS properties
- major projects – Courtenay Place refurbishment and Gore relocation. These are described in more detail below
- security – progressively rolling out monitored video cameras to core sites, and sustaining operation of electronic security systems across our sites
- fire – decommissioning obsolete detection systems, and sustaining operation of remotely monitored detection systems and fire extinguishers
- other specified systems – sustaining operation of other 'specified systems' to maintain compliance with building warrant of fitness requirements. These include fail-open locks, emergency lighting and backup power supplies.

ROUTINE

Ensuring 506 network buildings are compliant, serviceable, and adapted to changing needs.

506 sites

The largest single building sustain investment is a refurbishment programme for the Courtenay Place exchange in central Wellington. This is a large project that we started during PQP1. Project delivery was disrupted by COVID-19-related impacts on the construction sector, leading to delays and increased costs. This project also involves service sustain costs.

The Courtenay Place exchange is a core site and important handover location, housed in a large multi-storey building. The refurbishment programme:

- was approved following consideration of alternatives, such as relocating services
- is being carried out as a staged programme of upgrades
- will renew or replace lifts, windows, roofing, fire stopping, active fire systems, toilets, and electrical systems. It will also improve seismic performance.

MAJOR PROJECTS

Courtenay Place core site refurbishment and Gore regional mesh site relocation.

2 projects

Our forecast assumes completion of this programme after PQP2.

The other major project is relocation of the regional mesh site at Gore. The existing building is 64 years old in 2023 and:

- has several building fabric and engineering elements that are at end-of-life
- is classified as earthquake prone, and has been identified as flood prone
- is over 20 times larger than required for fibre equipment.

We have identified that relocating to a new building, at an estimated cost of $5 million, is a lower cost option than remediating the existing building.

Expenditure and forecasting methodology

As above, we forecast building sustain expenditure of $15.7 million during PQP2. Forecasts are built up from:

- high-level project costings for major projects
- our security operations centre (SOC) project plan for security and fire system upgrades and replacement. The plan uses age-based prioritisation for security systems, while planned fire system work is based on compliance needs. Planned projects are costed using contract rates
- service company schedules of building fabric and site assets work items. We prioritised weathertightness and safety items, and profiled work evenly across five years. Work items are costed using contract rates where available, or historical costs. The forecast includes four to six roof replacements per year across PQP2.

Our forecast carries uncertainties and risks that we plan to mitigate through re-prioritisation as needed. In particular:

- information quality – we have recently transitioned to a new facilities provider. A key goal of this change is to improve information quality and useability. However, because much of our legacy asset information is supplier-held, there is a temporary reduction in information available during the transition. As we build a better information base, this is likely to influence our prioritisation during PQP2. Our forecast for building fabric and site asset works is based on assessments and schedules prepared by our previous contractor in 2021
- project scope and construction cost uncertainty – building and building system remediation projects can encounter unanticipated scope and cost changes as they progress – for example, when roofing replacement reveals damage to roof structures.
- hazard identification – we have recently had climate change risk assessments completed across our buildings. As we work through these assessments and formulate mitigation plans, we may scope additional relocation or protection works that are not currently included in our plans
- defect identification – as our new provider works through their inspection regimes, we may find additional defects or hazards that should be prioritised.

7.4.2 Seismic upgrades

Drivers

During PQP1 we reviewed our obligations relating to earthquake prone buildings. As part of this review, we concluded that our core and mesh sites should be categorised as importance level four (IL4) under the New Zealand Building Code. This conclusion is consistent with advice from the building consent authorities (BCAs) who enforce the Building Code.

IL4 is the second-highest rating on a five-level scale and applies to buildings that "...must be operational immediately after an earthquake or other disastrous event, such as emergency shelters and hospital operating theatres, triage centres and other critical post-disaster infrastructure".

IL4 buildings must be assessed against a higher seismic design loading than IL3 buildings, and all buildings must be upgraded if their strength is lower than 34% of the new building standard (NBS). As such, during the remainder of

SEISMIC UPGRADES

Upgrading buildings to comply with seismic resilience requirements.

$22.6m

PQP1 and PQP2 we are working through detailed seismic assessments against IL4 loadings for 20 of our core and mesh buildings that score less than 50% of NBS with IL3 loadings.

Of the five buildings assessed to date, four fall below the 34% requirement and are therefore classed as earthquake prone. We expect to find 24 buildings will be earthquake prone in total. Building owners are required to strengthen earthquake prone buildings, with the timeframe depending on seismic risk. For example, buildings in an area of 'high' seismic risk must be strengthened with 15 years.

For each building that requires strengthening, we will assess remediation options and compare these with alternatives such as relocation. Our high-level estimate is that seismic-driven work will cost on the order of $135 million over a period of up to 15 years.

Expenditure and forecasting methodology

We have forecast expenditure of $22.6 million during PQP2. This is based on high-level cost estimates and project phasing for strengthening the Forrest Hill building and five other core and mesh sites.

This represents a relatively slow start to the 15-year programme, which we will need to ramp up in PQP3 and PQP4 to ensure we meet legislative requirements. This phasing is prudent, as it allows us to gain experience early and improves prospects of finding lower cost remediation or relocation options.

7.4.3 Services sustain

Drivers

Engineering services provide the infrastructure to power network equipment, and to remove heat so that the temperature of the operating environment is suitable for reliable operation of network equipment.

As we transition from copper to fibre services:

- power requirements initially increase (as we are running two networks) and then decrease (because the fibre service is more energy efficient than copper)
- heat load similarly increases (as we are running more equipment) and then decreases (because fibre equipment sheds less heat than copper equipment)
- we can, once copper equipment is removed from a room altogether, operate to higher temperature setpoints (because fibre electronics can tolerate higher temperatures) which reduces cooling costs
- we will have some opportunities to consolidate sites or consolidate equipment within sites.

SERVICES SUSTAIN

Engineering services provide power and cooling for network equipment.

$20m

This means our objectives for engineering services involve:

- sustaining and optimising the operation of engineering services assets. This includes a mix of age-based and reactive investment to:
  - rectify faults

  - replace end-of-life assets, where end-of-life may be driven by deteriorating reliability, safety or performance, or by obsolescence
  - replace stolen assets (particularly batteries)
- adapting to changing requirements to optimise overall costs, including by:
  - upgrading (as needed)
  - repurposing equipment from copper to fibre as loads shift
  - retiring assets, including through consolidating loads.

We also have a programme of work underway to replace the obsolete 'Trouble Management System' (TMS) that provides remote monitoring. The TMS components are end-of-life, and we can no longer procure replacement parts.

Expenditure and forecasting methodology

We forecast expenditure of $20 million during PQP2. Forecasts are built up from:

- project phasing and costings for the TMS replacement programme. We have completed a pilot site deployment, which has helped inform our planning and costing. Our forecast is based on delivery of 775 sites during PQP2 and completion of all 3,000 sites over 10 years.[58] The early (PQP2) part of the programme focuses on larger sites, so will be weighted toward fibre
- costings for planned works associated with the Courtenay Place refurbishment and Forrest Hill remediation projects
- projected volumes of replacements for our power and air conditioning systems. Projected volumes are based on projected needs. We have multiplied projected volumes by market rates.

Our forecast carries risk and uncertainties that we will manage through reprioritisation as needed. In particular:

- as our new facilities contract beds in, and as our asset management evolves, we may identify new issues (higher cost) or find opportunities to increase our use of risk-based (as opposed to reactive or age-based) replacement strategies (higher or lower cost)
- the Courtenay Place remediation project is large and complex, so phasing and costs may continue to evolve as we progress through the work
- we have not yet worked through the implications of recent climate change risk assessments. This could result in additional work to protect or relocate engineering services assets.

PROJECTS

Alongside routine replacements, we plan to replace our ageing monitoring system and support two building projects.

3 projects

58 These counts include all network sites, not only PQ-FFLAS.

7.4.4 Solar upgrades

Drivers

Our exchanges use grid-supplied electricity, and many have diesel and battery backup systems to provide resilience.

With the falling cost of solar equipment there is an opportunity to invest in on-site solar generation. Benefits of solar investment include:

- operating cost savings – solar output profiles are well correlated with cooling-dominated demand profiles, so solar can be effective at reducing net demand. Based on data from a trial installation at the New Brighton exchange and expert advice, we have modelled an expected reduction in grid demand per solar-equipped exchange. This provides a pay-back period of approximately 13 years, which is less than the expected life of solar installations.
- sustainability – we estimate a reduction of approximately 400 tCO2e per year by the end of PQP2. This adds to the value proposition of fibre as the most energy efficient broadband option and contributes to our science-based climate change targets.
- resilience – solar installations reduce net demand, which extends the period that an exchange can operate on backup power.

Expenditure and forecasting methodology

We forecast capex of $11.5 million during PQP2 (as well as opex savings of $1.2 million).

Our forecast is based on costings from our trial project and plans to roll solar out to up to 200 exchanges by the end of PQP2.

SUSTAINABILITY

"Building the network is important, but doing so in an environmentally sustainable way is imperative, and New Zealand and Kiwis should be leading the way in this regard."

Stakeholder feedback

SOLAR

Adding solar panels to network buildings produces cost savings, emission reductions and resilience improvements.

$11.5m

7.4.5 Leases

Drivers

We enter into four main types of lease arrangements that are capitalised within Site Sustain capex:

- exchange space
- poles
- network leases
- fibre cables.

We lease exchange space, predominantly from Spark. This reflects that Spark and Chorus have a shared history – when we separated from Telecom, both parties inherited a mix of exchange assets, with leasing arrangements in place wherever our network assets occupy Spark buildings and vice versa.

We have entered into lease agreements with a number of electricity distribution companies to use their power poles to support the UFB network.

Similarly, distribution companies utilise our poles for service leads. This has arisen because historically, poles for phone and power were installed down opposite sides of the same street. This was set out in the Telecommunications Act 2001 and the Electricity Act 1992.

Network leases relate to leases entered into to provide support to the physical network and network electronics required to provide our services. A lot of these leases relate to easements and rights of access to enable us to place equipment, such as across railway lines.

Chorus also has arrangements with other providers to lease capacity on certain stretches of fibre around the country, including with Transpower for the Cook Strait. Most of these fibre leases are non-FFLAS.

Consistent with accounting standards, we capitalise these lease costs.

LEASES

We have lease agreements where we share infrastructure with other utilities, and we capitalise these costs.

$10.3m

Expenditure and forecasting methodology

We forecast expenditure of $10.3 million on leases. This is the capital expenditure value, which reflects changes in the present value of future lease payments. As such, we build up our forecast though:

- collating existing lease commitments
- anticipating new leases, particularly with poles as we expand our footprint
- modelling the anticipated changes in present value as leases are renewed.

7.4.6 Exchange modifications

Drivers

As our network evolves, including with removal of copper equipment, there are opportunities to reconfigure our network buildings to:

- reduce exposure to lease costs
- accommodate co-location by other providers
- enable edge datacentre services.

MODIFICATIONS

We modify network buildings to meet evolving needs and optimise costs.

$11.1m

These investments support cost reduction or revenue growth and ensure we are optimising exchanges over time. This work can include modifications to building fabric and engineering services.

Expenditure and forecasting methodology

We forecast expenditure of $11.1 million.

The forecast is built up from estimated costs for an anticipated schedule of modification projects.

7.5 Relocations

Sometimes we are required to move network elements – we call this work relocations. Our Relocations capex forecast is $18.2 million for PQP2

FIGURE 7.4: RELOCATIONS CAPEX (UNALLOCATED AND PQ FFLAS)

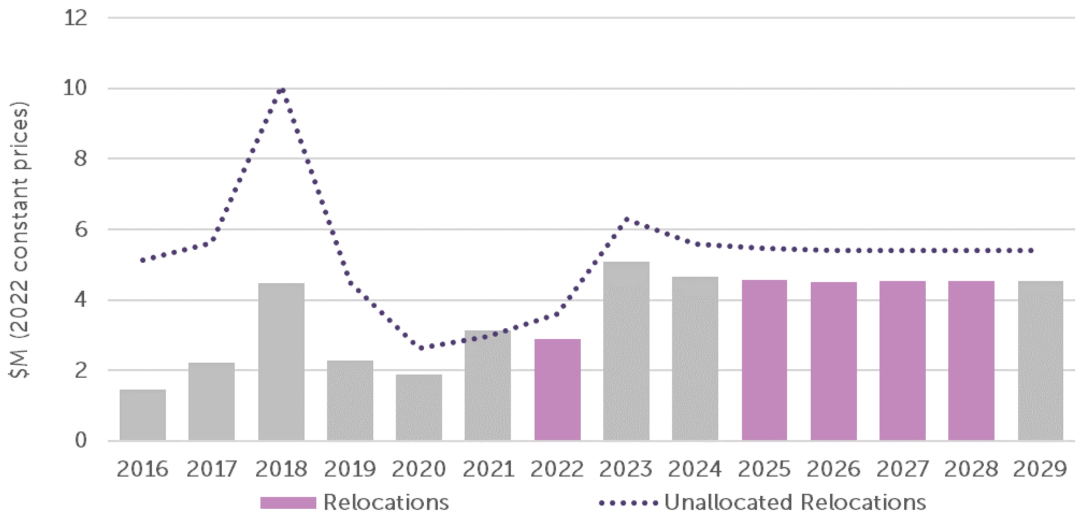


TABLE 7.4: RELOCATIONS CAPEX (PQP2 PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

	2025	2026	2027	2028	TOTAL PQP2
Relocations	4.6	4.5	4.6	4.5	18.2

Expenditure on relocations is demand driven and largely reactive. As such, we expect our spending to remain relatively steady in real terms over PQP2.

Relocations costs for individual projects vary depending on the scale and type of affected network elements. We use costs set under our Field Services Agreement (FSA) for different types works.

We relocate the network for three reasons:

- Roadworks – relocating network elements due to changes to road layout, new road construction, utilities, bridges or seal replacement
- Overhead to Underground (OHUG) – removing cables from poles and installing replacement routes in underground ducts
- Third-party requests – relocating network elements when requested to do so for practical or cosmetic reasons.

7.5.1 Roadworks

We are obligated under Section 147A of the Telecommunications Act 2001 to relocate the network if requested by a road-controlling authority (i.e. NZTA or local councils). This can be triggered by any change to road layout, including new road construction, new utilities (e.g. water mains), bridges or road seal replacement.

The relocation works ensure that our network elements remain accessible and are protected from damage during the roadworks and once they are completed. As a result, roadworks relocations perform a key network function by repositioning or rebuilding parts of the network to maintain network integrity.

When we carry out such work there is often a "betterment" component – for example, if asked to relocate an old pit it may be prudent to use a new pit with modern equipment and additional capacity to accommodate infill.

This area of expenditure covers the betterment component of roadworks. The balance (and larger share) of the cost is recovered directly from the roading authority.

ROADWORKS

The betterment component of work initiated due to our obligations to roading authorities.

$6.1m

Drivers

Roadworks activity requests, from NZTA or councils, are the primary driver of roadworks relocations. Legislation also determines which portion of the cost is recoverable from the roading authority.

Such civil construction is more common in urban areas that were built in the early years of the UFB build. More recent network growth in UFB2/2+ areas has tended to occur in in smaller and more rural communities, which have fewer roadworks activities, meaning that this build has not resulted in a significant increase in Relocations expenditure.

Betterment is prompted by relocation work and aims to ensure we make optimal use of the construction project. Betterment avoids incurring future costs (including project and civil) that would occur if we instead returned to the relocated asset to renew or alter it in future.

Expenditure and forecasting methodology

Roadworks expenditure is difficult to predict because of the uncertainty around which activities will need to be performed. This portfolio is reactive, so any long-term trend shares a logical relationship with Extending the Network capex. We expect roadworks activity in PQP2 to be similar to activity in the past. Cost efficiencies in this area are driven by our field services contracts, as labour forms the bulk of this expenditure.

Our forecast expenditure is calculated using a P x Q method based on historical average costs and volumes. This approach is appropriate as roadworks relocations work is demand driven and has relatively consistent costs and volumes.

Prices are calculated based on historical costs over the previous 12-month period (offset by three months to account for the 90-day billing cycle and align with associated volumes).

Quantities are calculated based on a historical average run rate.

Due to its opportunistic nature, we have no way of predicting when betterment is likely to occur. As such, we include expenditure on betterment in our P x Q calculations.

Where we have received additional information from NZTA or local councils (i.e. if they inform us of their plans for motorway/highway development), we adjust our forecasts accordingly. For example, the announcements by the government for shovel ready projects have had a flow-on impact to forecast roadworks activity.

The nature of this work is reactive, and the historical trend of both spend and volumes are a fair indication of future activity. Our main forecasting assumption is that the proportion of roadworks activity for the fibre network will continue to remain consistent now that the UFB areas are established.

7.5.2 Overhead to Underground

Historically lines companies had power poles down one side of the street and our (and our predecessor company) poles were on the other side. We therefore lease many poles from lines companies.[59] Some of our agreements for the use of power poles require us to remove network elements that rely on poles and undertake undergrounding works when the lines companies remove their poles and underground the power network.

When it is necessary or economic, we remove cables from poles and install replacement routes in underground ducts.

Drivers

The primary driver of OHUG relocations expenditure is lines companies' undergrounding work programmes.

When we built the fibre network, Chorus obtained access to lines companies' poles on the condition that we would remove the fibre if or when the lines companies undertook any undergrounding projects. As such, most of our OHUG relocations expenditure is mandatory to fulfil our contractual obligations with the lines companies – i.e. the spend is reactive to lines companies works.

Expenditure and forecasting methodology

Lines companies tend to have limited capex budgets so are limited in the amount of undergrounding they can do at any one time. This has driven a low and consistent level of our OHUG relocations expenditure.

We expect the level of OHUG work to continue at the current level, as lines companies continue to have work programmes and drivers to underground their power network.

However, there have been peaks in expenditure due to large OHUG projects in Auckland, driven by Vector. We work with line companies to get the best forward view of their works programme, however this is not perfect and the work and timings are subject to change.

Expenditure is based on historical information, with an overlay for known lines companies' projects.

OHUG

Relocating network elements to accommodate power pole undergrounding.

$7.1m

59 Capital expenditure for these leases is forecast within Site Sustain.

Individual projects are created as required funded from a placeholder budget. This has proven to be the best approach as the expenditure is externally driven through our contractual obligations with the lines companies.

7.5.3 Third-Party Requests

We are occasionally requested to relocate network elements for practical or cosmetic reasons, for example where a cabinet or pole is blocking the development of a new driveway or development, or a Chorus cable is blocking a third party's view. This does not include requests from NZTA or local Councils, as these are covered in the Roadworks section above.

The cost of relocating infrastructure is charged to the third party that requests the relocation. They must enter into a contract with Chorus before any works are initiated. These types of requests are lower volume and ad-hoc in nature, so we manage their planning, design and delivery on a case-by-case basis. Only a very small number go ahead due to the cost involved to move our infrastructure.

THIRD PARTY

The betterment component of work initiated to accommodate third-party requests.

$5.0m

Drivers

Third-party work is driven by requests from third parties (usually end-users and developers) to move part of our network that is obstructing their future development plans or for aesthetic reasons.

Expenditure and forecasting methodology

We forecast $5.0 million investment during PQP2 on the betterment component of works initiated by third parties.

Our forecast is based on historical run rate. This reflects that this work is unpredictable and not linked to our typical demand drivers.

7.6 Resilience

Ensuring our network is resilient and can maintain supply to our end-users, even in adverse circumstances, is a high priority for Chorus and a core driver of investment. The impact of Cyclone Gabrielle demonstrated the importance of fibre connections to communities and businesses and the criticality of being able to restore supply quickly after a catastrophic event.

Feedback from our customers and stakeholders following Cyclone Gabrielle has indicated they see investment in a resilient network as "non-negotiable" and a core function of a fibre network provider.

RESILIENCE

"It's almost like an insurance premium that you're paying to put into our business."

Stakeholder feedback

Resilience is our ability to prevent network assets from failing, keep the network running when assets do fail, and restore connectivity quickly when necessary. This requires careful planning and expenditure on architecture, technology, buildings and fibre. There are three key areas of Resilience expenditure addressed in this section:

- Dual fibre paths – providing route diversity so connectivity is sustained if a single fibre route fails or is taken out of service (e.g. for planned works)
- Functional limits – building or upgrading network sites so that no site is a single point of failure for more than a set number of connections (depending on the function undertaken at that site)

- **Critical spares** – putting measures in place to support rapid recovery if connection is lost.

Some investments serve both resilience and other purposes, such as sustaining parts of the network. As such, the following activities have a resilience component to them but are not included in our Resilience expenditure sub-category:

- o Backup power supply is included in the Site Sustain sub-category
- o Seismic strengthening is included in the Site Sustain sub-category
- o Capacity headroom is covered in the Network Capacity category
- o Proactive fibre route inspections are covered in the Field Sustain sub-category

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7.6.1 Forecast overview

During PQP2, we have forecast $79.6 million of FFLAS capex for Resilience.

FIGURE 7.5: RESILIENCE CAPEX (UNALLOCATED AND PQ FFLAS)

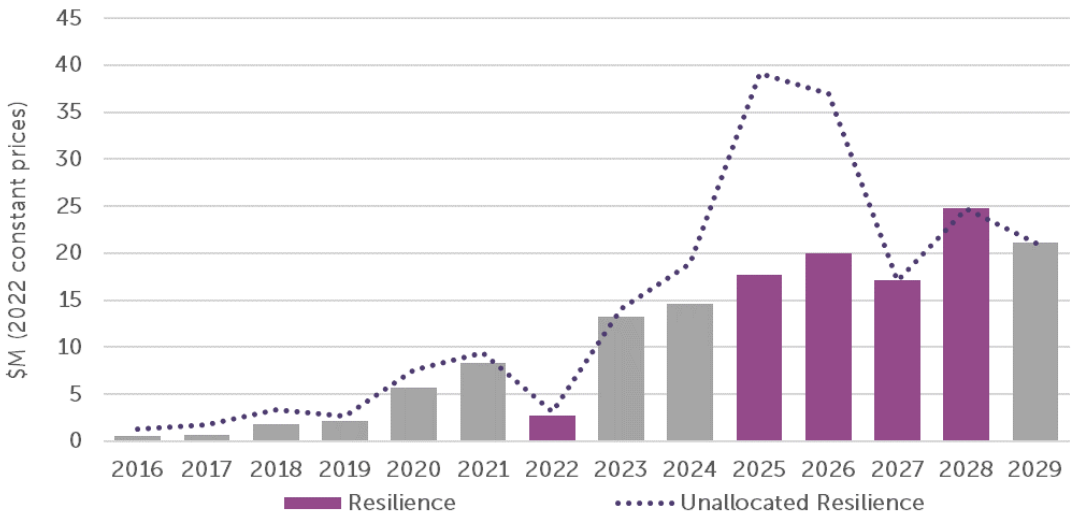

TABLE 7.5: RESILIENCE CAPEX (PQP2 PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

	2025	2026	2027	2028	TOTAL PQP2
Resilience	17.7	20.0	17.1	24.8	79.6

Resilience spending is set to increase significantly during the rest of PQP1 and into PQP2. We forecast PQ FFLAS resilience expenditure peaking at $25 million in 2028.

Historical levels of Resilience expenditure are a less helpful indicator as Resilience capex was suppressed during the UFB build phase. We now have an increased credit rating and the ability to fund more Resilience expenditure.

During 2024 to 2026 we have a high proportion of non-FFLAS expenditure for Resilience. **CCI [**

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RESILIENCE

We are planning a programme of work to enhance network resilience.

$79.6m

7.6.2 Strategic objectives

Our resilience investments aim to:

- maintain services to communities even where an asset fails or is damaged, or
- reduce the impact of a major (high impact but very unlikely) loss of a large exchange site by limiting the number of connections served by any one exchange, and by investing in mobile exchanges to enable services to be restored more quickly.

Chorus is required to meet certain standards of resilience. We also need to manage the Chorus brand and ensure service availability is at a level that the customer and community expects. To do this, dual fibre routes need to be established to UFB areas so that traffic can be routed over both routes, which means that if one route is lost for whatever reason the traffic can still get through. Also, the impact of failure of an exchange needs to be planned for and mitigated.

We invest to ensure dual paths are provided to communities of 3,000 premises or more and no access site supplies more than 25,000 connections. These are standards set in our network architecture standard and approved by the Chorus Board. We have applied the deterministic standard set by the Chorus Board, which is consistent with government's expectations as set out in the UFB contract.

Stakeholder engagement

Our stakeholder consultation found that resilience is the top investment priority for end-users, retailer service providers (RSPs) and other stakeholders. End-users see this as a core function of an infrastructure provider, while RSPs see it as an important enabler of good customer experience. Stakeholders noted that reliance on the internet is only growing and is already essential. The social and economic impact of sustained non-connectivity was largely viewed as unacceptable.

RESILIENCE

"Having reliable fibre is a no brainer."

Stakeholder feedback

We ran a stakeholder survey in 2022, where there were mixed views on whether customers and end-users would be willing to pay more for fewer outages, with the balance being slightly opposed. However, in the final round of consultation we tested 'current', 'decreased' and 'increased' investment options and there was majority support for the highest investment option – these terms relate to our business plan, and the 'current' option was a substantial increase in investment relative to PQP1.[60] In this round we presented actual cost information, so stakeholders had a clear cost-benefit choice available to them, which gives this round's feedback greater weight. However, we note this Kantar-led process was held just a few months after Cyclone Gabrielle, when the importance of resilience was highlighted. On balance, this proposal puts forward Resilience spending that is consistent with the 'current' rather than 'increased' investment option (noting that the 'current' option is still a significant step-up in Resilience investment relative to PQP1).

Our consultation focused on the 'dual path' type of resilience investments – where we add diverse routes to create redundancy. However, we believe the strong feedback regarding resilience would have been broadly similar for the other types of Resilience investment included in this proposal.

RESILIENCE

"The internet is such a huge part of our daily life. You can't guarantee there wouldn't be dropouts or breakages in coverage but we just really need the security of increased resilience because so many day-to-day things rely on it."

Stakeholder feedback

7.6.3 Drivers

The key drivers of Resilience investments are the resilience standards for our network architecture. These include:

- **availability quality standard** – this is one of two quality standards set by the Commerce Commission as part of Chorus' price quality regulation. The availability standard requires average downtime (excluding planned outages) per end-user per regulatory year to be no more than 160 minutes for Layer 1 and 40 minutes for Layer 2 across each Point of Interconnect (POI) area. These are similar standards to what was required under the Network Infrastructure Project Agreement (NIPA) (see below), so require continued levels of Resilience investment.
- **contractual quality standards** – before 2022 we were required to meet targets for network availability as specified in the NIPA. The NIPA set a maximum number of consumers that could be affected by a single Layer 1 or Layer 2 element failure, and the maximum number of consumers that could be supported by a single POI of 3,000 customers. The NIPA also required all towns with 3,000 premises or above to have dual path. While the NIPA no longer applies, it remains relevant because it set the requirements for how Chorus designed and built the fibre network and therefore has ongoing effects on the costs of supporting the network. In the absence of a value of lost service (VOLS) estimate, or clear evidence of end-user willingness to pay, adherence to the original direction of the Crown is a reasonable proxy for end-user preferences. There is no evidence that would support a move to a different standard.

RESILIENCE

"You are an infrastructure company – this is your key job."

Stakeholder feedback

60 We presented the benefits and costs, in terms of $ per user per month, for each option. More details are provided in the Engagement chapter in Our Fibre Plans.

- **architecture standards** – our architecture specification (CADS0046 section 4.4), which was informed by the NIPA, requires that communities greater than 3,000 premises should have dual path fibre routes. Additionally, dual path fibre routes or partially diverse routes should be planned for all communities greater than 1,000 premises and for all regional transport routes. Communities between 100 and 1,000 premises are provided with dual path fibre if possible and may be part of other diverse activity. Additionally, no exchange (i.e. access site) should supply more than 25,000 connections, to mitigate the impact of a high-impact-low-probability (HILP) loss of an exchange.
- **service level agreements** – our contracts with Retail Service Providers (RSPs) include availability targets.
- **customer expectations** – as discussed above, our end-users, RSP customers and other stakeholders expect a high level of network availability.
- **government expectations** – policy work led by the Department of Prime Minister and Cabinet, influenced by the impacts of Cyclone Gabrielle, indicates a strong view within government that the level of resilience of the infrastructure in Aotearoa needs to be lifted. There is discussion of setting minimum resilience standards and increased reporting on critical assets. It is fair to say that the government expects asset owners such as Chorus to invest appropriately in resilient infrastructure.

DRIVERS

Architecture standards, regulatory quality standards, contractual standards, service level agreements and stakeholder expectations drive resilience investment.

Value of lost service estimate

Chorus does not currently have a 'value of lost service' (VOLS) estimate to test the economic benefits of investments. We have carried out some initial analysis to start the process of developing a VOLS that is suitable for Chorus' FFLAS business, including:

- reviewing international approaches to VOLS, for both the telecommunications sector and other sectors
- assessing potential VOLS estimates based on international examples
- starting to test how a VOLS estimate could be applied for Chorus.

CRITICAL

Cyclone Gabrielle reinforced the importance of resilience for critical infrastructure, including communications networks.

We have done some initial exploratory analysis, but that has not yet delivered a reliable methodology for testing the economic benefits of Resilience capex. This is something we intend to develop further in advance of PQP3. However, for HILP events such as the loss of a major exchange, we anticipate that a VOLS estimate may not fully capture the benefits to end-users of the risk-mitigating investments.

Given the nature of HILP events, including their long return periods, unpredictable impacts on networks, users and wider systems, and scope for non-linear effects (i.e. the impact of one large event may be greater than the sum of many small events), they are not well-suited to the assumptions and methodologies of standard economic models. As such, we expect that a deterministic backstop, such as our network architecture standard, may have an ongoing role in ensuring we manage risk to a socially acceptable level. This is consistent with good telecommunications industry practice, and with good electricity industry practice where hybrid economic and deterministic approaches are the norm.

7.6.4 Forecasting methodology

Our forecast is calculated using a volumetric P x Q model. This forecast addresses the expenditure required to achieve the resilience outcomes as measured by our functional limits and quality standards.

Price is based on historical information using the average price for each deployment type as of February 2023. We have assumed costs based on previous build activity.

Quantities are based on our planned resilience programmes and some additional reactive projects. The forecast for reactive projects is based on our demand modelling assumptions.

To ensure costs are efficient, all dual path projects are tendered. Projects are budgeted on contractual rates agreed under the FSA and actuals experienced on prior similar projects. These produce historical rates per metre (overall, not broken down by material), which vary based on different civil construction conditions, and are classified as easy, medium and hard routes.

HIGH IMPACT

Deterministic backstop standards represent good industry practice for high-impact events.

Key assumptions, uncertainties and risks

- Health and safety and NZTA compliance requirements could push resilience costs higher (e.g. depending on the rules they apply for placing fibre cables in road corridors), which creates some risk and uncertainty in our forecast. Similarly new or changed traffic management restrictions (e.g. limits on roading works at peak holiday travel times) could also affect costs and timeframes. We manage these risks by working with NZTA and local authorities to plan and test the requirements in advance and seek changes where necessary.
- In limited cases, where it is not possible to add fibre routes in road corridors, there is risk in terms of access to land. We manage this by planning in advance and seeking routes over land where the owners are more likely to be constructive.
- Our long-term resilience plan is a 10-year programme of investments to improve route diversity and robustness. That programme can be sped up or slowed down based on capital prioritisation and field resource. However, this risk is in Chorus' control and we can choose whether to change the pace of investment.
- Government policy changes could drive different resilience requirements or focus. There is ongoing policy work regarding government's approach to critical infrastructure resilience, which could include increased reporting requirements and/or minimum standards that asset owners would be required to meet. Policy changes could require Chorus to deliver a different level of resilience to our current network architecture. However, the policy process is at an early stage and it is too early to predict or plan for any particular outcome.
- For resilience capital investment to meet our functional limits, there is some uncertainty regarding availability of suitable land to construct new exchanges on.

- Our field deliverability constraints have not affected our ability to deliver diversity projects in the past, so we don't expect our forecast to change as we approach and enter PQP2. Chorus will manage and prioritise work to ensure the quality is achieved as set out by the Commerce Commission.

Planning and prioritisation

New resilience projects are planned and prioritised by considering the risk (likelihood and impact) of network outages that the proposed network infrastructure would avoid. Outage impact is based on:

- the number of customers affected (driven by the location of the line, including how close to the handover point it is).
- the length of time the network is unavailable (driven by, amongst other factors, the remoteness of the network and the length of the line that needs to be inspected).

7.6.5 Dual paths (redundancy)

Chorus hands over the Layer 2 traffic to RSPs at around 26 handover points (POIs). These are generally located in our major towns (in UFB1 areas). UFB2/2+ towns must be backhauled to the appropriate handover point, often over long distances on fibre cable using a suitable transport system. Should the fibre cable be cut then the UFB2/2+ town would be isolated and all broadband services lost.

Fibre can be cut unexpectedly by a number of events; diggers working on the roadside or other roadside activities, storms, land slips, road bridge washouts, damage caused by sea storms, etc. Repairs to cut fibre cables can take many hours, if not days. The fault needs to be located, repair lengths of fibre often have to be moved to site, and jointing and potentially trenching has to be carried out. In the worst cases land slips, washouts, loss of bridge crossings, and other weather events can impact the time to repair as health and safety and access issues must be attended to first – any danger from the event itself needs to be considered before repairs can even begin. In the case of severe events such as Cyclone Gabrielle and the Kaikoura earthquake, repairs to the fibre cable (even temporary repairs) took several days. Without redundancy investments, a single failure can result in an entire community being without fibre service.

As our network grows it becomes more cost efficient to close loops in the network and incrementally add redundancy. For example, when planning extensions to the physical network we can consider routes that achieve improved network resilience using existing infrastructure. When possible, we avoid areas which could present a hazard to the infrastructure, such as areas of land slips and erosion, to ensure maximum availability.

Improving redundancy involves adding equipment and capability that is always in a standby mode and ready to take over in the event other network equipment fails. It provides duplication for critical network assets so that if certain parts should fail then the network can still operate (i.e. the concept of an "A side" and a "B side"). For the purposes of this section, we focus on redundancy to the Layer 2 network from route diversity (e.g. dual fibre paths) in the Layer 1 network as shown in Figure 7.6 below. Other forms of

BUILD-UP

We have built up cost estimates based on a prioritised programme of planned work.

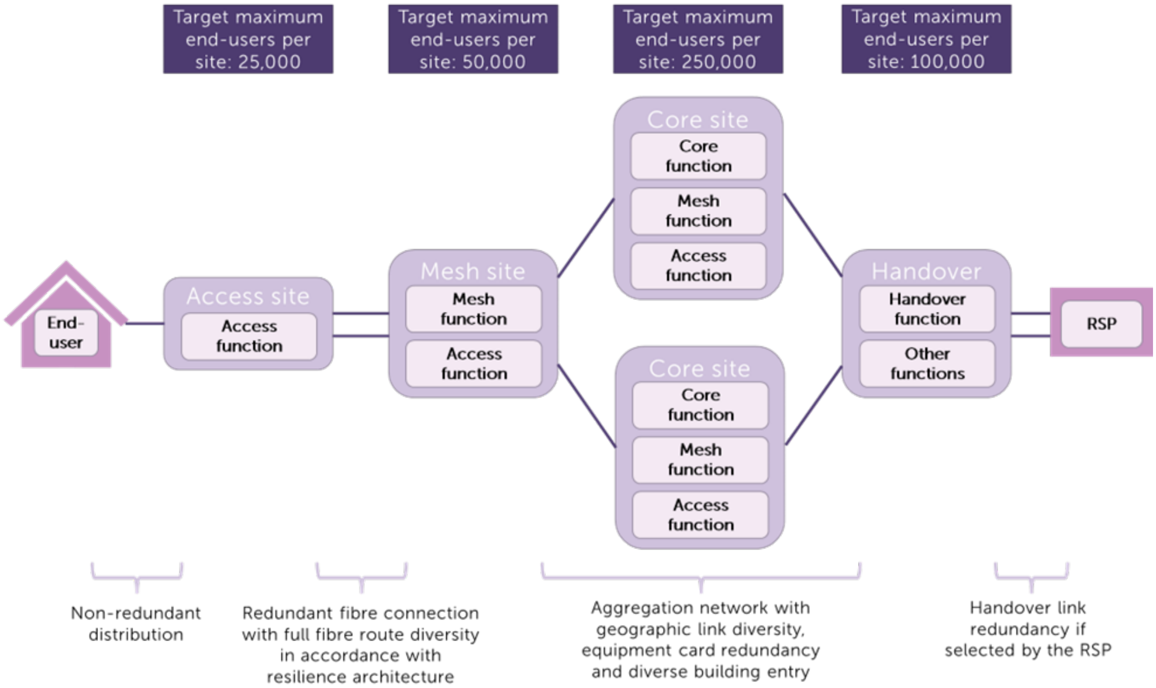
DUAL PATHS

Dual paths and loops reduce vulnerability to fibre cuts, including those due to road or bridge failures.

$69.1m

redundancy (e.g. backup power supplies) are included in other expenditure categories or sub-categories.

FIGURE 7.6: LAYER 1 NETWORK REDUNDANCY



Key points to note from Figure 7.6 include:

- The default connection from the end-user's premise to the access site is a single fibre path. End-users can order a diverse connection, but it will be a bespoke solution and they will have to fund it themselves.
- Access sites are required to have dual fibre uplinks to their connected mesh site as the access nodes (OLTs) are required to terminate on separate uplink cards.

Our investment

Prior to 2020 most network resilience was built as part of the UFB1 rollout. As a result of winning UFB2/2+, several major projects commenced to establish capacity for UFB2/2+ and provide for UFB1 robustness.

In 2019, we started our multi-year programme for ongoing resilience in support of our 'always on' objective and customer quality expectations. Recently completed projects include Fox Glacier to Haast to Lake Hawea fibre feeder and the Te Anau to Milford Sound fibre feeder. To add redundancy during the UFB1 build we utilised dual fibre paths between core and mesh sites. However, establishing redundancy for UFB2/2+ towns is more complex because the towns are a long way from aggregation switches. Traffic from the OLTs to the handover must travel over a long fibre path. The risk of a fibre cut increases with cable length. Direct buried fibre in rural areas is more susceptible to cuts and damage than fibre cable in ducts in cities.

UFB

We built-in resilience as we delivered the UFB programmes. As connections grow, adding more resilience becomes a standalone driver.

We are implementing an ongoing programme of work to ensure that no single element failure impacts over 3,000 premises. This is consistent with our network architecture standard. The investment results in most towns of that size requiring dual fibre paths to their handover point (POI), while smaller towns on the same ring also benefit from the dual path. In many cases these new diversity projects address routes where redundancy is currently only achieved by having two fibre paths in the same cable, which is not as effective as geographically diverse routes.

Benefits of this investment are:

- increased reliability – connectivity is essential for ensuring people's ability to contact emergency services when needed. Our network also supplies mobile cell towers which are usually the primary source of communications during an emergency
- improved customer experience/service availability – around 100,000 connections will have increased resilience and be included in the PQ availability standard. It also reduces the number of times end-users experience a loss of service.

RESILIENCE

"New Zealand needs reliability and we need it for our way of life. We need to build more resilience for our future, for what's happening in the world."

Stakeholder feedback

Alternatives considered

Doing nothing to improve redundancy (i.e. ceasing further investment to create dual paths to communities of 3,000 or more premises) would create an inequitable outcome where some end-users are protected to the NIPA (government-agreed) standard, and some are not. This would be unacceptable to Chorus from a safety, consumer protection, equity and brand perspective.

Beyond PQP2, our business plan includes investment to build resilience infrastructure for most UFB2/2+ towns and communities with 1,000 or more premises. To bring any of these projects forward into PQP2 would require government funding support, which would be treated as capital contributions and, as such, should not affect expenditure allowances.

Risks being managed

The dual path investment programme aims to manage the risk of communities above a certain size being cut off due to failure of a single supply element (e.g. a fibre cut).

7.6.6 Functional limits (robustness)

Improving the robustness of the network involves minimising the effect of any asset failures on our customers and end-users, bringing the risk associated with the loss of a critical asset to a manageable level.

To mitigate the impact of the (very unlikely but very high impact) risk of losing a major supply site, we apply functional limits on our network sites. As shown in Figure 7.6 in the section above, under our standard, we can have no more than 25,000 connections directly connected to any access sites, 50,000 connections dependent on any mesh site, 250,000 connections dependent on any core site, and 100,000 connections dependent on any handover site.

To comply with our functional limits and be consistent with our network architecture standards, we transfer connections from exchanges that are at or above the limit to other exchanges that are below the limit. However, given

LIMITS

Capping the number of connections served by a site reduces vulnerability to catastrophic site failures.

$9.9m

growth levels, this generally defers the need for new exchanges but does not remove the need. We are continuously working on the most cost-efficient method to balance the number of connections per access, mesh and core site.

Our investment

The Auckland CBD exchange and six other exchange sites are at or close to their functional limits. As a result, we need to construct additional exchange sites to absorb the growing capacity.

Limiting the physical coverage size of exchanges limits the potential impact of such a catastrophic event. We assessed the 25,000 connections per exchange limit against the PQP1 quality standards (i.e. assessed whether a fault at the Access Functional Limit of 25,000 connections would breach the Layer 1 and Layer 2 availability standards). Our analysis showed a failure of exchanges of 25,000+ connections would result in downtime that would breach the Layer 1 and Layer 2 standards and thus expose Chorus to a risk of financial penalties of up to $5 million (see section 215 of Telecommunications Act 2001).

ACCESS LIMITS

We will invest to move connections for seven sites nearing the limit of 25,000 end-users served by a single access site.

<25,000

Alternatives considered

The first option considered was to move traffic to another exchange site that has capacity to absorb additional connections. However due to growth, this is not a feasible solution for the seven exchange sites being considered.

Doing nothing is not a feasible option, as it would allow the number of connections served by some exchanges to exceed 25,000, which would be inconsistent with our network architecture standard.

Risks being managed

These projects are important because we estimate that it would take approximately one month to fully restore services after a failure of a large exchange site, so we want to ensure this disruption would be limited to no more than 25,000 connections. This timeframe was previously three months, but our acquisition during PQP1 of two mobile exchanges has significantly reduced the expected restoration timeframe.

7.6.7 Critical spares (contingency)

Contingency involves adding resources that allow connection to be restored quickly. It is required for circumstances where, despite redundancy and robustness measures, the network still loses connectivity. Although we plan for known risks and implement associated redundancy measures, our network is still exposed to risk factors.

For example, Cyclone Gabrielle demonstrated that two geographically diverse routes can both be damaged during the same event. Such events may be outliers, so redundancy investments to withstand them (such as a third route) may not be economic. Rather, we need to be able to restore connectivity quickly, even if this is only a temporary fix.

Improving contingency involves us holding critical spares (equipment over and above our normal operational spares, including mobile exchanges) as well as proactively surveying major fibre routes (to action remedial works to exposed fibre cable and marking our routes to reduce risk of damage by

RECOVERY

Critical spares support faster recovery from catastrophic events.

$0.7m

landowners and contractors). Equipment spares are categorised in the follow two groups, "normal" and "critical".

- Normal spares are those which are held in accordance with the spares policy and are primarily for the replacement of plug-in electronic cards and hardware items that fail in line with the mean time between failure (MTBF) and mean time to repair (MTTR) expectations and in line with predictable expected events like lightning damage, etc. At times, investment needs to be made to replenish some spares holdings as unrepairable items are replaced.
- Critical spares (also referred to as "unexpected" or "catastrophic" spares) typically relate to rare or catastrophic events such as fires, earthquakes, flooding, landsides, etc. (rather than MTBF of MTTR). The volume and type of spares needed for these events usually exceeds the normal holdings of the spares systems. Special arrangements for emergency spares may need to be made with equipment vendors. Alternatively, working and portable replacement systems can be held at convenient locations that can be transported to site where and when needed and connected into the network to quickly restore some level of service. These typically include items such as transportable containerised network nodes, quantities of complete roadside cabinets, full drums of cable, etc.

7.7 Links and synergies

7.7.1 Other expenditure areas

Field Sustain capex links to other expenditure areas:

- Extending the Network capex increases the population of assets to sustain longer term and shifts the balance between fibre and copper. Construction can displace Field Sustain work in the near term (as some assets are replaced or refurbished to enable extension)
- Installations capex shifts the balance between copper and fibre for shared assets such as ducts and poles
- Network opex is impacted by Field Sustain investment. Generally, replacing assets reduces maintenance requirements
- Support opex (specifically Asset Management opex) and Network and Customer IT capex support prudent and efficient Field Sustain investment.

Site Sustain capex links to other expenditure areas:

- Extending the Network capex increases the population of assets to sustain longer term and shifts the balance between fibre and copper. Construction can displace Site Sustain work in the near term (as some assets are replaced or refurbished to enable extension)
- Installations capex shifts the balance between copper and fibre. Fibre is more space and power efficient, and more temperature tolerant. Initially, fibre installations increase demand for engineering services, but high uptake enables copper removal and a reduction in engineering services needs

- Network Capacity investment alters site space, power and cooling requirements over time
- Network opex is impacted by Site Sustain investment. Generally, replacement assets have lower Operating Costs and Maintenance requirements
- Support opex (specifically Asset Management opex) and Network and Customer IT capex support prudent and efficient Site Sustain investment

Relocation work links to other expenditure areas:

- Extending the Network and Installations capex increases the population of assets exposed to Relocation capex. Underground vs. aerial components have different exposures to Relocation costs, as does urban vs. rural.

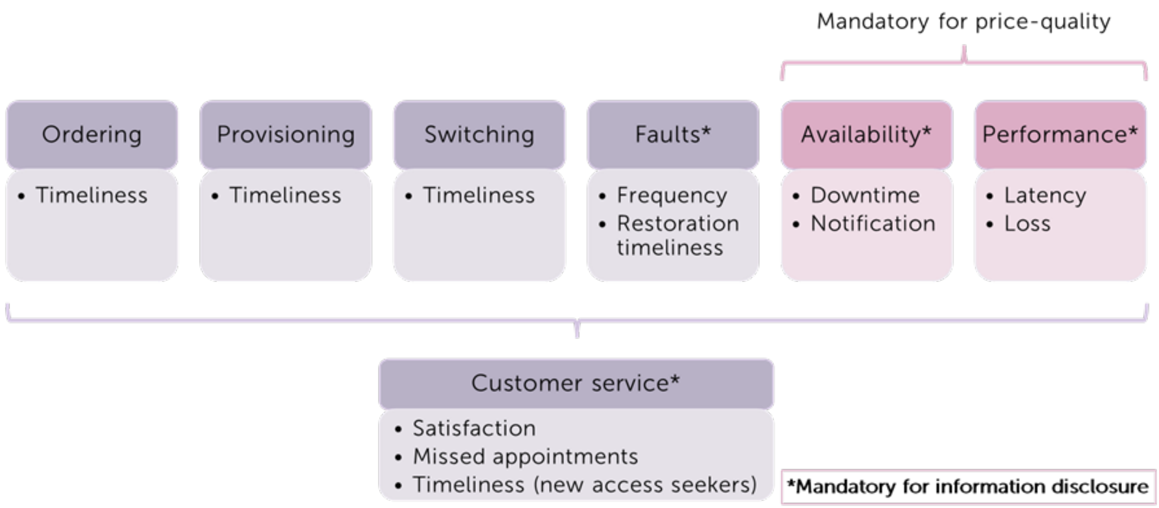
Resilience work links to other expenditure areas:

- Installations capex prompts ongoing Resilience work to sustain architecture standards for the maximum number of connections exposed to a single point of failure
- as described in the Resilience section of this chapter, other Resilience work (outside of dedicated Resilience programmes) is captured in Field Sustain, Site Sustain and Network Capacity.

7.7.2 Quality

The Fibre Input Methodologies define six lifecycle- based quality dimensions and one over-arching customer service quality dimension. Two quality dimensions are mandatory for price-quality (PQ) regulation, meaning they must have associated quality standards. Four dimensions (including the two PQ dimensions) are mandatory for information disclosure.

FIGURE 7.7: QUALITY DIMENSIONS AS DEFINED IN THE FIBRE IMS



Each discussion of linkages between expenditure and quality includes a summary with simple icons to depict the strength and pace of each linkage. The icons provide a broad characterisation, rather than a precise assessment.

TABLE 7.6: LINKS BETWEEN NETWORK SUSTAIN AND ENHANCE CAPEX AND OUR QUALITY DIMENSIONS

Linkage strength:
How direct is the relationship between spend and quality?

One of several drivers | A key driver | Direct link

Linkage pace:
How quickly would a change in spend materially alter quality?

Beyond PQP2 | By the end of PQP2 | Within 12 months

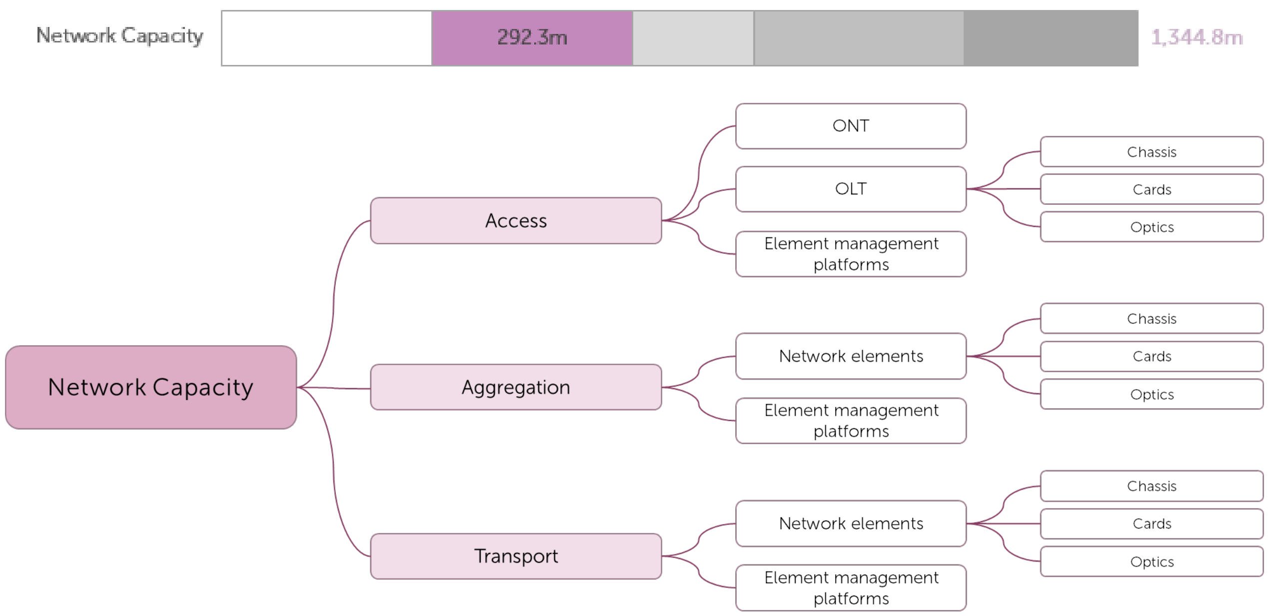
DIMENSION(S)	EXPENDITURE SUB-CATEGORY	STRENGTH	PACE
Availability and faults	Resilience Investment in resilience can reduce the risk of widespread downtime events.		
Availability and faults	Field Sustain Replacing or refurbishing in-field assets reduces Layer 1 downtime risk.		
Availability and faults	Site Sustain Replacing or refurbishing site assets reduces Layer 2 downtime risk.		
Availability and faults	Relocations Relocation work protects network elements.		
Customer service	All sub-categories Asset replacement and refurbishment and investment in resilience sustain our low fault and downtime rates, which support customer satisfaction.		

8.0 NETWORK CAPACITY

Te Āheinga Aka Matua

8.0 Network Capacity

This chapter describes Network Capacity capital expenditure (capex) category. It covers ongoing investment in network electronics and associated systems to optimise for capacity growth, lifecycle requirements, and new product sets.



8.1 Introduction

This chapter describes the Network Capacity expenditure category, which is a category capturing non-growth capex.

Network capacity is a measure of the amount of data that electronic devices can connect, aggregate and transport through the network. We use network electronics to aggregate data and provide a network connection from end-users to a handover point in network buildings.

Our aim is to:

- send data through the network quickly and efficiently
- provide high-quality broadband services (consistent with the quality standards set for network availability and performance)
- minimise whole-of-life cost and risk of network failure.

NETWORK CAPACITY CAPEX

We will invest to manage lifecycle costs, support new product sets and accommodate growing bandwidth demand.

$292.3m

Network Capacity assets cover the network electronics hardware and network element management platforms (i.e. software and systems) required to transmit data between Internet Service Providers (ISPs) and end-users across the communal fibre network and related infrastructure.[61] More detail about these assets can be found in the 'Our Network' chapter of this document.

There are three Network Capacity expenditure sub-categories:

- Access – enables end-users to use the fibre network by connecting end-user sites to Chorus access sites
- Aggregation – connects access electronics to ISPs using Handover Links at Points of Interconnect (POIs), by collecting and aggregating data coming from access electronics to ISPs, and by directing traffic coming from ISPs to the correct access network
- Transport – increases the amount of data and distance data can be carried over fibre cables using enhanced lasers/optical technology, providing connectivity where the capacity or distance between aggregation switches and access optical line terminals (OLTs) (or between multiple aggregation switches) is more than can be achieved by fibre cables alone.

SUB-CATEGORIES

Access connects end-users to Chorus access sites.

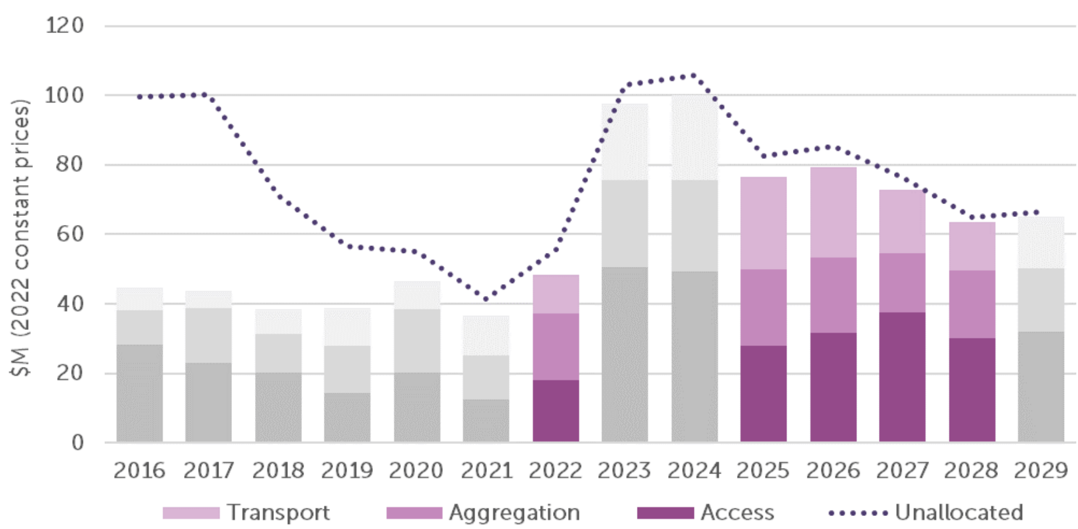
Aggregation connects access electronics to points of interconnect (POIs).

Transport provides long-distance connections between nodes.

8.2 Forecast overview

Our PQP2 forecast expenditure for Network Capacity is $292.3 million. This represents 22% of our total PQP2 forecast capex for this period.

FIGURE 8.1: NETWORK CAPACITY CAPEX (UNALLOCATED AND PQ FFLAS)



61 Traditionally ISPs were separate from Mobile Network Operators (MNOs), however in NZ, all our MNOs happen to be ISPs as well. Some Retail Service Providers (RSPs) focus on enterprise and business solutions that do not provide 'internet' service.

TABLE 8.1: NETWORK CAPACITY CAPEX (PQP2 PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

	2025	2026	2027	2028	PQP2 TOTAL
Access	27.9	31.7	37.6	30.2	127.5
Aggregation	21.8	21.6	16.9	19.5	79.8
Transport	26.7	26.1	18.3	13.9	85.0
NETWORK CAPACITY TOTAL	76.4	79.5	72.7	63.7	292.3

Prior to PQP1, total unallocated network capacity capex peaked at around $100 million in 2017 (as electronics were deployed ahead of the physical Ultra-Fast Broadband (UFB) communal fibre build), before falling again in 2019-2021 (when the communal build was prioritised). On the other hand, allocated PQ FFLAS capex remained more constant at around $40 million during this time.

However, since the beginning of PQP1, almost all network capacity capex has been allocated to PQ FFLAS, so allocated and unallocated trends are very similar.

During PQP1, expenditure has been and is expected to continue to increase to a new peak in 2024 as investment is made to address areas of growth and where lifecycle investment had been delayed.

In PQP2, Network Capacity capex is expected to generally decrease from 2025 as a number of time-sensitive lifecycle replacement and capacity upgrades are completed. However, this is dependent on what works are successfully completed in PQP1. The expenditure forecast each year has been reduced and activity spread over longer periods than is ideal due to a combination of financing and delivery resource contention issues.

Activity and expenditure beyond PQP2 is forecast to gradually increase again, primarily due to the move to next generation network technology to allow for Hyperfibre uptake and ongoing bandwidth growth. Our network electronic assets are relatively young, as they were deployed as part of the UFB initiative, but rapid technological development means that the assets often become obsolete before their design lives are reached. Aggregation equipment, in particular, has a historical obsolescence of 5-10 years on average, so the next round of replacements is anticipated to commence around 2028.

MEETING GROWING CONSUMER DEMAND

"Society is determining the usage and reliance on technology therefore the said technology has to have the capability to provide assurance that whatever or whenever it is used it is fit for purpose."

Stakeholder feedback

8.3 Strategic objectives

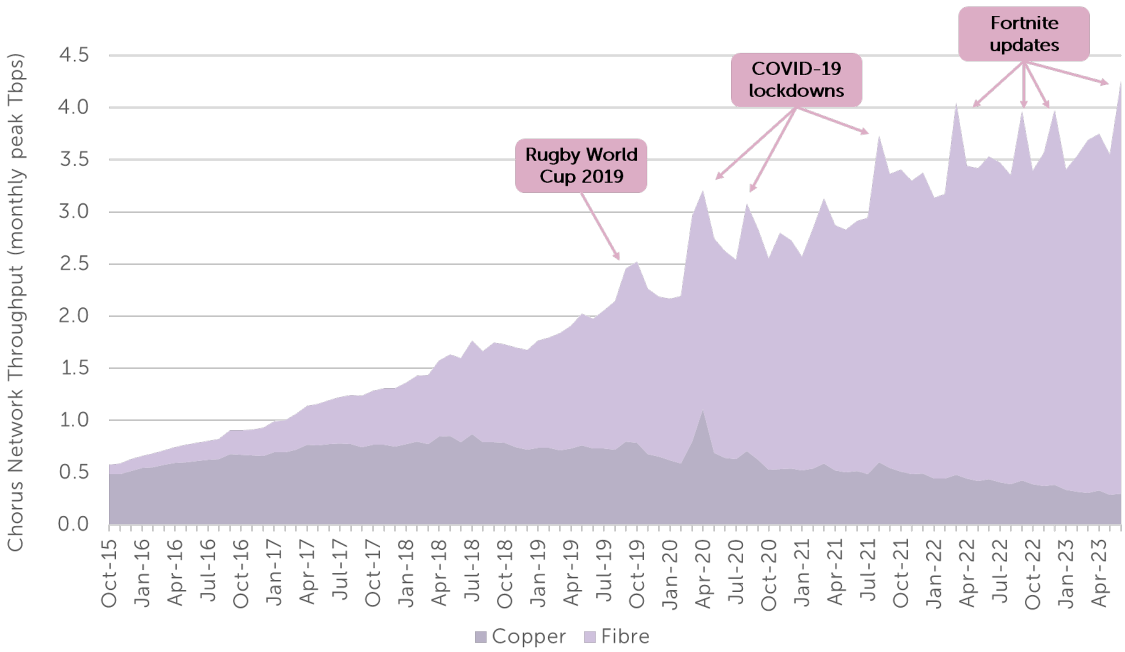
Network Capacity capex is required to build new and maintain existing bandwidth capacity for the forecast bandwidth requirements from new and existing connections. Historically, our investment in all three Network Capacity capex sub-categories has been driven by UFB build and connecting new end-users. However, the contracted UFB network build is now complete, and installations are predicted to slow as fibre uptake approaches saturation.[62] As such, the forecast Network Capacity capex is driven by three key factors:

- Bandwidth growth
- Lifecycle renewal
- New product sets.

8.3.1 Bandwidth growth

Bandwidth growth refers to an increase in traffic on the network, measured by Average Throughput Per User (ATPU) multiplied by the number of connections. Expenditure on new devices and components is required to stay ahead of bandwidth demand. As discussed in the Demand chapter of Our Fibre Plans, we currently forecast this to continue to grow at an average of between 20-25% per year from 3.5Tbps in 2023 to between 22-31Tbps in 2033. We aim to maintain capacity in the network 12 months ahead of anticipated demand to take account of build lead times and (up to a point) one-off demand events such as those shown in in Figure 8.2 below.[63]

FIGURE 8.2: BANDWIDTH GROWTH



62 Any expenditure on network electronics as part of our Fibre Frontier programme will be categorised as Extending the Network capex.
63 It is impossible to build a network that can accommodate any and all demand spikes, particularly as they become increasingly more unprecedented and unforeseeable.

The relationship between bandwidth growth and Network Capacity capex is not linear – new investment will result in a step-up in both capacity and capex, following which bandwidth growth can continue without further capex until the next investment (and corresponding step-change in expenditure) is required.

Without this expenditure to increase bandwidth capacity, traffic growth would lead to network congestion, breaching the port utilisation performance quality standards and driving poorer customer experience.

DRIVERS

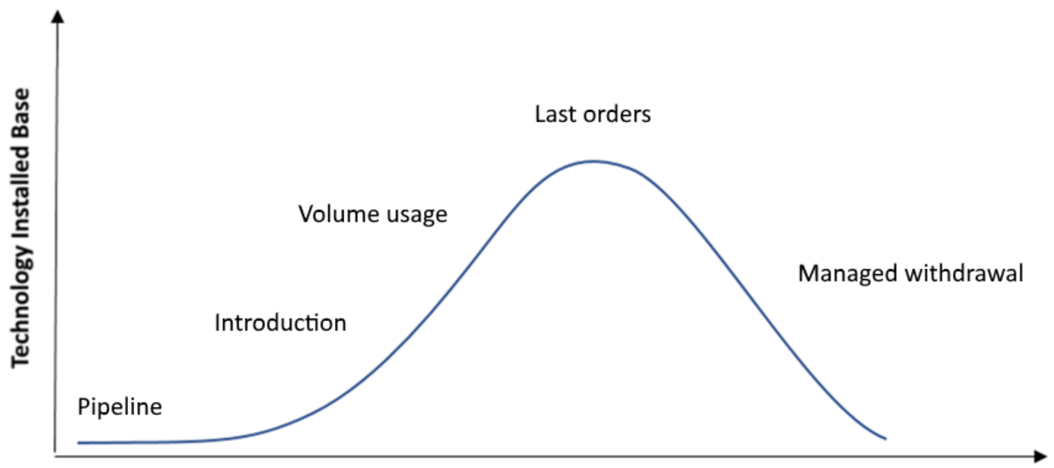
Bandwidth demand growth is only one driver of network capacity investment, and the relationship is not linear. The other drivers are lifecycle cost optimisation, and product set support.

8.3.2 Lifecycle renewal

Lifecycle renewal means that devices or components must be replaced when they become obsolete.[64] Network technology progresses through the product lifecycle (as shown in Figure 8.3 below) very quickly, driven by customer demand and competition. Old hardware can become obsolete more quickly when new software does not work on existing hardware.

Without expenditure to replace obsolete technology, the network would degrade and become harder to keep running, leading to increased downtime, frustrating customers and potentially breaching the availability quality standard. Poor customer experience can also drive customers to alternative technologies, which could push the price up for remaining customers.

FIGURE 8.3: SUPPLIER TECHNOLOGY LIFECYCLE



The management of our network capacity and our level of investment depends on the lifecycle stage of the technology, as shown in Table 8.2 below.

64 Asset health is usually not a material factor in the lifecycle of network electronics (i.e. compared to physical plant), as in most cases they become functionally obsolete before they need to be replaced due to asset health reasons. We note that our assumptions about asset lifespan are based on historical products, but new products may have different lifespans.

TABLE 8.2: SUPPLIER TECHNOLOGY LIFECYCLE MANAGEMENT

STAGE	DESCRIPTION	ACTIONS
Pipeline	New technologies are available to solve new problems or support growth more cost effectively than existing technologies	• Matching requirements with capabilities of available technology • Undertaking business case analysis and feasibility
Introduction	Specific technologies are chosen and introduced for use in the network, including integration with other network and IT systems	• Procurement • Capability introduction projects to onboard to Chorus network, systems and operational roles
Volume usage	We build and grow the network using network equipment	• Capacity planning • Build programme planning • Managing in-life upgrades as required (software)
Last orders	Suppliers announce the end of sale and manufacture of equipment	• Final purchases of current technology • Planning for network equipment retirement/replacement
Managed withdrawal	Suppliers no longer offer technical support, repair services or capability with new software	• Removing/retiring network • Migrating or removing services • Pipeline review for replacement technology begins

As part of managing our lifecycle renewals, we also engage with our suppliers regarding regular development updates to track when new products could provide efficiency gains.

8.3.3 New product sets

Demand for new product sets often requires new network equipment to be installed and element management platforms to be upgraded. For example, the Hyperfibre product set relies directly on new equipment in the access network (i.e. XGS-PON equipment including optical network terminals (ONTs) and line cards and modern OLT shelves), as well as supporting aggregation and transport infrastructure. Another example is the use of small form-factor pluggable ONTs to support services typically outside a building environment in small enclosures, e.g. in small cell sites.

8.3.4 Network capacity capex co-optimises investment drivers

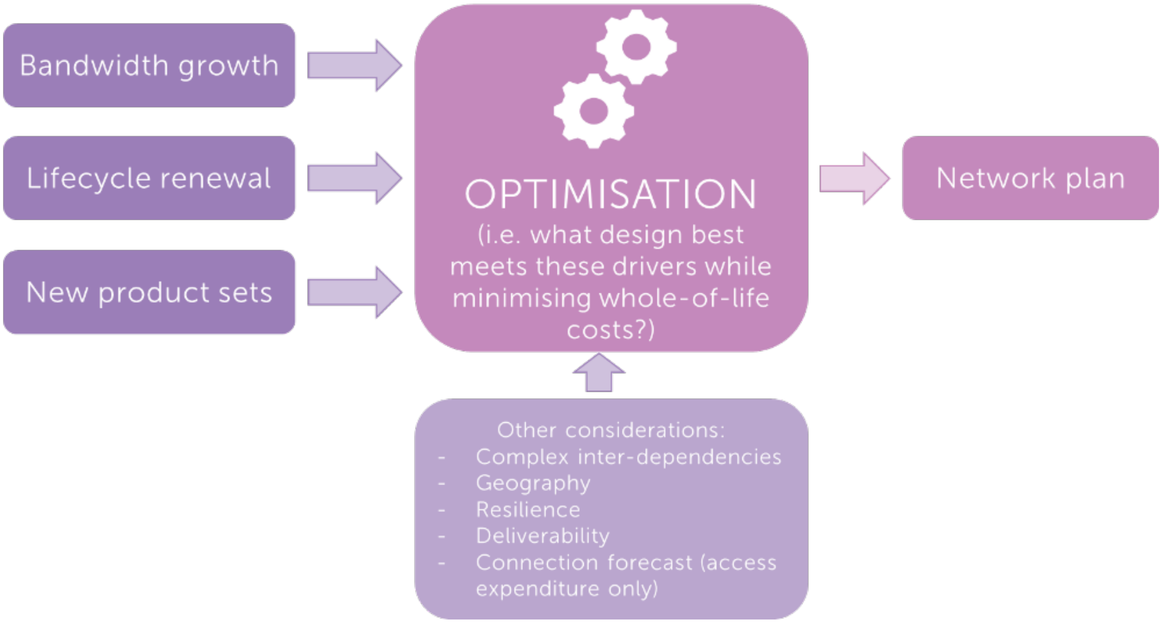
'Network capacity is planned based on a co-optimisation of these drivers, with an aim of meeting underlying quality standards and minimising whole-of-life cost. This optimisation is an iterative process that is regularly updated as inputs change. It produces an optimised network plan, allowing us to identify what equipment will be needed to bring this network design to life, and when this will be required. This informs the 'quantity' aspect of our price (P) x quantity (Q) forecasting approach for each of our investment areas.

This process is shown in Figure 8.4 below.

CO-OPTIMISED

We co-optimised our network capacity investment plan across demand, lifecycle and product drivers.

FIGURE 8.4: OPTIMISATION OF NETWORK CAPACITY INVESTMENT BASED ON MULTIPLE DRIVERS



This process considers the existing network, using up-to-date data held by our element management platforms. As shown above, this optimisation also takes into account other factors[65] such as:

- Complex interdependencies – network electronics have a complex set of dependencies between hardware and software within each sub-category. There are also dependencies between sub-categories for coverage and capacity outcomes. Planning the efficient use of resources to achieve all the required outcomes requires significant engagement and makes it challenging to make seemingly small changes to a programme of work due to unexpected consequences.
- Geography – our network design needs to consider not just what new electronics will be needed, but also where they will be needed. While it may be easiest and cheapest to locate new electronics in the same place as the legacy assets that are being replaced or upgraded, as the network changes it may be optimal to locate it elsewhere, taking into account the location of:
  - future growth in connections and bandwidth demand
  - Chorus' other access, aggregation and transport assets
  - Retail service provider (RSP) handover capacity at each POI
  - geographical features or terrain that affect the feasibility of certain fibre routes.
- Resilience – we use architecture, engineering and planning techniques to manage device/component vulnerability and malicious activities, such as

DESIGN FACTORS

Our co-optimisation also addresses factors such as resilience and deliverability, and the need to manage complex interdependencies.

65 We note that while new network electronics are more energy efficient than legacy technologies (reducing our energy consumption and helping achieve our emissions reduction targets), this is considered as more of a side-benefit rather than a material factor that inputs our network planning.

limiting the number of customers served by an individual device or component to an appropriate level for its reliability (contractual limits in the Network Infrastructure Project Agreement (NIPA) are currently baked into our design standards) and using diversity to provide backup for devices/components serving higher numbers of customers.

- Deliverability – industry and company resource contention means we need to schedule work to take account of required deadlines and ensure steady delivery by that date for large-scale geographically distributed work. In practice this means our ability to replace equipment, for example for obsolescence or product development reasons, is constrained by real world factors including international and domestic supply chains, internal capacity, and impacts on RSPs and end-users. We incorporate these limitations into our forecasts initially, and then make further adjustments through internal challenge/prioritisation forums during planning and again during delivery.
- Connection forecasts – our investment in access electronics is influenced by the number of network connections we expect to have, as we need to ensure we have sufficient ports to serve new connections. This factor does not directly affect aggregation or transport investment.

Previously, the NIPA imposed specific rules on Chorus for network architecture. However, the quality standards imposed in PQP1 focus only on the quality outcomes, not how the outcomes are met. Further work is required to ensure that the network is designed in such a way that leverages these new freedoms of architecture. Our network plan assumes that our quality standards remain the same, although we note that we are proposing a change in our performance quality standard from a port utilisation from 90% to 95% (see our Quality report in Our Fibre Plans).

ILLUSTRATIVE EXAMPLE: BUILDING NETWORK CAPACITY IS LIKE BUILDING A HARBOUR BRIDGE

1. We forecast how many cars will want to cross the bridge and when (i.e. we forecast bandwidth demand)

2. We determine the specifications of the bridge, such as the number of lanes required to avoid traffic jams, even at peak times (i.e. we determine the network components needed to cope with bandwidth growth)

3. We design the bridge by co-optimising these specifications with other considerations like earthquake strengthening, cost of materials, etc. (i.e. we co-optimise by considering lifecycle renewals, new product sets, and other factors).

As a result of this optimisation, we:

- may replace existing network electronics with newer technology to minimise whole-of-life-cost. This is because the cost of adding further capacity to existing technology can be high, exposing us to significantly increased capex as bandwidth demand grows. Newer technology, which provides higher capacity per unit cost, limits the rate of increase in future spending
- manage the purchase of technologies as efficiently as possible. New technology tends to be expensive, but bulk purchases can prove cost effective over time, due to economies of scale
- maintain software within support and introduce new capability through periodic upgrades. Element management platform versions are generally supported by the manufacturer for two years as part of the initial purchase, after which extended support must be procured. This ensures we remain in support and can deploy newer, faster optical network electronics as needed. At times the upgrade may be deferred beyond the two years, where a step change in the performance of new electronics is anticipated
- switch to alternative technology as suppliers reduce support and as replacement and maintenance costs increase. This ensures that capacity is added ahead of growth to sustain congestion-free performance and that technologies are optimised to retain support, add features and enable cost-effective growth
- make steady and constant investments to keep Chorus in band of the quality standards and to meet customer expectations. This helps us avoid falling behind and needing to make large, urgent and, often inefficient, investments. Building network capacity is a complex task that requires time and planning, so it is important to be sufficiently proactive.

TECHNOLOGY CHOICES

Technology choices are a key part of the co-optimisation process, as we manage performance, purchase cost and support.

Capital constraints mean there are very few completely discretionary expenditure areas in our past or current programmes. Typically, discretion has been limited to the timing of activities that will be required eventually. Any timing flexibility in activities to address the above drivers is used to ensure feasibility for delivery execution and efficiencies with other work programmes.

Current and future areas with wider discretion include ONT replacement activities and the rate and rollout of Hyperfibre to support/stimulate demand.

8.4 Access expenditure

Access expenditure includes expenditure on replacing or upgrading existing ONTs (as the cost of initial ONTs is included in the Installations expenditure category), OLTs, and element management platforms.

ACCESS

ONTs, OLTs and element management platforms.

$127.4m

8.4.1 Drivers

The availability of, and particularly demand for, new products is a key driver of Access expenditure, as new products require sufficient Layer 2 capacity. Our Hyperfibre product requires ONTs and OLTs to be upgraded from GPON to XGS-PON technology, which will drive a major proportion of our Access spend.[66]

For clarification, we note that we incur ONT deployment cost every time we take a new ONT out of the box and install it at an end-user's premise.[67] This deployment cost is categorised either under Network Capacity capex or Installations capex:

- Network Capacity capex captures the ONT expenditure we incur in regard to ONT upgrades and fault-related ONT replacements
- Installations capex captures the ONT expenditure we incur when doing a first-time installation at an end-user's premise.

Another key driver of Access expenditure is the number of connections (as informed by our connections model – see the Demand chapter in Our Fibre Plans). The number of connections drives expenditure in two ways:

- New connections may require expenditure on OLT hardware, as more ports may be needed to serve the additional connections. This is particularly true in new network areas – entirely new OLTs may be required where connections come from new property development, whereas new connections in established network areas may be able to be served by existing OLTs if these have sufficient capacity.
- New connections mean that there are simply more end-users on the network, which amplifies the effect of other drivers. For example, more connections mean there are more customers who may need ONT upgrades due to new products like Hyperfibre.

Bandwidth growth caused by increased traffic (i.e. ATPU) is a more limited driver of Access expenditure – rather, it primarily drives Aggregation and Transport expenditure, as discussed later in this chapter. This is because additional uplink ports on access chassis can be installed at a relatively low cost (provided that access electronics are kept modern). A higher capacity access uplink uses the same amount of fibre and labour as a lower capacity uplink, so the only additional cost is the hardware. As the incremental cost of building extra capacity is fairly low, where possible we err on the side of installing extra capacity in order to:

- reduce the frequency of augmentations and the attendant workforce demands (and costs) and service impacts
- reduce risk of capacity shortage (and associated quality standard impacts), in particular as traffic volatility increases
- simplifying capacity management and planning activities.

LINKAGES

Network Capacity captures costs of upgrading ONTs and replacing faulty ONTs. First-time installations are captured in Installation capex.

DEMAND

Connection growth and upgrades are stronger drivers of Access investment than bandwidth growth.

66 See our ONT Strategy for more information, including on our response to increasing Hyperfibre demand.
67 Each new uptake of a Hyperfibre product will require a new ONT, and may (depending on the existing capability of the respective OLT) require the replacement of the line cards and Multi PON Module (MPM) optics in the OLT chassis.

Lifecycle renewals will require access equipment to be replaced in time when our suppliers' product roadmaps indicate that the equipment is reaching end-of-life. However, we expect this will drive only limited expenditure in PQP2, as the network is fairly new so it may be some time before lots of equipment starts to become obsolete.

We expect ONTs to have a long lifespan. As we explain in detail in our ONT Strategy chapter, we currently do not forecast a proactive ONT replacement programme. The **CCI [**] forecast ONT expenditure captured in Access is to upgrade end-users to Hyperfibre services, where they decide that is in their best interest. A **CCI [**] of forecast expenditure over PQP2 is in regard to replacing ONTs that fail. The replacement of some of our older OLT chassis is partly lifecycle-driven, but like ONT replacement, **CCI [**].

RENEWALS

We do not expect lifecycle replacements to be a big driver of Access capex during PQP2.

8.4.2 Forecasting methodology

Our Access expenditure forecast uses a volumetric price (P) x quantity (Q) approach.

Unit costs are based on the costs of hardware, software and labour. These costs are defined in the contracts with our suppliers and service companies. Our core contractual agreement with our supplier provides a **CCI [**] purchasing framework. **CCI [**]. **CCI [**]. We have assumed **CCI [**]. As well as our contracts, we use other ad-hoc arrangements when necessary. These include 'bulk purchase' contracts that we use to achieve additional savings depending on the demand, discount opportunity and the available capex.

P X Q

Our optimised plan provides a quantity forecast, which we multiply by applicable unit costs.

The volume of access network electronics required is derived from our optimised network plan based on the drivers and inputs discussed in the Strategic Objectives section of this chapter. Our key assumptions and uncertainties relate to our various demand forecasts. A more complete description of our demand modelling, including these assumptions, can be found in the Demand report of Our Fibre Plans.

More insights on our approach to forecasting ONTs capex is in the ONT Strategy chapter.

8.4.3 Expenditure

TABLE 8.3: ACCESS CAPEX (PQP2 PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

	2025	2026	2027	2028	PQP2 TOTAL
Access	27.9	31.7	37.6	30.2	127.4

Investment during PQP1 so far has been to meet bandwidth growth, complete the UFB rollout, and begin the introduction of Hyperfibre technologies (whilst being optimised to maintain the quality, reliability and capacity of the network). This involved beginning the following work programmes:

- upgrading capacity for OLT uplinks from 10Gbps to 100Gbps ahead of forecast bandwidth growth
- replacing earlier generation access hardware (i.e. OLT shelves), which are close to ten years old and cannot be upgraded to support new services such as Hyperfibre
- expanding the coverage and quantity of Hyperfibre ports to improve customer connection experience. Our expenditure on next generation ONTs was considered as part of our ONT Strategy. We considered proactively upgrading ONTs compared to only upgrading them when an end-user requested a Hyperfibre product, with the latter being our chosen strategy for PQP2 and driving our ONT-related capex. As we explain more in our ONT Strategy chapter of this document, we will however remain flexible and possibly start deploying XGS-PON ONTs in instances where we are incurring a truck-roll anyway, as this results in the lowest whole-of-life cost.

HYPERFIBRE

Ahead of PQP2 we are investing to expand the coverage and quantity of Hyperfibre ports.

During the remainder of PQP1 and in PQP2 we will continue and complete these work programmes discussed above to ensure a quality customer experience whilst pursuing lowest whole-of-life-cost, and to future-proof the network against the continued growth in traffic.

We forecast expenditure to increase over the remainder of PQP1, averaging around $50 million per year in 2023 and 2024.

In PQP2, we expect this to reduce to less than $30 million in 2025 as a large proportion of the proactive Hyperfibre line card deployment work will have been completed. Around 50% of the Access PQ FFLAS expenditure for this period is towards Layer 2 ONT upgrades (and fault replacements to a much lesser extent). The rest of PQP2 sees expenditure fluctuate between CCI [ ] as we continue expanding coverage and quantity of Hyperfibre ports, upgrading capacity for OLT uplinks, and deployment of additional ports for new coverage areas.

8.5 Aggregation expenditure

Aggregation expenditure includes expenditure on replacing or upgrading our aggregation electronics.

8.5.1 Drivers

Bandwidth growth drives Aggregation expenditure specifically by requiring extra core switches and links to maintain sufficient capacity.[68] If we did not invest in aggregation capacity, bandwidth growth would lead to an increase in our port utilisation, breaching the quality standards and eventually impacting customer experience detrimentally. As such, this expenditure is necessary and prudent.

Our initial plan for PQP1 was to invest in new chassis driven solely by bandwidth growth, as optimising for lifecycle was not possible as the full extent of technical obsolescence was not yet known. As such, existing chassis were expanded up to their design limits and new chassis were added to deal with any capacity needs over and above what existing chassis could meet.

However, since 2020, new supplier product roadmap updates specified that the older equipment in the aggregation network family was identified to fall out of support in the short to medium term.

Initially we looked at just replacing these older components in old chassis with modern equivalents. However:

- as bandwidth growth drives capacity upgrades, continuing to use old, lower capacity chassis becomes increasingly less economic as they require more chassis per network link, risking inefficient spend
- this old equipment cannot be sufficiently expanded to meet forecast peak bandwidth growth, putting us at risk of breaching the performance quality standard
- some of these old components have no modern equivalents that are compatible with the older generation chassis
- when the old chassis become obsolete, we will have a greater proportion of network equipment to replace, creating delivery risk.

A revised approach to addressing obsolescence was determined, driven by lifecycle optimisation as well as bandwidth growth. Instead of retaining older chassis with upgraded components, we began to invest in new chassis (earlier than we would have based on bandwidth growth alone) and migrate links and services from older chassis to these new chassis. This brings expenditure forward, but will result in lower whole-of-life cost for the network and reduce the likelihood of us breaching the performance quality standard.

AGGREGATION

Adding and upgrading chassis to manage lifecycle costs and meet bandwidth demand.

$79.8m

DRIVERS

Bandwidth growth and lifecycle renewals are key drivers for PQP2 Aggregation plans.

PQP1

Ahead of PQP2 we adapted our plans to bring forward investment in new chassis. This addresses obsolescence and growth drivers, while reducing whole-of-life costs.

68 Currently new products do not directly drive aggregation spend, although over time they may lead to bandwidth growth. In the future, new high-speed products may require the upgrade of uplinks from 10Gbps to 100Gbps. However, during PQP2 such upgrades are predominantly driven by bandwidth growth, with the accommodation of high-speed products being an additional benefit.

8.5.2 Forecasting methodology

Our Aggregation expenditure forecast also uses a volumetric P x Q approach.

Unit costs (i.e. prices) are based on the costs of hardware, software and labour in the same way as Access expenditure.

The volume of aggregation network electronics required are derived from our optimised network plan based on the drivers and inputs discussed in the Strategic Objectives section of this chapter. Our key assumptions and uncertainties relate to our bandwidth demand forecast. A more complete description of our demand modelling, including these assumptions, can be found in the Demand report of Our Fibre Plans.

8.5.3 Expenditure

This phasing of lifecycle management (i.e. investment driven by lifecycle renewals that have been delayed) will generate a peak in Aggregation expenditure in 2024, before it generally trends downwards over PQP2.

TABLE 8.4: AGGREGATION CAPEX (PQP2 PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

	2025	2026	2027	2028	PQP2 TOTAL
Aggregation	21.8	21.6	16.9	19.5	79.8

There are three main streams of related activities that contribute to this expenditure:

- adding new network chassis (i.e. to meet bandwidth growth forecasts or where existing chassis are facing obsolescence and must be replaced, as discussed above)
- expanding the existing network chassis (i.e. adding line-cards or enabling new existing ports for use in the network)
- migrating OLT uplinks and Handover Link services from older generation equipment to the replacement equipment.

8.6 Transport expenditure

Transport equipment is used where the distance between access and aggregation nodes (or between two aggregation nodes) is too long to be served by fibre cables alone, or where the capacity is more than the fibre cables can deal with alone (i.e. it can be a substitute for laying more fibre).

We note that not all our transport services are regulated PQ FFLAS – our transport assets also support other services, such as voice services or mobile connections. We design and build our transport network to support the requirements of all these services, and then determine PQ FFLAS transport expenditure using cost allocation.

TRANSPORT

Equipment to provide capacity over longer distances.

$85.0m

8.6.1 Drivers

As with our Access and Aggregation expenditure, our Transport expenditure is driven by bandwidth growth. Investment in transport electronics is necessary to ensure that the network has sufficient capacity to meet the increased traffic on the network. Without this investment, increased traffic could lead to port utilisation increasing to an extent that we breach the performance quality standard set by the Commerce Commission.

Lifecycle renewal also drives the replacement of transport electronics. This includes business-as-usual replacements to avoid obsolescence, but also includes the CCI [ ], which represents a large proportion of our transport expenditure. CCI [ ].

Other considerations (such as resilience) result in a network plan that requires additional hardware requirements to achieve the desired quality of service for our customers.

As with Aggregation expenditure, new product sets do not drive Transport expenditure except to the extent they cause an increase in bandwidth growth.

DRIVERS

Obsolescence and bandwidth growth are key drivers for Transport.

8.6.2 Forecasting methodology

Like Access and Aggregation expenditure, our Transport expenditure forecast uses a volumetric P x Q approach.

Unit costs (i.e. price) are based on the costs of hardware, software and labour in the same way as Access and Aggregation expenditure

Like the Aggregation expenditure forecast, the volume of network electronics (i.e. quantities) are derived from our network plan, which comes from optimising our investment based on multiple drivers and inputs. Our key assumptions and uncertainties relate to our bandwidth demand forecast. A more complete description of our demand modelling, including these assumptions, can be found in the Demand report of Our Fibre Plans.

8.6.3 Expenditure

Our Transport expenditure is forecast to increase in 2024 and the first half of PQP2 (peaking at over $26 million in 2025), before reducing to less than $14 million in 2028.

TABLE 8.5: TRANSPORT CAPEX (PQP2 PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

	2025	2026	2027	2028	PQP2 TOTAL
Transport	26.7	26.1	18.3	13.9	85.0

We began a project to expand the Auckland and Wellington networks in 2022, which involves significantly expanding and upgrading capacity to support bandwidth growth in these metro centres along with providing the high-speed linking between the new aggregation electronics mentioned above. We are also planning to grow the capacity of regional and core routes to support bandwidth growth requirements of the Layer 2 aggregation network in other areas. We are expecting to see bandwidth demand growth (in part enabled by Hyperfibre uptake) and are planning on upgrading our transport links to provide capacity for these services. This results in an increase in spending in 2023, 2024, and throughout PQP2.

The **CCI [ ]** commenced in 2023, despite not being part of the original PQP1 proposal. **CCI [ ]** was the chosen supplier as they were the only supplier that had the required mix of technology for Chorus' unique regional network requirements.[69] This programme has a total cost of around $45-50 million, which will be incurred across the remainder of PQP1 and in PQP2.

Finally, we will also incur expenditure on replacing transport assets ahead of their end-of-life as part of our usual lifecycle management. As mentioned in the drivers section above, we need to replace components before they reach the end of the supplier lifecycle, otherwise they will become obsolete and the network may fail.

METRO AND REGIONAL

We have begun a project to significantly expand and upgrade capacity in Auckland and Wellington, and plan to grow capacity of regional and core routes.

8.7 Links and synergies

8.7.1 Other expenditure categories

Access capex links to the following other expenditure areas:

- Extending the Network prompts investment to provide initial (or infill) coverage
- Installations contribute to bandwidth demand, which prompts investment in access capacity (once initial capacity limits are reached)
- Site Sustain investment provides the power and cooling plant needed to support access equipment, while electricity purchase is captured in Network opex (specifically Operating Costs).

Aggregation capex links to the following other expenditure areas:

- Extending the Network prompts investment to provide initial aggregation capacity
- Installations contribute to bandwidth demand, which prompts ongoing investment in capacity
- Site Sustain investment provides the power and cooling plant needed to support aggregation equipment, while electricity purchase is captured in Network opex (specifically Operating Costs).

69 Unlike higher population centres which require higher capacity links, small regional centres are most economically served by smaller (i.e. 10Gbps) links for the next few years. **CCI [ ]** technology mix is able to deal with 1Gbps, 10Gbps and legacy connections, whereas other suppliers' platforms were optimised for core and metro scenarios (i.e. 100Gbps and 400Gbps).

Transport capex links to the following other expenditure areas:

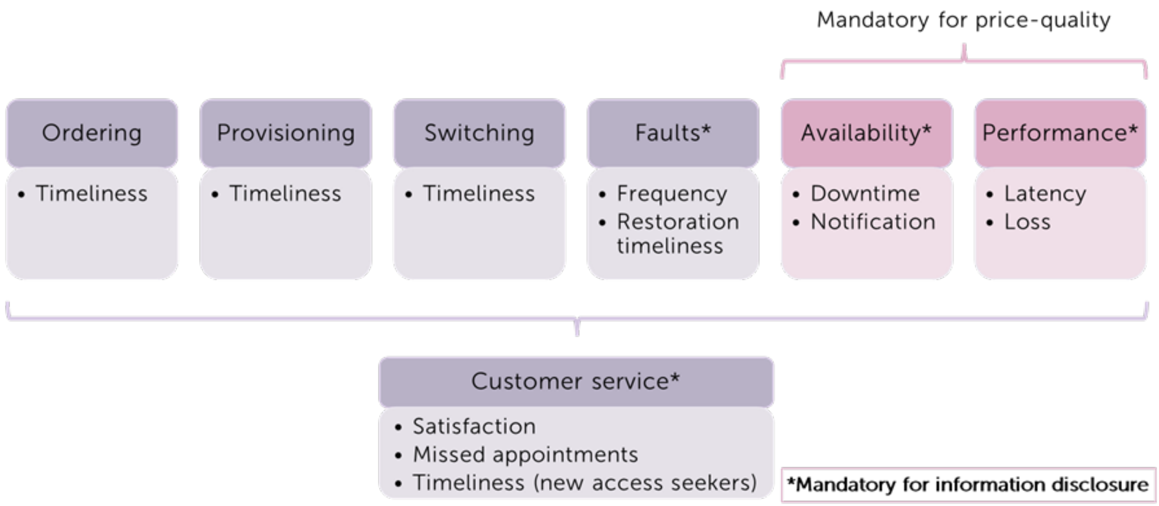
- Extending the Network prompts investment to provide medium or long-distance links as needed
- Installations contribute to bandwidth demand, which prompts ongoing investment in capacity
- Site Sustain investment provides the power and cooling plant needed to support transport equipment, while electricity purchase is captured in Network opex (specifically Operating Costs).

We do not expect to be able to consider trade-offs between Network Capacity capex and opex alternatives in PQP2. This is because we expect bandwidth growth during PQP2 to be high enough that network electronics investment will be due to obsolescence, not due to asset health. This means we will not be able to defer replacement of these assets (capex) by increasing Maintenance opex. Such a trade-off could be possible in the future if bandwidth growth ever reduces to the extent that the replacement of electronics becomes driven by asset age rather than obsolescence, but this is not the case now.

8.7.2 Quality dimensions

The Fibre Input Methodologies define six lifecycle- based quality dimensions and one over-arching customer service quality dimension. Two quality dimensions are mandatory for price-quality (PQ) regulation, meaning they must have associated quality standards. Four dimensions (including the two PQ dimensions) are mandatory for information disclosure.

FIGURE 8.5: QUALITY DIMENSIONS AS DEFINED IN THE FIBRE IMS



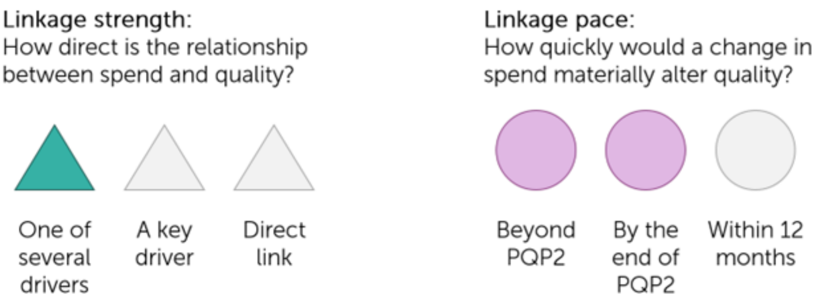
For Network Capacity, there are two key quality dimensions. Firstly, Availability of the network to provide service for users meaning the network and related systems are designed and installed to be reliable and have robust fault restoration practices. This is measured by network downtime.

Secondly, Performance seeks to ensure the network has sufficient capacity to meet demand without congestion that would degrade user experience. Forecasting bandwidth growth is critical in determining the size of network and therefore investment required. This is measured by port utilisation.

Chorus proposes to strengthen the linkage between our expenditure allowance and our quality standard obligations for PQP2. During PQP1, Chorus faces an unlimited obligation to provide additional capacity to meet actual bandwidth growth on the network but it has a restricted expenditure allowance. More information on the proposed change can be found in the Quality chapter of Our Fibre Plans.

Each discussion of linkages between expenditure and quality includes a summary with simple icons to depict the strength and pace of each linkage. The icons provide a broad characterisation, rather than a precise assessment.

TABLE 8.6: LINKS BETWEEN NETWORK CAPACITY CAPEX AND OUR QUALITY DIMENSIONS



DIMENSION(S)	EXPENDITURE SUB-CATEGORIES	STRENGTH	PACE
Performance	All sub-categories We manage aggregation port utilisation through ongoing aggregation Network Capacity investment. Aggregation capacity investment has knock-on impact on transport needs. We invest in new transport links or link capacity to stay ahead of demand. Our Access network is designed to minimise the need for physical reconfiguration. We stay ahead of bandwidth growth through technology investment. We will sustain investment to meet growing demand as connections grow and as ATPU increases. Even without bandwidth growth, we would invest for lifecycle (reliability and supplier support) and product evolution.		
Availability and faults	All sub-categories The age, built (or configured) quality and capacity of our network electronics influences Layer 2 reliability. We build in a certain amount of duplication in high customer concentration areas to protect services. Investing in non-production environments allows us to test changes to give confidence they will be delivered as seamlessly as possible into the live network.		

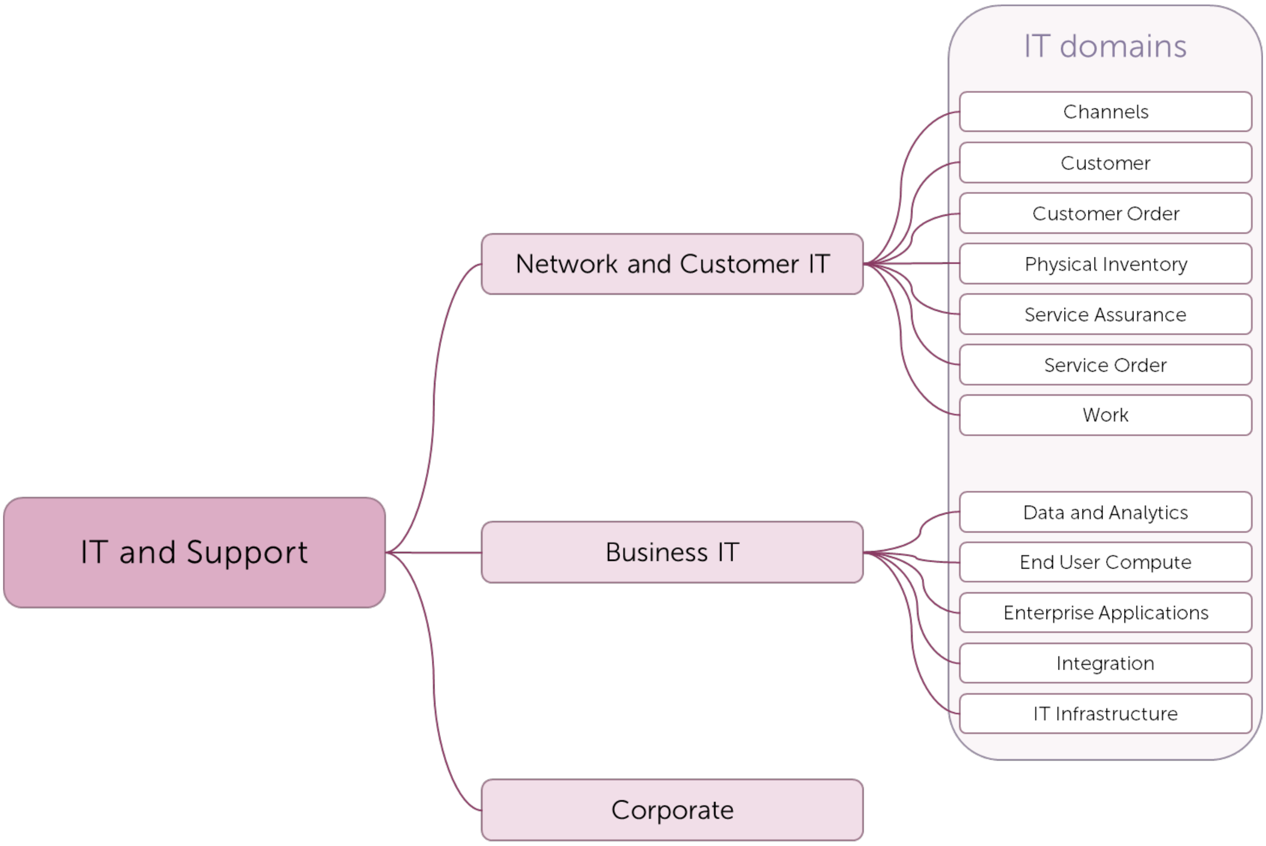
DIMENSION(S)	EXPENDITURE SUB-CATEGORIES	STRENGTH	PACE
Customer service	All sub-categories Our investment in network capacity ensures the performance of our network supports customer satisfaction.	▲▲▲	●●○
Switching	All sub-categories There is a connection with market share of RSPs. Switching could require new ports for different RSPs to manage their demand.	▲△△	●○○
Provisioning	Access and Aggregation Network management systems are needed to facilitate provisioning. Sometimes provisioning involves providing new access coverage or capacity.	▲△△	●●○

9.0 IT AND SUPPORT

Ngā Tukanga Hangarau

9.0 IT and Support

This chapter describes IT and Support capital expenditure (capex) category. It covers investment in our information technology systems, plus corporate capex.



9.1 Introduction

IT and Support covers three capex sub-categories:

- Network and Customer IT – systems and platforms that help us run the network and manage the processes that are important for our customers
- Business IT – systems and applications to support business decision-making, e.g. managing data, communicating, and our financial software
- Corporate – accommodation, office equipment and associated capital expenditure to support our people in their working environment.

The diagram above shows the organisation of the IT sub-categories into IT domains, which reflect Chorus' operational model for IT planning and delivery and the three drivers of IT investment applied to these domains as part of our planning and forecasting methodology.

Given they are both forecast and managed in similar ways, we discuss both IT sub-categories together in this chapter and refer to them collectively as 'IT'. Both of these sub-categories have been identified as 'Priority Areas' by the Commerce Commission for this proposal. We discuss Corporate expenditure (a non-Priority Area) separately.

IT AND SUPPORT CAPEX

We will invest in Network, Customer and Business IT systems, plus office leases and other Corporate assets.

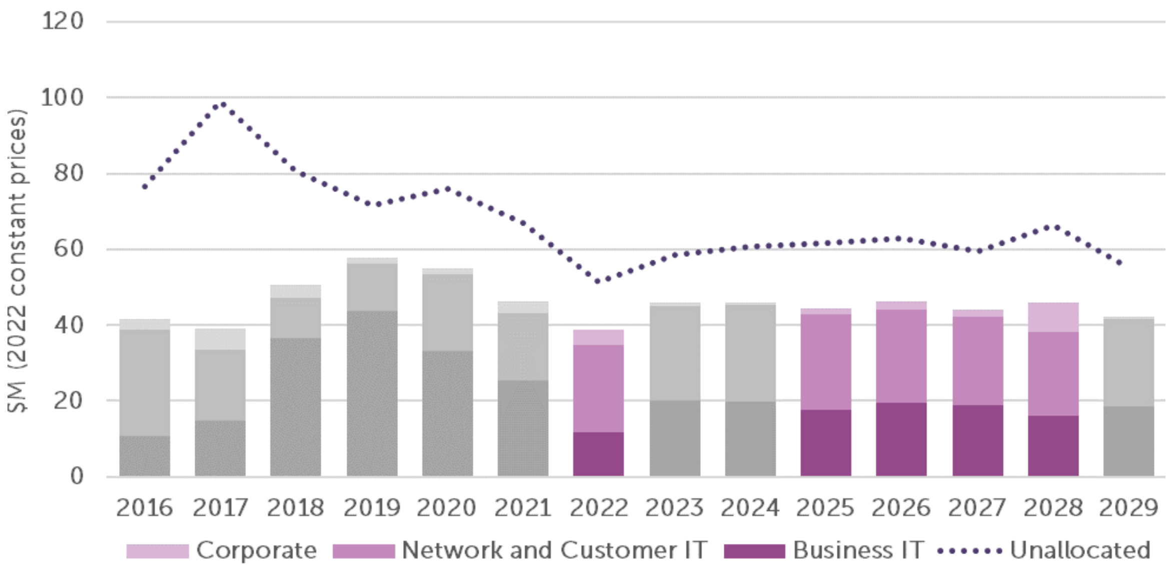
$180.4m

9.2 Overall forecast and trends

During PQP2 we plan to invest $180.4 million in IT and Support, which represents 13% of Chorus's proposed capex for PQP2:

- Network and Customer IT – $94.9 million
- Business IT – $72.6 million
- Corporate support – $12.9 million.

FIGURE 9.1: IT AND SUPPORT CAPEX (UNALLOCATED AND PQ FFLAS)



Network and Customer IT, and Business IT, make up most (93%) of total planned IT and Support capex for PQP2. Of this expenditure:

- 56% is driven by Lifecycle and Compliance investment
- 24% is driven by Product and Customer investment
- 20% is driven by Chorus Optimisation investment

Following an organisation-wide shift to 10-year business planning in 2022, our IT forecasting approach has evolved to place more emphasis on medium- and long-term investment strategy objectives and overlaying top-down planning assessments. Our new technology delivery operating model is aimed at more predictable and less lumpy IT investment in which required resources remain relatively stable over time.

Overall IT capex (unallocated) trends downwards from 2016 through PQP1 and into PQP2. The ongoing capex reductions are largely a result of the completion of large Spark separation programmes, and the adoption of Agile principles in 2021 to support the insourcing of resources directly under Chorus planning control and reduced outsourced spend. We note that the proportion of costs allocated to FFLAS will increase however, as we more accurately allocate costs shared between FFLAS and non-FFLAS, and more customers migrate from copper to fibre over time.

Our Corporate capex is a smaller spend area (7% of total planned IT and Support capex for PQP2) but is more variable, largely due to the term profile of our various corporate accommodation leases. In PQP2 we have a major lease expiring, and we expect a one-off increase in expenditure in 2028 to retain our corporate footprint.

IT & SUPPORT TRENDS

Historically, unallocated expenditure has trended down, while allocation to fibre has grown. Both trends will level off through PQP2.

9.3 IT investment

Chorus is, by its nature, a technology company. We depend heavily on IT for all aspects of our operation, including the orchestration and activation of our products, and enabling our marketing, finance, legal and operational activities.

Our IT asset portfolio covers telecommunications, unified communications and computing technology, as well as enterprise software, middleware, storage, and audio-visual hardware, which are designed to enable users to access, store, transmit, understand and manipulate information.

Key features of our IT systems are that:

- IT platforms are highly integrated with each other as well as with our Retail Service Provider (RSP) customers and our technology and field force suppliers. This allows the consumer processes that traverse a complex supply-chain to be responsive, accurate and reliable
- our business operations are highly automated using IT, avoiding the need for greater resource deployment, and instead allowing operations resources to typically focus on managing and resolving non-automated exceptions, issues, and customer-raised problems
- our employees use IT platforms to communicate, collaborate, enquire, and do their jobs effectively in the corporate offices around Aotearoa or while working from home. Modern, secure and reliable IT platforms allow efficient work practices and ensure Chorus is an attractive place to work.

IT CAPEX

IT systems, which include hardware and software. Includes Network, Customer and Business systems.

$167.5m

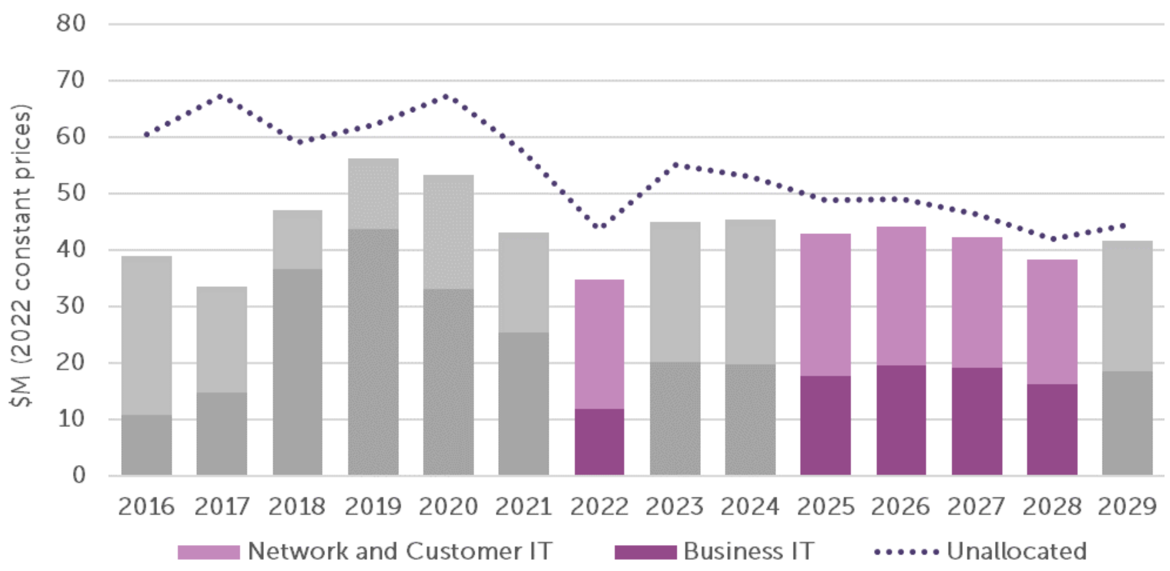
Most (91%) of our planned IT investment is needed to establish and maintain software and hardware, and relates to the people-based effort to specify, design, build, test, and deploy the complex business processes and interfaces that are integral to the various IT platforms. A smaller proportion (9%) is the cost of purchasing hardware and software, and capital costs during development.

Our forecasting methodology has resulted in planned PQP2 expenditure for IT of $167.5 million, comprised of:

- Network and Customer IT – $94.9 million
- Business IT – $72.6 million.

Overall, IT capex is trending downwards from PQP1 to PQP2 (in constant price terms) as IT people costs are reduced in line with future technology lifecycle events and known demand. However, the attribution of FFLAS costs will continue to increase as we more accurately allocate costs between FFLAS and non-FFLAS, and as more customers migrate from copper to fibre.

FIGURE 9.2: IT CAPEX (UNALLOCATED AND PQ FFLAS)



9.3.1 Forecasting methodology

At a high level, there are three steps to our forecasting approach for PQP2:

1. **Investment strategy** – The starting point for our expenditure forecasts is to understand our changing environment over a longer-term horizon informed by internal and external priorities. This is reflected in our corporate strategies, including our technology strategy, which identify our organisational goals and aspirations and how best to achieve these.
2. **Bottom-up plans** – To understand the work required to meet our strategic objectives, we identify key drivers of IT investments across our different technology domains, considering technology supplier roadmaps and organisational and stakeholder priorities. A needs and options assessment for each IT domain results in a bottom-up list of projects and plans over a 10-year horizon.
3. **Top-down assessments** – A portfolio view is then overlaid to help identify, within the constraints of our largely fixed resourcing, the overall scope of projects and programmes which is feasible. Decisions on the optimal mix of projects and programmes that provide the best value, align with longer term investment priorities and reflect customer demands, continues

within each period as annual business plans are validated and challenged, and subject to final Chorus Board approval.

As mentioned above, following a shift to an organisation-wide 10-year planning horizon in 2022, our IT forecasting approach has evolved to place more emphasis on our investment strategy and top-down assessments.

Our new technology delivery operating model (see our Delivery report in the Our Fibre Plans document) is aimed at more predictable and recurring IT investment where our available resources are under direct Chorus planning and remain relatively stable over time. This has allowed us to better integrate top-down forecasts of capacity and costs with bottom-up forecasts of initiatives, purchases, and statements of work from vendors.

Previously, we outsourced more of our technology delivery and organised and delivered projects using a price (P) × quantity (Q) waterfall methodology for each individual investment initiative across domains. Historical spend was used to validate feasibility and overall forecasts. Under our new operating model, historical spend is still relied on for estimating some project costs, but does not directly drive planned projects or programmes.

9.3.2 Strategic objectives

Our investment decisions are driven by corporate strategy, which articulates what is important for Chorus to do for its customers and supports Chorus' organisational objectives. It identifies various influencers and sources of demand that point to longer-term investment needs to enable Chorus to continue delivering the value and quality that end-users demand and remain focused on efficiencies and innovation. It also seeks to manage risks within acceptable boundaries and identifies areas/opportunities for improvement.

Table 9.1 describes the various influencers and sources for Chorus' strategy information technology, which, considered together, provide a holistic context and framework for Chorus' IT investment decisions. The influences and sources are expected to continue as key strategic drivers for investment throughout the PQP2 period.

GETTING THE BASICS RIGHT

"There's a speed of change and modernity to your IT stack that is table stakes."

Stakeholder feedback

TABLE 9.1: IT INVESTMENT INFLUENCERS

KEY INVESTMENT INFLUENCER	SOURCE	EXAMPLES – NEED FOR INVESTMENT
Customer and end-user needs	• End-user expectations on broadband experience, quality outcomes and their digital experiences • Verbatim or direct customer and end-user feedback on Chorus experience and processes	• Provide customers and end-users with easy-to-use websites that provide the information they require • Provide capability for quoting, ordering, fulfilment, billing and interaction management for non-RSP customers, such as property developers • Provide a single source of truth for all customer data and interactions • Provide availability information on where Chorus has or will have network or services • Provide timely information on network location where customers or civil companies are seeking to dig
RSP customer needs	• RSP requirements for integration and automation in pursuit of operational efficiency and end-user experience • RSP need for products and services that allow them to differentiate and compete in the market • RSP consultation feedback on product and feature priority and desirability	• Provide application programming interfaces (APIs) and automation to RSPs so that they can create self-service experiences for end-users • Continuously deliver product, product feature and process enhancements related to customer ordering for RSPs to uptake (e.g. Hyperfibre products, Hyperfibre process improvements, Fibre in a Day) • Provide more information on order and fault events and notifications from technicians and activity in the field to better support end-user experience • Provide data on network performance, traffic and risk to RSP customers
Industry and regulatory conditions	• Chorus competitive landscape (e.g. Fixed Wireless Access, emerging satellite services) • Price-quality (PQ) Regime (e.g. expenditure proposals, commitments and roadmaps with the Commerce Commission) • Regulatory obligations (e.g. Telecommunications Service Obligations, Telecommunications (Interception Capability and Security) Act 2013 (TICSA), Business Line Restrictions)	• Regulatory scenario planning, modelling, and insight • Annual legal changes • Continue to meet our legal, regulatory and compliance requirements (Lawful Intercept, Assurance, service delivery Service Level Agreements (SLAs), and regulated Quality Standards).

KEY INVESTMENT INFLUENCER	SOURCE	EXAMPLES – NEED FOR INVESTMENT
Chorus business, product and market strategy	• Customer and market objectives to support fibre uptake • New product line extensions to meet current and future customer needs • New products to open new markets	• Provide capability to manage the migration of end-users from copper-to-fibre, and from off-network to fibre • Regulatory scenario planning, modelling, and insight capability • Spares and inventory utilisation • Decision-making support for strategic business cases • Provide support for frequently changing network, network components such as optical network terminals (ONTs), and new product introductions
Chorus operational strategy	• Operational efficiency • Service and quality outcomes	• Automation and integration to reduce friction in the fibre order and fulfilment process for operations and the field force • Improvements to accurately track and manage the SLAs for fibre orders and installations • Improvements to provide information between ordering platforms and service assurance platforms to support operational efficiency • Fault and maintenance trends and insight to better direct improvements • Orchestrate billing automation for customer orders and provide accurate billing reducing disputes • Resilient network elements and equipment to support continuity of Chorus operations • Improved capability and network capacity to restore services more rapidly in case of major incident and reduce operational downtime
Chorus technology strategy	• Enable industry agility and growth • Enable the best service on the best network • Actively manage platforms • Fuel business with information	• Respond to technology supplier roadmaps • Continue to meet cyber security and data privacy requirements

9.3.3 Bottom-up drivers

To allow a bottom-up identification and assessment of the various investment projects needed to meet the investment needs to meet our corporate objectives we consider and apply three key drivers for IT investment across 13 separate IT domains. Bottom-up planning acts as a cross-check that adequate need exists within each IT domain to justify existing and assumed future resourcing levels.

IT DRIVERS

Our IT expenditure is driven by lifecycle and compliance, product and customer, and optimisation.

Drivers for IT investment

The three drivers for IT investment are:

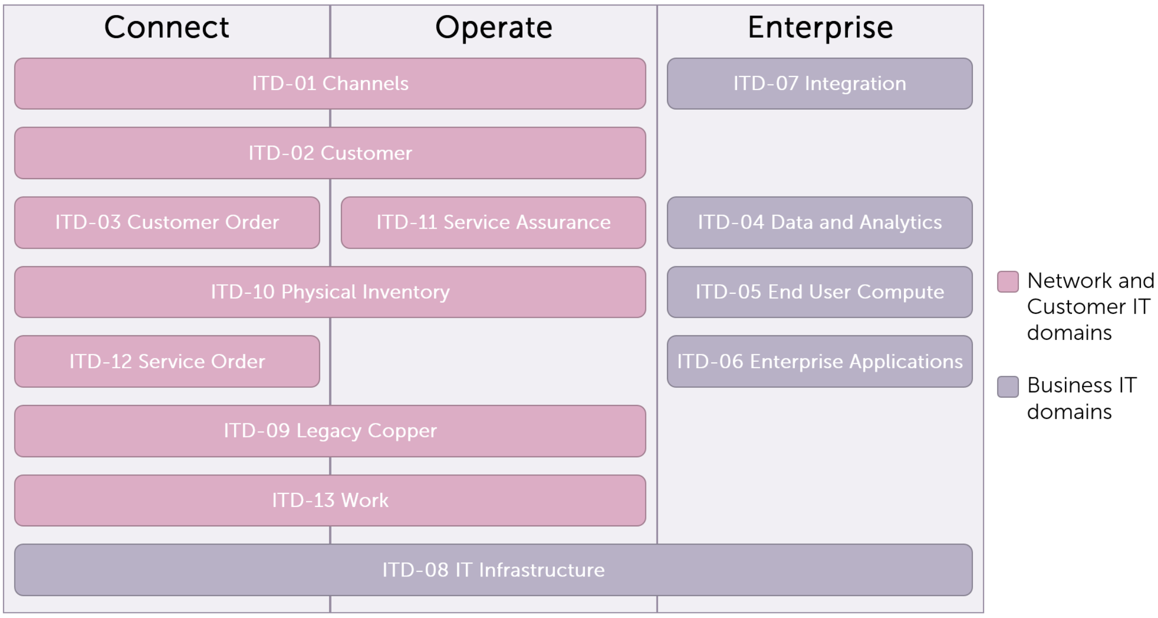
- Lifecycle and Compliance (56% of planned expenditure) – IT expenditure is primarily focused on ensuring the ongoing operation of our technology which supports the efficient ongoing operation of our company. Chorus is highly integrated, and our business processes run almost entirely on or are directly supported by IT. Lifecycle and Compliance investments ensure that our IT systems are dependable and operate well, remain aligned with technology supplier roadmaps, are on current versions and remain within vendor support, protect our platforms from risk of failure or malicious exploitation, and continue to run efficiently. Tolerances agreed by our Board within Chorus' Risk Management Framework are a factor in planning expenditure, and we have guidelines for how we select, refresh and replace different applications during their technology lifecycle. Specific lifecycle events can drive future resourcing, software and/or hardware requirements with a high degree of certainty.
- Product and Customer (24% of planned expenditure) – IT expenditure is also used to develop new products or product features for customers, as well as to deliver capability that directly supports end-users. Chorus is part of a complex supply chain that works together to deliver products and supporting processes so that end-users can enjoy a great broadband experience. Some of those processes need to evolve as volumes scale and we learn more about them, some require exposing more information or capability to RSPs so they can better serve end-users directly, and some support end-users when they choose to interact directly with Chorus. The strategy for product, sales and marketing sets the context for how Chorus engages with the market and customers, and products are developed through our business-as-usual consultation with RSPs. We use consultation to share, seek feedback, and validate the types of investments and proposed changes. This is a critical function as it ensures that the investments we make are also desired by our customers.
- Chorus Optimisation (20% of planned expenditure) – IT expenditure is also used to drive efficiency improvements through automation, streamlining, technology consolidation and the simplification of our work processes. This ensures that our staff and field service providers (FSPs) can efficiently and easily access our data and systems to engage with these complex processes, which ultimately drives customer benefits through a better end-user experience. Optimisation can occur several ways:
  - The removal or avoidance of external costs such as technology licensing fees, volume-driven supplier costs, capacity-driven supplier costs, and supplier people costs.

- The removal or avoidance of internal costs such as labour, training, travel by automating processes to allow existing labour resources to better manage additional, new or different work.
- The optimisation of internal capital costs such as automating elements of technology delivery in order to deliver technology change faster and bring any benefits to bear earlier.
- The reduction or optimisation of external capital costs such as the more efficient delivery of long-running capital programmes with FSPs.

Technology domains

There are 13 IT domains that allow us to suitably segregate technology platforms and suppliers, and to provide clear accountabilities and divisions of labour. As shown in Figure 9.3 below, eight of the domains relate to the Network and Customer IT sub-category (including Legacy Copper for the provision of copper-based services), and five of the domains relate to the Business IT sub-category.

FIGURE 9.3: IT DOMAINS



Each IT domain has its own IT Domain Plan, which identifies the drivers of investment, named initiatives that are anticipated, as well as domain-based provisions for recurring activity and the expected timing of investments.

Chorus has increasingly established its own technology capability within each of these domains, and has investment guidelines that inform procurement strategies and assist with minimisation of whole-of-life costs.

- The majority of Chorus domains are mature, stable, and follow an approach of aligning to technology supplier roadmaps. Investment is there to maintain support and currency.

- If a domain nears end-of-life investment we seek to avoid 'regretful spend' (e.g. with respect to Legacy Copper) and/or run a technology selection process for replacement to determine if we remain with the same technology vendor or migrate to another.
- If a domain is early in its lifecycle and is able to adopt and exploit changing market capability at lower costs due to the widespread or commodity nature of the technology (e.g. Channels, Data and Analytics) then we consider opportunities and logistics for this.

An overview of the distribution of investment applicable to each domain for PQP2 is shown in Table 9.2 below.

TABLE 9.2: PERCENTAGE OF PQP2 CAPEX BY DOMAIN

DOMAIN	CAPEX %	DOMAIN	CAPEX %
01 Channels	3%	08 IT Infrastructure	11%
02 Customer	12%	09 Legacy Copper	1%
03 Customer Order	13%	10 Physical Inventory	3%
04 Data and Analytics	8%	11 Service Assurance	6%
05 End User Compute	11%	12 Service Order	12%
06 Enterprise Applications	7%	13 Work	4%
07 Integration	9%		

The percentage of capex is an approximate view, and will vary between domains year-to-year, but gives an indicative view of investment by domain.

The Appendix at section 9.6 provides further details on the scope of each of the domains and examples of the investments that were prioritised for each domain in PQP1, and examples of those planned for, or possible, in PQP2.

9.3.4 Top-down portfolio focus

Once a bottom-up assessment of potential projects has been completed, we apply a top-down portfolio view to highlight the degree to which the bottom-up plans contain elements of potential over-utilisation. This process is informed by expectations of the availability and nature of resources, how those resources will be managed within Chorus, and the key assumptions, uncertainties and risk that relate to the forecast need and priorities.

Where bottom-up planning results in surplus initiatives being identified over and above that which top-down profiled resources could complete, then organisational prioritisation assessments are conducted to determine which initiatives proceed, and in which sequence. Proposed trade-offs are taken to governance forums, where relevant investment, risk and benefits are evaluated.

Where a need for hardware, software, or specific vendor engagements are identified over and above the top-down financial provisions, then these initiatives and their estimates are elevated to the overarching IT budget. This planning process is managed quarterly and confirmed during annual business planning.

Deliverability of the final forecasts is assessed in three broad ways:

1. Our future required resource profiles are based on current resourcing, deliverables and throughput experiences, and are further matched against future forecasts of demand for each IT domain
2. Budgetary provisions for areas of moderate uncertainty such as hardware, software, and vendor engagements are informed by historical activity, with deliberate constraints to force budgetary trade-offs between provision areas should unplanned costs emerge
3. Our overall IT budget levels for PQP2 is reducing from 2020 through 2023 levels in line with planned reductions of both resourcing and other budgetary provisions.

As mentioned above, the top-down focus is also reliant on expectations of ongoing prioritisation *during* PQP2 to identify the optimal mix of projects and programmes that will add most value in-period and can feasibly be delivered. Controls over deliverability of in-period spend exist at multiple levels:

- Financial controls ensure purchasing transactions have approval hierarchies that are aligned with the Board-approved delegated authority framework
- Capital labour allocation to projects is approved by management
- Journals of cost can only be executed by approved Finance roles
- IT capital outturn and forecasts are reported and managed each month within the Executive and senior leadership
- Capital and programme delivery is governed at an integrated Executive Steering Group where progress and outcomes are monitored and prioritisation or spend trade-off decisions can be taken if required
- Annual business planning and re-forecasting processes cater for any re-allocation of budgets.

Available resources

Our operating model is predicated on largely fixed resources as a result of a move to in-sourcing prior to and during PQP1. Our objective was to take greater control of planning and delivery, whilst smoothing peaks and containing costs. As a result we are able to forecast more predictable expenditure to deliver on our required needs. We generally expect step-changes upwards or downwards only in line with the commencement or completion of major initiatives, or with expected procurement of hardware or software.

With respect to IT investment drivers:

- We size Lifecycle and Compliance work and our expenditure forecast based on our best view of system risk, complexity and criticality, and on the extent of work needed to manage risk and maintain support across our existing systems.
- We cannot execute more IT change than our customers (or FSPs) can absorb, which puts limits on the amount of IT change we implement. We therefore plan out our Product and Customer and Chorus Optimisation work (and therefore expenditure forecast) to deliver a steady pace of change.
- Chorus Optimisation initiatives can be flexed over time to help balance peaks, troughs, and delivery constraints across the IT delivery programme.
- Our planning includes provision for asset management-focused work to link existing systems and introduce new capability.

IT RESOURCE

The IT operating model is based on a largely fixed labour pool, which drives active prioritisation of which initiatives we can pursue, and smooths the overall profile of work.

Composition of inputs in 10-year plan

Our forecast expenditure incorporates a mix of different cost input types, needed to specify, design, build, test and deploy the complex business processes and IT solutions and deliver on each IT Domain plan.

There are five key input components of our IT forecasts in our 10-year plan (illustrated in Figure 9.4):

- Chorus Resources account for approximately 61% of the capital cost on average. This is the capital cost of the Chorus permanent and contract resources who play a role in the delivery of the IT business plan.
- Vendor Staff Augmentation Resources account for approximately 15% of the capital cost on average. This is the capital cost of the highly specialised vendor resources that we use to augment our own Chorus Resources on specific domains for the delivery of the IT business plan.
- Vendor Statements of Work account for approximately 15% of the capital cost on average. Chorus can engage existing or new vendors for IT professional services over time. This method is used for more infrequent work where permanent resourcing would not be appropriate, or to manage complex components of initiatives in a fixed-price manner for better certainty.
- Software Costs account for approximately 4% of the capital cost on average. Although Chorus now consumes more cloud and software-as-a-

IT CAPEX

Most 91% of our planned IT investment relates to the people-based effort, whether internal or vendor resources.

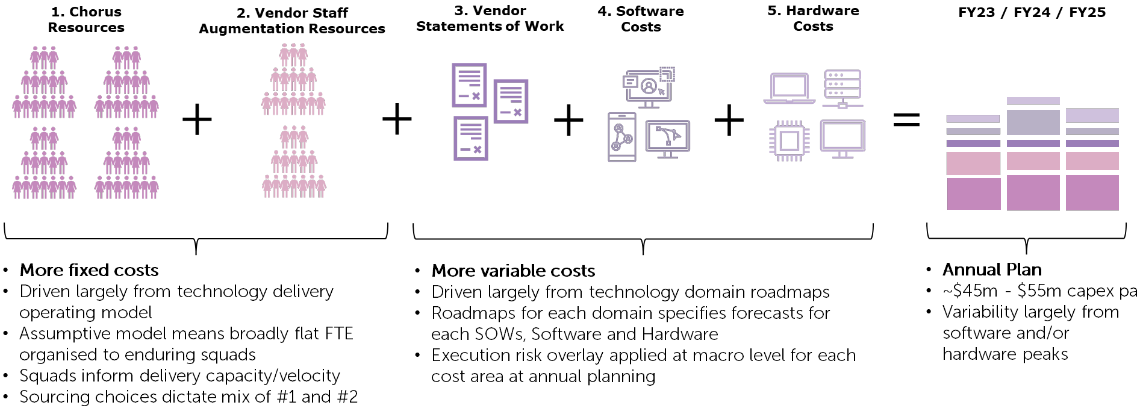
91%

service-based software, we still purchase and are able to forecast future investment to acquire software and licensing.

- Hardware Costs account for approximately 4% of the capital cost on average. Chorus acquires hardware when required to support new capability, or to replace existing hardware in line with asset lifecycle treatment. This ranges from large equipment within our datacentres down to individual laptops.

The residual (around 1%) of spend is capitalised interest.

FIGURE 9.4: COMPONENTS OF IT FORECAST



Nature of resources

The Chorus Resources combined with the Vendor Staff Augmentation Resources are organised into squads (teams), largely orientated around our various technology domains and in most cases interacting directly with Chorus business units. This allows us to build and retain specialised knowledge and deliver continuously and more efficiently.

As described above, these two forecasting input components are considered 'mostly fixed' – i.e. we expect them to remain relatively consistent, but adjustments or reallocations in resourcing numbers within and across squads do occur as circumstances change or technology evolves.

- We continuously try to find the optimal squad sizes for each technology domain based on three principles:
  - As a starting position, a squad must have the right mix and number of specialised resources in order to manage the predictable recurring peaks of Lifecycle and Compliance activity.
  - A squad should also be capable of delivering the Product and Customer initiatives, as well as Chorus Optimisation initiatives. This should be achieved with residual capacity (i.e. mostly outside of peak times for Lifecycle and Compliance work).
  - However, a squad must always have a backlog (pipeline) of work waiting so that they do not run out of work. This forces the squad to work on the next most important initiative, even if that means taking

AGILE

Our internal and external labour resources use Agile methodologies to deliver our IT solutions, organised into 'squads'. A backlog of work ensures the squads focus on the next most beneficial investments as any time.

on some additional risk by deferring some lifecycle activity in favour of a Product and Customer or Chorus Optimisation initiative.

- Infrequent major lifecycle events may require temporary augmentation to a squad. This could be achieved via more Resources (i.e. adding a squad) or via contracting a Vendor Statement of Work. While forecasting we assess whether we can deliver major lifecycle events within our existing model or whether this would need to be altered.
- Leading in to PQP2 we are reducing the number of resources by CCI [ ]. This is due to the completion of a major lifecycle platform upgrade in the Service Assurance domain, with a number of Vendor Augmentation resources forecast to be released, and the Customer Order domain's pipeline demand reducing throughout PQP1.

We consider Vendor Statements of Work (SOW), Software and Hardware to be more variable as demand is inconstant. Where we have more certainty in plans we can forecast costs (e.g. laptop purchases, specific software renewals). For the residual value we forecast a top-down provision in each category based on averaged historical spend. Any unforeseen peaks in one area of expenditure must be traded off against and funded from another expenditure area within overall budget.

Key assumptions, uncertainties and risks

Our macro expenditure assumptions for IT during PQP2 include that:

- on the whole, our major technology vendors will continue to evolve and support their products as they have in the past. Many technology vendors only provide product roadmaps for the next three to four years.
- demand for Product and Customer investment will continue at historical and current trends. Broadband as a product is never still, and there is always demand for faster speeds and new features as end-user expectations continue to grow.
- we will be able to continue to capitalise (rather than expense) certain software licenses. Accounting changes in the past have clarified what can be capitalised. In addition, many technology vendors are moving to more cloud and subscription-based licensing models.
- Spark separation is largely complete for FFLAS products. We will also require our own Aotearoa-based datacentre footprint and resources for hosting those platforms which control our telecommunications network resources through PQP2 and beyond. This will continue to require resource, hardware and software investment to maintain. As a national infrastructure provider we have regulatory obligations (e.g. Telecommunications Interception Capability and Security Act 2013) that we must continue to meet, which is not feasible within non-Aotearoa-hosted public cloud providers.

Our macro uncertainties and risks include that:

- the full effort and timing of a major upgrade of our enterprise resource planning platform may not be fully clear until after we submit our PQP2 proposal. We will need to significantly augment our resources for this

NEAR-TERM FOCUS

Pace of change in the technology sector means product and investment roadmaps are generally only available for the near-term. Longer range forecasts need to make assumptions based on historical and current trends.

work. In addition, software costs are not yet fully clear and could be material. If we determine that this is a material cost variation from expectations then we will likely need to utilise an Individual Capex Proposal.

9.3.5 Historical expenditure

In a largely steady-state environment, we have looked to build on historical expenditure and trends to provide an indication of what is deliverable with finite resources.

Prior to PQP1, our IT expenditure had several large step-changes as we delivered several programmes to exit shared Spark systems and establish standalone Chorus capability.

So far during PQP1, our IT expenditure has been tracking slightly above expenditure allowances by 1%. There has also been a redistribution of capex from Business IT to Network and Customer IT, as our focus areas changed from our original plan, with the new focus areas outlined below.

Throughout 2022 a large focus of our IT expenditure has been on the establishment of modern capability for FSP work distribution, and then the managed transition of FSPs for the new Field Services Agreement (FSA) and Facilities Management (FM) contracts. These were large and complex programmes of work, requiring the coordination of several teams, platforms, suppliers, FSPs and RSPs. Now completed, this supports RSPs and end-users through integrated and automated connection activity, network configuration management, service assurance, field activity management, and billing and invoicing. Almost all of these systems interact with each other, and with RSP systems/staff, driving huge efficiencies for both us and RSPs, which ultimately drives benefits to end-users through providing them with a better service.

In addition to the above, so far during PQP1 we have delivered:

- end-user capability improvements, including:
  - a new property development ordering and management portal to receive and manage orders, automate order variations, provide flexible product and pricing options, and deliver benefits such as instant automated quotations which previously took approximately two weeks
  - automated customer surveying tools to capture end-user sentiment and allow Chorus to better target improvements based on real end-user issues
- new product features and extensions for RSPs, including:
  - a new geographically diverse handover solution that provides resilience for the network links RSPs share with Chorus that each carry traffic for thousands of end-users
  - improvements to Hyperfibre processes for automating feasibility and scheduling which has improved customer connect times at the 90th percentile from 93 days in August 2022 to 37 days in August 2023
  - improvements to Hyperfibre processes to improve connect times by approximately 50%

RE-PRIORITISATION

We constantly review our plans and ensure we re-prioritise as needed to focus on the most beneficial investments.

PQP1 DELIVERY

We have delivered many IT initiatives during PQP1 so far, including some Hyperfibre-related improvements, which have improved connect times by approximately

50%

   - a new PowerSense digital product to support electricity distribution businesses (EDBs) to identify and communicate power outages using Chorus ONTs.
- improved capability for FSPs, including:
   - new integrated capability for how work is routed for orders and faults, allowing FSPs to reduce manual overheads and exit legacy Chorus/Spark platforms
   - mobile applications for technicians to enter information directly while auditing Chorus poles, pits and manholes, saving Chorus operational and capital expenditure across each multi-year programme
- Improved capability for Chorus, including:
   - new planning capability for regulatory modelling and forecasting in support of PQP2 price-quality submissions
   - new data and analytics capability that allows the large-scale ingestion, storage and querying of Chorus information that supports better insights and decision making.

The above examples demonstrate how our IT investments have changed from our original plans as a result of changes to our priorities and assessment of relative value, but the amount of expenditure is still in line with previous expectations due to the fixed resourcing pool that delivers the solutions.

9.3.6 Future expenditure

Our forecasting methodology has resulted in planned PQP2 expenditure for IT of $167.5 million, comprised of:

- Network and Customer IT – $94.9 million
- Business IT – $72.6 million.

Overall, IT capex is trending downwards from PQP1 to PQP2 (in constant price terms) as IT labour costs are reduced in line with future technology lifecycle events and known demand. However, the allocation of FFLAS costs will continue to increase as we more accurately allocate costs between FFLAS and non-FFLAS, and more customers migrate from copper to fibre.

TABLE 9.3: IT CAPEX (PQP2 PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

	2025	2026	2027	2028	TOTAL PQP2
Network and Customer IT	25.2	24.4	23.2	22.1	94.9
Business IT	17.7	19.7	19.0	16.2	72.6
IT TOTAL	**42.9**	**44.1**	**42.2**	**38.3**	**167.5**

Over the course of PQP2 we are planning to continue to focus on three key investment categories of work. These are set out below.

Lifecycle and Compliance

Our Lifecycle and Compliance expenditure will fund several major software upgrades and purchases including:

- major version upgrades of a number of our technology platforms, including but not limited to our trouble ticketing software, fibre service order manager, and fibre customer order manager
- a major version upgrade of our virtualised server hosting and firewall platforms within our datacentres
- continuous and ongoing minor upgrades of all software, operating systems, and databases across our IT estate in order to maintain currency and support
- major hardware purchases to replace datacentre compute, networking, firewalls and storage as assets reach end of expected life
- technology hardware and fitout costs for corporate office changes when leases expire
- continued software licence purchases and upgrades to support our integration and automation systems.
- continued minor hardware purchases for our laptop fleet, peripherals, mobile phones, and audio-visual equipment.

Product and Customer

This involves the improvement and refinement of our product offerings and RSP support tools, such as continued capability to create self-service experiences for RSPs to offer to end-users. Product and Customer investment leads to new or improved systems or network services and we expect the number of products offered to end-users to continue to grow as fibre connections increase.

Chorus Optimisation

Our Chorus Optimisation expenditure will fund a number of new organisational capabilities, as well as continue to tune, automate and optimise our existing business operations. This includes investment to further evolve our asset management capability, as outlined in the three asset management roadmaps submitted to the Commerce Commission in August 2022:

- Asset information modernisation will allow us to shift to condition-based asset assessments, support asset analytics, and evolve the management throughout the lifecycle of all of our assets.
- Asset management modernisation through establishment of new Service Assurance and enhancements to Physical Inventory systems allow us to lift our asset management maturity and become a more efficient asset operator.

LIFECYCLE AND COMPLIANCE

Our Lifecycle and Compliance expenditure is primarily focused on ensuring the ongoing operation of our technology which supports the efficient ongoing operation of our company. It will fund several major software upgrades and purchases in PQP2.

$93.6M

PRODUCT AND CUSTOMER

Our Product and Customer investment is used to develop new products or product features for customers, as well as to deliver capability that directly supports end-users.

$41M

- Network and service performance insight, in support of data and insight-driven network operations, allow us to better identify and proactively treat our network before it becomes an issue for customers and end-users.
- The continued automation of business processes, of technology testing and across all of our technology domains will ensure Chorus remains an efficient operator.
- The constant improvement and re-factoring of software and integrated solutions allow us to continue to scale with volume and future changes, maintain their efficiency, and provide stability to customers and Chorus operations.

Ultimately, the realisation of these investments will allow Chorus to meet its committed overall opex and capex efficiency targets within this proposal.

OPTIMISATION

Optimisation investment is used to drive efficiency improvements through automation, streamlining, technology consolidation and the simplification of our work processes. For PQP2, this includes further investment into asset management system improvements.

$32.9M

9.4 Corporate expenditure

Support assets are included in our Corporate capex, which is a smaller expenditure area (compared with IT). Expenditure on support assets is largely determined by our corporate accommodation needs.

We have a portfolio of leased corporate office locations across Aotearoa. There are four main office buildings (Auckland, Hamilton, Wellington, and Christchurch) as well as a customer experience lab in Auckland. The lease costs and capital costs associated with refits, make good and office equipment are included within our Corporate capex.

The leases for these sites have remaining terms ranging from two to seven years, depending on whether renewal options are taken.

We also accommodate a small number of staff (<30) in smaller regional satellite offices. These offices are located within our network buildings or space leased within Spark exchanges.

CORPORATE CAPEX

Relates largely to our corporate accommodation needs, including office leases and associated costs.

$12.9M

9.4.1 Forecasting methodology

Lease capex is forecast based on the IFRS 16 Leases accounting treatment for leases, which requires the present value of future lease costs to be capitalised at the point of new leases or planned changes.

The associated business and accommodation expenditure is forecast using a P x Q approach.

The forecast is based on upcoming lease events (renewal or expiry) and considers occupancy and space requirements. This planning and spending is in our control, and therefore uncertainty is low.

9.4.2 Drivers

Significant Corporate capex is aligned with the expiry of leases for corporate accommodation, because at this time it is expected that investment for office refit or the fit out of new office premises will be required to support the Chorus goals of sustainability, efficiency, employee wellbeing, health and safety, and employee effectiveness.

9.4.3 Historical expenditure

Over the course of PQP1, Corporate capex is a relatively small amount and in line with expectations. It covers leasehold improvements and other corporate expenditure.

9.4.4 Future expenditure

Our PQP2 expenditure forecast for Corporate capex is $12.9 million.

FIGURE 9.5: CORPORATE CAPEX (UNALLOCATED AND PQ FFLAS)

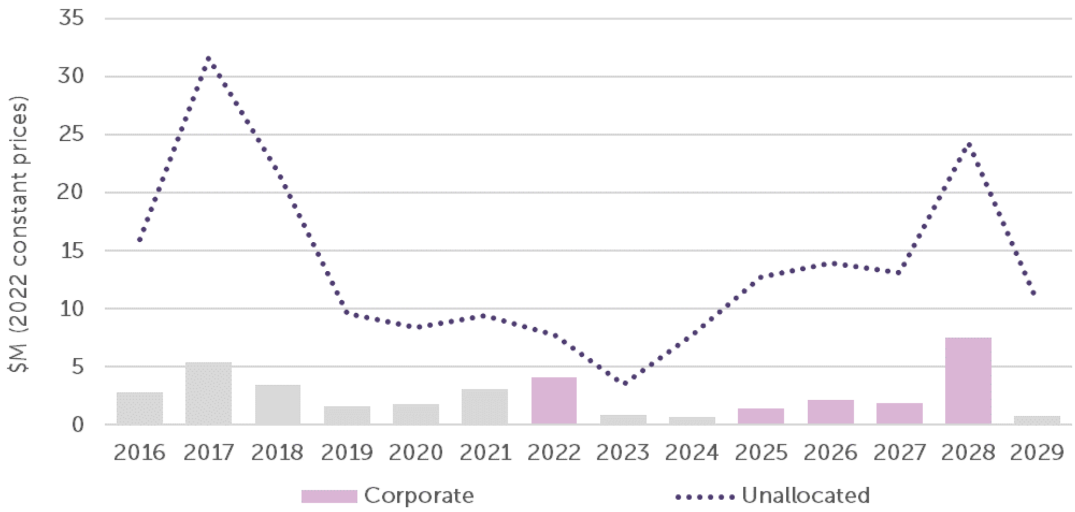


TABLE 9.4: CORPORATE CAPEX (PQP2 PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

	2025	2026	2027	2028	TOTAL PQP2
Corporate	1.4	2.2	1.8	7.5	12.9

Our Corporate capex is variable and increases when our various corporate accommodation leases expire for our Christchurch, Wellington, Hamilton, and Auckland. Our current assumption is we will continue to lease corporate accommodation in all these locations throughout the PQP2, and results in a spike in 2028 as our Auckland corporate office lease expires. We currently expect to renew this lease (the capex treatment of which is causing the spike), with final decisions made closer to the lease renewal event.

During PQP2 we plan to keep non-accommodation-related Corporate expenditure steady.

9.5 Links and synergies

9.5.1 Other expenditure areas

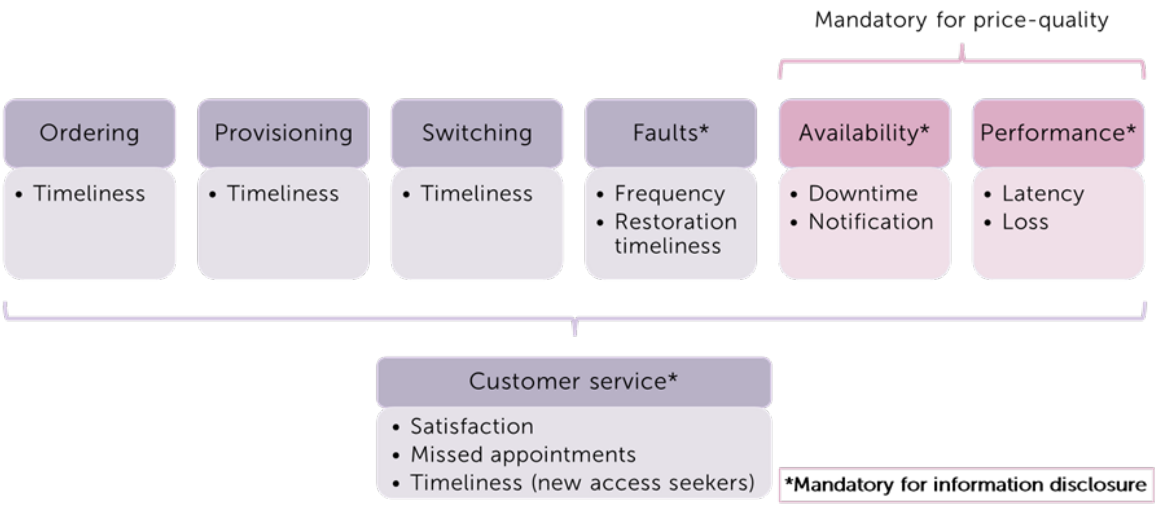
IT work links to other expenditure areas:

- IT systems support and enable efficient operation in all opex areas.
- IT systems support and enable efficient capital investment, including in Network Sustain and Enhance, Network Capacity, and in IT investment itself.
- IT systems are used to automate processes that would otherwise drive Customer Operations opex (part of Customer opex) or capitalised labour.
- Technology opex (part of Support opex) covers costs associated with our IT systems, including where we use an opex (service) solution in favour of a capex (build) solution, or the cost of outsourced services used to help maintain and operate those IT systems.
- Asset Management opex (part of Support opex) includes people who manage our IT investment.
- Product, Sales and Marketing activities form the product roadmap and pipeline that we deliver through Network and Customer IT.

9.5.2 Quality dimensions

The Fibre Input Methodologies define six lifecycle- based quality dimensions and one over-arching customer service quality dimension. Two quality dimensions are mandatory for PQ regulation, meaning they must have associated quality standards. Four dimensions (including the two PQ dimensions) are mandatory for information disclosure.

FIGURE 9.6: QUALITY DIMENSIONS AS DEFINED IN THE FIBRE IMS



Each discussion of linkages between expenditure and quality includes a summary with simple icons to depict the strength and pace of each linkage. The icons provide a broad characterisation, rather than a precise assessment.

TABLE 9.5: LINKS BETWEEN IT AND SUPPORT CAPEX AND OUR QUALITY DIMENSIONS

Linkage strength:
How direct is the relationship between spend and quality?

Linkage pace:
How quickly would a change in spend materially alter quality?

DIMENSION(S)	EXPENDITURE SUB-CATEGORIES	STRENGTH	PACE
Availability and faults	Network and Customer IT and Business IT Our network and customer systems coordinate management of the network, including fault response activities. Our business IT systems provide the infrastructure and integration to support them.	▲▲△	●●○
Customer service	Network and Customer IT and Business IT Our systems support our network operations and customer interactions, including installations, connections, fault restoration and billing.	▲▲▲	●●○
Switching	Network and Customer IT and Business IT Automated switching activity uses systems developed, maintained and enhanced through our network and customer IT investment, supported by our business IT infrastructure and integration.	▲▲▲	●●●
Provisioning	Network and Customer IT and Business IT Automated provisioning activity uses systems developed, maintained and enhanced through our network and customer IT investment, supported by our business IT infrastructure and integration.	▲▲▲	●●○
Ordering	Network and Customer IT and Business IT	▲▲▲	●●●

DIMENSION(S)	EXPENDITURE SUB-CATEGORIES	STRENGTH	PACE
	Automated ordering activity uses systems developed, maintained and enhanced through our network and customer IT investment, supported by our business IT infrastructure and integration.		

9.6 Appendix – Our IT domains

We have 13 technology domains across our two IT expenditure sub-categories (Network and Customer IT, and Business IT).

We describe each domain in the tables below, and provide examples of investments made in PQP1 and planned for PQP2.

Network and Customer IT domains

This section explains our Network and Customer IT domains.

TABLE 9.6: NETWORK AND CUSTOMER IT DOMAINS

DOMAIN	DETAILS	EXAMPLE PQP1 INVESTMENTS	EXAMPLE PQP2 INVESTMENTS
Channels	Channels systems and platforms provide external access to Chorus information and processes. Websites and web applications support various use-cases for the general public, RSPs, FSPs and Chorus employees. These allow access to the availability of services, location data, marketing and product information, fault logging and customer billing. Other Channels platforms include more traditional capability, such as Chorus' contact centre telephony, SMS capability, user surveying and feedback, as well as public API integration points covering several business domains. Key platforms include: • Chorus websites – multiple external-facing websites and web applications that have over 5 million views per year • Chorus API Gateway – digital API hub for direct integration of Chorus processes for RSPs and Service Companies. These handle approximately 50 million transactions per month • Call Centre Telephony – inbound call centre telephony platform that handles approximately 100,000 call minutes per month.	• Front-end web application lifecycle replacement • Upgrade of API software • Chorus Outages website improvements	• Provide customers websites that are easy to use and provide customers the information that they require • Provide APIs and automation to RSPs so that they can create self-service experiences for end-users • Respond to vendor Technology roadmaps • Continue to meet data privacy and cyber security capability requirements

DOMAIN	DETAILS	EXAMPLE PQP1 INVESTMENTS	EXAMPLE PQP2 INVESTMENTS
Customer	The purpose of Customer management systems is to administer interactions with customers – including RSPs, end-users and direct customer-bases like new property developers. Chorus is unique wholesaler in that we don't have direct relationships with end-users, but we still interact with them. This can lead to complications, such as where end-users are unsure of the respective roles and responsibilities of RSPs and Chorus. As a result, some end-users contact Chorus directly to resolve issues that are outside of our role in the supply chain. We have found that these end-users often expect a personalised service – i.e. they expect companies to be able to have a conversation with them across all communication channels. Key platforms include: • Customer relationship management software and applications focused on sales, customer service, marketing automation, e-commerce, analytics, and application development. For example, it manages the 180,000 network plan requests per year by third parties annually through the B4UDIG programme.	• Enhanced customer interactions, new products, and improved variation management for new property development customers • Lifecycle activities through backup and restore, and antivirus upgrades • Improvements to network damage reporting, to improve recovery from network damage-doers	• Provide capability for Quoting, Ordering, Fulfilment, Billing, and interaction management for non-RSP customers, such as property developers • Provide RSP and end-users case management capability, with integration into other systems, in order to identify and resolve issues more quickly • Provide capability to manage the migration of end-users from copper to fibre, and from off-network to fibre
Customer Order	The purpose of Customer Order Management systems is to orchestrate the ordering, tracking and fulfilment of customer orders. This domain administers and runs the business processes related to orders for Chorus copper and fibre products and services. It does this by taking orders from RSPs, then integrating with other platforms to orchestrate these outcomes. Key platforms include: • Wireline – copper broadband products (non-FFLAS) and Business and Network products (FFLAS) • Fibre Customer Order Manager – fibre broadband products (FFLAS), used by more than 2,000 unique RSP users, which handles around 1.2 million technician availability queries each month.	• Hyperfibre process and product enhancements • 4th Generation ONT and 2nd Generation Hyperfibre ONT introductions • Lifecycle investments, through modernisation and integration to field force platforms, and software upgrades	• Continuously deliver product, product feature and process enhancements related to customer ordering for RSPs to uptake • Provide more information on order events and notifications from technicians and activity in the field to better support end-user experience • Improvements to provide information between ordering platforms and service assurance platforms to support operational efficiency

DOMAIN	DETAILS	EXAMPLE PQP1 INVESTMENTS	EXAMPLE PQP2 INVESTMENTS
Physical Inventory	Physical Inventory platforms manage the physical network inventory and location. This domain allows us to understand where our physical network is located (e.g. cables, ducts, poles and the connectivity back to exchanges) and the connection status of addresses and locations. This enables services to be provisioned by our technicians or repaired when there is a fault or service degradation. These systems hold the theoretical model of our physical networks. This includes representation of the network's duct, copper, fibre, poles, and manholes. Key platforms include: • NetMAP – GIS platform based on GE Smallworlds, that models all of Chorus' physical network and asset information including almost 1.8 billion network inventory records. • PRA - Physical Resource Allocation is a software solution created by GE and Chorus that collates physical inventory components from NetMAP and aggregates them to a 'logical path' on which the customer connection is created. There are almost 1.2 million fibre paths modelled.	• PRA version upgrade • NetMAP Problem Management upgrade • Pits and Manholes asset management capability for technicians	• Provide availability information on where Chorus has or will have network • Provide timely information on network location where customers or civil companies are seeking to dig • Provide physical inventory for test diagnostic and assurance activities, including service company technicians' needs in the field • Provide access into asset information to support asset management activities
Service Assurance	Service Assurance platforms support the diagnosis, management, and resolution of end-user faults on behalf of RSPs. These platforms return network service to end-users in the event of a fault or service degradation. The Service Assurance domain is vital in providing a means for RSPs to do initial fault diagnosis, triage and fault reporting. Key platforms include: • Service Manager – trouble ticketing and incident management for network and RSP incidents at over 10,000 tickets a month • Service Performance Manager – troubleshooting and diagnostic test tools for fibre and non-fibre products with over 110,000 tests run a month.	• Legacy System decommissions • Service Level Agreement changes	• Provide digital service testing capability so end-users have the ability to test their Chorus service from their RSP portals/websites • Provide up-to-date information about status, notifications and events related to an active fault • Provide real-time network outage information via our public channels and websites • Provide support for frequently changing network, network components (ONTs) and new product introductions

DOMAIN	DETAILS	EXAMPLE PQP1 INVESTMENTS	EXAMPLE PQP2 INVESTMENTS
Service Order	Service Order platforms contain resource and inventory information for our network services. RSPs use the information obtained from these platforms when they place an order, investigate a fault, or update their products. The systems allocate resources, such as capacity on exchange equipment and network routing information, to RSP orders, translating product offerings into service delivery. The service order domain provides two essential business roles: resource management (which co-ordinates and allocates our fixed asset resources so that a customer order can be broken down into the discrete elements required to connect an end-user and deliver network services from the RSP to our network) and inventory records for our electronic configurations and profiles (which are used with resources to create network services, e.g. how the broadband connection from an individual consumer is routed across the network to the allocated RSP handover point and what bandwidth/speed has been assigned). Key platforms include: • Fibre Service Order Manager – the service order manager for fibre services, which is based on the Nokia software suite and manages more than 3.5 million network requests per annum • Copper Service Order Manager – the service order manager for copper services, which is based on the Nokia software suite.	• Service Order manager software upgrade, which activates products on our fibre network • Replacement of major component of our fault management systems • Upgrade of the middleware software supporting our fibre customer order manage that manages customer orders	• Provide new product features and product line extensions • Support the introduction of new network equipment that allows end-users to continue to enjoy a congestion-free network • Support RSP requirements to bulk-migrate end-users connections between handover links • Support network growth and network rearrangement requirements and targets in order to continue to maintain a congestion free network and avoid any breaches of the quality standards
Work	Our Work platforms manage and distribute work requests and work tasks to our FSPs so that field technicians can install services, or repair faults and restore network service. The systems also manage visibility of FSP schedules so that field resources can be assigned to appointments and provide information back to RSPs on the status of jobs. Most of the systems are legacy (some are over 25 years old) and are in the process of being replaced with modern solutions. All FSP work passes through these systems, therefore it is a critical component supporting our network services. These systems also have a role in providing reporting for payment and reconciliation for FSPs. Key platforms include:	• iTools cloud version upgrade • WRM establishment and transition of FSPs to new Field Services Agreement contract in 2022	• Provide up-to-date information about status, notifications and events related to an active orders and faults • Provide ability to differentiate for different SLAs and response experiences • Support new products and services introductions • Provide FSP information via digital interfaces to allow RSPs to automate and create differentiated experiences for end-users

DOMAIN	DETAILS	EXAMPLE PQP1 INVESTMENTS	EXAMPLE PQP2 INVESTMENTS
	• iTools – the shared platform for Chorus and Service Companies to manage the build work for various Chorus Projects e.g. Ultrafast Broadband roll out, complex work, MDU/ROW Fibre Deployment, Rural Broadband initiative and subdivisions. • Work Request Manager (WRM) – transports work tickets for all Fibre Provisioning and all Assure work to and from our FSPs.		

The Legacy Copper domain is additional to, and separate from, those in the table above, as it covers platforms that are not part of FFLAS.

Legacy Copper platforms are the collection of disparate legacy technologies which are largely associated with the provision and assurance of copper-based services. These legacy systems, which would naturally be associated with other technology domains, have been grouped together for their lifecycle to be managed in a cohesive way. This domain is responsible for managing the residual copper product management that is not shared with FFLAS or common platforms.

There are more than 35 legacy copper platforms, almost all hosted within the Spark environment.

Business IT domains

This section explains our Business IT domains.

TABLE 9.7: BUSINESS IT DOMAINS

DOMAIN	DETAILS	EXAMPLE PQP1 INVESTMENTS	EXAMPLE PQP2 INVESTMENTS
Data and Analytics	Data and Analytics refers to the platforms, people and processes centrally responsible for sourcing, transformation and surfacing of data and information for Chorus to ensure quality, consistency and performance and to ultimately support decision making. Products cover the majority of Chorus domains and business processes. Key platforms include: • A data repository – to gather and store data with over 1.6 trillion data points • Analytical tools – to analyse data, this includes machine learning capabilities to look for patterns across 24TB of data • Reporting tools – to enable users to access data and visualise results from over 35 different source systems	• Data and visualisation implementation to deliver better consumption of information through Chorus • Delivery of Marketing datamart.	• Provide data on network performance, traffic, and risk to RSP customers • Analyse customer process efficacy and prediction of failure (e.g. machine learning) • Provide decision-making support for strategic business cases • Provide regulatory scenario planning, modelling, and insight

DOMAIN	DETAILS	EXAMPLE PQP1 INVESTMENTS	EXAMPLE PQP2 INVESTMENTS
			• Provide fault and maintenance insight, broadband performance, and fibre installation insight
End User Compute	Our End User Compute platforms enable our staff to access business and operational support IT applications through computers and laptops. Applications include word processing, email, and video messaging. Expenditure on End User Compute includes the day-to-day IT equipment used by all our functional teams in our corporate offices. Key platforms include: • Chorus Virtual Desktop and Application Delivery Platform – Virtual Desktop Infrastructure and Application Delivery Platforms based on VMWare Horizon capability. All Chorus staff, contractors and some external technology suppliers use these platforms to access the Chorus environment • Laptops, mobiles, and technology peripherals – a fleet of hardware devices for working flexibly, as well as monitors, mobile handsets and peripherals supplied to support staff working flexibly • Corporate LAN, WAN and WIFI – connectivity hardware and supporting capability • Collaboration end points and meeting room equipment – audio and video collaboration equipment and capability for meeting rooms and spaces, as well as printers and other multi-use devices • Microsoft 365 – the Microsoft suite of applications including email, collaboration, SharePoint, Teams, Single Sign On, etc.	• Laptop rollout • LAN, WAN and wifi improvements, to improve connectivity for our people	• Provide tools such as laptops and equipment to staff so they can perform their roles effectively • Provide modern collaboration and productivity tools to staff so they can perform their roles effectively
Enterprise Applications	Our Enterprise Applications are a group of systems that support the organisation at an enterprise level across various business units. This domain includes the following system categories: • Billing management – systems that support the end-to-end billing process, e.g. disputes management, invoice generation and payment gateways	• SAP database upgrade	• Upgrade our existing Enterprise Resource Planning (ERP) • Meet annual lifecycle and legal requirements

DOMAIN	DETAILS	EXAMPLE PQP1 INVESTMENTS	EXAMPLE PQP2 INVESTMENTS
	• Finance – applications that support business functions such as finance and reporting • HR management – systems that support our people and culture team and the human resources function, i.e. payroll, employee self-service, etc. • Other – systems that support the project management office and user access management.	• Business Performance (BPC) module implementation, to improve financial forecasting including regulatory reporting.	
Integration	Integration platforms connect or allow the transfer of data between different systems. They help us automate and streamline our processes, they provide information for analysis and insight, and they serve RSP customers by providing the same. Key platforms include: • On-premise integration platform • Cloud-based integration platform.	• Improvements for RSP to integration with Chorus Fibre fulfilment processes • Lifecycle activities through licensing upgrades and API platforms.	• Support the requirement to integrate different domain platforms to drive other domain outcomes • Purchase platform licensing
IT Infrastructure	Our IT Infrastructure platforms and assets are the underlying systems supporting our applications. They include core inter-system connectivity, protection/security, computation and data storage. The bulk of these systems reside in datacentres. We also leverage and manage cloud-based infrastructure to support other domains and business outcomes. The main components of IT Infrastructure are: • data storage, for example of email • the firewall, load balancing and security capabilities • the core internal interconnect switching and routing of inter-system messaging • the interconnection between our internal systems and all external parties • the Chorus compute located in the cloud. Licencing for software used to manage our datacentre equipment and various systems is continuously refreshed and kept up to date or replaced as appropriate for business-as-usual support or as required by project activity. To give a sense of scale, 300TB of data is backed up in datacentres every week.	• Windows 2012 to 2019 upgrades • Improvements to firewalls • Upgrades to our datacentre hardware • Server virtualisation version upgrade	• Provide refreshes of datacentre firewalls, switches, routers, and compute • Upgrade a major virtualised server and firewall platform • Upgrade all operating systems to ensure they are current and supported

10.0 CONNECTION CAPEX

Ngā Tukanga Hono

10.0 Connection Capex

This chapter explains how we propose to manage installation volume risk using the connection capex mechanism. It is our connection capex baseline proposal.

10.1 Installation volumes are uncertain

Although volumes have passed their peak, new installations will remain a significant investment area in PQP2 – we forecast more than 135,000 single dwelling unit (SDU) installations with an average cost of about $957 per SDU connection.

The connection capex mechanism was designed under the Fibre Input Methodologies (Fibre IMs) to isolate and mitigate the installation volume risk because it is demand dependent and outside of our control. It is appropriate that any risk around the cost per installation should rest with us, because we are the party best able to manage this risk. If installation volume risk is not isolated and mitigated, then:

- if volumes turn out to be lower than our forecast, we could recover materially more than our actual costs. This would flow through to higher prices over time
- if volumes turn out to be higher than our forecast, we would need to slow down or turn away installations to ensure we don't face a material funding shortfall.

CONNECTION CAPEX

14% of our total capex forecast falls within the scope of the connection capex mechanism to address connection volume uncertainty.

$190m

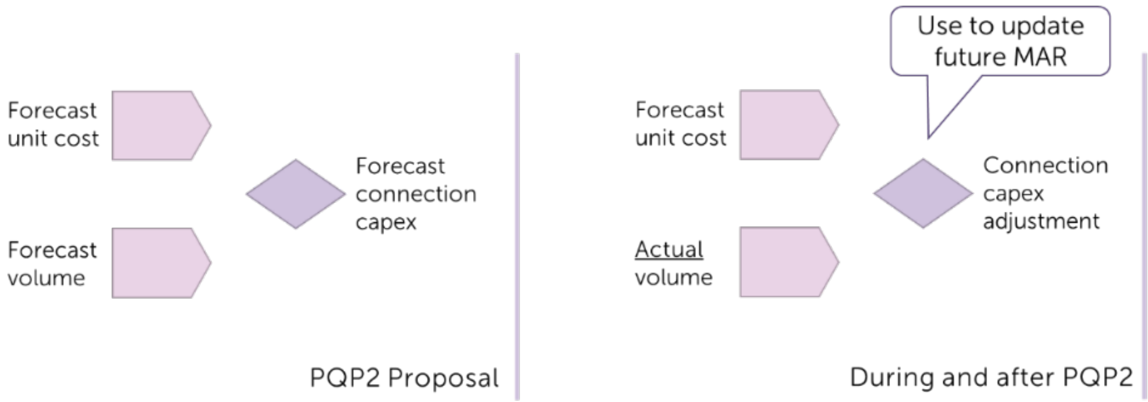
10.2 Connection capex mechanism

The connection capex mechanism works by adjusting the installation volumes that drive our allowance ex-post (up or down), while using pre-set unit rates. In practice, the rates are applied to differences between forecast and actual volumes to determine a capex adjustment, which is then applied to our future allowable revenues.[70]

With this mechanism, risks relating to cost per installation rest with us, but we isolate and mitigate the risk around installation volumes.

70 For clarification, it is not the capex adjustment itself that is applied to future revenue for the next regulatory period, but the associated return on and of capital that we either missed out on or over-recovered in the current regulatory period.

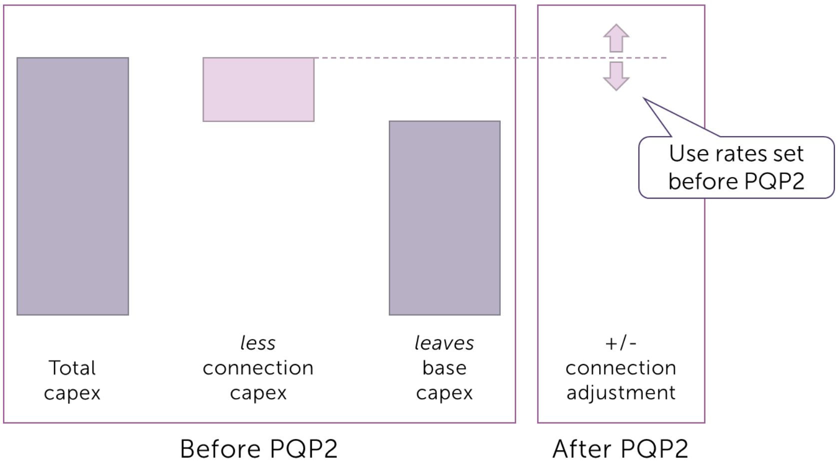
FIGURE 10.1: CONNECTION CAPEX MECHANISM OPERATION



We have approached this mechanism using the following principles:

- consistency – we developed our entire proposal using our best estimate of installation volumes. This aligns with our normal business planning approach and means we implicitly assume our business, IT systems, network, service partner arrangements, etc. are all sized to suit expected installation volumes and connection levels
- symmetry – we use a P50 estimate – i.e. we think our installation volume forecast is as likely to be too high as too low. This means stakeholders can be confident we have no reason to over- or under-state our unit cost forecasts
- completeness – we have built our view of total costs first, and then used installation volume and unit cost estimates to separate total costs into base and connection components. This means there is no risk of double counting between these component parts of our proposal.

FIGURE 10.2: TOTAL, CONNECTION, AND BASE CAPEX DEFINITIONS



10.2.1 Cost groups

There are 11 cost groups (see Table 10.1 below) spread across the following four broad activity types, which are defined in the Fibre IMs and discussed in our PQP2 proposal:

- extensions – if an end-user is not in a standalone building fronting a public street, a connection request may trigger work to extend the communal network. This can involve fitting fibre in the shared areas of a Multi Dwelling Unit (MDU) or down a Right of Way (ROW). Requests for non-premises fibre access (e.g. for digital billboards) trigger similar network extension work. There are four cost groups for this work
- installation – once extension work is completed (if applicable) each installation request triggers additional work to visit the site and fit fibre to the premises. There are three cost groups for this work
- optical network terminal (ONT) – during PQP2, GPON ONTs (applicable only to non-Hyperfibre installations) will remain our default ONT initially. Our ONT Deployment Strategy chapter further outlines our approach. There are two cost groups for this work.
- complex – installations for sites such as cell towers, hospitals, schools, banks and large offices are different from our standard installations. These are lower-volume, specifically designed projects. There is one cost group for this work
- non-linear – for costs of a non-linear nature. There is one cost group for this work. As explained later in the chapter, we are not proposing non-linear costs for PQP2, but do have non-linear costs in PQP1.

CONNECTION CAPEX COST GROUPS

There are 11 connection capex cost groups.

11

10.2.2 Connection capex in PQP1

The actual capex adjustment for 2022, our first year in PQP1, is $1.5m. The impact on future revenue is approximately $150,000, reflecting the consequential return on and of capital that we will have missed out by the end of PQP1.

Relative to the forecast assumptions for PQP1, so far volumes have been significantly higher for simple installations and lower for complex installations. The unit costs have been lower than reflected in the allowances for simple installations but higher for complex installations. This is due to the Field Services Agreement (FSA) reset, which is discussed in the Delivery report in the Our Fibre Plans document and also lower GPON and Hyperfibre ONT costs per unit following global market trends.

TABLE 10.1: BREAKDOWN OF 2022 WASH-UP AMOUNT (NOMINAL)

GROUP	DESCRIPTION	2022 PQP1 VOLUME VARIANCE	2022 PQP1 FINAL DECISION UNIT COST ($)	2022 PQP1 VOLUME WASH-UP ($000)
Standard – installation				
1	Simple – installation to greenfield, or to MDU or ROW extension	13,003	754	9,809
2a	SDU general (excluding civil)	9,453	1,154	10,905
2b	SDU civil	(3,993)	1,404	(5,606)
Standard – extension				
3	Class 1 (two to five MDU drop-off points or ROW buildings) and fibre access	CCI [ ]	CCI [ ]	(9,797)
4	Class 2 (six to 12 MDU drop-off points or ROW buildings)	CCI [ ]	CCI [ ]	(1,004)
5	Class 3 (13 to 48 MDU drop-off points or ROW buildings)	CCI [ ]	CCI [ ]	(337)
6	Class 4 (49+ MDU drop-off points or ROW buildings)	CCI [ ]	CCI [ ]	(547)
Standard – ONT				
7	Hyperfibre	CCI [ ]	CCI [ ]	(75)
8	Non-Hyperfibre	CCI [ ]	CCI [ ]	1,374
Complex				
9	All complex	(1,144)	2,691	(3,077)
Hyperfibre access				
10	Non-linear Hyperfibre costs	(107)	1,305	(140)
	TOTAL WASH-UP			$1,503

10.2.3 Connection capex in PQP2

The table below shows our forecast volumes and unit costs for PQP2.

TABLE 10.2: INSTALLATION COST GROUPS

GROUP	DESCRIPTION	PQP2 VOLUME	UNIT COST (2022 $)	PQP2 TOTAL CONNECTION CAPEX ($K)
Standard – installation				
1	Simple – installation to greenfield, or to MDU or ROW extension	75,791	666	50,498
2a	SDU general (excluding civil)	44,891	1,089	48,904
2b	SDU civil	14,490	1,374	19,912
Standard – extension				
3	Class 1 (two to five MDU drop-off points or ROW buildings) and fibre access	CCI [ ]	CCI [ ]	CCI [ ]
4	Class 2 (six to 12 MDU drop-off points or ROW buildings)	CCI [ ]	CCI [ ]	CCI [ ]
5	Class 3 (13 to 48 MDU drop-off points or ROW buildings)	CCI [ ]	CCI [ ]	CCI [ ]
6	Class 4 (49+ MDU drop-off points or ROW buildings)	CCI [ ]	CCI [ ]	CCI [ ]
Standard – ONT				
7	Hyperfibre	CCI [ ]	CCI [ ]	CCI [ ]
8	Non-Hyperfibre	CCI [ ]	CCI [ ]	CCI [ ]
Complex				
9	All complex	4,512	2,162	9,754
Hyperfibre access				
10	Non-linear Hyperfibre costs	-	-	-
	TOTAL CONNECTION CAPEX			$190,048

TABLE 10.3: AGGREGATED INSTALLATION COST GROUPS

GROUP	DESCRIPTION	PQP2 VOLUME	UNIT COST ($)	PQP2 TOTAL CONNECTION CAPEX ($K)
Standard – installation				
1	Simple – installation to greenfield, or to MDU or ROW extension	75,791	666	50,498
2	General	59,381	1,159	68,815
Standard – extension				
3-6	Class 1 to Class 4 (from two or more MDU drop-off points or ROW buildings) and fibre access	16,341	3,047	49,800
Standard – access equipment (ONTs)				
7-8, 10	Hyperfibre	CCI [ ]	CCI [ ]	CCI [ ]
Complex				
9	All complex	4,512	2,162	9,754
	TOTAL CONNECTION CAPEX			$190,048

Table 10.3 provides an aggregated view of installation cost groups. Following discussions with the Commerce Commission, we have aggregated volumes and unit costs across certain groups to enable effective stakeholder consultation given that the detailed volume and unit cost information provided for certain categories is commercially sensitive. Groups 3-6 reflect installations where an extension to the network is required, and groups 7, 8 and 10 reflect access equipment and incentive costs associated with installation activity. For completeness, the aggregated unit costs are calculated as the total cost of the group divided by total volume of the group.

Points to note:

- volumes shown are totals across PQP2, and unit costs are an average across PQP2
- regulatory template RT04 presents price and volume breakdowns by year
- a single installation request can trigger costs from multiple groups. For example, the first installation request in an apartment building could trigger costs from (say) groups 1, 5, 7 and 10. Subsequent requests in that building would not trigger further group 5 costs
- forecast amounts are net of capital contributions (where applicable).

Group 2 (both 2a and 2b) makes up the biggest part of total connection costs, averaging more than $20 million per year. Group 2a covers the aerial, conduit and surface-mount constructing types which have similar unit costs. Group 2b covers civil construction.

We have not included any non-linear expenditure in cost group 10 for PQP2. This is due to a technological change since PQP1. Hyperfibre connections now use the same ports cards as GPON services and the installation is not triggered by a new connection orders. The Hyperfibre access costs (port cards and optics) are included in base capex.

The connection capex forecast excludes any expenditure for intact connections. The volume input used is for first-time connection orders only for customers who are not already connected to our network.

Detail on the:

- impact the connection capex has on quality as delineated by the quality dimension under the Fibre IMs
- forecasting methodology used to forecast connection capex (volume and unit cost), including key assumptions and risks

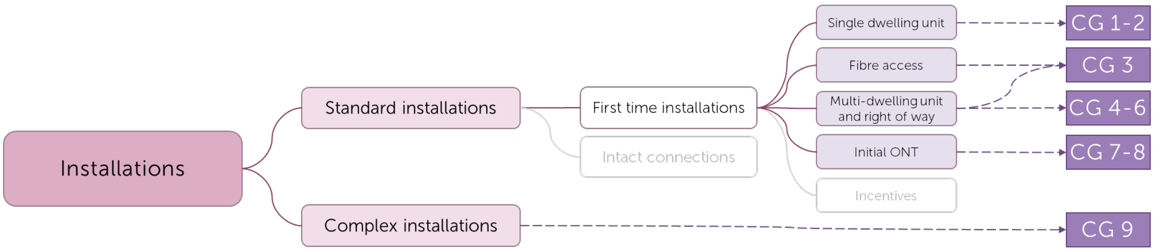
is provided in the Installations capex chapter, which more broadly discusses the type of expenditure the connection capex comprises.

10.2.4 Expenditure categories

Connection capex is defined using the cost groups discussed above – i.e. unit rate times volume across all cost groups. Base capex is defined as the remaining costs (i.e. total capex minus connection capex).

The diagram below shows how cost groups, connection capex, and narrative categories relate to each other. Note that the categorisation differs slightly from how it is shown in the Installations expenditure chapter. The fourth-tier categories divide expenditure by project type (to enable mapping to cost groups) rather than by in ways that map to cost groups rather than by input cost.

FIGURE 10.3: MAPPING BETWEEN EXPENDITURE CATEGORIES AND INSTALLATION COST GROUPS



Most capex in the Installations expenditure category is connection capex. Installations also includes retention capex relating to both new and intact connections which remain as base capex.

We also note that connection capex does not encompass all costs that would vary in some way if installation activity were materially higher or lower than forecast. Other examples are:

- Network Capacity capex – new connections add to bandwidth demand, which is a driver for aggregation, transport and access capacity investment
- Network opex (specifically Maintenance and Operating Costs) – installations add to the pool of assets for which we incur inspection, repair and lease costs. Installation activity also adds to aggregate activity levels that support higher in-field utilisation and help achieve lower costs.

The nature of these costs is such that we cannot readily break out the amounts that would vary across a given range of installation volumes.

10.3 Future Fibre IMs changes

The connection capex proposal has been developed in accordance with the current Fibre IMs, however, we suggest the Commerce Commission considers amending them to better mitigate the risk that is associated with our forecast Customer Incentives capex (refer to the Installations chapter for more detail).

Amongst the options we considered, including Customer Incentives capex in the connection capex category would be a material improvement to the current settings. This would be beneficial, because the Commerce Commission could specify an efficient unit rate up front, which could be confirmed as being lower than the expected incremental revenues per added connection. Chorus would then bear the risk of any commercial need to spend more than that amount per connection, but the volumes would be washed-up – removing the risk associated with forecasting incentives uptake. This is Chorus' preferred option.

To be clear, Customer Incentives capex is currently treated as base capex within our PQP2 proposal.

INCENTIVES

We recommend the Commission amend the Fibre IMs to allow Customer Incentives within the scope of the connection capex mechanism.

10.4 Connection capex baseline proposal

This chapter is part of our connection capex baseline proposal as per clause 3.7.14(1) of the Fibre IMs. The other components of the proposal are:

- regulatory template RT04 (connections capex and adjustment) – sets out forecast connection volumes and unit costs by year for each year of PQP1 and for each connection cost group
- regulatory template RT01 (forecast expenditure) – calculates the breakdown of total capex into connection and base capex amounts for each year
- Our Fibre Assets chapters:
  - Installations – explains how we manage installation activity, including how we forecast installation costs and information on historical investment
  - Network Capacity – explains how we manage network capacity, including cards and optics

- Our Fibre Plans chapters:
  - Demand report – explains how we forecast installation demand
  - Governance report – our governance and key management systems
  - Delivery report – information on procurement, resourcing and deliverability.

11.0 OPEX INSIGHTS

Ngā Tukanga Whakahaere

11.0 Opex insights

This chapter introduces the overall makeup of our PQP2 opex forecast, and summarises our forecasting approach.

11.1 Introduction

This chapter presents information that helps build an understanding of our forecast opex for PQP2:

- overall trends – how we expect our opex to change over the course of PQP2
- labour trends – how we expect internal labour costs to change over PQP2
- methodology – how and why we have applied a base-step-trend (BST) approach, including key assumptions
- opex/capex trade-offs – areas where we have adjusted our opex forecast to reflect investment benefits
- capitalisation – how we account capitalisation adjustments.

OPEX

We forecast operating expenditure of $740m during PQP2.

$740m

11.2 Overall trends

During PQP2 we forecast opex of $740 million.

For regulatory purposes, we divide opex into three categories of expenditure:

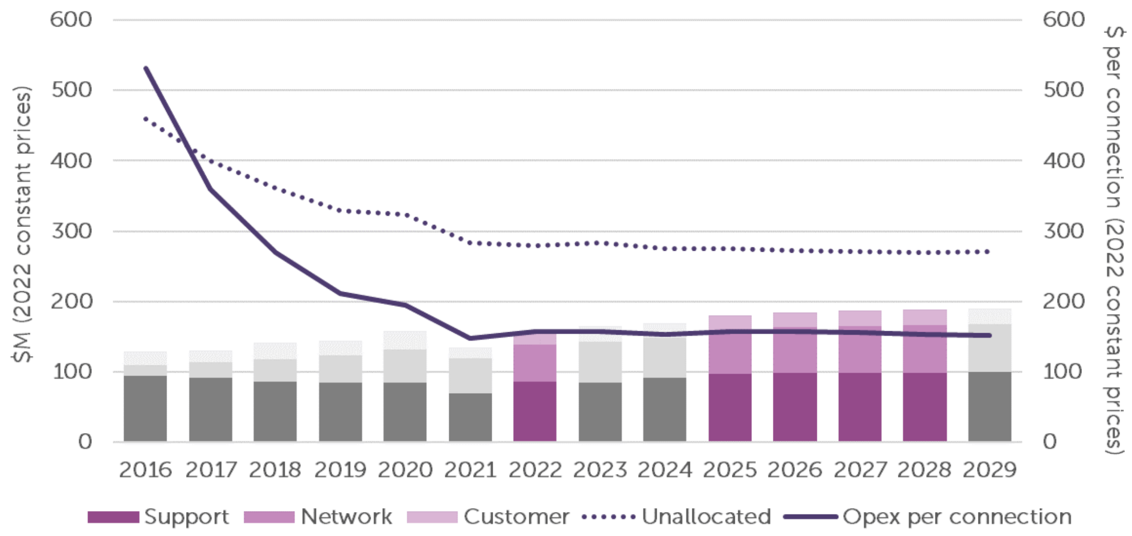
- Customer – product management and wholesaling costs associated with fibre products, costs associated with promoting fibre and fibre products, and (non-capitalised) costs of provisioning fibre services
- Network – maintenance activities in the field and in exchange, operating costs such as fuel and electricity, and costs of network and security operations
- Support – asset management activities, support, licensing, and other technology costs, and corporate costs such as finance, legal and management.

TABLE 11.1: OPEX SUMMARY (PQP2 PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

	2025	2026	2027	2028	TOTAL PQP2
Customer opex	21.3	21.5	21.7	21.9	86.4
Network opex	62.1	65.3	66.7	67.0	261.1
Support opex	97.1	98.1	98.3	98.9	392.4
TOTAL OPEX	180.5	184.9	186.7	187.8	739.9

Our opex forecast includes direct fibre costs, and an allocation of shared costs. As such, it can be useful to observe trends in unallocated and allocated opex.

FIGURE 11.1: HISTORICAL AND FORECAST OPEX (TOTAL AND PER CONNECTION) (UNALLOCATED AND PQ FFLAS)



This presentation highlights the following major trends:

- we have significantly reduced our operating costs since 2016. This reflects a reduction in the size of our (more costly to operate) copper network, changes in accounting treatments, and ongoing efforts to improve the efficiency (of copper, fibre, and shared operating costs)
- the size of our fibre network has grown, which increases direct fibre operating costs. This trend is most prominent in Network opex, which includes direct maintenance of fibre assets
- as fibre has become a larger part of our business, it has attracted a growing allocation of shared costs
- the historical trend captures a period of rapid growth in fibre (and displacement of copper) as we built the Ultra-Fast Broadband (UFB) programmes and end-users took up fibre services. This growth has flattened out since 2022 and will remain comparatively flat through PQP2
- as a result, we forecast a continued (but more gradual) decline in unallocated opex and a gradual increase in opex allocated to fibre.

In addition to these major trends, COVID-19 has had a disruptive effect on opex since 2020. This is particularly noticeable as a temporary reduction in activity levels during 2021 but with consequential impacts in 2022 in the form of labour market conditions (technician shortages) and inflationary pressures.

To complement the above view, it is useful to examine how opex cost per connection has trended over time. Opex per connection has trended downwards consistently with the unallocated opex view over time, flattening out into PQP2:

- As we built the UFB programmes and end-users took up fibre services, the cost per connection has decreased.
- As fibre has become a larger part of our business, it attracts a growing allocation of shared costs, with the cost per connection continuing to decline (albeit at a declining rate).
- COVID-19 has had a disruptive effect on cost per connection since 2020, similar to the impact seen above. This is particularly noticeable as a temporary reduction in activity levels during 2021.

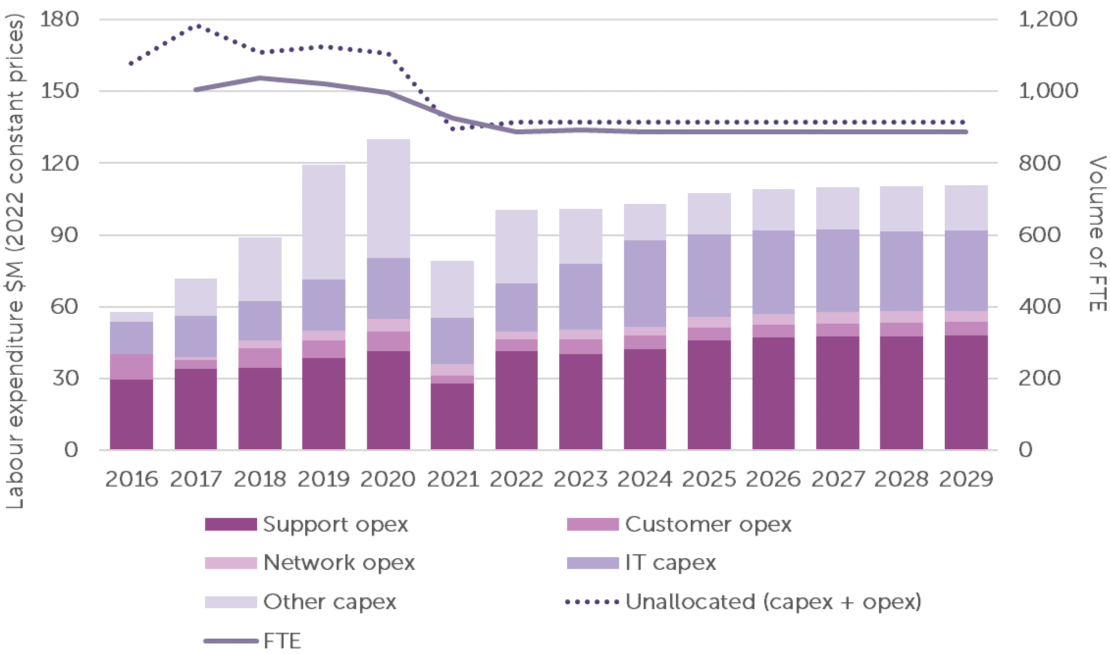
REBALANCING

Fibre makes up a growing share of a declining cost base. Overall, we forecast ongoing reduction on opex per connection.

11.3 Labour trends

Labour costs are distributed across expenditure categories – including as opex and as capitalised labour (discussed at section 11.6).

FIGURE 11.2: HISTORICAL AND FORECAST INTERNAL LABOUR COSTS AND EMPLOYEE NUMBERS



The presentation above shows labour trends, including:

- internal employee and contractor labour, but excluding outsourced labour (for example, from our Field Service Providers), consultants and professional services
- capitalised internal labour.

Key observations are that:

- internal labour costs across Customer and Network opex are relatively small compared to the total labour cost of delivering our services, because these activities are largely delivered through outsource partners
- IT and Support capex accounts for a large share of internal labour, because we deliver IT projects with internal and contractor labour
- full-time employees, and total unallocated labour costs have both declined as we have completed the UFB programmes and streamlined our business
- non-IT capex accounted for a growing amount of labour costs through to 2020, as we delivered the UFB programmes and peak installation activity.
- a growing share of Support opex and IT and Support capex labour have been allocated to fibre over time as connection numbers have grown. This reflects that support labour, and many IT assets, are shared resources across fibre and copper
- forecast increases across PQP2 are due to changes in the allocation of shared costs, rather than increases in unallocated labour costs.

LABOUR

Most of our field technicians are external labour via our sercos. Internal customer and network activities (including maintenance) support these activities.

We note that we are in the early stages of implementing major operating model changes, which have started with changes to our executive team structure. Over the coming year, this will flow through to deeper changes in how we organise and manage our activities.

We have not forecast costs or savings associated with these changes, as both are uncertain. In addition, the driver for the changes is to adapt to changing priorities and operating environment rather than to deliver a particular cost outcome.

11.4 Methodology

We have adopted a base-step-trend (BST) approach to forecasting opex for PQP2. This is a top-down approach that is well suited to long-horizon forecasts and is commonly used in regulatory processes – for example:

- the Commerce Commission has used a BST approach to forecast opex for all its routine electricity distribution business determinations so far
- Transpower has applied a BST approach as part of its last and its pending regulatory proposals
- BST is commonly used in Australia and the United Kingdom in similar price-path determination processes.

BST FORECAST

We have revamped our approach to forecasting long-term operating costs – adopting the base-step-trend (BST) approach commonly used by regulated businesses.

The BST approach involves selecting a starting level of efficient opex ('base') which is then escalated and adjusted for 'step' and 'trend' changes in expenditure. The simplicity of this approach supports clarity of assumptions and avoids the risk of false precision that can arise with more granular bottom-up methods.

We have applied BST to all opex, but removed scale trends from the majority of our Support opex areas, e.g. corporate insurance. In addition to this, we have separately made adjustments to reflect solar and IT optimisation and presented them in the opex/capex trade-off section below.

11.4.1 Features of our approach

Key features of our BST approach are that we have:

- sought expert advice from NERA[71] to add rigour, including in the selection of appropriate trend factors
- forecast on a constant price basis. We then apply cost escalators for inflation. This is consistent with our approach to capex forecasting
- worked with unallocated opex, then applied cost allocation to derive fibre forecasts. To support this approach our modelling maps base-year adjustments, steps, and trends to individual general ledger accounts and cost centres

71 NERA is an independent economics advisory firm.

- used 2022 as our base year, with base-year adjustments applied to remove material one-off effects
- considered trends relating to input costs, productivity, and scale
- developed a long list of potential steps that we have refined by applying a set of filtering criteria.

11.4.2 Base year and adjustments

As above, we have used actual 2022 expenditure as the starting point for determining an efficient base level of recurring expenditure.

2022 provides the most recent available full-year record of actual expenditure. It also captures the accumulated impact of efficiency gains we have made prior to PQP1 and during the first year of PQP1.

Since the formation of Chorus, we have had strong incentives to manage expenditure down to an efficient level because:

- pricing for our legacy copper services were regulated down 25% in 2014, prompting a severe tightening of revenue and intense pressure to manage costs down
- delivering the UFB programme created a steep financing challenge, with a lengthy period of up-front build costs significantly exceeding revenue, driving good cost management disciplines
- during PQP1 our actual fibre revenue is lower than our maximum allowable revenue, encouraging continued careful management of operating profits and reinvestment levels
- fibre competes with other technologies, such that maintaining a competitive cost base and service offering is of fundamental strategic importance
- Chorus is a listed company, which brings constructive scrutiny and pressure from investors and investment advisors.

In effect, our operating environment provides confidence that revealed (actual) opex is broadly efficient. In addition, the 2022 year:

- was not as severely impacted by COVID-19 effects as the prior year
- was at the tail end of delivering the UFB programmes, with network extension activity comparable in scale to that proposed for PQP2.

Allocated opex in 2022 was $156 million. If relevant, the base year must be adjusted up or down for any non-recurrent items of expenditure to reflect recurring opex. We have adjusted to $161 million to take account of non-recurring factors, which is equivalent to $162 per connection per year.

Below we summarise the base year adjustments we have made to the 2022 base year, with more detail provided in the Customer, Network, and Support opex chapters.

BASE YEAR

We adopted 2022 as our base year, with four base year adjustments. This provides a prudent and efficient starting point for our forecast.

2022

TABLE 11.2: SUMMARY OF BASE YEAR ADJUSTMENTS (PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

DESCRIPTION	REASON	CATEGORY	ADJUSTMENT
Labour shortages constrained advertising spend	Temporary reduction in marketing due to shortages in labour to deliver this work (internal and agency labour) and satisfy resulting demand (technician labour).	Customer (Product, Sales and Marketing)	+2.2
Transition to new property maintenance supplier	Temporary reduction in property maintenance work volumes as we transitioned to a new supplier.	Network (Maintenance)	+0.5
CCI [ ]	CCI [ ]	Network (Network Operations)	+0.7
Self-insurance	Self-insurance costs for uninsured portion of the network not covered via existing insurance policies.	Support (Corporate)	+1.2
TOTAL			+4.6

11.4.3 Step changes

We developed a list of potential steps that were then screened by considering:

- prudency – whether the step change is prudent, which may be the case if it is necessary to meet an obligation, respond to an external factor beyond our control, deliver a benefit supported by end-users, or optimise total costs
- confidence – whether we can be sufficiently confident regarding the likelihood, timing, and size of the step
- additionality – whether the cost or saving is captured elsewhere (i.e. in the base or in a trend).

This screening approach was informed by Commerce Commission precedent. Overall, our aim is to ensure a balanced forecast that is neither too high (which would adversely impact long-term prices) nor too low (which would drive poor outcomes due to under-funding).

The outcome of the screening was to confirm two steps for inclusion in our forecast.

STEPS

We added steps for two cost drivers.

2

TABLE 11.3: SUMMARY OF STEP CHANGES (PQP2 PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

DESCRIPTION	REASON	CATEGORY	2025	2026	2027	2028	PQP2 TOTAL
CCI [ ]	CCI [ ]	Network (Maintenance)	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]
Compliance (new)	External assurance costs required to meet new compliance obligations for price-quality (PQ), information disclosure (ID) and climate reporting, and, to resource delivery of asset management improvement initiatives.	Support (Corporate)	1.1	1.4	1.5	1.5	5.5
TOTAL			**CCI [ ]**	**CCI [ ]**	**CCI [ ]**	**CCI [ ]**	**CCI [ ]**

In addition to the above steps, we also considered other steps which we are not included in our BST forecast as they do not meet our criteria. A summary of these proposed steps and why they did not meet our criteria is set out in the following table.

TABLE 11.4: ANALYSIS OF STEPS CONSIDERED BUT NOT APPLIED FOR PQP2

STEP	DESCRIPTION	REASON FOR EXCLUSION
Electricity spot prices	We forecast electricity spot prices using the ASX electricity spot price and this was around $2m higher per year	**Captured elsewhere**. While this is largely outside of our control, this is likely to be captured by the input price trend.
Business transition/ operating model change	Change costs required to support the business transitions described above and develop and implement new operating model	**Lack of evidence, captured elsewhere.** Costs are difficult to quantify, and we expect them to be offset through productivity gains.

11.4.4 Trends

Input cost trends

We use independent forecasts from NZIER to adjust our constant price forecasts for economy-wide movements in the real price of inputs (we call these 'real price effects'). This is consistent with our approach to capex and the approach we used in our PQP1 proposal.[72]

For opex input prices, we apply adjustments for movement in:

- producer's price index (PPI)
- labour cost index (LCI)

Productivity trend

Productivity growth occurs when the aggregate quantity of outputs grows at a faster rate than the aggregate quantity of inputs. Here the focus is on opex, so only inputs relating to operating costs are relevant.

Forecasting changes in productivity is inherently uncertain, as the past is not necessarily a good guide to the future. Opex productivity is influenced by multiple factors, including:

- the realisation of economies of scale and scope
- changes in technology and tools – including incremental improvements in everyday tools, software, and devices
- changes in methods of organising production – for example, advances in deploying Agile methodologies or in providing inclusive workplaces and fostering engagement
- changes in operating norms – for example, in the areas of safety, environmental protection, and supply chain management. Improvements in these areas can reduce apparent productivity (while delivering non-monetary benefits).
- 'catch up' by inefficient firms to the technology/organisation/practices of efficient firms (i.e. catching up to the 'efficient frontier').

INPUT COSTS

We will apply trends based on independent forecasts of two input cost indicators – PPI and LCI.

2

72 More information on our approach to real price effects can be documented in the Modelling and Cost Allocation Report

Based on assessment of regulated New Zealand and overseas businesses in comparable sectors, and Statistics New Zealand's measurement of historical productivity rates, NERA recommended a range from 0% (no change) to 1.25% improvement.

We have adopted an assumption of no change in productivity (i.e. 0%).[73] This reflects that we have separately identified and accounted for the factors the productivity adjustment is set to capture:

- We have accounted for the realisation of economies of scale and scope by including a measure of elasticity as part of the growth trend. This captures the assumption that opex will grow more slowly than output.
- We have incorporated material reductions in opex (see section below) that capture expected benefits (in terms of opex reduction) from a range of projects, such that there is a risk that adding a general productivity improvement assumption would be double counting.
- Our operating environment has driven a lean approach that will be challenging to sustain as our network and its regulation matures. As such, there is a risk of setting allowances below efficient levels.
- While historically we have been in a period of 'catch-up', where productivity gains have been high due to period of rapid growth and the displacement of copper, growth has flattened out and any forward productivity gains are expected to be frontier shifts only,[74] and therefore not as large.

This is consistent with the Commerce Commission's standard method,[75] which is to apply a cost elasticity assumption as a first step (reflecting economies of scale and scope), and then separately consider whether there are further factors that justify any additional productivity assumptions, of which there are none in this case.

Scale trends

Some operating costs are impacted by the size of our network or the scale of our activities. To account for this, we sought advice from NERA on linking cost categories to scale drivers. We have used connection numbers as a measure of scale because they are:

- an underlying driver for some costs
- a reasonable proxy for network length, which is a driver for some other costs.

Costs can be driven by copper connections, fibre connections, both, or neither. NERA identified six broad cost categories to represent how different types of costs are driven by different connection numbers and to different degrees. Table 11.5 below sets out the driver and elasticity for each cost category, and maps which cost categories each narrative sub-category includes.

PRODUCTIVITY

We do not forecast any additional change in productivity as we have separately accounted for drivers of productivity.

0%

SCALE

We have applied trends based on our own forecasts for three scale measures – copper, fibre, and total connections.

3

73 This is supported by advice from Incenta: Including a productivity assumption in opex forecasts, Jeff Belchin, 3 August 2023
74 Efficiency gains that are possible for an efficient firm.
75 See Commerce Commission approach to EDB DPP3.

TABLE 11.5: DRIVER CATEGORY FEATURES AND MAPPING TO NARRATIVE CATEGORIES

Cost category:		COPPER MAINTENANCE[76]	FIBRE MAINTENANCE[77]	OTHER NETWORK[78]	NON-NETWORK[79]	ADVERTISING	INSURANCE
Driver		Copper connections	Fibre connections	Total connections	None	Fibre connections	None
Elasticities		0.45	0.45	0.45	0	0.65	0
Customer	Customer operations	✓		✓	✓		
	Product, sales and marketing				✓	✓	
Network	Maintenance	✓	✓	✓			
	Network operations			✓	✓		
	Operating costs			✓	✓		
Support	Corporate			✓	✓	✓	✓
	Asset management			✓	✓	✓	
	Technology				✓		

While we have applied BST to all opex, we have identified two cost categories which are not affected by connection numbers. These are insurance and other non-network costs (excluding advertising). We do not apply a scale trend to these categories, which holds these costs constant.

For cost categories where we do apply a scale trend, it is necessary to estimate the elasticity of this trend – i.e. the strength of the relationship between the increase in connections and the corresponding increase in our opex. Ideally, we would determine elasticity using historical data from Chorus and other fibre businesses, but we do not have data that is sufficiently long or stable enough to do so. Instead, we have used the elasticity estimates that the Commerce Commission applied to electricity distribution businesses for their third default price-quality path determination. While cautious of cross-sector comparisons, we think this approach is reasonable in the absence of fibre-specific data because electricity distribution services have a similar high fixed cost/low variable cost business model to fibre services.

76 Includes copper maintenance and provisioning.
77 Includes fibre maintenance and provisioning.
78 Includes other network costs, electricity, property maintenance.
79 Includes net labour, IT and other expenses.

We have used an elasticity of 0.45 for most cost categories, and 0.65 for advertising. This means that costs grow more slowly than connection numbers. For example, an elasticity of 0.45 means that means that for every 1% of growth in connections numbers we can expect costs to increase 0.45%, resulting in a falling cost per connection.

We also note that:

- we have included a copper maintenance cost category (linked to copper connections) because we forecast total opex before applying cost allocation. Applying a scale factor to copper maintenance means we capture cost reductions as copper connections decline
- we have applied the elasticities to volumes derived from our connection forecasts, which are described in the Demand report in Our Fibre Plans.

11.5 Opex/capex trade-offs

We have incorporated material reductions in opex that are directly linked to capex investments we are proposing. During PQP2 we expect two material reductions to our opex from such capex investments. These are:

- investment in solar panels at exchanges that will reduce our electricity purchase volumes
- a portion of our IT optimisation capex that will be directed at reducing our operating costs.

PROJECT BENEFITS

We have applied adjustments to recognise the opex reduction benefits of two classes of capital projects.

2

TABLE 11.6: SUMMARY OF CAPEX/OPEX TRADE-OFFS (PQP2 PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

DESCRIPTION	REASON	CATEGORY	2025	2026	2027	2028	PQP2 TOTAL
Solar production (saving)	We expect investment in solar panels at exchanges will reduce electricity purchase volumes.	Network	0.0	-0.1	-0.4	-0.7	-1.2
System improvements (saving)	We expect a portion of the optimisation component of our IT investment will be directed at reducing our operating costs.	Support	-2.3	-3.0	-3.7	-3.6	-12.7
TOTAL			-2.3	-3.2	-4.1	-4.3	-13.9

11.6 Capitalisation

We capitalise a proportion of our labour costs, consistent with our accounting policies. Our policy is aligned with accounting standard NZ IAS 16 Property, Plant & Equipment, and NZ IAS 38 Intangible Assets. The aim is to capture labour costs directly associated with creating assets, such that asset costs are accurate. In practice, this means we:

- apply a labour capitalisation rate (hour rate per employee) specific to each business unit, which includes two components:
  - base – remuneration costs, based on an average across all staff
  - on-costs – associated property and IT costs
- add costs specific to functional areas where applicable – for example, the cost of team managers for teams whose efforts are fully capitalised
- record effort applied to capital projects through a time sheeting system, with the applicable labour capitalisation rate applied to recorded hours
- refresh capitalisation rates annually to reflect changes in remuneration, on-costs, additional costs.

For opex forecasting purposes, we:

- take net labour for the 2022 base year
- trend the base year forward using the non-network cost driver (as set out above), which holds labour constant across the period.

This is consistent with assuming that forecast changes in capex will not impact residual labour costs.

CAPITALISATION

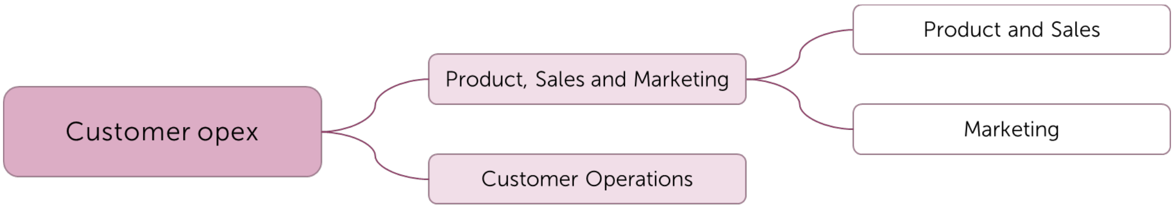
Our opex forecast is consistent with our capitalisation policies and does not double-count any costs.

12.0 CUSTOMER OPEX

Ngā Tukanga Whakawhiti

12.0 Customer opex

This chapter describes the Customer opex category, which covers operating expenditure on products, sales, marketing and customer operations.



12.1 Introduction

We break our overall opex down into three broad narrative categories – Customer, Network, and Support. This chapter examines Customer opex, which we further break down into three functional areas to facilitate discussion of prudency and efficiency:

- Product and Sales
- Marketing
- Customer Operations.

This chapter provides an overview of Customer opex and then, for each functional area, we provide information on:

- scope of activities and the rationale for those activities
- our resourcing model
- our forecast.

This expenditure is included in our base-step-trend (BST) opex forecast. The forecast section includes an examination of historical trends and discusses any base-year adjustments, step changes or scale trends applicable to the functional area.[80]

CUSTOMER OPEX

Customer opex covers consumer research, marketing, and sales, plus customer operations.

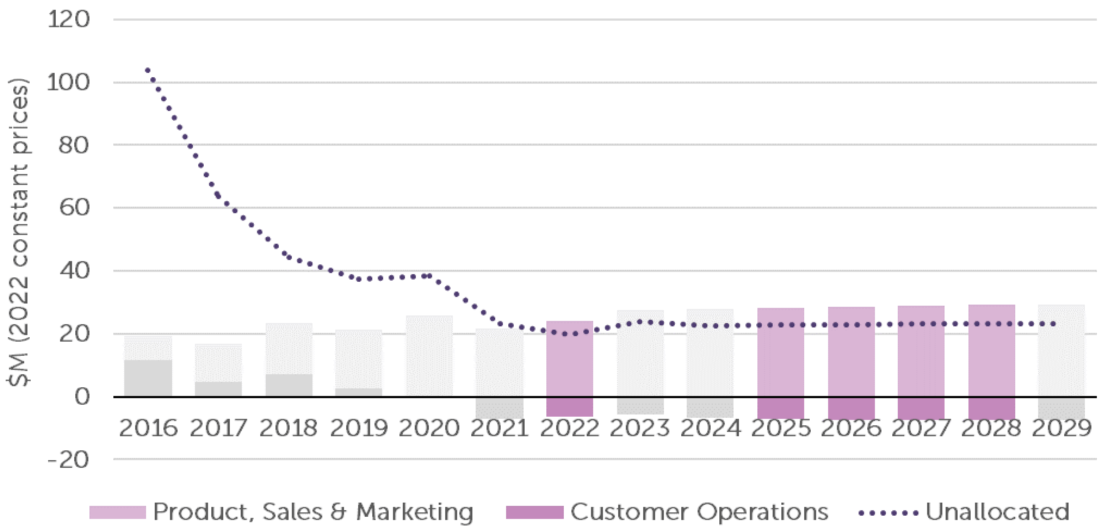
$86.4m

12.2 Customer opex forecast overview

During PQP2 our forecast expenditure for Customer opex is $86.4 million, representing 12% of our total forecast opex.

80 We do not focus on input cost trends, as these are added to our constant price forecasts based on independent forecasts and using a previously accepted methodology. More information on this approach can be found in the Modelling and Cost Allocation Report.

FIGURE 12.1: CUSTOMER OPEX (UNALLOCATED AND PQ FFLAS)



We present unallocated and allocated opex above. Key observations are:

- unallocated Customer opex has reduced significantly over time, driven by:
  - steep reduction in copper provisioning costs between 2016 to 2022, from a high of $60 million, down to $1.5 million
  - accounting treatment – consistent with NZ IFRS 15, we have adopted capitalisation of customer acquisition costs. This drives a further step down in Customer Operations opex between 2018 and 2021
- Customer Operations is recorded as a negative expense from 2021, which reflects our reporting of the capitalisation of customer acquisition costs[81] and means some care is required in interpreting the above presentation.[82]
- the overall trend has been for total Customer opex to reduce and stabilise, with fibre accounting for a growing share.

The below table shows the forecast opex by regulatory year, broken into sub-categories.

CUSTOMER OPEX TRENDS

Following a dip in 2022 and 2023, we expect customer opex to stabilise and gradually decline on a cost-per-connection basis.

81 The negative figures represent mismatches between general ledger-level recording of cost and capitalisation relative to the mapping for regulatory expenditure categories. This occurs because overhead costs are recorded centrally (not against each cost centre) and because regulatory reporting categories for Customer Operations and Network Operations (covered in Network opex) draw from the same cost centres. Essentially, when we capitalise labour costs from Customer Operations, a portion of Support and Network overhead costs are included, resulting in a net negative balance in this sub-category. The treatment is correct at a total opex level.
82 We note that allocated expenditure is lower than unallocated due to the negative customer operations balance, noted in the previous footnote.

TABLE 12.1: CUSTOMER OPEX (PQP2 PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

	2025	2026	2027	2028	TOTAL PQP2
Customer Operations	(7.1)	(7.2)	(7.3)	(7.3)	(28.9)
Product, Sales & Marketing	28.4	28.7	29.0	29.2	115.3
CUSTOMER TOTAL	21.3	21.5	21.7	21.9	86.4

12.3 Product and Sales

12.3.1 Scope and rationale

The Product and Sales area covers product management and wholesaling costs associated with fibre products, including:

- consumer and market research
- product strategy, lifecycle management and pricing
- sales and account management
- managing customer incentives programmes.

These activities enable us to identify, develop, and optimise products so they best match network capabilities to end-user preferences. This involves maintaining an understanding of evolving market demands, competitive landscapes and customer and end-user needs and using this understanding to manage our product roadmap. This in turn helps us maximise revenue generation (which represents success at matching products to end-user preferences and is essential for ensuring cost recovery) and optimise resource allocation.

Additionally, product management drives continuous improvement, facilitates cross-functional coordination, and maintains a customer-centric approach, ultimately leading to enhanced customer satisfaction.

Our sales activities acquire new Retail Service Providers (RSPs), maintain existing client relationships, and ensure personalised solutions to meet specific demands. This function drives revenue growth through upselling, cross-selling, and negotiating contracts, while gathering valuable market insights to inform product development and marketing strategies. Additionally, the sales/account management team acts as a liaison for conflict resolution, ensuring customer satisfaction and long-term business sustainability.

12.3.2 Resourcing model

We manage research activities in-house, and partner with parties such as Kantar, who provide expertise, platforms, and networks that we could not cost-effectively self-supply. We deliver other product activities predominantly in-house, including strategy, planning, and pricing.

We deliver sales and account management activities with in-house resources, who represent Chorus to our customers. These activities are supported by various systems, including business-to-business ordering and provisioning systems.

PARTNERS

We partner with parties such as Kantar to support our consumer research activities.

12.3.3 Expenditure forecast

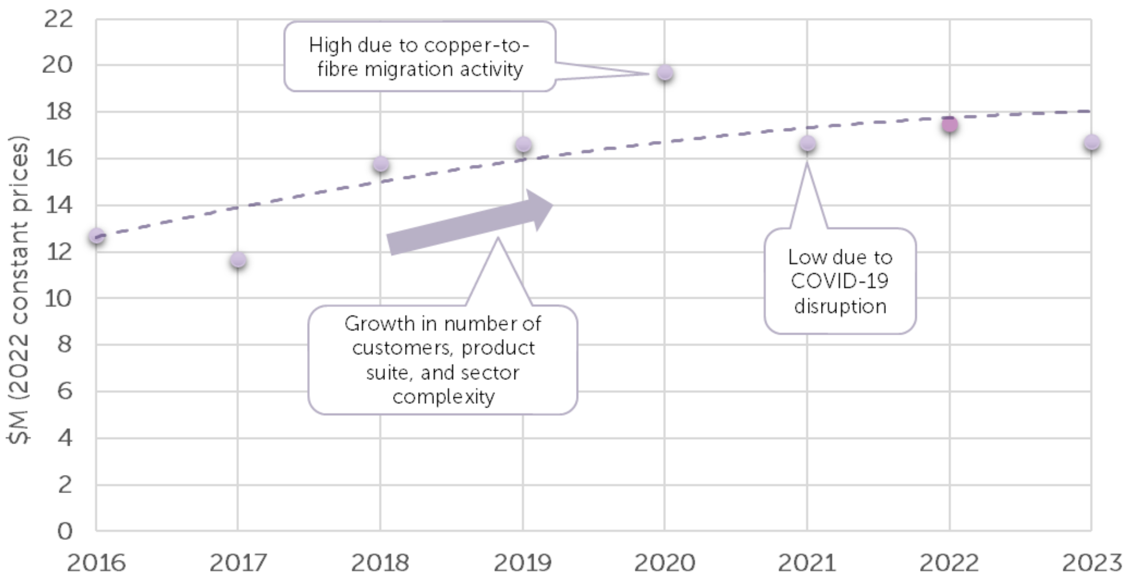
The table below sets out our Product and Sales opex forecast with the following base year adjustments, step-changes and trends.

TABLE 12.2: PRODUCT AND SALES BST ADJUSTMENTS (PQ FFLAS)

AREA	BASE YEAR ADJUSTMENTS	STEP-CHANGES	TREND	OPEX/CAPEX TRADE-OFFS
Product and Sales	None Adopted 2022 actual expenditure without adjustment.	None	None Costs do not scale with connections.	None

To test the base year, we examined the trend in unallocated product and sales opex.

FIGURE 12.2: HISTORICAL PRODUCT AND SALES OPEX TREND (UNALLOCATED)



The trend shows a growth phase to 2020, followed by a levelling off phase that has been impacted by one-off factors:

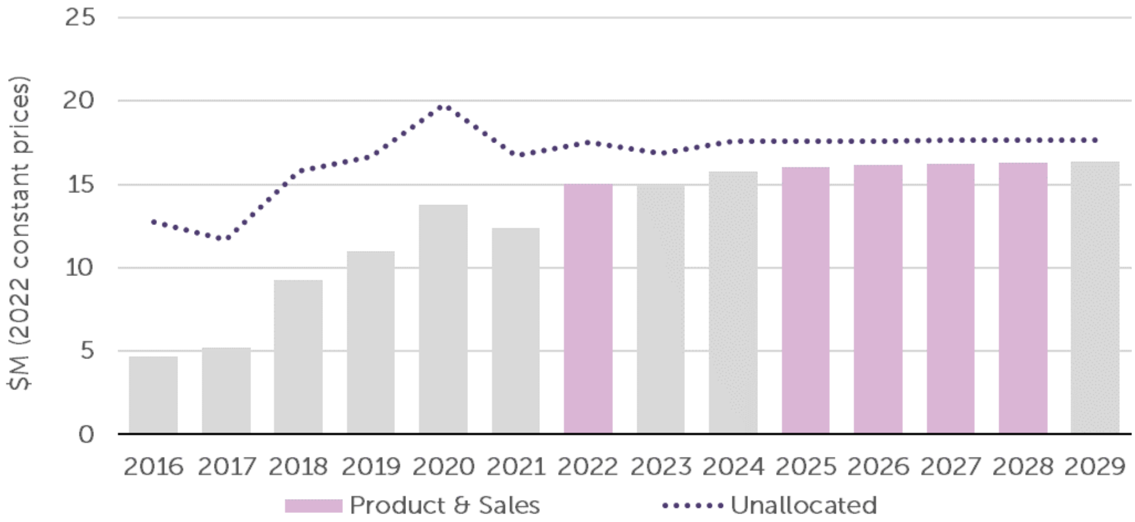
- opex grew from 2016 to 2020 as we onboarded more retailers, added (and then expanded) fibre products and grappled with growing complexity and strategic challenges from rival technologies
- 2020 included a 'big push' on copper-to-fibre migration that elevated costs for that year
- 2021 was impacted by COVID-19-related disruptions that reduced activities and costs.

The 2022 base year represented a return to normal operations, with costs materially in line with the average from the preceding two years and close to 2019 levels.

PRODUCT AND SALES OPEX TRENDS

Product and sales opex grew as we expanded our customer and product bases.

FIGURE 12.3: PRODUCT AND SALES OPEX (UNALLOCATED AND PQ FFLAS)



12.4 Marketing

12.4.1 Scope and rationale

Marketing includes expenditure managing and promoting the Chorus brand, the fibre category and fibre products. It includes internal management costs, and external marketing activities.

These activities advance our 'active wholesaler' strategy for fibre, which is prudent given the telecommunications market structure in Aotearoa. In particular:

- fibre services are but one of a sometimes-confusing range of technology and product alternatives available to end-users. We have a strong interest in ensuring end-users in Aotearoa understand the relative merits of fibre
- our services are promoted and on-sold by RSPs, of which the three largest (who have around 75% combined market share) also operate mobile networks. These large RSPs have an incentive to promote alternatives to fibre that they can offer on a vertically-integrated basis
- other market participants, including the RSPs without their own mobile networks and the smaller local fibre companies, are too small to promote the fibre category nationally or at an effective scale.

MARKET STRUCTURE

Aotearoa's market structure means we have a key role promoting fibre broadband.

This leaves us with the task of raising awareness of fibre as a category, as well as educating potential end-users on the benefits of fibre relative to other categories. We note that we were required to invest in marketing fibre as part of our Ultra-Fast Broadband (UFB) contract with Crown Infrastructure Partners, and it remains a prudent activity given market structure and dynamics.

We sought stakeholder feedback on our role as an active wholesaler as part of our PQP2 consultation process:

- RSPs who own mobile networks that compete with our fibre network opposed Chorus promoting fibre to end-users.
- the only RSP submitter on this topic who did not own a mobile network agreed there were benefits in informing end-users about different technologies and what was most suitable for them but did not see any need to increase investment.
- for wider stakeholders, this was a lower priority area of investment than other options (e.g. resilience) but on balance they supported our planned expenditure (relative to the 'lower' and 'higher' investment options). They also noted a preference for spending on education rather than marketing.

NEED FOR EDUCATION

"The general public needs to know about Fibre. That it is reliable and speedier than plain Broadband and, just as important, how to get it and the price. That will help maintain the calibre , innovation, availability and overall development of the Fibre Network."

Stakeholder feedback

Based on this feedback, we propose to continue with our planned levels of expenditure, which already includes education as a core component of our marketing strategy, for example we aim to ensure people are aware of the benefits of fibre and the best broadband option for them.

Ultimately, our marketing spend helps sustain efficient uptake of fibre services and helps end-users find the product that delivers best value for them. This investment is prudent given the high fixed costs of the fibre network, and the continuing competition from other technologies.

12.4.2 Resourcing model

We manage activities with in-house resources, and deliver research, creation, and placement activities through partners with specialist expertise and networks. We select our major partners through competitive processes with periodic market testing.

Our marketing programme and customer incentives programmes[83] are each overseen by senior managers who work alongside each other and wider product and sales teams. Allocation of effort and resources between and within each programme is coordinated through the annual budgeting process and ongoing programme governance.

BENEFITS REALISATION

"If you don't raise the awareness, you can't gain the benefits of the other investments."

Stakeholder feedback

12.4.3 Expenditure forecast

The table below sets out our Marketing opex forecast with the following base year adjustments, step-changes, and trends.

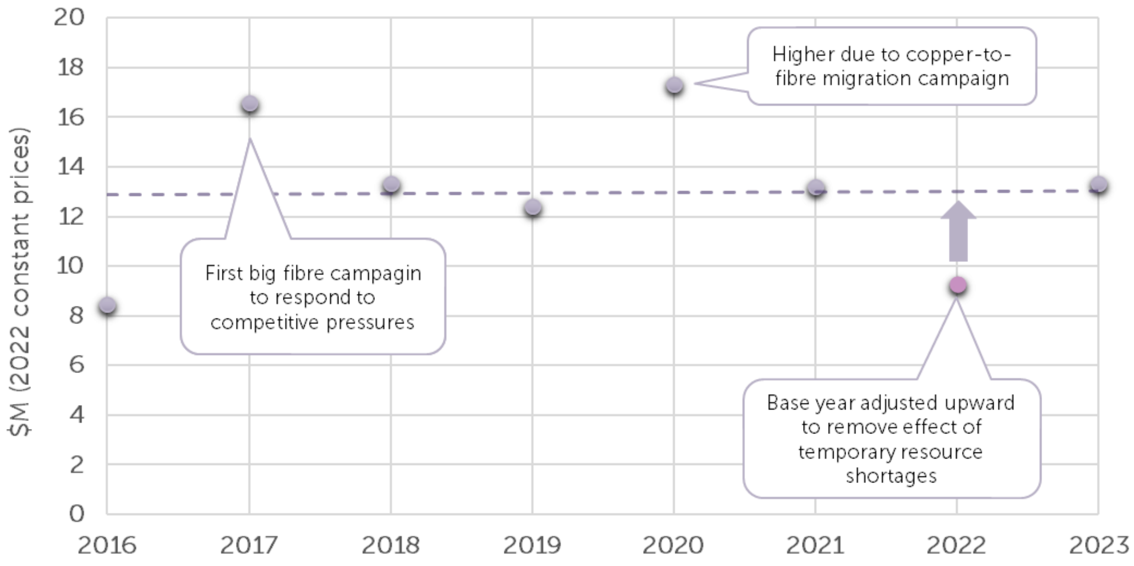
TABLE 12.3: MARKETING BST ADJUSTMENTS (PQ FFLAS)

AREA	BASE YEAR ADJUSTMENTS	STEP-CHANGES	TREND	OPEX/CAPEX TRADE-OFFS
Marketing	+$2.2m Base year adjustment needed as temporary reduction in marketing in 2022 due to deliverability issues We typically spend around $12m on advertising per year. Due to internal, agency and technician labour shortages, we were unable to deliver our 2022 marketing programme as intended and campaigns to boost current fibre demand (today) were halted. Expenditure is expected to return to around $12m in 2023 and 2024. This level of expenditure is required to build awareness and understanding of our services and fund customer-facing teams and processes including for our copper to fibre migration programme. This ensures end-users can make informed decisions to ensure they have the best service to suits their needs.	None	Some marketing costs (i.e. 'advertising' costs) scale with fibre connections, with 0.65 elasticity. Other marketing costs do not scale with connections.	None

To test the base year, we examined the trend in unallocated marketing opex.

83 Noting that Customer Incentives expenditure is within Installations capex but managed by the same teams discussed here.

FIGURE 12.4 : HISTORICAL MARKETING OPEX TREND (UNALLOCATED)



The trend shows some volatility in our marketing spend around a stable baseline of about $13m of unallocated marketing opex per year (around $12m PQ FFLAS). We note that:

- we cut marketing spend in 2016 as part of our 'manage for cash' response to an adverse copper price determination
- we lifted investment in 2017 as a response to increasingly aggressive promotion of competing fixed wireless technology, and in 2020 as part of a campaign to drive copper to fibre migration (alongside higher product and sales expenditure in that year)
- 2018, 2019 and 2021 were 'normal' years, and 2023 is on track for similar expenditure to those years
- 2022 was an abnormally low year due to a combination of:
  - internal labour shortages, which constrained our capacity to execute marketing activities
  - a deliberate decision to pause some activity because temporary technician shortages meant we had limited capacity to service installation demand.

We expect our marketing spend to return to around $13m (unallocated) in 2023 and 2024, as this level of expenditure is required to build awareness and understanding of our services and fund customer-facing teams and processes (including for our copper to fibre migration programme). This ensures end-users can make informed decisions to ensure they have the service that best suits their needs.

Adjusting the 2022 base year by $2.2m (PQ FFLAS) corrects for abnormally low expenditure in that year and brings it in line with typical years.

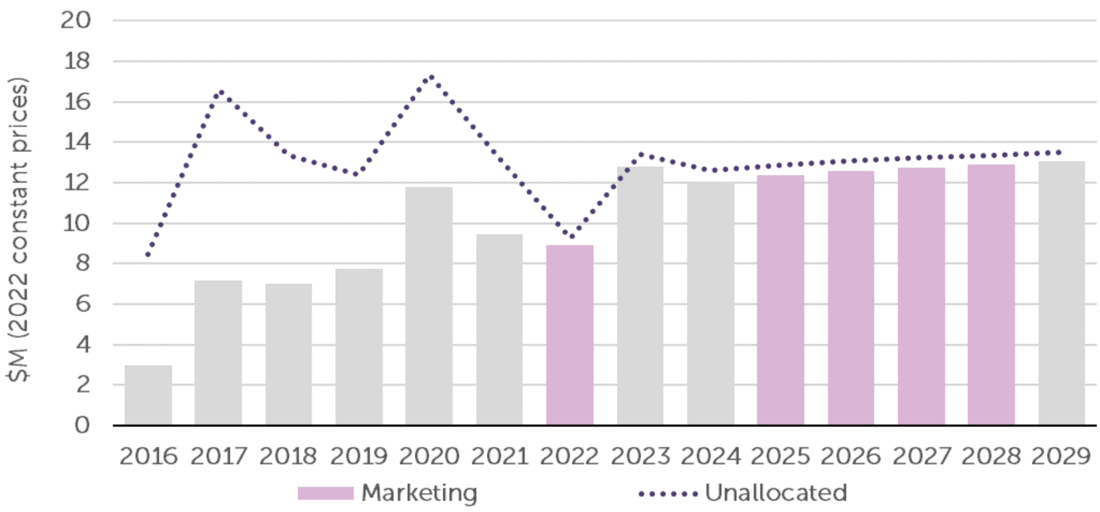
MARKETING OPEX TRENDS

Our marketing spend was abnormally low in 2022 due to temporary resource shortages.

We benchmark our expenditure against our competitors through market analysis (i.e. observing their activity and deriving spend estimates) and believe our expenditure is significantly lower than any of the three largest RSPs.

We do not use economic analysis to determine the optimal level or mix of Marketing expenditure, because this would not add insight compared to our approach of relying on the value revealed through ongoing application of expert knowledge under conditions that encourage efficient investment.[84]

FIGURE 12.5: MARKETING OPEX (UNALLOCATED AND PQ FFLAS)



12.5 Customer Operations

12.5.1 Scope and rationale

Customer Operations covers activities related to coordinating installations, switching, and provisioning. The Customer Operations area includes five teams:

- consumer and business connect – manage operational coordination with RSPs and end-users
- fibre field operations – manage operational coordination with field service providers
- complex fibre projects – manage complex orders and new property developments
- managed migrations – assist with migrating customers from copper to fibre

CUSTOMER OPERATIONS

Customer operations teams coordinate with RSPs, FSPs and developers.

84 As a sense check, we note that $13 million (unallocated) is less than 2% of reported FY2022-23 fibre revenue. As such, our investment would be economic if it sustained at least a 2% uplift in annual revenue. Given the degree of competition and churn in the broadband market we do not think there is any doubt that this is the case.

- fibre initiatives – manage process changes resulting from changes to products, services, or systems, or aimed at delivering improvements (in customer experience or process efficiency).

These activities are a necessary part of wholesaling fibre services, connecting end-users and extending fibre to new property developments. Part of their work is to ensure that we meet contractual, legislative, and regulatory obligations.

12.5.2 Resourcing model

We deliver Customer Operations with in-house resources supported by IT systems that assist with tracking, business-to-business coordination, and linking to network and billing management.

12.5.3 Expenditure forecast

The table below sets out our Customer Operations opex forecast with the following base year adjustments, step-changes and trends.

TABLE 12.4: CUSTOMER OPERATIONS BST ADJUSTMENTS (PQ FFLAS)

AREA	BASE YEAR ADJUSTMENTS	STEP-CHANGES	TREND	OPEX/CAPEX TRADE-OFFS
Customer Operations	None Adopted 2022 actual expenditure without adjustment.	None	Most customer operations costs do not scale with connections. A small proportion (i.e. ‘copper maintenance’ and ‘other network’ costs) scale with copper connections and total connections respectively, with 0.45 elasticity.	None

Since 2016, we have capitalised a portion of Customer Operations expenditure relating to customer connection, acquisition, and retention. This means the opex amount is sensitive to:

- overall activity levels (and efficiency) which influence gross labour costs. Activity drivers include simple and complex installations, new property developments, moves (from one property to another) and switches (from one product or retailer to another)
- the mix of activities, which influences the portion of gross labour costs that is capitalised.

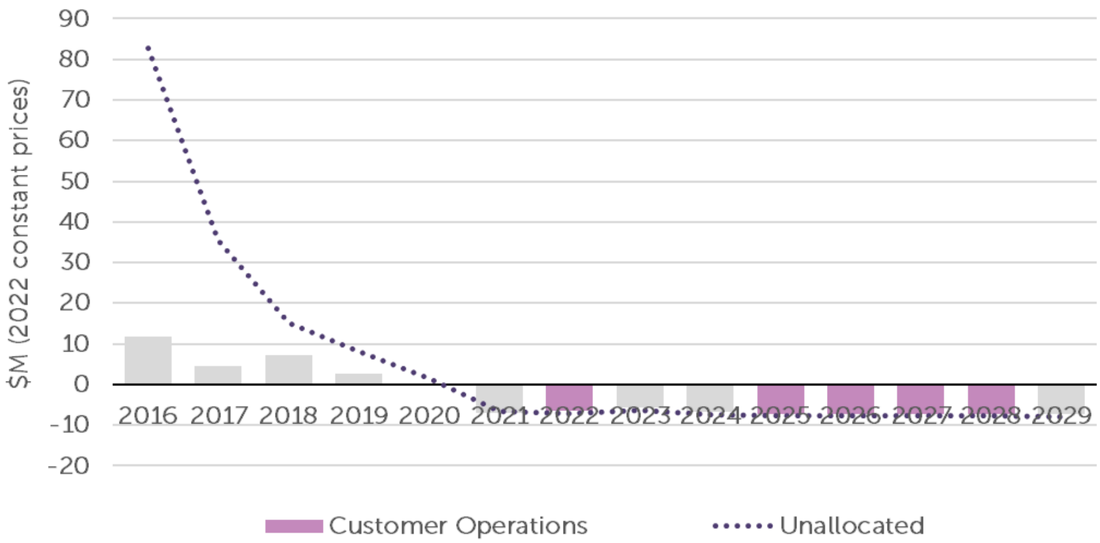
To understand the reasonableness of the base year, we have examined the trend in aggregate expenditure across Customer Operations and Network Operations. These areas are budgeted and managed together, so this allows a more robust assessment of net opex. The trend is presented and discussed in

CUSTOMER AND NETWORK OPERATIONS

We have examined Customer Operations and Network Operations opex trends in aggregate in the Network opex chapter the Network opex chapter, but our conclusion is that we should adopt 2022 as the base year without adjustment.

We note that a material portion of the savings enabled by the optimisation component of our IT investment may occur in customer operations. However, as set out in the Opex Insights chapter, we have presented savings against Technology opex rather than allocating them to areas where savings may occur.

FIGURE 12.6: CUSTOMER OPERATIONS OPEX (UNALLOCATED AND PQ FFLAS)[85]



12.6 Links and synergies

Other expenditure areas

Customer opex supports demand for fibre services, so has links to installation and infill work.

Customer Operations and Network Operations (covered in Network opex) are managed together, so there are resourcing links between these activity areas. The Customer Operations portion is capitalised, including on-costs that are accounted for centrally. This means Customer Operations opex presents as negative. As such we have assessed the base year for Customer Operations and Network Operations together. In addition, support of Customer Operations and Network Operations is captured under Asset Management, which is Support opex.

Customer opex is a process-heavy part of our business that makes extensive use of IT systems to manage internal process and business-to-business

AUTOMATION

Customer operations is a process-heavy activity that makes extensive use of IT systems.

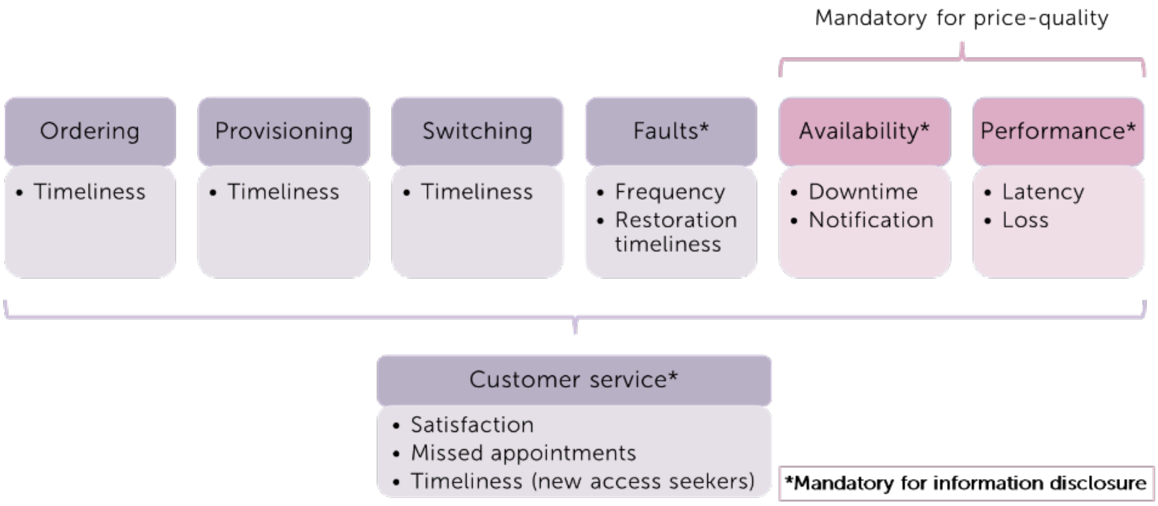
85 The negative figures represent mismatches between general ledger-level recording of cost and capitalisation relative to the mapping for regulatory expenditure categories. This occurs because overhead costs are recorded centrally (not against each cost centre) and because regulatory reporting categories for Customer Operations and Network Operations (covered in Network opex) draw from the same cost centres. Essentially, when we capitalise labour costs from Customer Operations, a portion of Support and Network overhead costs are included, resulting in a net negative balance in this sub-category. The treatment is correct at a total opex level.

interactions. As such, there is a link between Customer opex and IT and Support capex.

Quality dimensions

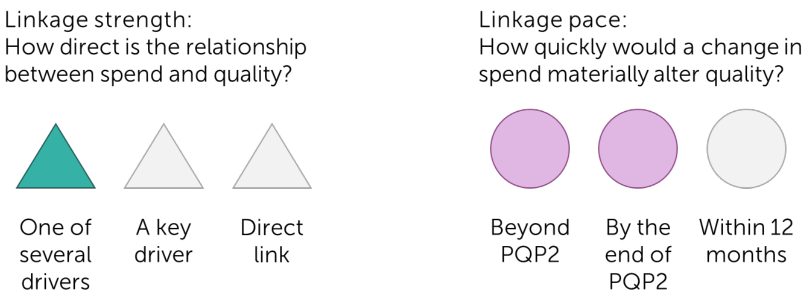
The Fibre Input Methodologies define six lifecycle- based quality dimensions and one over-arching customer service quality dimension. Two quality dimensions are mandatory for price-quality (PQ) regulation, meaning they must have associated quality standards. Four dimensions (including the two PQ dimensions) are mandatory for information disclosure.

FIGURE 12.7: QUALITY DIMENSIONS AS DEFINED IN THE FIBRE IMS



Each discussion of linkages between expenditure and quality includes a summary with simple icons to depict the strength and pace of each linkage. The icons provide a broad characterisation, rather than a precise assessment.

TABLE 12.5: LINKS BETWEEN CUSTOMER OPEX AND OUR QUALITY DIMENSIONS



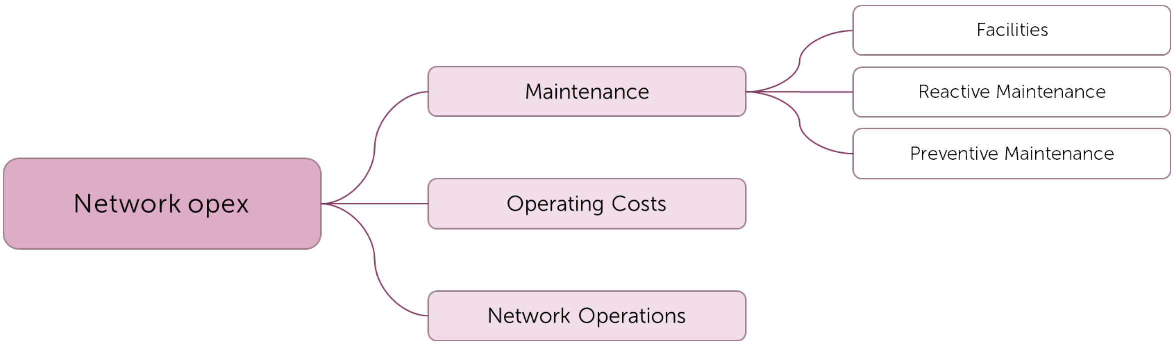
DIMENSION	EXPENDITURE SUB-CATEGORIES	STRENGTH	PACE
Customer service	All sub-categories Our customer-facing operations, and our product, sales and marketing activities have direct links to customer satisfaction.	▲▲▲	●●●
Switching	Customer Operations We have obligations to provide a smooth transfer of service from one RSP to another, reducing barriers to fibre access and switching.	▲▲△	●●●
Provisioning	All sub-categories Customer operations team handles provisioning tasks that require more complex coordination.	▲▲▲	●●●
Ordering	All sub-categories Need to keep customers and RSPs informed about what product offerings we have available and when. Communication is important to explain and smooth processes.	▲▲▲	●●●

13.0 NETWORK OPEX

Ngā Tukanga Aka Matua

13.0 Network opex

This chapter describes the Network opex category, which covers operating expenditure relating to our physical network.



13.1 Introduction

We break our overall opex down into three broad narrative categories – Customer, Network, and Support. This chapter examines Network opex, which we further break down into three functional areas to facilitate discussion of prudency and efficiency:

- Maintenance
- Operating Costs
- Network Operations.

This chapter provides an overview of Network opex and then for each functional area, we provide information on:

- scope of activities and the rationale for those activities
- our resourcing model
- our expenditure forecast.

This expenditure is included in our base-step-trend (BST) opex forecast. The forecast section includes an examination of historical trends and discusses any base-year adjustments, step changes or scale trends applicable to the functional area.[86]

NETWORK OPEX

Network opex covers Maintenance, Operating Costs and Network Operations.

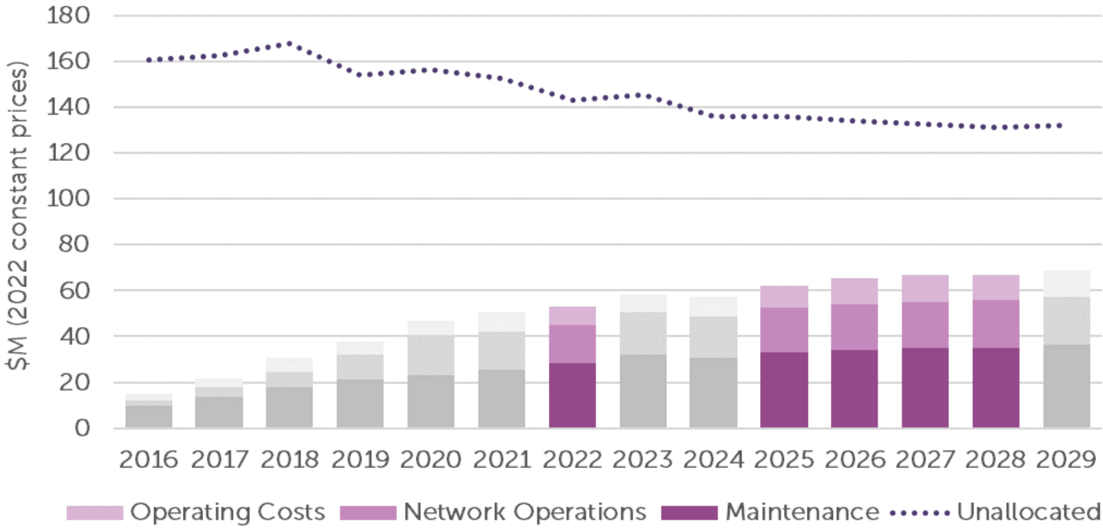
$261m

13.2 Network opex forecast overview

During PQP2 our forecast expenditure for Network opex is $261 million, representing 35% of our total forecast opex.

86 We do not focus on input cost trends, as these are added to our constant price forecasts based on independent forecasts and using a previously accepted methodology. More information on this approach can be found in the Modelling and Cost Allocation Report.

FIGURE 13.1: NETWORK OPEX (UNALLOCATED AND PQ FFLAS)



We present unallocated and allocated opex above. Key observations are:

- unallocated Network opex has trended down over time, and we forecast it will reduce further through PQP2. This reflects migration from copper to fibre, since:
  - the fault rate for fibre is lower than copper, so maintenance costs are lower
  - operating costs for fibre are lower than copper, so these reduce as we decommission copper equipment
- fibre has accounted for a growing share of network costs over time, and this trend will continue through PQP2. This is due to growth in direct fibre costs, and reduction in the portion of shared costs allocated to copper.

The below table shows the forecast opex by regulatory year, broken into sub-categories.

NETWORK OPEX TRENDS

Unallocated Network opex is falling, while fibre accounts for a growing share.

TABLE 13.1: NETWORK OPEX (PQP2 PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

	2025	2026	2027	2028	TOTAL PQP2
Maintenance	33.2	34.2	34.8	35.1	137.3
Network Operations	19.2	19.9	20.3	20.6	80.0
Operating costs	9.7	11.1	11.6	11.3	43.7
NETWORK TOTAL	62.1	65.2	66.7	67.0	261.0

13.3 Maintenance

13.3.1 Scope and rationale

The Maintenance area covers inspections, servicing and repair of our network assets. We break maintenance opex into three components:

- Facilities
- Reactive Maintenance
- Preventive Maintenance.

Facilities maintenance opex is focussed on network property maintenance, and power and building services with costs including inspections, planned/programmed property maintenance, scheduled maintenance on electronic equipment (e.g. filter cleaning), cleaning, ground maintenance and repairs of buildings and building services (such as power systems and air conditioning). This opex is necessary to maintain facilities in a state that complies with legal obligations, sustains a secure and watertight environment for electronics and manages lifecycle costs (e.g. painting).

MAINTENANCE

Maintenance includes facilities, reactive fault response, and preventive maintenance.

Reactive Maintenance opex includes outsourced network fault response (i.e. restoring service) and defect response (e.g. pit repair) for field assets. Fault response is necessary to restore service to meet quality standards and customer service level agreements (SLAs). Defect response is necessary to address public and worker safety risks, prevent faults, and manage lifecycle costs.

Preventive Maintenance opex includes physical network inspections, scheduled maintenance, and other proactive maintenance for field assets, as well as location services for third parties (for underground assets). Inspections are necessary to provide asset information and awareness that allows us to manage public safety, identify defects, and support investment planning. Scheduled and proactive maintenance is necessary to manage lifecycle costs.

13.3.2 Resourcing model

Field activities and operational management of Facilities maintenance is outsourced to single specialist provider through competitive tender. This enables us to tap into an efficiently sized supplier with national coverage, expertise, and an ability to optimise its workforce across its customers.

We outsource field services for both Reactive and Preventive Maintenance together through periodic re-tendering. As field work volumes have declined with completion of the Ultra-Fast Broadband (UFB) build and connect projects (and copper volumes), we have reconfigured our field service contracts so we now have two suppliers each with their own geographic coverage. This approach balances scale efficiency and competitive tension.

PARTNERS

We work with outsource partners to deliver maintenance activities.

We have an in-house team that manages outsourced field services, but the outsource model delivers lower cost and better flexibility than would be achievable with dedicated in-house resources. This is due to competitive tension and the economies of scope that our suppliers achieve by deploying their resources across multiple utilities.

13.3.3 Expenditure forecast

The table below sets out each area of our Maintenance opex forecast with the following base year adjustments, step-changes and trends.

TABLE 13.2: MAINTENANCE BST ADJUSTMENTS (PQ FFLAS)

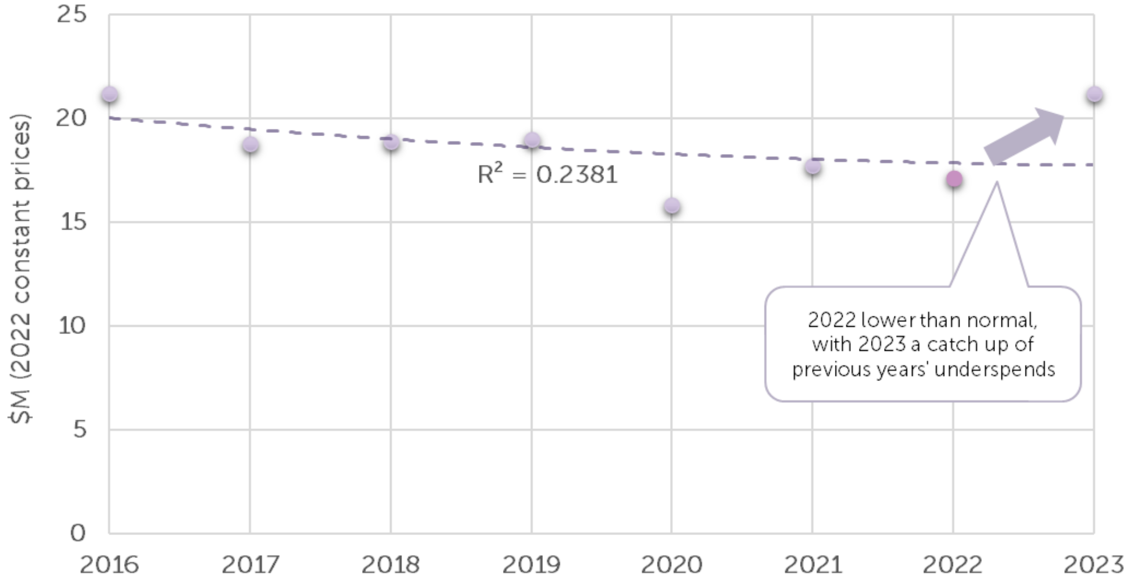
AREA	BASE YEAR ADJUSTMENTS	STEP-CHANGES	TREND	OPEX/CAPEX TRADE-OFFS
Facilities	+$0.5m Base year adjustment needed as work volumes and resulting expenditure on property maintenance were below the historical average in 2022 due to the transition to new contracts and a new service company. The historical average reflects the minimum level of expenditure for this aging asset class.	None	Most facilities costs scale with fibre connections, with 0.45 elasticity. A small proportion (i.e. 'copper maintenance' and 'other network' costs) scale with copper connections and total connections respectively, also with 0.45 elasticity.	None
Reactive Maintenance	None Adopted 2022 actual expenditure without adjustment.	CCI [ ].	Most reactive maintenance costs scale with fibre connections, with 0.45 elasticity. A small proportion (i.e. 'copper maintenance' and 'other network' costs) scale with copper connections and total connections respectively, also with 0.45 elasticity.	None
Preventive Maintenance	None Adopted 2022 actual expenditure without adjustment.	None	Most preventive maintenance costs scale with fibre connections, with 0.45 elasticity. A small proportion (i.e. 'copper maintenance' and 'other network' costs) scale with copper connections and total connections respectively, also with 0.45 elasticity.	None

We tested the base year for each of Facilities, Reactive Maintenance, and Preventive Maintenance forecasts as set out below.

Facilities

The chart below shows the trend in unallocated historical Facilities opex, which removes the effect of shifting allocations and best highlights the reasonableness of the 2022 base year. We have added a trend line based on a second-order polynomial.

FIGURE 13.2: HISTORICAL FACILITIES OPEX TREND (UNALLOCATED)



The trend provides a good fit, showing a decline in Facilities opex (albeit at a decreasing rate), that has been impacted by one-off factors:

- COVID-19 disrupted some activity in 2020, which deferred some expenditure from 2020 to 2021
- 2022 included reduced work volumes and expenditure on property maintenance due to a transition to new contracts and a new service company. Expenditure in 2022 was around $1.5m[87] below historical average (with the historical average reflecting the minimum level of expenditure for this aging asset class)
- In the first 6 months of 2023 we have seen a rebound and catchup of expenditure, due to previous years under investment. This will not continue into outer years.

FACILITIES MAINTENANCE TRENDS

Unallocated Facilities Maintenance costs have reduced over time.

As such, we have applied a $0.5m[88] uplift to the 2022 base year to bring it in line with longer-term average expenditure.

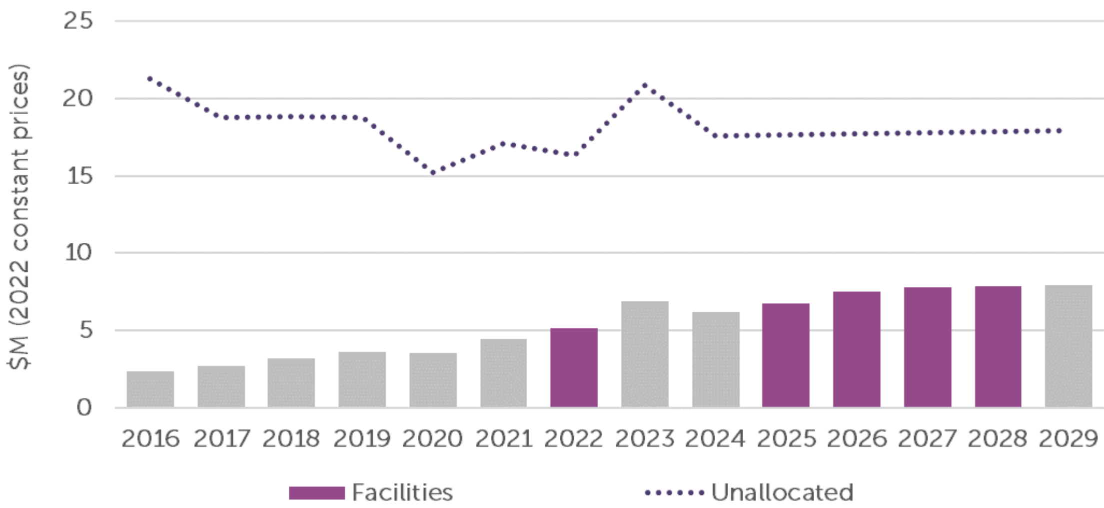
We apply a trend so that costs scale with connections, with a 0.45 elasticity – i.e. a resumption of the historical trend of declining cost per connection.

The chart below shows historical and forecast PQ FFLAS Facilities opex, which increases gradually over the period due to shifting allocation towards fibre.

87 Unallocated amount
88 FFLAS amount, after allocation percentages applied

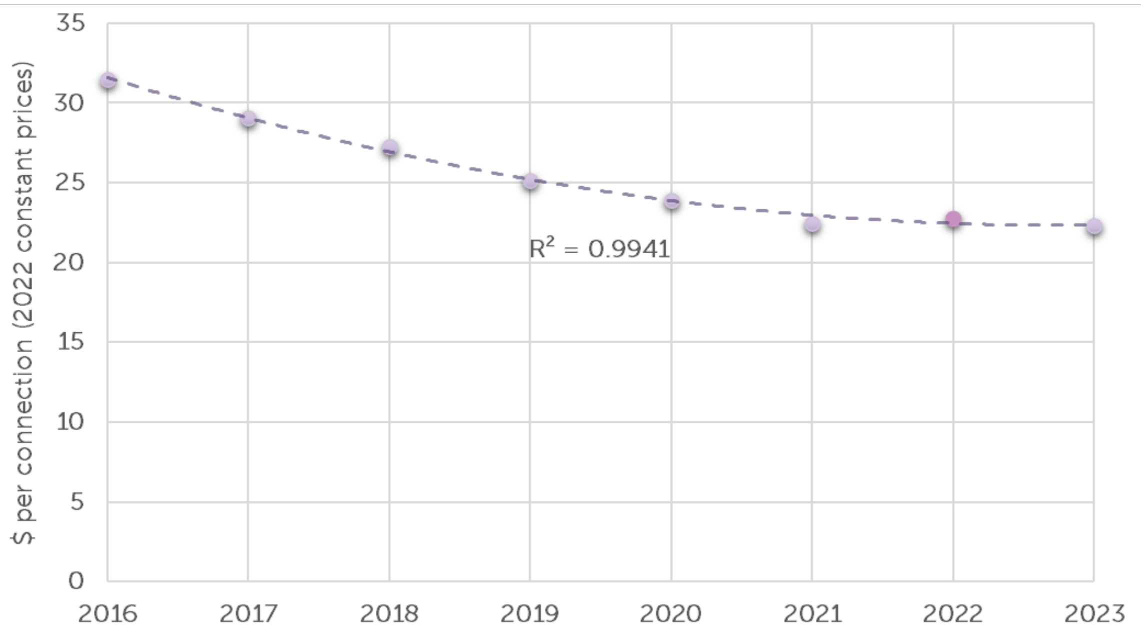
This reflects that declining copper volumes does not reduce Facilities opex but does reduce the degree of cost sharing.

FIGURE 13.3: FACILITIES OPEX (UNALLOCATED AND PQ FFLAS)



Reactive Maintenance

The chart below shows the trend in historical Reactive Maintenance opex per connection, which best highlights the reasonableness of the 2022 base year. We have added a trend line based on a second-order polynomial.



The trend shows that cost per connection declined as the fibre network grew from 2016 to 2021. The trend then reset from 2022 as we shifted from three to two suppliers to mitigate the cost impact of declining overall work volumes as UFB build and installations taper off. In contrast to Facilities opex, there was no COVID-19-related drop-off in 2020 because Reactive Maintenance is non-deferrable priority work.

Our forecast:

- CCI [

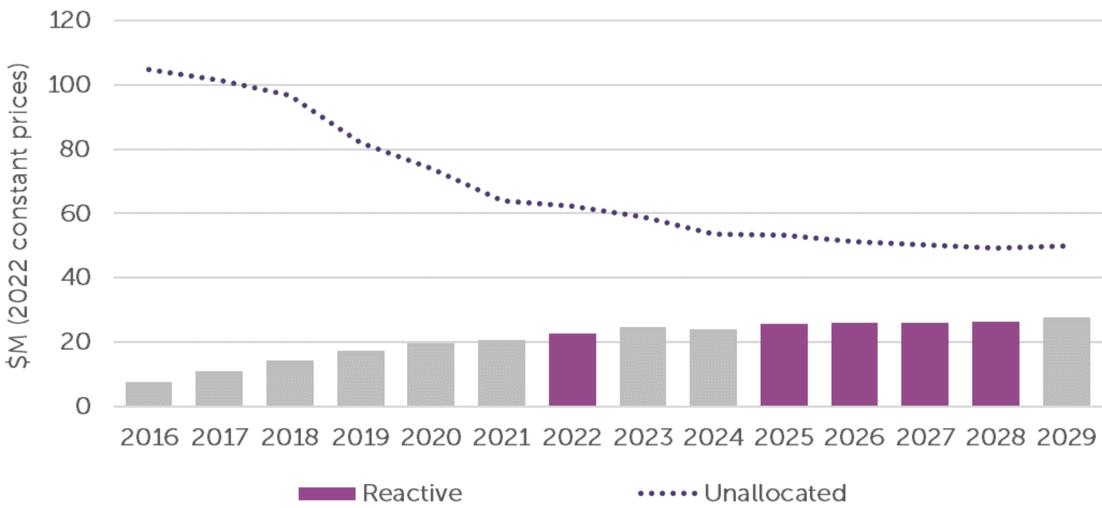
]

- applies a trend so that costs scale with connections, with a 0.45 elasticity – i.e. a resumption of the historical trend of declining cost per connection.

REACTIVE MAINTENANCE TRENDS

Reactive maintenance cost per connection has declined as our network has grown.

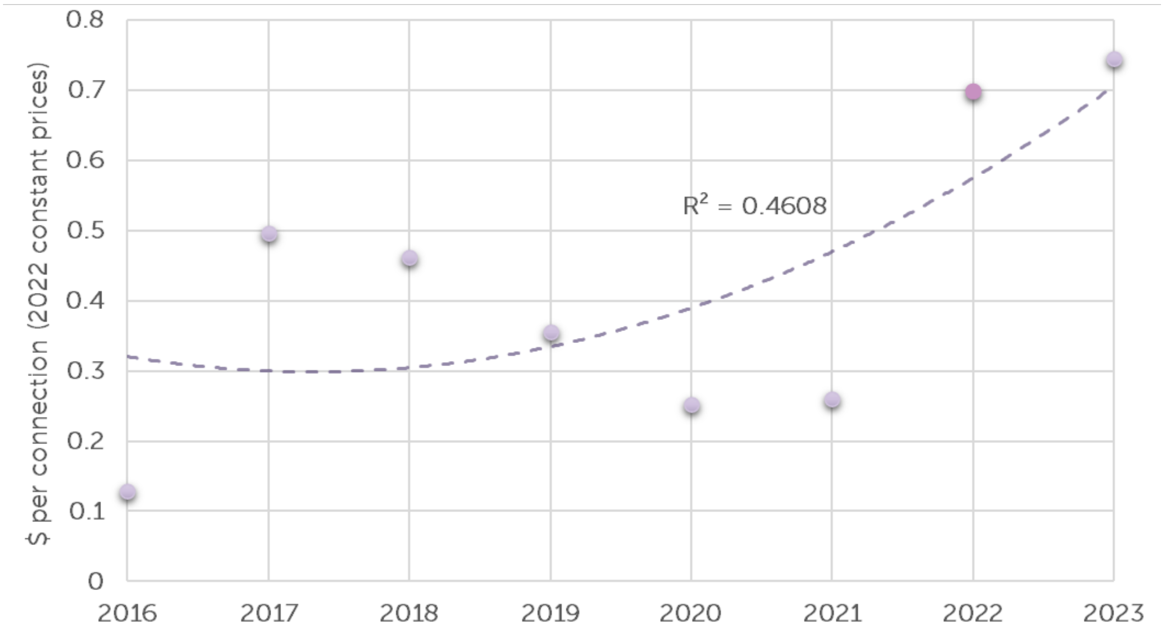
FIGURE 13.4: REACTIVE MAINTENANCE OPEX (UNALLOCATED AND PQ FFLAS)



Preventive Maintenance

The chart below shows the trend in historical Preventive Maintenance opex per connection, which best highlights the reasonableness of the 2022 base year. We have added a trend line based on a second-order polynomial.

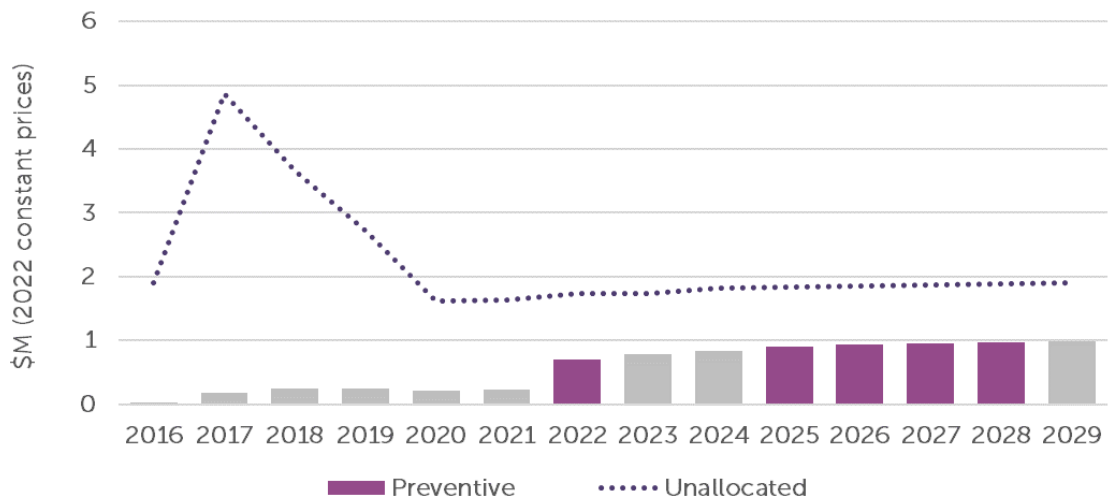
FIGURE 13.5: HISTORICAL PREVENTIVE MAINTENANCE OPEX PER CONNECTION TREND (PQ FFLAS)



Cost per connection is relatively low and fell through to 2021 and subsequently has increased with an increased focus on Preventive Maintenance such as surveying fibre routes. Going forward it has stabilised. As we have addressed supplier performance payments within Reactive Maintenance, we have taken 2022 as our base year with no adjustment.

We have not applied any step changes, and have applied a trend so that costs scale with connections with an elasticity of 0.45 – i.e. falling cost per connection.

FIGURE 13.6: PREVENTIVE MAINTENANCE OPEX (UNALLOCATED AND PQ FFLAS)



13.4 Operating Costs

13.4.1 Scope and rationale

The Operating Costs sub-category includes:

- network leases and rates
- electricity costs
- security operations centre (SOC), fire protection and building compliance services.

Network lease opex includes the non-capitalised costs for our network sites and assets (e.g. running costs such as cleaning or maintenance). Rates cover land rates for our network buildings and infrastructure rates for our underground network and are treated as passthrough costs as per the input methodologies (IMs). Both leases and rates are unavoidable costs of owning fibre network sites and assets.

Electricity costs are the costs of powering our network electronics, and air-conditioning units in network buildings and cabinets. This expenditure is required for the network to function.

Our SOC, fire protection and building compliance services cover the additional costs required to operate our network property portfolio. Our SOC manages all aspects of security in relation to network operations, including the maintenance and monitoring of security systems and CCTV feeds, management of access cards, locks and keys for our sites and ad hoc security related investigations (e.g. theft of our cable). This expenditure is prudent to ensure our sites and the assets located there are protected, and also may be required for compliance reasons.

OPERATING COSTS

Operating Costs are the running costs of our sites and equipment, including electricity costs, plus our security operations centre (SOC).

13.4.2 Resourcing model

Our SOC is overseen by some internal labour and staffed by our service contractors. We also outsource our fire protection and building compliance services. As with our Facilities Maintenance opex, this outsourcing enables us to tap into an efficiently sized supplier with national coverage, expertise, and an ability to optimise its workforce across its customers.

PARTNERS

We work with outsource partners for our SOC and for compliance services.

13.4.3 Expenditure forecast

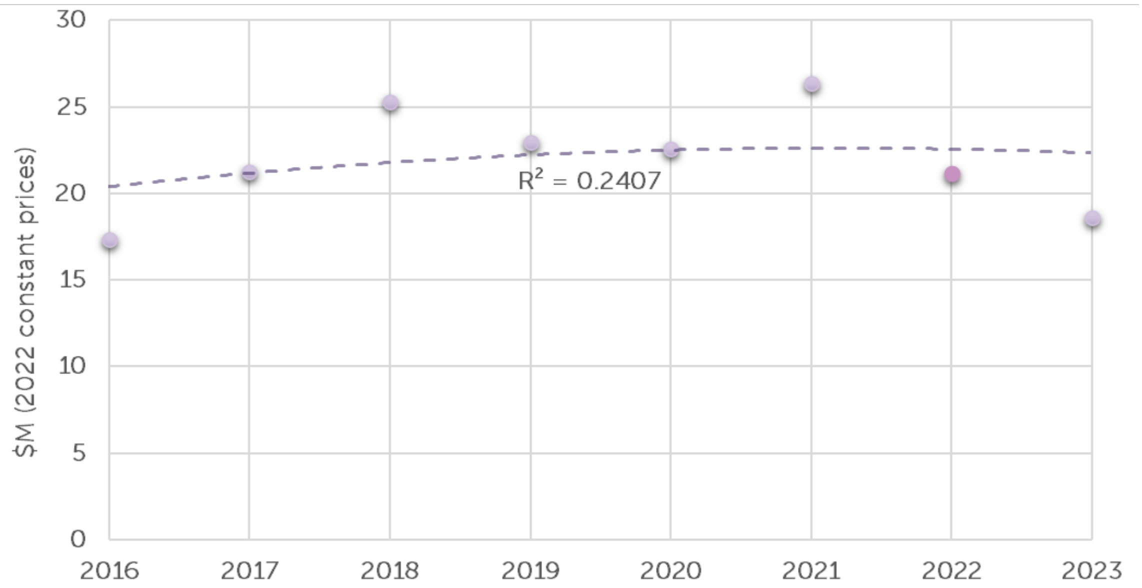
The table below sets out our Operating Costs opex forecast with the following base year adjustments, step-changes and trends.

TABLE 13.3: OPERATING COSTS BST ADJUSTMENTS (PQ FFLAS)

AREA	BASE YEAR ADJUSTMENTS	STEP-CHANGES	TREND	OPEX/CAPEX TRADE-OFFS
Operating Costs	None Adopted 2022 actual expenditure without adjustment.	None	Most operating costs do not scale with connections. A small proportion (i.e. 'other network' costs) scale with total connections, with 0.45 elasticity.	-$1.2m total over PQP2 We expect investment in solar panels at exchanges will reduce electricity purchase volumes.

The chart below shows the trend in unallocated historical operating costs, which removes the effect of shifting allocations and best highlights the reasonableness of the 2022 base year. We have added a trend line based on a second-order polynomial

FIGURE 13.7: HISTORICAL OPERATING COSTS OPEX TREND (UNALLOCATED)



There are a mix of factors that influence operating cost, with electricity as a key driver. This is influenced by factors such as:

- variations in the cost of electricity (including network and energy components)
- changes in the mix of equipment, including as we add fibre and remove copper equipment
- variations in outdoor temperature, which impacts energy demand from cooling equipment.

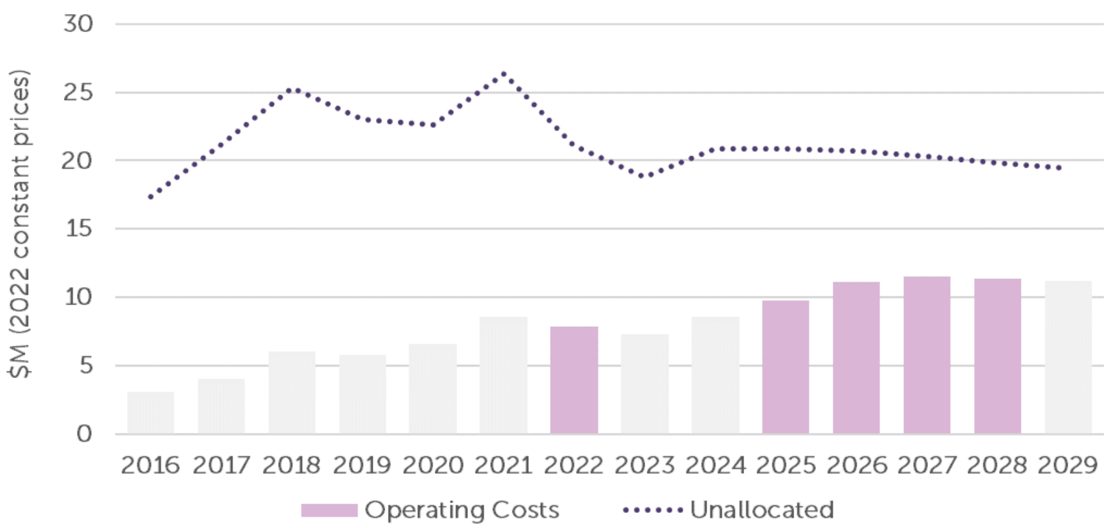
OPERATING COST TRENDS

Operating Costs have increased gradually as our network has grown.

Given that nature of these variations, we have taken 2022 as a representative base year.

The chart below shows historical and forecast PQ FFLAS Operating Costs opex, which increases gradually over the period due to shifting allocation towards fibre.

FIGURE 13.8: OPERATING COSTS OPEX (UNALLOCATED AND PQ FFLAS)



13.5 Network Operations

13.5.1 Scope and rationale

Our Network Operations expenditure includes:

- network operations labour
- Field Service Provider (FSP) incentive payments
- shared Spark systems
- software license and technology hardware maintenance
- project opex.

Network operations labour includes the costs of:

- internal teams involved in network operation. This includes Customer and Network Operations (CNO) teams that manage quality and performance of FSPs, network standards, customer billing, complaints and escalations, general enquiries, faults and interruption events, the SOC, and location services

NETWORK OPERATIONS

Network Operations covers a range in internal and external costs, including our network operations centre (NOC) and management of our FSP contracts.

- the outsourced Network Operations Centre (NOC), which supports our network electronics alarm systems, undertakes complex software and hardware technical support and maintenance, and manages equipment repair and return service in support of network electronics.

Both our internal and outsourced network operations labour is necessary to ensure that the network runs smoothly.

FSP incentive payments are the cost of arrangements that incentivise FSP performance. This scheme involves an at-risk amount that penalises underperformance and targeted incentives for excellent performance, based on quarterly performance against key performance indicators. This scheme is prudent expenditure as it improves the alignment of FSP incentives.

Shared Spark systems costs cover support for legacy systems leftover from before our demerger from Spark (then Telecom) in 2011. While we have transitioned away from many shared systems, there are still some systems that we expect to share for the foreseeable future. This opex includes costs for the ongoing use, hosting and support of shared systems, including the Spark network operations centre. As long as we still use these systems, this expenditure is necessary, however as the remaining shared systems support the copper network, the expenditure is substantially non-FFLAS.

Software license and technology hardware maintenance includes the maintenance costs of licensed software, firewalls, routers, etc. Without this expenditure these critical IT assets would be at risk of failing.

Project opex is necessary to ensure these projects can be delivered effectively and on time (and therefore benefit the wider business).

INCENTIVES

Our contracts with FSPs include at-risk amounts and targeted incentives linked to KPIs.

13.5.2 Resourcing model

We outsource the NOC, as this provides cost-effective access to specialised skills. The balance of activities rely on internal labour, as these are core activities for management of our operations, commercial arrangements, and project management.

13.5.3 Expenditure forecast

The table below sets out our Network Operations opex forecast with the following base year adjustments, step-changes and trends.

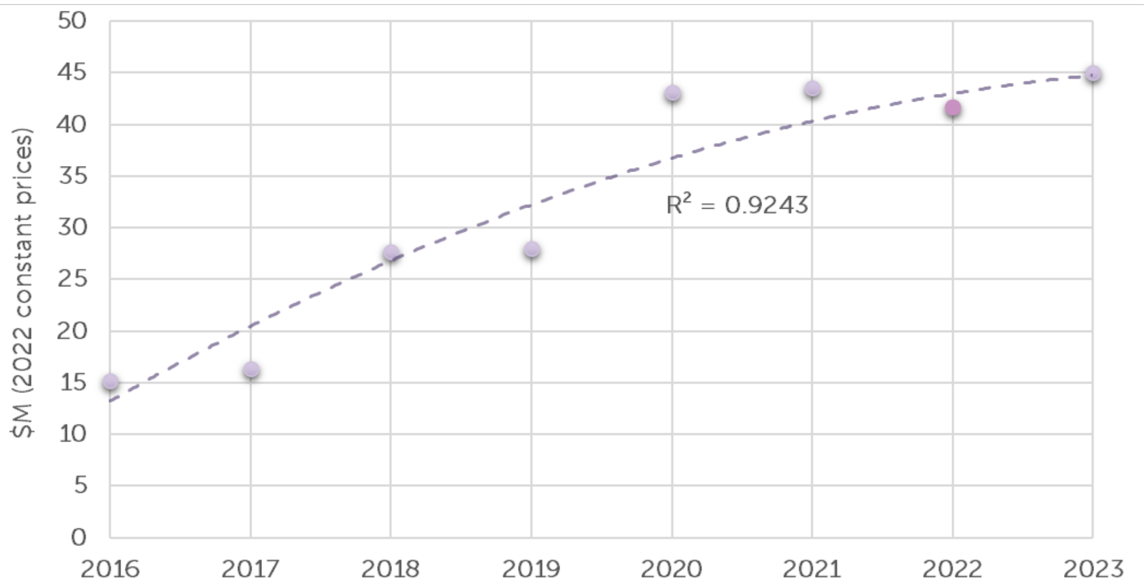
TABLE 13.4: NETWORK OPERATIONS BST ADJUSTMENTS (PQ FFLAS)

AREA	BASE YEAR ADJUSTMENTS	STEP-CHANGES	TREND	OPEX/CAPEX TRADE-OFFS
Network Operations	+$0.7m CCI [[redacted]].	None	Most network operations costs do not scale with connections.	None

AREA	BASE YEAR ADJUSTMENTS	STEP-CHANGES	TREND	OPEX/CAPEX TRADE-OFFS
			A small proportion (i.e. 'other network' costs) scale with total connections, with 0.45 elasticity.	

The chart below shows the trend in unallocated historical Network Operations opex, which removes the effect of shifting allocations and best highlights the reasonableness of the 2022 base year. We have added a trend line based on a second-order polynomial.

FIGURE 13.9: HISTORICAL NETWORK OPERATIONS OPEX TREND (UNALLOCATED)



Costs have trended up over time, with mild variation year-to-year. This reflects factors such as:

- declining capitalisation as network extension and installation activity declines
- growth of the fibre network
- variations in FSP performance, and hence incentive payments
- changes in the mix and cost of licences.

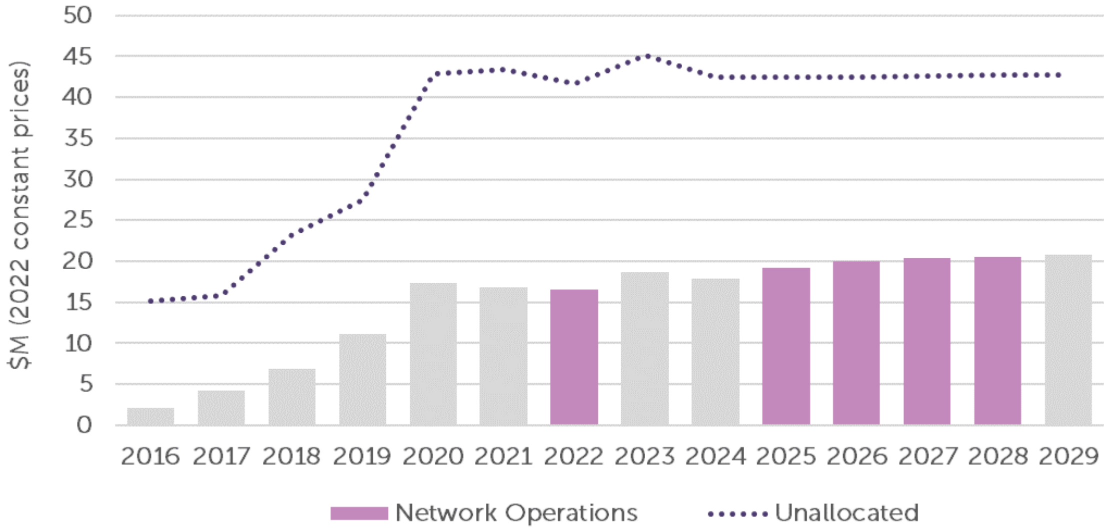
Given this mix of drivers, we have adopted 2022 as a reasonable base, with adjustment for abnormally low incentive payments.

The chart below shows historical and forecast PQ FFLAS Network Operations opex, which increases gradually over the period due to shifting allocation towards fibre.

NETWORK OPERATIONS TRENDS

Costs have increased over time as the network has grown.

FIGURE 13.10: NETWORK OPERATIONS (UNALLOCATED AND PQ FFLAS)



13.6 Links and synergies

13.6.1 Other expenditure categories

Expenditure from the following capex categories creates new assets that add to the pool of assets to be maintained and operated over time:

- Extending the Network
- Installations
- Network Capacity.

Network opex and Network Sustain and Enhance capex are closely linked. Notably:

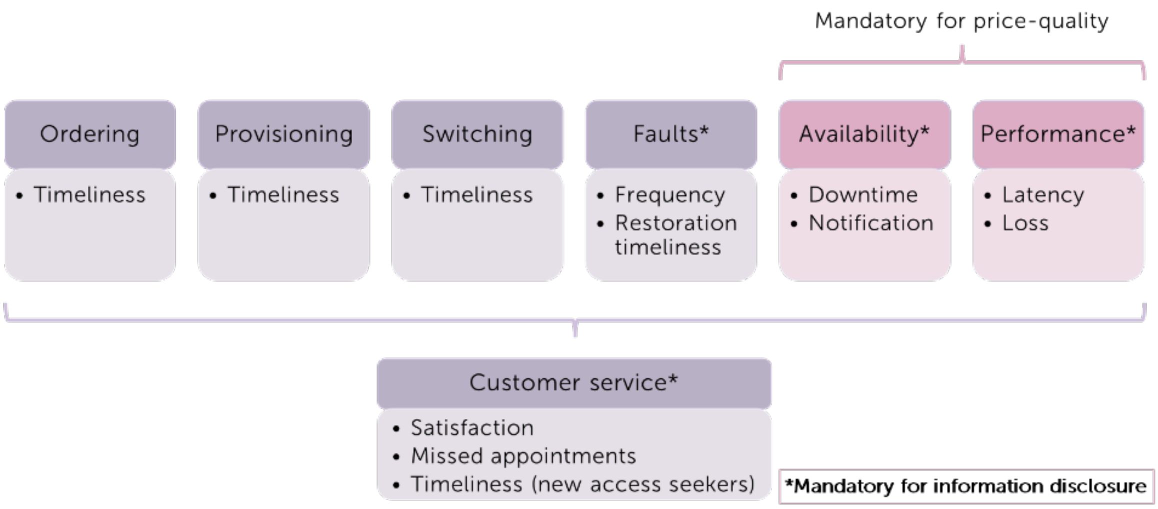
- both expenditure categories draw on common resource pools, including our field service and facilities providers
- fault responses generate renewal activities
- inspections inform proactive renewal activities
- renewals reduce faults and fault response costs
- network capacity investment alters the equipment mix in our network buildings, which impacts operating costs
- our planned investment in solar panels will reduce operating costs.

Customer Operations (covered in Customer opex) and Network Operations are managed together, so there are resourcing links between these activity areas. The Customer Operations portion is capitalised, including on-costs that are accounted for centrally. This means Customer Operations opex presents as negative. As such we have assessed the base year for Customer Operations and Network Operations together. In addition, support of Customer Operations and Network Operations is captured under Asset Management, which is Support opex.

13.6.2 Quality dimensions

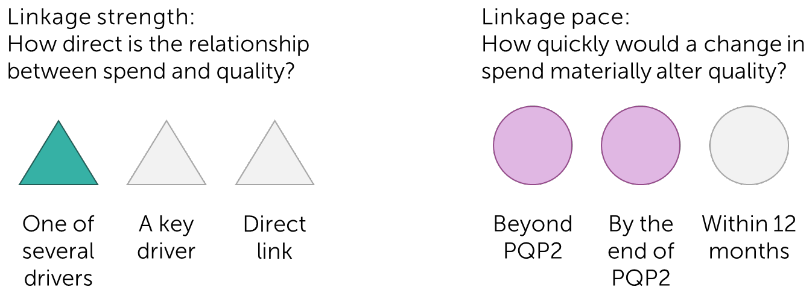
The Fibre Input Methodologies define six lifecycle- based quality dimensions and one over-arching customer service quality dimension. Two quality dimensions are mandatory for price-quality (PQ) regulation, meaning they must have associated quality standards. Four dimensions (including the two PQ dimensions) are mandatory for information disclosure (ID).

FIGURE 13.11: QUALITY DIMENSIONS AS DEFINED IN THE FIBRE IMS



Each discussion of linkages between expenditure and quality includes a summary with simple icons to depict the strength and pace of each linkage. The icons provide a broad characterisation, rather than a precise assessment.

TABLE 13.5: LINKAGES BETWEEN NETWORK OPEX AND OUR QUALITY DIMENSIONS



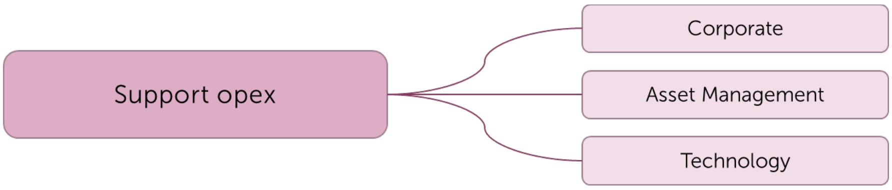
DIMENSION	EXPENDITURE SUB-CATEGORIES	STRENGTH	PACE
Performance	Network Operations Our network operating centre (NOC) monitors and manages network operation, including technical support and escalation.	▲▲△	●●●
Performance	Operating Costs Investment in capacity can impact power and cooling needs and increase the fibre access share of exchange space.	▲▲△	●●●
Availability and faults	Maintenance Network maintenance directly addresses downtime through preventive (e.g. inspections, locations) and reactive (e.g. repair and restoration) activities.	▲▲▲	●●●
Availability and faults	Network Operations Our NOC monitors and manages network operation, including technical support and escalation.	▲▲△	●●●
Customer service	All sub-categories Our fault-response work and network operations impact customer experience and satisfaction.	▲▲△	●●○

14.0 SUPPORT OPEX

Ngā Tukanga Tautoko

14.0 Support opex

This chapter describes our Support opex category, which covers operating expenditure on asset management, corporate functions and IT systems.



14.1 Introduction

We break our overall opex down into three broad narrative categories – Customer, Network, and Support. This chapter examines Support opex, which we further break down into three functional areas to facilitate discussion of prudency and efficiency:

- Corporate
- Asset Management
- Technology.

This chapter provides an overview of Support opex and then for each functional area, we provide information on:

- scope of activities and the rationale for those activities
- our resourcing model
- our expenditure forecast.

This expenditure is included in our base-step-trend (BST) opex forecast. The forecast section includes an examination of historical trends and discusses any base-year adjustments, step changes or scale trends applicable to the functional area.[89]

SUPPORT OPEX

Support opex covers Corporate, Asset Management and Technology costs.

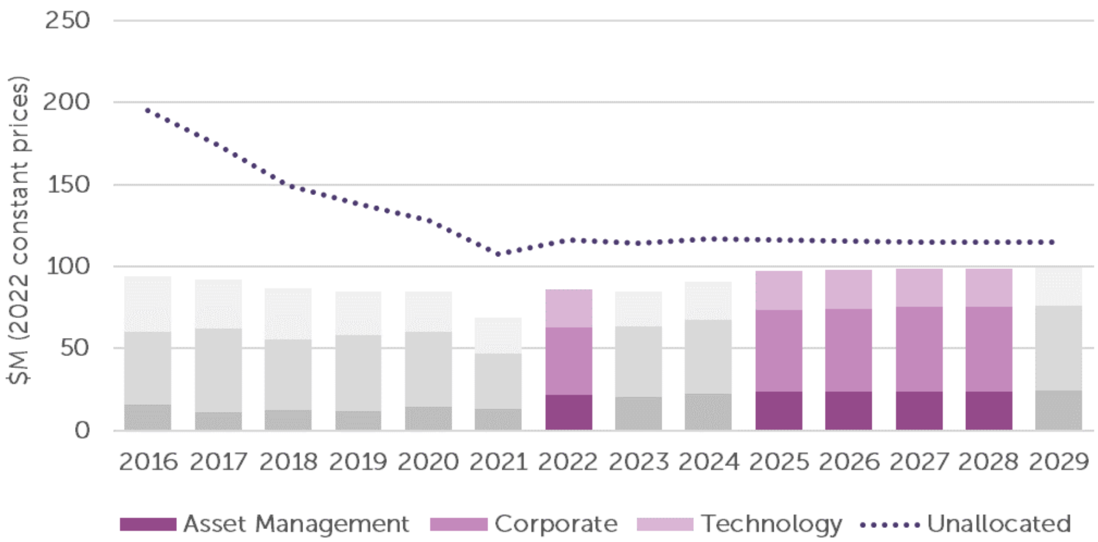
$392.4m

14.2 Support opex forecast overview

During PQP2 our forecast expenditure for Support opex is $392.4 million, representing 53% of our total forecast opex.

89 We do not focus on input cost trends, as these are added to our constant price forecasts based on independent forecasts and using a previously accepted methodology. More information on this approach can be found in the Modelling and Cost Allocation Report.

FIGURE 14.1: SUPPORT OPEX (UNALLOCATED AND PQ FFLAS)



Key observations are:

- unallocated Support opex has trended down over time, largely reflecting ongoing refinement of our internal resourcing as our business evolves
- the share of costs allocated to fibre has increased over time. As this has been a growing share of a declining total, the net result has been falling fibre support costs
- expenditure was abnormally low in 2021, reflecting COVID-19 disruptions
- we forecast stabilisation of both total (unallocated) and fibre support costs.

SUPPORT OPEX TRENDS

Unallocated support opex has fallen historically, and we forecast it will stabilise. Fibre will continue its trend of accounting for a growing share.

The below table shows the forecast opex by regulatory year, broken into sub-categories.

TABLE 14.1: SUPPORT OPEX (PQP2 PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

	2025	2026	2027	2028	TOTAL PQP2
Corporate	49.7	50.8	51.4	51.6	203.5
Asset Management	23.4	23.7	23.8	23.9	94.8
Technology	24.0	23.6	23.2	23.3	94.1
SUPPORT TOTAL	97.1	98.1	98.4	98.8	392.4

14.3 Corporate

14.3.1 Scope and rationale

Our Corporate opex includes the cost of:

- corporate teams
- accommodation
- other business costs.

Corporate teams includes costs related to:

- our Board – provides governance and oversight for all business activities
- executive team – responsible for our corporate strategy and management of our business
- business support teams – support and admin teams assisting with daily operations
- finance team – leads financial planning, financial control, management accounting and internal/external reporting
- people and culture – contribute to the future of the business through developing strategic people and capability plans and ensuring we have the right operating model in place
- corporate, regulatory and legal affairs team – enable legal, regulatory and governance outcomes that support our strategic business ambitions.

Our accommodation opex includes the operating costs (e.g. power, cleaning, maintenance, lease charges and security) of our corporate office locations that house our staff across Aotearoa.[90]

Other material cost items covered in the Corporate sub-category include:[91]

- audit fees and services – fees for the statutory audit, half-year review, information disclosure, internal controls audit, three yearly regulatory audit, TDL audit, telecommunications service obligations audit and general advice
- consultancy and legal services – costs to bring in specialist expertise for project work or advice
- insurance – fees for insurance to cover material damage, business interruption, directors and officers, and general insurance premiums
- corporate office expenses – communication costs, printing, postage, stationery, travel, etc.

CORPORATE

Corporate includes corporate labour and accommodation, insurance costs, and external audit, consultancy, and legal fees.

90 The majority of these lease costs are capitalised as a lease under IFRS 16.
91 For management purposes we also track regulatory levies via our Corporate opex. However, as these are pass-through costs as per the Input Methodologies (IMs), these expenses do not appear in our expenditure proposal. Regulatory levies include fees for the Telecommunications Development Levy (TDL), telecommunications regulations levy and building block model levy.

All these types of Corporate opex are necessary to meet compliance obligations, or support our operations.

14.3.2 Resourcing model

We retain internal resources for most functions, with external support where this provides:

- independence, for example audit activities
- efficient access to flexible capacity, or specialised expertise.

STEP CHANGES

We are forecasting step changes relating to external assurance costs, and asset management improvement initiatives.

14.3.3 Expenditure forecast

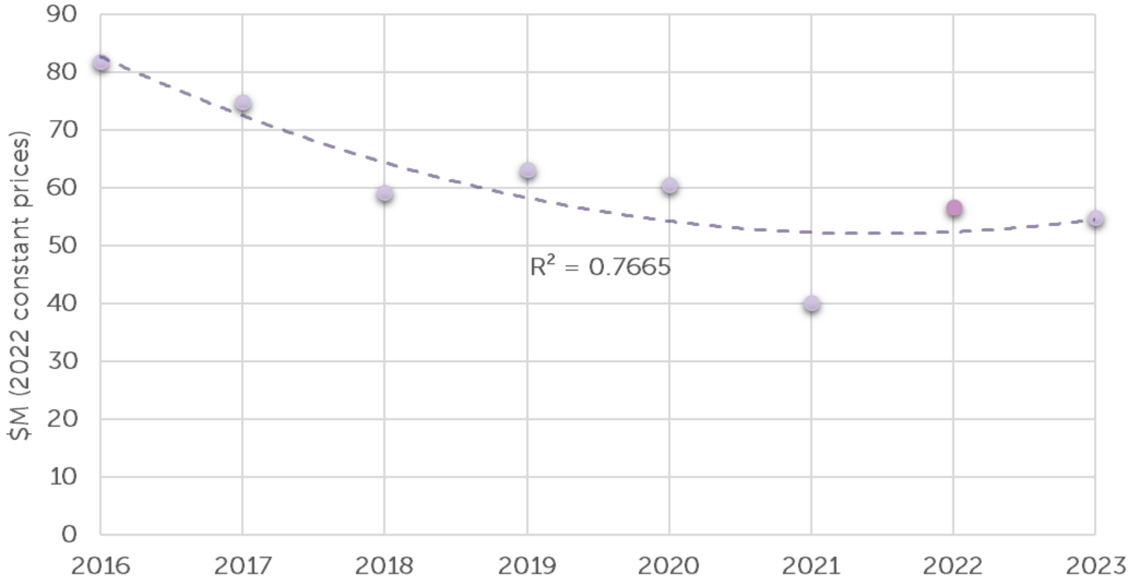
The table below summarises Corporate opex base year adjustments, step changes and trends.

TABLE 14.2: CORPORATE BST ADJUSTMENTS (PQ FFLAS)

AREA	BASE YEAR ADJUSTMENTS	STEP-CHANGES	TREND	OPEX/CAPEX TRADE-OFFS
Corporate	+$1.2m Base year adjustment needed as self-insurance costs for uninsured portion of the network not covered via existing insurance policies.	+$5.5m total over PQP2 We expect a step-up in external assurance costs required to meet new compliance obligations for PQ, ID and climate reporting, and to resource delivery of asset management improvement initiatives.	Most corporate costs do not scale with connections. A small proportion (i.e. 'other network' and 'advertising' costs) scale with total connections and fibre connections respectively, with 0.45 and 0.65 elasticities respectively.	None

The chart below shows the trend in unallocated historical Corporate opex, which removes the effect of shifting allocations and best illustrates the reasonableness of the 2022 base year. We have added a trend line that uses a second-order polynomial to achieve a good fit with historical data.

FIGURE 14.2: HISTORICAL CORPORATE OPEX TREND (UNALLOCATED)



Corporate opex reduced over the period from 2016 to 2020, due organisational changes. The 2022 base year is in-line with trend, and within the bounds of normal year-to-year variation.

Our forecast carries the base year forward with an adjustment for self-insurance, and a step for new assurance and compliance costs, but is not altered by trends.

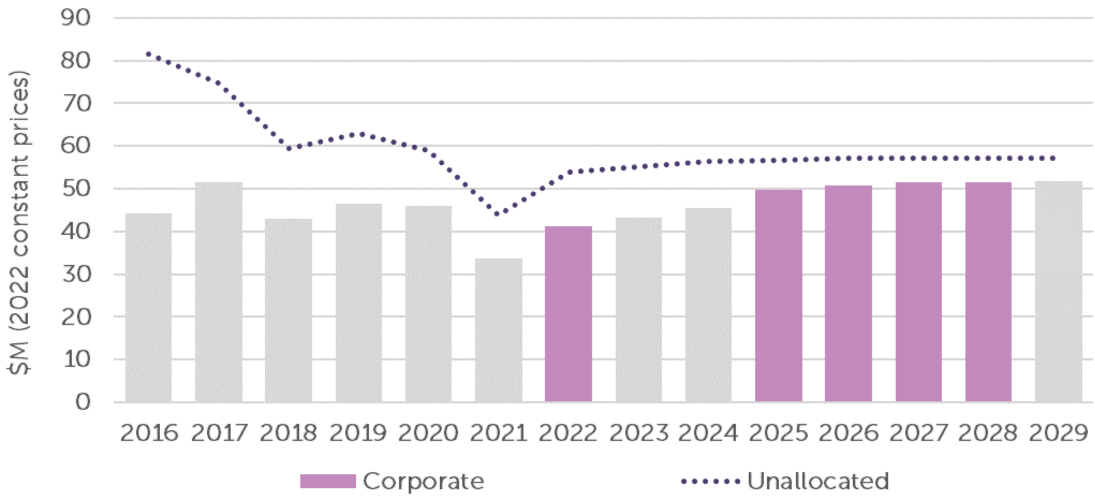
Our step change is reasonable because it meets the following criteria:

- Additionality – these costs are not captured by changes in connection volume as these are external shocks and are therefore not captured elsewhere
- Confidence – formal obligations give us confidence around timing and recent processes have illustrated quantum range
- Prudency – the increase in compliance and sustainability audits are in response to new regulatory and commercial obligations. These are required to give stakeholders assurance we are meeting our obligations.

CORPORATE TREND

Unallocated Corporate costs have reduced over time, then levelled out.

FIGURE 14.3: CORPORATE OPEX (UNALLOCATED AND PQ FFLAS)



14.4 Asset Management

14.4.1 Scope and rationale

Our Asset Management opex includes the cost of internal resources across two parts of Chorus:

- Chief Technology Office (CTO)
- Customer and Network Operations (CNO).

ASSET MANAGEMENT

Asset Management includes engineering and other specialist resourcing across our CTO and CNO teams.

CTO is responsible for defining, planning, and executing our technology strategy and asset management strategy, as well as planning network capacity, deploying new network technologies, delivering IT change and operating our technology. This provides the engineering and other specialist resources needed to ensure successful management of network assets and supporting systems.

Asset Management opex captures the portion of CNO that supports operational activities. This covers matters such as programme management, contract management, reporting and insights, process optimisation and health and safety management.

Because cost centres have been reallocated between CTO and CNO historically, we have analysed expenditure on a combined basis.

14.4.2 Resourcing model

CTO and CNO have in-house teams, supplemented by specialist resources as needed (i.e. to access special skills and expertise or supplement in-house capacity).

Our in-house CTO team are focused on the following activities:

- technology leadership

- technology investment and asset management
- strategic technology planning and governance
- data and analytics, business insight and decision support
- technology supplier management
- technology operations and security.

Our CNO teams are focused on the following activities:

- programme management
- contract management
- records management
- property operations
- consent acquisition
- network scoping
- health, safety and environment
- process optimisation
- reporting and insights.

14.4.3 Expenditure forecast

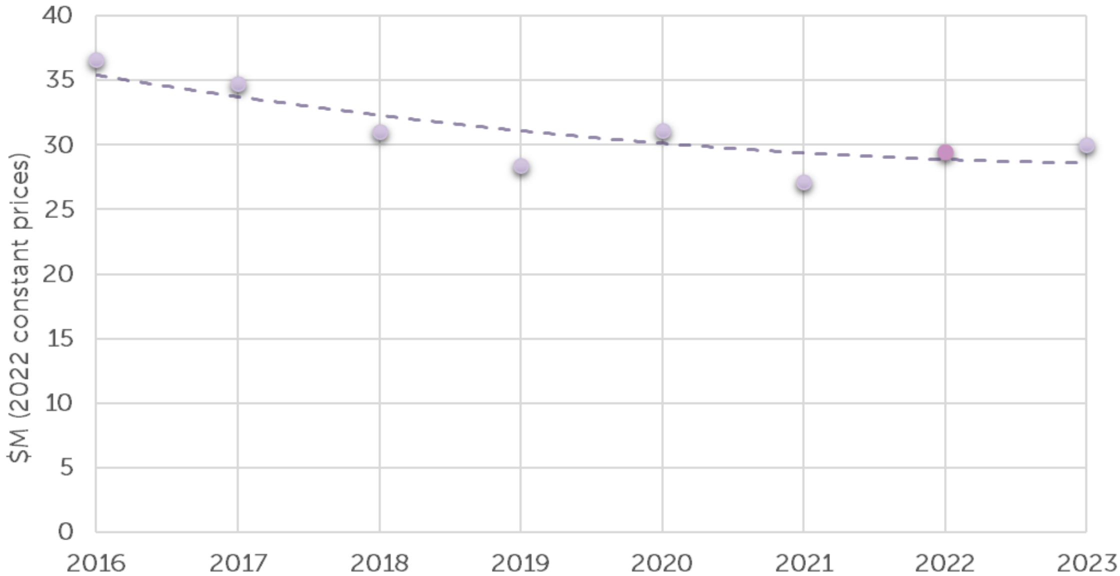
The table below shows that there are no base year adjustments, step-changes or trends for either area of our Asset Management opex forecast.

TABLE 14.3: ASSET MANAGEMENT BST ADJUSTMENTS (PQ FFLAS)

AREA	BASE YEAR ADJUSTMENTS	STEP-CHANGES	TREND	OPEX/CAPEX TRADE-OFFS
Asset Management	None Adopted 2022 actual expenditure without adjustment.	None	Most asset management costs do not scale with connections. A small proportion (i.e. 'other network' and 'advertising' costs) scale with total connections and fibre connections respectively, with 0.45 and 0.65 elasticities respectively.	None

The chart below shows the trend in unallocated historical Asset Management opex, which removes the effect of shifting allocations and best illustrates the reasonableness of the 2022 base year. We have added a trend line that uses a second-order polynomial to achieve a good fit with historical data.

FIGURE 14.4: HISTORICAL ASSET MANAGEMENT OPEX TREND (UNALLOCATED)



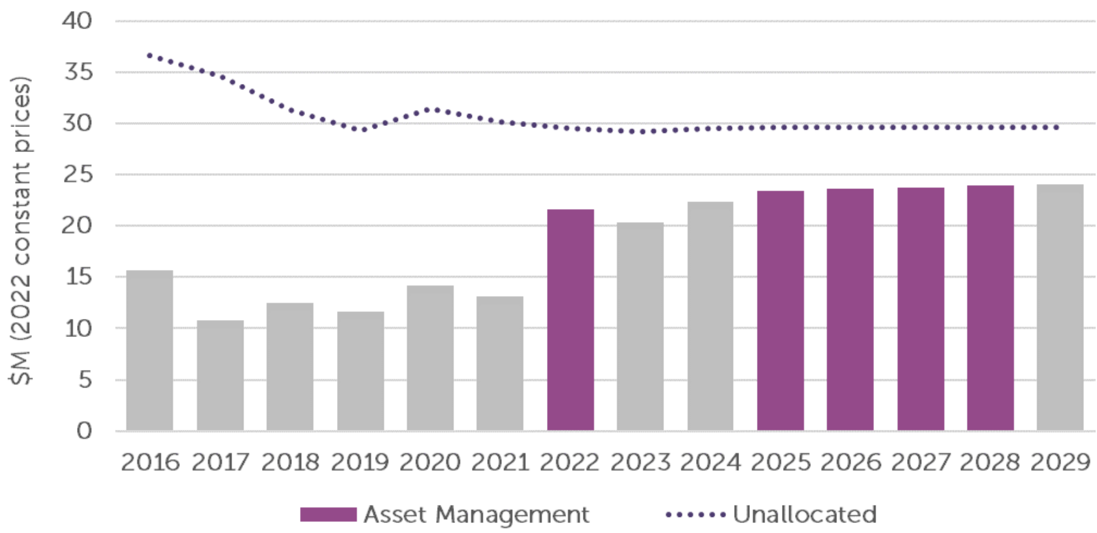
Asset Management opex reduced over the period from 2016 to 2019, due to a higher degree of capitalised labour and have since stabilised with relatively small year-on-year variation. The 2022 base year is in-line with trend, and within the bounds of normal year-to-year variation. As such, we have not proposed any base year adjustment for asset management.

Our forecast carries the base year forward with no adjustments, steps, or trends. This leaves allocation as the driver of change for our forecast – noting that we do not expect declining copper volumes to have a significant impact on Asset Management opex until such time as copper products and associated infrastructure are removed altogether.

ASSET MANAGEMENT

Unallocated Asset Management costs have reduced over time, then levelled out.

FIGURE 14.5: ASSET MANAGEMENT OPEX (UNALLOCATED AND PQ FFLAS)



14.5 Technology

14.5.1 Scope and rationale

The Technology sub-category covers external costs associated with IT and network systems, including licenses, support contracts, maintenance, and outsourced technology services. It does not include internal technology labour spend – this is included in the Asset Management sub-category discussed above.

This opex is necessary to support and maintain the systems that support customer, network, or business functions. It allows Chorus to access, operate, repair, and coordinate change to these systems, as well as making sure they remain secure and current.

Furthermore, outsourced technology service costs are necessary for processes that are executed by external technology suppliers who are better suited (either through capability or ability to scale) to run those processes than Chorus.

TECHNOLOGY

Technology covers external costs associated with IT and network systems, including licences, support contracts and outsourced services.

14.5.2 Resourcing model

The precise mix of internally building vs. outsourcing these IT and network systems and the level of support and maintenance required for them is determined on a case-by-case basis (but consistent with architecture principles and technology strategies). Our solutions balance cost, functionality, service levels and risk, flexibility, and competitive tension.

In general, our approach is as follows:

- Licencing – we are frequently required to contract for the use of our software or hardware. We also pay subscription costs for cloud-based software for our integrated platforms, email and analytical tools.
- Support and maintenance – we outsource for specialist support for our technology including proactive maintenance and fault restoration. The cost is mainly for technical specialist resources and consultants to resolve issues and maintain the software or hardware. This can include extended support costs to allow continued use beyond standard vendor support dates.
- Outsourced technology services – we outsource technology services for scale, expertise and ultimately cost. This includes IT service management functions such as service desk, security management, change management, incident and problem management and capacity management. This also includes network management functions such as the network operations centre (NOC), network inventory repairs and returns for network line-cards and optical network terminals (ONTs), and second and third level technology support for network element management platforms.

When Chorus and Spark separated, we had extensive shared systems and network components for which we paid fees to Spark. We have invested to reduce our dependence on shared systems over time. This approach:

- is cost effective, including because it allows for contestable procurement
- reduces reliance on a large company that is both competitor and customer
- allows each organisation to ensure their systems suit their diverging needs.

When we select new technology or new technology solutions, we use a Technology Selection process and our Chorus procurement processes. These processes consider and seek to best balance factors such as innovation and capability, investment, and total cost of ownership, integrity and risk, integration and compatibility, and information and regulatory fit.

SPARK

When Chorus and Spark separated, we had extensive shared systems for which we paid fees to Spark. We have been investing to reduce this dependency over time.

14.5.3 Expenditure forecast

The table below shows that there are no base year adjustments, step-changes or trends for our Technology opex, but we do include an opex/capex trade-off.

TABLE 14.4: TECHNOLOGY BST ADJUSTMENTS (PQ FFLAS)

AREA	BASE YEAR ADJUSTMENTS	STEP-CHANGES	TREND	OPEX/CAPEX TRADE-OFFS
Technology	None Adopted 2022 actual expenditure without adjustment.	None	None Costs do not scale with connections.	-$12.7m over PQP2 We expect a portion of the optimisation component of our IT investment will be directed at reducing our operating costs

The key trends in technology opex have been:

- decreasing payments to Spark for shared systems as we have established and then transitioned to our own systems. This contributed to consistent year-on-year reductions in total (and unallocated) technology opex from 2016 to 2020
- ongoing optimisation as we trade-off between capex and opex solutions, and manage technology costs through contract renewals
- increasing allocation to PQ FFLAS as fibre connections have grown and copper connections have reduced.

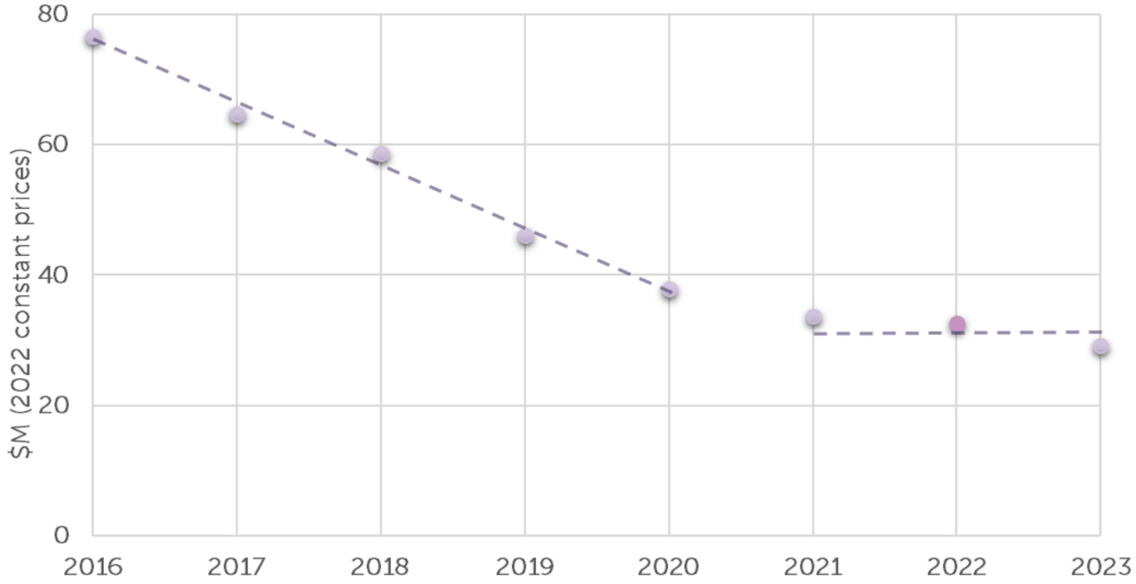
The chart below shows the trend in unallocated historical Technology opex, which removes the effect of allocations and best highlights the reasonableness of the 2022 base year. We have manually indicated linear trend lines for the 2016 to 2020 period, and the period from 2021 to 2023 (noting that 2023 includes six months of actuals and six months of forecast).

TECHNOLOGY OPEX TRENDS

Technology costs declined as we invested to reduce our dependence on Spark shared systems.

The chart shows that the 2022 year is consistent with a flat post-separation trend and within the range of normal year-to-year variation against trend.

FIGURE 14.6: HISTORICAL TECHNOLOGY OPEX TREND (UNALLOCATED)



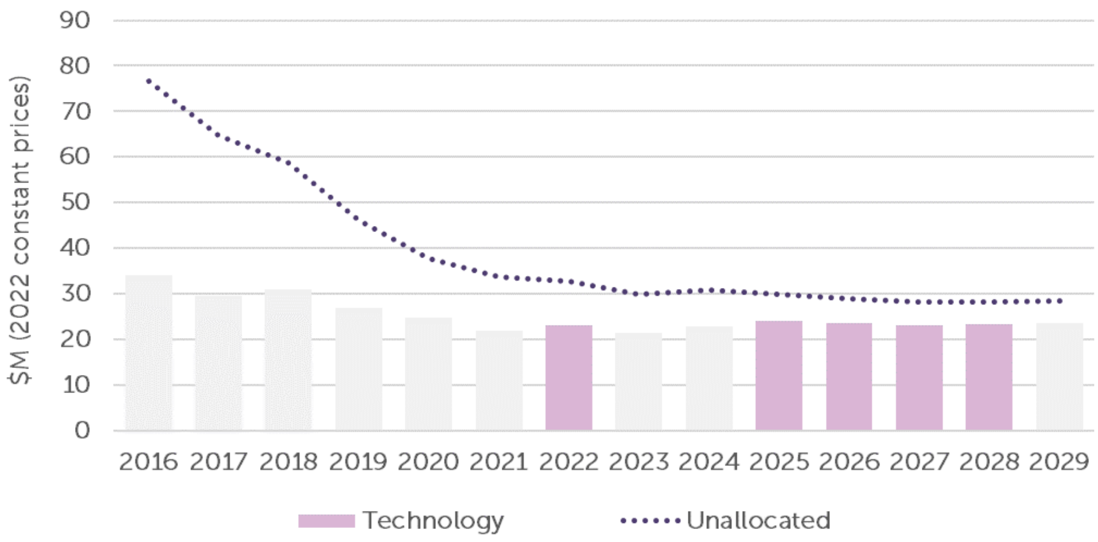
The opex/capex change removes $12.7 million of PQ FFLAS opex in total across PQP2. This reduction is based on assumptions that:

- 7% of IT capex is directed at projects that reduce opex, amounting to $11.4m in PQP2 or $2.9m per year
- to break even, opex reduction projects need to achieve an average reduction of $2.9m per year for five years
- the timing of opex reduction projects is uncertain, so we have simply spread savings across the period (starting from 2023).

The net effect of these step changes and changes in allocations are shown in the chart below of PQ FFLAS Technology opex, with notable features being:

- the $3 million reduction between 2020 and 2023
- a gradual increase driven by higher allocation to PQ FFLAS, noting that we do not expect the decline in copper connections to drive *any* cost savings in this area (so shared costs are reallocated to fibre over time).

FIGURE 14.7: TECHNOLOGY OPEX (UNALLOCATED AND PQ FFLAS)



14.6 Links and synergies

14.6.1 Other expenditure categories

Support opex provides context and supporting frameworks (such as policies, strategies, and plans) within which all other activities are carried out, including all opex and capex.

Our Technology opex links to other expenditure areas:

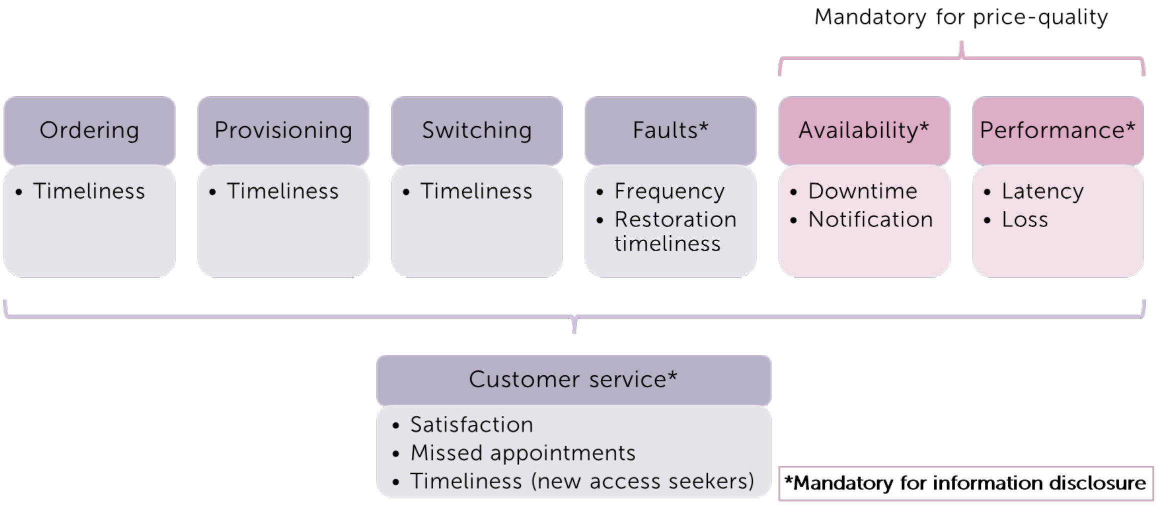
- some system costs are capitalised, including to Installations capex
- Technology opex supports the systems created through IT capex, and we sometimes have the option to purchase IT services (Technology opex) rather than building or modifying systems (IT capex) where this provides a lower whole-of-life cost
- some Technology opex links to headcount, which is distributed across Customer, Network and Support Opex.

The Asset Management component of the Customer Operations and Network Operations activities are captured in Support opex.

14.6.2 Quality dimensions

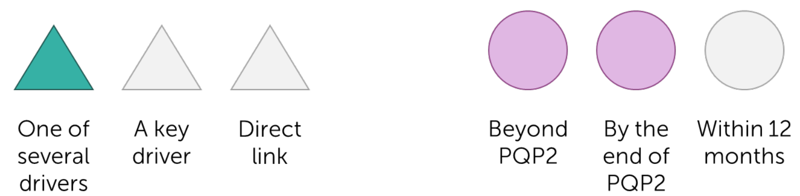
The Fibre Input Methodologies define six lifecycle- based quality dimensions and one over-arching customer service quality dimension. Two quality dimensions are mandatory for PQ regulation, meaning they must have associated quality standards. Four dimensions (including the two PQ dimensions) are mandatory for information disclosure.

FIGURE 14.8: QUALITY DIMENSIONS AS DEFINED IN THE FIBRE IMS



Each discussion of linkages between expenditure and quality includes a summary with simple icons to depict the strength and pace of each linkage. The icons provide a broad characterisation, rather than a precise assessment.

TABLE 14.5: LINKS BETWEEN SUPPORT OPEX AND OUR QUALITY DIMENSIONS



DIMENSION(S)	EXPENDITURE SUB-CATEGORIES	STRENGTH	PACE
Performance	Asset Management Our engineering teams manage Network Capacity. Our IT teams manage IT platform operations, capacity and performance.		
Availability and faults	Asset Management Our engineering teams manage network risk. Our IT teams manage planning, capacity and performance of the IT platforms that support availability and fault management.		

DIMENSION(S)	EXPENDITURE SUB-CATEGORIES	STRENGTH	PACE
Availability and faults	Technology We can’t take or fix faults without working and well-supported IT, including licensing, hosting and support.	▲▲△	●●○
Customer service	Asset Management Our engineers aim to align network quality and performance with customer and consumer preferences over time. Our IT teams plan the capacity, performance, and new capability required to deliver customer service expectations.	▲▲△	●○○
Customer service	Technology We can’t take orders, fix faults, provide network and product availability information, or manage customer interactions without working and well-supported IT, including licensing, hosting and support.	▲▲△	●●○
Switching	Asset Management Our IT and engineering teams plan the capacity, performance, and new capability required to meet current and emerging customer switching expectations.	▲▲△	●●○
Switching	Technology Our switching activities require working and well-supported IT, including licensing, hosting and support.	▲▲△	●●○
Provisioning	Asset Management Our engineering teams plan the Network Capacity, inventory and new capability required to meet customer provisioning service expectations. Our IT teams plan the capacity, performance, and new capability required to deliver capability to meet customer provisioning service expectations.	▲▲△	●●○
Provisioning	Technology Our provisioning activities require working and well-supported IT, including licensing, hosting and support.	▲▲△	●●○
Ordering	Asset Management Our IT teams plan the capacity, performance, and new capability required to deliver customer ordering service expectations.	▲▲△	●●○
Ordering	Technology We can’t take orders without working and well-supported IT, including licensing, hosting and support.	▲▲△	●●○

Corporate opex links to quality dimensions:

- by supporting our ability to deliver services.

Asset Management work links to quality dimensions:

- by helping to understand quality preferences and network performance, and guiding network investment accordingly to drive customer service satisfaction.

Technology opex links to quality dimensions:

- by supporting the systems used to deliver services.

15.0 FIBRE FRONTIER

Ngā Urutaunga ki Tua

15.0 Fibre Frontier

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

15.1 Our proposal

Over the four years of PQP2 we are proposing to spend $201 million (2022 constant prices) to provide communal fibre infrastructure to a further 40,506 premises. This would increase the current overall fibre network coverage in Aotearoa from 87% to 89.2% as part of our Fibre Frontier build programme.

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

	2025	2026	2027	2028	TOTAL PQP2
Fibre Frontier capex	47.1	48.7	49.4	55.9	201.1

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 from 87% to 89.2% of premises in Aotearoa.

$201.1m

89.2%

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 come from end-users adopting more and more digital services as well as the shift from traditional media consumption to online video.[92]

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.[93] 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.[94] 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.[95]

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.[96] 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.[97] 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

92 Where Are The Audiences 2021? NZ on Air, https://www.nzonair.govt.nz/research/where-are-audiences-2021/
93 MBNZ Autumn 2020 Report
94 https://www.nzherald.co.nz/nz/back-to-the-office-the-great-hybrid-return-to-work/R6V3XS2WTSWZT5NUME2JCOU4QE/
95 New Zealand's Internet Insights 2022, InternetNZ, https://internetnz.nz/assets/Uploads/Internet-insights-2022.pdf, December 2022.
96 "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.
97 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.[98]

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.[99] It is largely these populations that we are intending to cover as part of our PQP2 network expansion proposal.

98 Request for Proposals: Remote Users Scheme 2023, Crown Infrastructure Partners, April 2023.
99 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.[100]

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).[101] 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:[102]

> *"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."*

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

100 Annual Telecommunications Monitoring Report 2021, Commerce Commission, 17 March 2022, p5.
101 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
102 *Lifting Connectivity in Aotearoa (LCIA),* Ministry of Business, Innovation, and Employment, December 2022, p21.

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.

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.[103]

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.[104] 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:[105]

> *"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: [106]

> *"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*

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

103 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.
104 Measuring Broadband New Zealand, Autumn Report, May 2020, p4.
105 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%.
106 LCIA, p33.

customers, and access a greater volume and quality of information."

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.[107]

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.[108] 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.[109]

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.[110] 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:[111]

"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

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

107 LCIA, p41.
108 LCIA, p37.
109 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
110 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=
111 Benoit Felton & Karim Bensassi-Nour, Plum Consulting, Approaches to rural broadband in Europe, 2022.

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.

15.2.7 Improving rural connectivity is in line with government policy

The government recently acknowledged the importance and need for improved connectivity:[112]

> *"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:[113]

> *"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:[114]

> *"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.

112 Lifting Connectivity in New Zealand, MBIE, December 2022.
113 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.
114 Ibid.

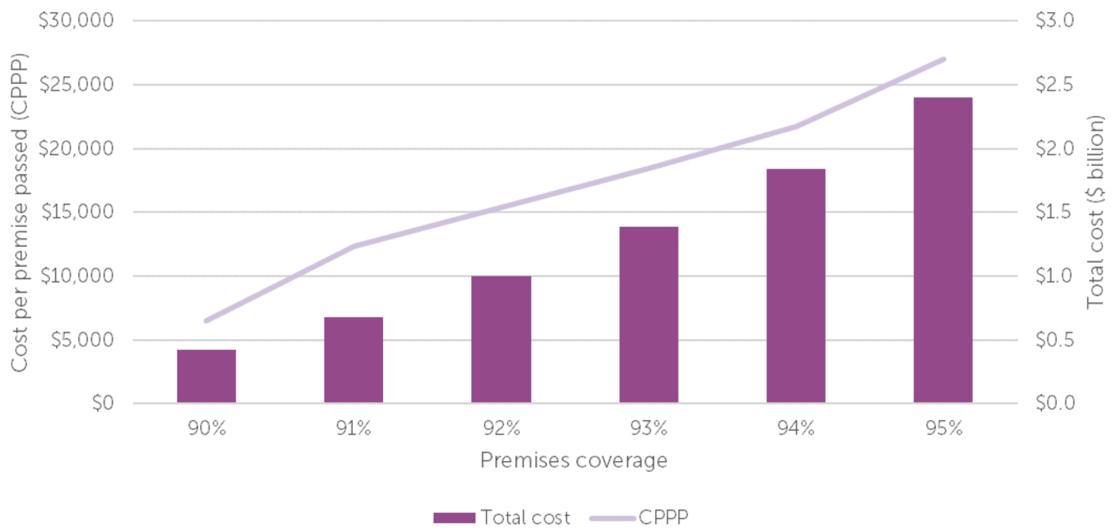
We are seeking funding in PQP2 for our Fibre Frontier build program, which we forecast to be $201m (2022 constant prices) which will see an additional 40,500 New Zealanders getting access to fibre. Any spend beyond PQP2 will be subject to market conditions to ensure investment is economic and in the best interest of end-users. We also plan to remain agile and consider opportunities to accelerate the build if and when they present themselves.

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.

Following the initial development of the cost model for the proposed network extension, we had an internal reviewer build their own arms-length model to act as a check and validate our proposed costings.

We tested the market in September 2023 with the first tranche of build, which is planned to commence in 2024. This market testing validated our costing model and gave us greater cost surety. However, further testing will be required to validate costings for the investment planned to occur during PQP2.

DELIVERY TRACK RECORD

We delivered the UFB programme on time and on time.

15.3.4 1,000km+ of fibre to be laid in PQP2 to 40,506 premises

A key cost driver of the rollout is the number of premises we are passing and the distance between them. We have completed desktop planning for each of the 220 areas we plan to build in PQP2. This will require:

- reaching 40,506 new premises – we identified this number by leveraging Chorus planning tools to identify the build boundaries and performing an address count
- laying 1,047km of new fibre – we calculated the meterage of fibre we need to lay by considering the frontage length of each of these premises. This allowed us to determine a meterage of fibre roll out we will need to complete
- building 939km of new ducts – we calculated the meterage of new ducts by considering the amount of useful ducting we already have in these areas. Chorus has a copper network in some of the areas where we are looking to roll out fibre, which provides some opportunities for efficiencies. From our desktop survey, we estimate that around 70% of spare ducting and 30% of used ducting could be leveraged for building fibre, for a total of 107km. The remaining meterage of new fibre will require new ducting. This is again based on our experiences in the UFB rollout.

FIBRE FRONTIER PLAN

220

Areas

40,506

Premises

1,047km

New fibre

939km

Ducts

15.3.5 Costings to roll out fibre

We considered a range of inputs in determining the cost to roll out fibre. The table below breaks down the key costings of the PQP2 spend of $201m (at today's costs):

TABLE 15.3: KEY COSTING INPUTS

CATEGORY	SPEND	INPUT 1	INPUT 2	NOTES
Civils – fibre lay cost	CCI [ ]	939km	CCI [ ]	Using existing service company civil costs per meter in our different Customer Service Areas (CSAs) across the country and meterage to be built
Consigned materials – L1 fibre	CCI [ ]	1,047km	CCI [ ]	Per meter cost of ribbonet and microduct required for rollout
Consigned materials – misc. cost	CCI [ ]	107km	CCI [ ]	Additional cost required for material leveraging existing ducting
Service company time – installation (hauling, splicing, pits etc.)	CCI [ ]	38,691 prems. (excl. existing duct programme)	CCI [ ]	Using existing service company cost codes in our different CSAs across the country
Service company time – laterals	CCI [ ]	38,691 prems. (excl. existing duct programme)	CCI [ ]	Using existing service company cost codes in our different CSAs across the country
Service company time – variations	CCI [ ]	1,047km	CCI [ ]	Based on UFB experience, sometimes the opposite side of the road is fed by aerial drops. As such, route length does not consider the entire route length. CCI [ ] allowance for additional civil works
GPON costs	CCI [ ]	44 new sites	CCI [ ]	Rolling out fibre into these areas requires new GPON cabinets at a cost of CCI [ ] per site where needed
Design costs per premises	CCI [ ]	38,691 prems. (excl. existing duct programme)	CCI [ ]	Small amount of service company design time required per premises
Chorus Project Management	CCI [ ]	$149.4m	CCI [ ]	Chorus PM time represents an additional CCI [ ] of service company field time
Existing duct programme	CCI [ ]	1,815	CCI [ ]	Additional notes provided below

CATEGORY	SPEND	INPUT 1	INPUT 2	NOTES
Layer 1 subtotal	$173.8m			($0.1m rounding difference)
Layer 2 GPON cards	CCI [ ]	40,506	CCI [ ]	Layer 2 GPON cards required per premises
Transport fibre	CCI [ ]	141km	CCI [ ]	In order to roll fibre out to these areas, many require additional backhaul fibre lays. An additional 141km of fibre is needed with costs using current actual service company costings. Additional notes provided below
TOTAL COST	$201.0M			

Where possible we have used current actual service company codes (the agreed prices for various activities as set in our Field Services Agreements with our subcontracted service companies) and current actual material costs.

Our costing estimates represent our balancing of the likely build conditions we will face, while acknowledging there is some uncertainty when entering new communities where we have not previously built fibre. They also reflect our current level of build efficiency, incorporating the efficiency gains we made over the UFB build programme. Once the programme is up and running, we will seek opportunities to further improve our efficiency in these areas.

Our experience has shown that a large-scale build programme generally provides more efficient pricing from our delivery partners (service companies) as larger programmes provide certainty and the ability to make longer term commitments on equipment and staff. At this stage our estimates are built on existing contracted rates with our service company partners.

15.3.6 Physical attributes of proposed areas are a key consideration in cost to deploy

The most significant cost in deploying fibre is the cost to physically take the fibre or ducting past the premises to be connected. Depending on the area this can be done in a number of ways, for example:

- trenching – digging and placing ducts in trenches
- mole ploughing – using a tractor to bury the cable as it drives along a grass berm
- aerial deployment – stringing the cable along poles (most commonly electricity network assets).

DEPLOYMENT COSTS

The most significant cost for deploying fibre is the cost to physically take the fibre or ducting past the premises to be connected.

These each come with different cost profiles, with trenching being the most expensive. The ability to use these methods is also dependant on the physical attributes of an area. For example, if there is a berm wide enough to bury the cable in the side of a road, we can use mole ploughing, which is one of the cheaper methods. However, this is usually only possible in rural environments, whereas most of our proposed build areas for PQP2 are more similar to our UFB2 areas (i.e. largely urban fringe), so we expect only around 30% of fibre lays will be able to use mole ploughing.

Aerial deployment is another potentially cheaper method, however this cost saving can be offset by the variable condition of poles in an area, with existing electricity line poles often requiring upgrades at cost to Chorus in order to also carry a fibre network. While we will investigate the extent to which this provides a viable option as detailed deployment is planned in an area, in the UFB2/2+ programmes we were unable to deliver any core network via aerial methods, so our current assumption for aerial deployment of the PQP2 network extension is 0%.

Existing duct programme – CCI [ ] premises

As part of establishing the most efficient (i.e. in cost per premises passed) build programme for network extension, we undertook an exercise to identify the extent to which we had existing duct outside of existing UFB areas that could be utilised to provide fibre services. This includes fibre deployed under the initial Rural Broadband Initiative for schools, and other network diversity assets.

Through this process we identified an additional **CCI [ ]** premises to include within the PQP2 proposal. We reviewed all Chorus' existing '7 way' and '12+3 way' micro duct (with numbers referring to the size and number of smaller ducts within a larger duct and therefore the capacity each can provide). These existing ducts can be used to provide fibre services without incurring significant additional civil build costs.

The average Layer 1 cost of delivering fibre to each of these premises has therefore been calculated as **CCI [ ]**. This was derived from the costs of:

- leveraging the existing ducting (**CCI [ ]** per premises)
- pulling in additional fibre and establishing splitters (**CCI [ ]** per premises)
- lateral builds on either side of the road (**CCI [ ]** per premises) – this core network fibre is laid along a single side of a road, so estimates include trenching costs for crossing roads 50% of the time (assuming an even distribution of premises on each side of a road).

Transport fibre – additional backhaul build: CCI [ ]

Finally, we considered whether additional backhaul build is required to get fibre into the community. We have identified an additional 141km of backhaul fibre that will be needed to connect these communities at an average cost per metre of **CCI [ ]**. We derived the costings using current service company codes in the different CSAs across the country.

We assessed the meterage on a line-by-line basis using Chorus planning tools to identify where additional backhaul fibre is required to connect an area.

15.3.7 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).[115]

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 40,500 premises covered by fibre over PQP2. We will take these from the existing high-level planning we have completed out to 95% of Aotearoa.

15.3.8 Sequencing and deliverability of the programme

Below we summarise our considerations when phasing the initial elements of the build. Cost is a key element, but ensuring a strong level of uptake is also critical to deliver economic return on our investment. This means that we may not necessarily complete build to the cheapest premises in the first year or two of the programme if we expect to see lower uptake levels.

- **Cost of delivery** – we want to roll out fibre to as many premises as possible, so will mostly focus the programme on delivering the most cost-effective build in the early stages.
- **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.

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.

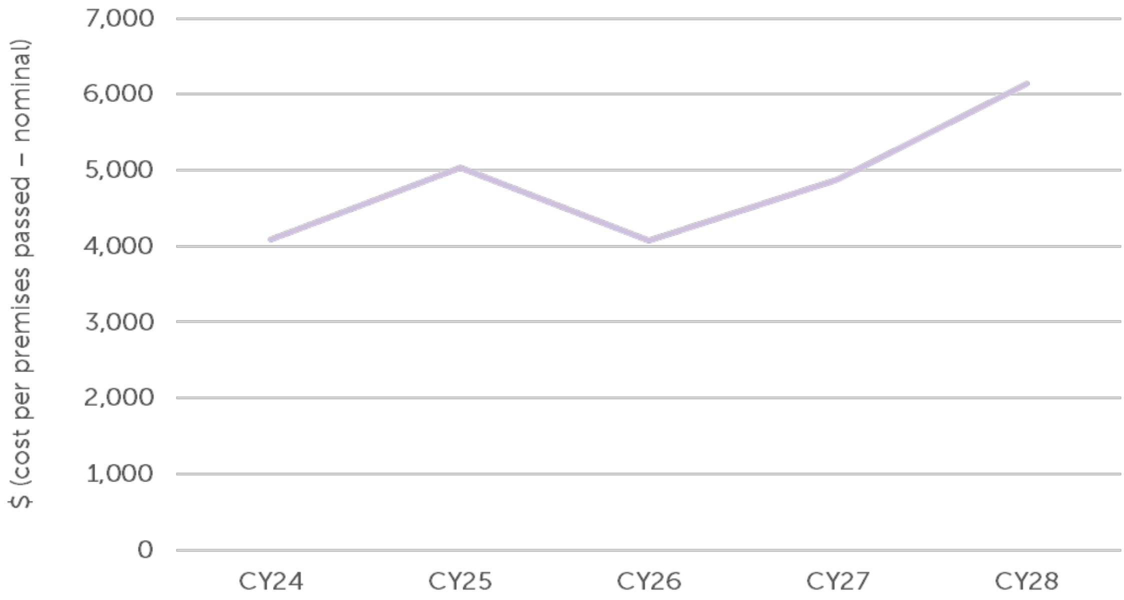
TAKE UP

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.

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

Once we identified the optimal build deployment area for the first phase of build (2024 and 2025), we have then sequenced the second phase on the basis of building to the lowest cost per premises first. This is why the chart below shows a lower cost per premises passed in 2026.

FIGURE 15.2: UNIT COST



15.4 Chorus Governance process around build extension

Given the nature and 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.

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.[116] 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.[117]

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

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.

WILLINGNESS TO PAY

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

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

116 Kantar, Rural Opportunities Research 2023.
117 Kantar, Understanding the investment preference of Chorus' key stakeholders, 2023

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.[118]

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.[119] 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%

WILLINGNESS TO PAY

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

Stakeholder feedback

118 Starlink offers huge hardware discount to rural users (farmersweekly.co.nz).
119 Kantar, Rural Opportunities Research 2023.

uptake would be $57 per connection per month, which is closely aligned to the wholesale price for fibre that Chorus would charge under the currently proposed price path.

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.

If we used an uptake rate of 80% (to reflect the uptake figure seen in end-user research and our experience in areas with established fibre)[120] this would reduce the break-even wholesale price to $51. This is below the current price path for fibre, so this network extension investment could be funded directly by the newly connected end-user base whilst generating incremental revenue that would help recover the cost of our initial UFB build and reduce prices for existing fibre end-users in the longer term.

EQUITY

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

Stakeholder feedback

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.

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

Network extension activity of this nature comes with an element of uncertainty, so we have included a range of sensitivities in our economic modelling below. 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.

EQUITY

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

Stakeholder feedback

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

120 In Chorus' Q3 FY23 Connections update published to NZX on 11 April, we note that UFB1 uptake grew to 76% (established build area); and UFB 2 areas grew to 54% which were build more recently. We also note a broadband retention rate of 88% on closed cabinets where Chorus withdraws copper services.

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.[121]

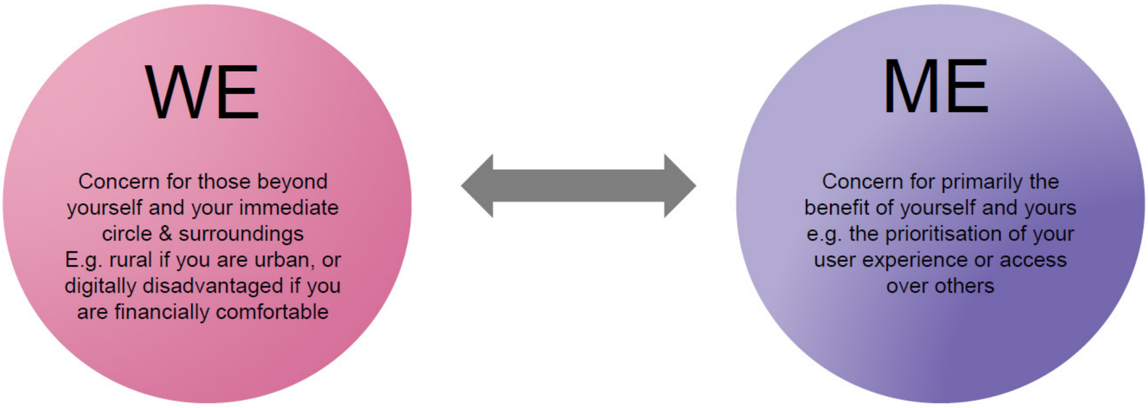
TABLE 15.4: FIBRE FRONTIER INVESTMENT OPTIONS PRESENTED TO STAKEHOLDERS

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:

121 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.

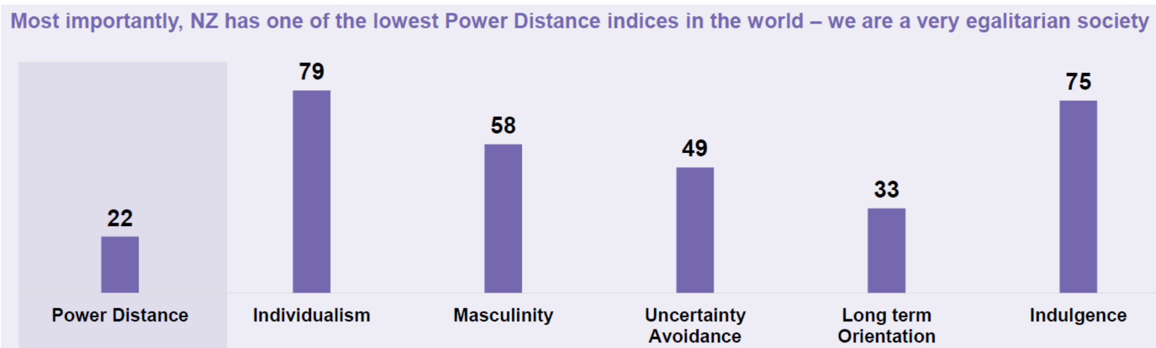
FIGURE 15.3: COLLECTIVE VS. INDIVIDUAL BENEFITS



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 15.4: 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[122]

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

122 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.

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."

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

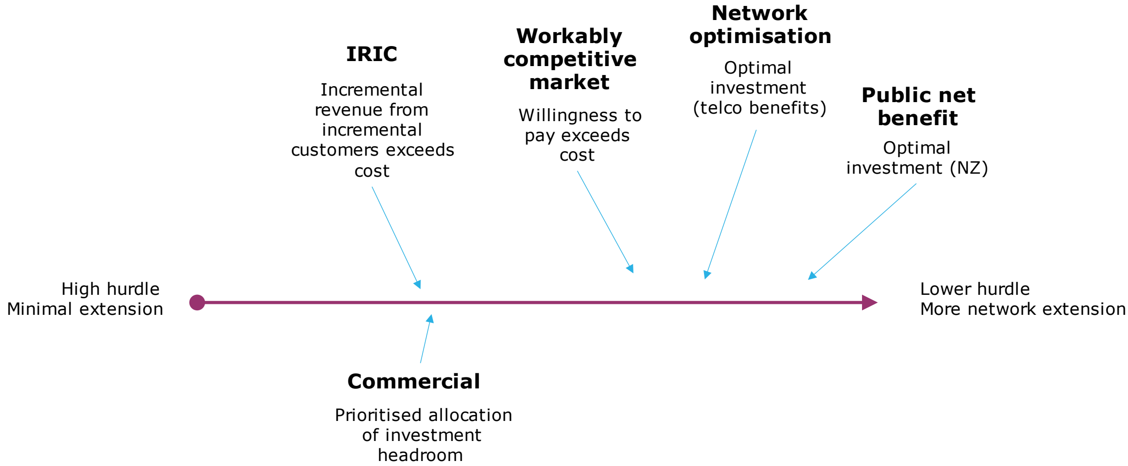
The Commission has previously formed a view on what this implied for the economic test it used to evaluate our proposal to invest in 2023 customer incentives. In that case, the Commission considered it was important to ensure that incentives did not amount to predatory pricing and decided investment 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."*[123]

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.

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

FIGURE 15.5: 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[124] 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

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.

124 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,

- our ability to finance new investment – we have limited debt headroom for new investment
- 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. 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.

15.7 Workably competitive market test

Our WCM test involves four steps:

1. calculate the incremental MAR from the proposed PQP2 investment
2. calculate the incremental MAR per connection if spread across the incremental connections (i.e. assuming no GCP)
3. estimate the required wholesale price at which the investment would breakeven.
4. 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.[125]

TABLE 15.6: INCREMENTAL MAR

PRICE-QUALITY PERIOD	PQP2				PQP3+				
Calendar year	2025	2026	2027	2028	2029	2030	2031	2032	2033
Incremental MAR ($m)	14.0	14.2	14.5	14.8	28.5	29.0	29.6	30.2	30.8

125 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.

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.

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)	441	185	111	73	89	74	75	77	78

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 $57 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 just marginally higher than our planned ARPU.

Any network extension beyond proposed PQP2 would 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 the premium required to satisfy the WCM test with 70% uptake. Supporting evidence for this judgement is that:

- research conducted by Kantar[126] found that CCI [ ]
- copper connections in rural areas have fallen below 50% of the market.[127] 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
- 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)	1.03	1.02	1.01	1.02	1.92	1.92	1.94	1.96	1.98

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, the impact on the bill would be much lower (and possibly close to zero) as our analysis has confirmed – see the sensitivity analysis below and in the Appendix to this chapter – 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.

126 Kantar, Rural Opportunities Research 2023.
127 Commerce Commission, 2022 Annual Monitoring report

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 will 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 substantial) MAR under-recovery associated with the Fibre Frontier investment will not manifest itself in higher prices, but may 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 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.

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).

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

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.

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).[128]

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.[129]

The challenge of FWA was described in Plum Consulting's report Approaches to rural broadband in Europe:[130]

> *"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*

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

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.

128 www.broadbandcompare.co.nz provides a sample of these when a rural address is entered.
129 NZ Government, Lifting Connectivity in Aotearoa, December 2022. P21.
130 Benoit Felton & Karim Bensassi-Nour, Plum Consulting, Approaches to rural broadband in Europe, 2022. P16.

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.[131] 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:[132]

"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 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.[133] 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,[134] 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:[135]

"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.

131 Ibid. p4
132 *A feast of urban broadband but rural internet a 'stale donut'*, Chris Keall, NZ Herald, 3 August 2021.
133 Crown Infrastructure Partners – RBI2/MBSF expansion announcement – Questions and Answers, 18 December 2018.
134 Kiwis to benefit from accelerated 5G roll-out, Minister David Clark, 20 October 2022.
135 Lifting Connectivity in Aotearoa, Ministry of Business, Innovation, and Employment, December 2022, p25.

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."[136] 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.[137] 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:[138]

> *"...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 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 macrocell 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."[139]

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.[140]

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

136 LCIA p25.
137 In 2014 the total revenue received by the Crown for the 700MHz spectrum auctioned was $259m.
138 *Juha Saarinen: Government rush to 5G trips up rural broadband*, NZ Herald, 3 May 2023.
139 Matt Yardley, Andrew Daly, Helena Fyles, Research on Very Hard to Reach Premises: technical and commercial analysis, Analysys Mason, 12 August 2021. P15.
140 NZ's big 4G rollout – progress report, NZ Herald, July 2014.

markets are facing economic headwinds, placing more emphasis than ever on cost control."[141]

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.[142] 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.[143]

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,[144] and in North America measures have been introduced to manage data usage due to capacity constraints.[145] 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.

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).

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.

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).

141 Are 5G Networks Meeting Consumers' Expectations? Ookla Insights Articles, February 2023.
142 Ookla Starlink Performance GraphQ2 2022: https://www.ookla.com/s/media/2022/09/ookla_satellite_internet_comparison_oceania_0922-01.png
143 Project Kuiper, https://www.aboutamazon.com/what-we-do/devices-services/project-kuiper, accessed April 2023.
144 Ookla Starlink Performance: https://www.ookla.com/articles/starlink-hughesnet-viasat-performance-q2-2022.
145 Starlink Fair Use Policy: Starlink Fair Use Policy - Starlink

TABLE 15.9: CHARACTERISTICS OF VARIOUS BROADBAND TECHNOLOGIES

	URBAN		RURAL				
	Fibre[146]	5G FWA[147]	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

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.

146 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.

147 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.

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% (for which we have included associated expenditure in our PQP2 proposal).

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[148] in the long term, however, we expect to reach 42% uptake by the end of PQP2. 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%.

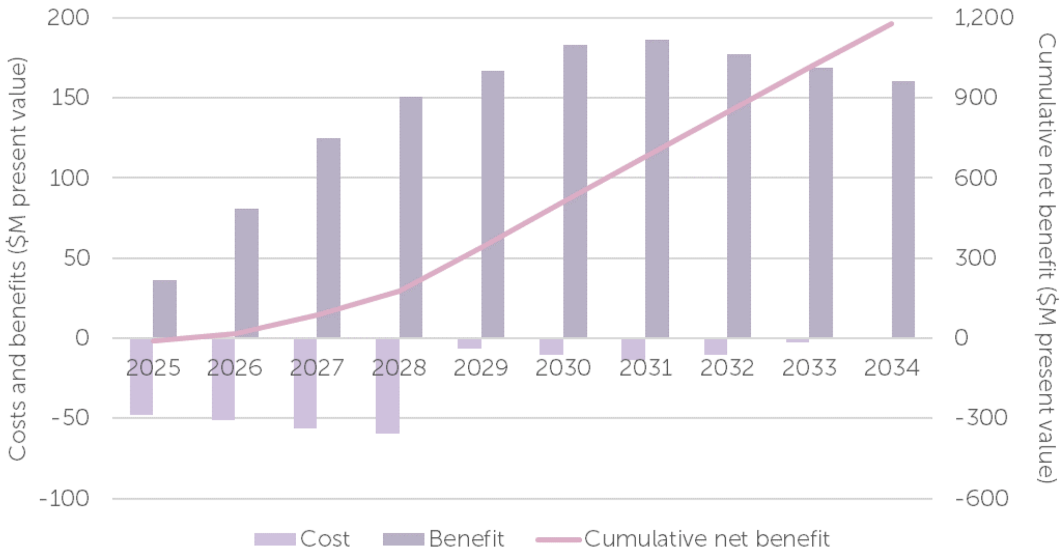
TABLE 15.10: COST BENEFIT ANALYSIS FOR FIBRE TO 89.2% (2022 CONSTANT PRICE TERMS)

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

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.

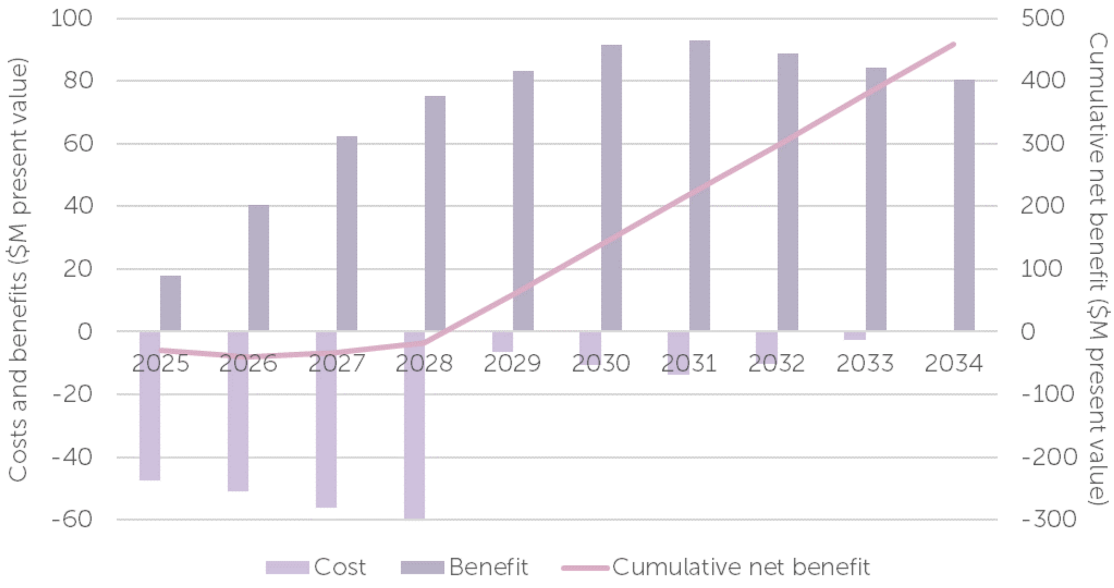
148 Kantar research commissioned by Chorus outlined 84% of rural users would be likely to take up a fibre service

FIGURE 15.6: COST BENEFIT ANALYSIS FOR FIBRE TO 89.2%



As shown by Figure 15.7, 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 15.7: 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.

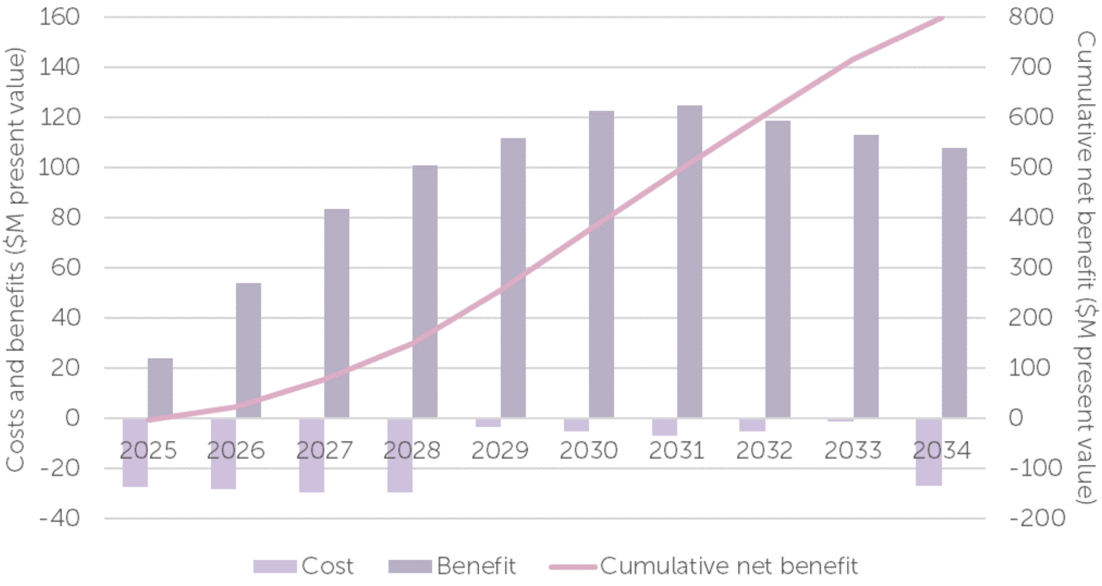
We anticipate that the installation cost for FWA will be somewhat lower than fibre because in some instances it will be possible to courier a modem/router to the end-user's premises. However, some installations will require a site visit in order to install an external aerial. On balance we've assumed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

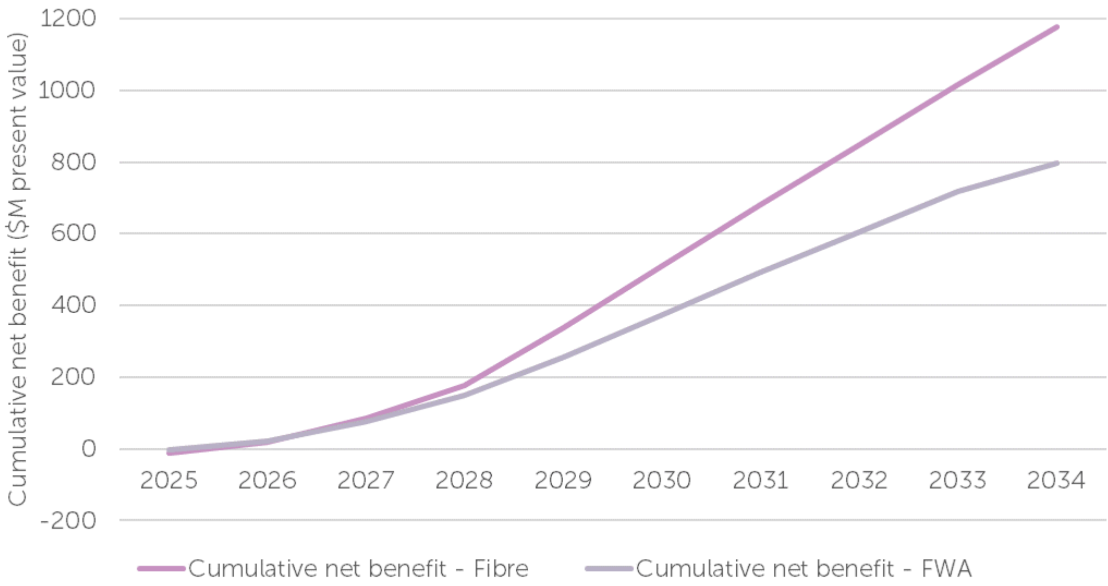
WIRELESS NET BENEFIT ANALYSIS	2025	2026	2027	2028	10 YEARS
Wireless network build cost	$27.0m	$27.0m	$27.0m	$27.0m	$135.0m
Connect cost	$0.4m	$1.4m	$2.4m	$2.6m	$28.7m
Apportioned NZIER benefits	$24.5m	$54.9m	$84.8m	$102.4m	$974.8m
Cumulative Net benefit	-$3.0m	$23.6m	$79.0m	$151.8m	$811.1m

FIGURE 15.8: 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 15.9: 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 $201m (2022 constant prices) to extend communal fibre to 40,506 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.[149]

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 comparable to 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 $57 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 our 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.

OUR PQP2 FIBRE FRONTIER INVESTMENT PASSES THE ECONOMIC TESTS

The breakeven wholesale price needed to justify investment would not only be competitive with offers from other networks, it would be comparable to our likely price path for fibre over the coming years. The wholesale monthly price required would be

$57

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).

149 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.

- 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.

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. 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, the cross-subsidisation of the Fibre Frontier investment by existing fibre end-users does not mean a rise in prices for them. Rather, it will 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.

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[150]	PQP2 WACC[151]
Incremental MAR per connection (all connections) @ Vanilla WACC	$1.25	$1.98
Break-even wholesale price per connection (new connections) @ Post-tax WACC	$38	$57

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 $125 million in present value terms ($780 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 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.

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

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.

As outlined above, we consider an 80% uptake assumption is possible, so have used it as our key sensitivity. At this uptake rate, the break-even wholesale price would drop to $51.40, **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.

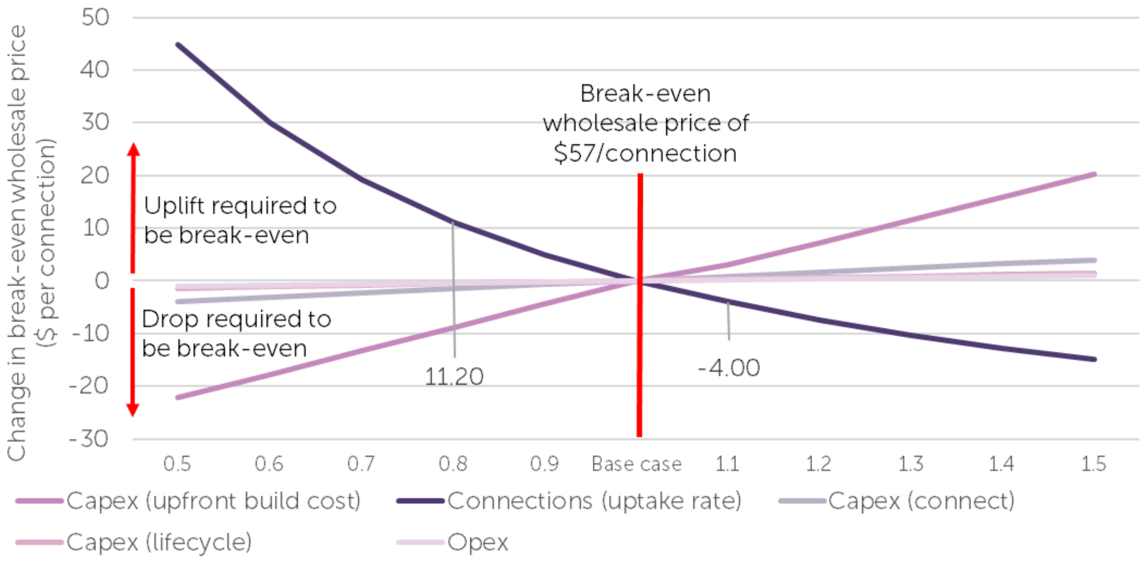
15.11.4 Break-even wholesale price sensitivity analysis

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 $57 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 $11.20 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 $4.00/connection to account for the revenue increase from more connections.

FIGURE 15.10: SENSITIVITY OF THE 2024 BREAK-EVEN WHOLESALE PRICE TO CHANGES INPUT ASSUMPTIONS (RELATIVE TO BASE CASE OF $57 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)

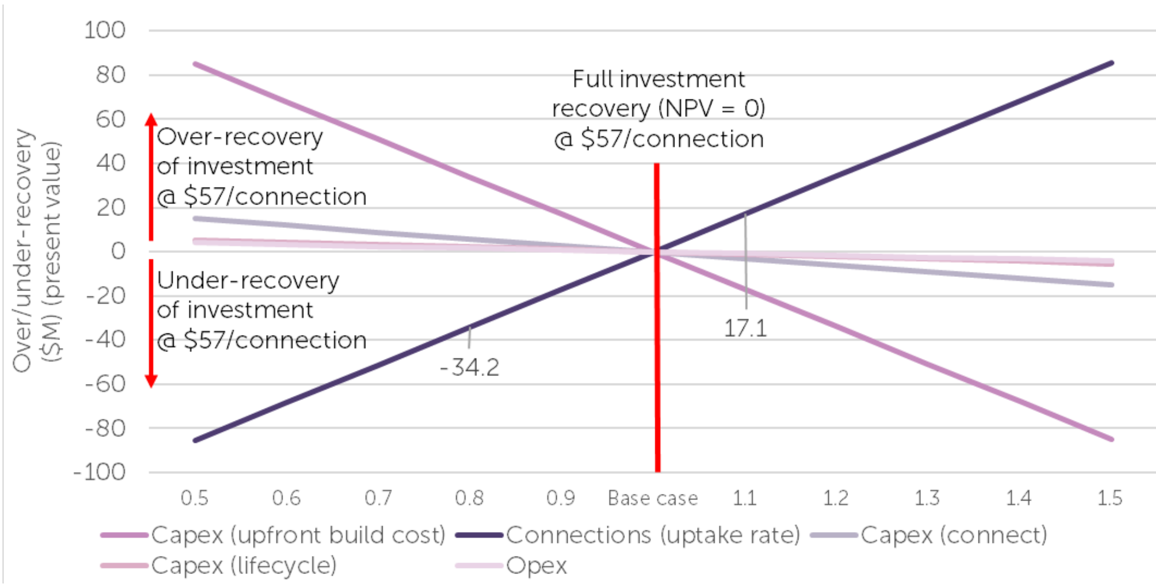
	-50%	-40%	-30%	-20%	-10%	BASE CASE	10%	20%	30%	40%	50%
Capex (build)	-22.2	-17.8	-13.3	-8.9	-4.4	0.0	3.0	7.3	11.6	15.9	20.2
Capex (connect)	-3.9	-3.1	-2.3	-1.5	-0.7	0.0	0.8	1.6	2.4	3.2	3.9
Capex (lifecycle)	-1.4	-1.1	-0.8	-0.5	-0.2	0.0	0.3	0.6	0.9	1.2	1.4
Opex	-1.0	-0.8	-0.6	-0.4	-0.2	0.0	0.2	0.5	0.7	0.9	1.1
Connections	44.8	29.9	19.2	11.2	5.0	0.0	-4.0	-7.4	-10.3	-12.8	-14.9

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 $57. 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 $17.1 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 $34.2 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 $1.25 and $1.98 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 as they would only have to make up for a potential shortfall in investment recovery from new Fibre Frontier end-users.

FIGURE 15.11: SENSITIVITY OF THE FIBRE FRONTIER INVESTMENT OVER/UNDER-RECOVERY TO CHANGES IN INPUT ASSUMPTIONS RELATIVE TO BASE CASE AND A WHOLESALE PRICE OF $57 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)	84.9	67.9	50.9	33.9	17.0	0.0	-17.0	-33.9	-50.9	-67.9	-84.9
Capex (connect)	14.9	11.9	8.9	6.0	3.0	0.0	-3.0	-6.0	-8.9	-11.9	-14.9
Capex (lifecycle)	5.4	4.3	3.2	2.1	1.1	0.0	-1.1	-2.1	-3.2	-4.3	-5.4
Opex	4.1	3.3	2.5	1.6	0.8	0.0	-0.8	-1.6	-2.5	-3.3	-4.1
Connections	-85.4	-68.3	-51.3	-34.2	-17.1	0.0	17.1	34.2	51.3	68.3	85.4

16.0 ONT STRATEGY

Te Ara Tūhonohono

16.0 ONT strategy

This chapter describes our Optical Network Terminal (ONT) management and replacement strategy.

16.1 Introduction

Optical network terminals (ONTs) are located in end-user premises and a critical component in the supply of FFLAS services. There are over 1.2 million installed ONTs, with early versions approaching end of their 10-year expected life. Our ONT strategy needs to balance cost, risk, deliverability and consumer preference to inform lifecycle management expenditure plans for PQP2.

A key benefit of our fibre network is the ability to support enormous capacity and speed growth through upgrades to electronics and optics. The current network technology, GPON,[152] can provide speeds of up to 1 gigabit per second (Gbps), while the modern equivalent or 'next generation' technology, XGS-PON,[153] can provide up to 10Gbps.

As new generations of fibre technology emerge and mature that can enable such growth, we need to consider carefully the most prudent and cost-effective way to transition to that technology whilst maintaining a good end-user experience, as well as managing physical asset life, service quality, deliverability and cost.

The network electronic upgrades required to transition to next generation technology have two geographically distinct elements. These are:

- upgrades to the line cards in the local exchanges
- upgrades to the optical network terminals (ONTs) in end-users' premises. An ONT is the device that connects the fibre wired to the outside of a premises to the router.

By the end of PQP1, we will have completed the proactive element of our line card upgrade programme in the local exchanges. We will continue to deploy next generation line cards in PQP2, but only where it is required by end-user demand and there is no corresponding line card in the exchange.

NEXT GENERATION FIBRE TECHNOLOGY

'Next generation' fibre technology enables fibre speed growth with network electronic upgrades to line cards and optical network terminals (ONTs).

152 Gigabit-capable passive optical network
153 More information about XGS-PON can be found online at: 10G-PON - Wikipedia

The focus of this chapter is on our ONT deployment strategy for PQP2, as we have not proactively rolled-out next generation ONTs yet.

Our ONT deployment strategy to date has been driven by the Ultra-Fast Broadband (UFB) rollout. Connecting as many New Zealanders as possible to our new fibre network has been key, allowing them to access the benefits of fast and reliable broadband as soon as fibre becomes available at their premises.

In determining an optimal ONT deployment strategy for PQP2, we were faced with significant uncertainty. Whilst it is commonly accepted that the transition to the next generation of fibre technology will occur over the next decade, the exact timing and speed is still unclear. The current ONTs installed in the fibre network use GPON technology and are more than capable of satisfying the majority of end-users' needs – now and for years to come. It would not be prudent to undertake this transition now via a significant rollout of next generation ONT technology (i.e. XGS-PON) as this would create costs to end-users now when the benefits for most users may only accumulate years later.

However, this is not the case when we need to visit an end-user's premises anyway to either replace an ONT that has failed or to do an initial ONT installation. Whole-of-life-cost analysis suggests that we should consider installing an XGS-PON ONT in those instances to avoid the cost of having to visit an end-user's premises twice – i.e. when initially installing/replacing a GPON ONT and again later when upgrading the end-user to an XGS-PON ONT.

There is also uncertainty around ONT reliability, particularly how reliability might change over an ONT's life. Many assets display an increase in fault rate as they age. ONTs, on the other hand, are still relatively new assets, having been installed in Aotearoa (and globally) for about ten years now. The limited information we have to date does not suggest fault rates correlate noticeably with age – ONTs are inherently reliable by design. Rather, it appears that ONT failures are driven by external factors such as heat exposure or physical damage. In any event, historical fault rates are low and do not suggest that we are likely to see a significant increase in the need to replace faulty ONTs in the network. Therefore, it would not be prudent and cost efficient to roll out a proactive replacement programme for some of the older ONTs installed in the network.

ONT CAPEX

We will invest $71.1m into ONTs during PQP2.

$71.1m

RELIABILITY

ONTs are reliable and a proactive replacement programme is not necessary or prudent at this point.

16.2 Stakeholder feedback

Stakeholder feedback from our proposal-focused consultation shows mixed views on the merits of investing in next generation XGS-PON technology over PQP2.

- All stakeholders value FFLAS service reliability highly and consider investment to maintain reliable and resilient services the top priority.
- End-users and stakeholders on balance supported our planned XGS-PON investment, recognising there are benefits to futureproofing our network by investing in the next generation of technology. However, this was a lower preference in terms of discretionary investment than fibre extension

and network resilience. There was also a notable minority who did not support the investment.

- Retail Service Providers (RSPs) that engaged in our PQP2 consultation process generally did not support proactive XGS-PON ONT deployment. However, we know that other RSPs are supportive and are offering Hyperfibre products that rely on XGS-PON technology to their customers.

This feedback is particularly valuable as we consider the need for a proactive ONT replacement programme during PQP2 and the extent to which we proactively deploy XGS-PON ONTs as part of that, to replace faulted ONTs or for new installations.

STAKEHOLDER FEEDBACK

We receive mixed feedback on the merits of next generation tech, which suggests the need for caution when planning our ONT deployment strategies.

16.3 Our options and recommendations at a glance

Our current strategy entails deploying the ONT required to support the required service (in most cases GPON) and replacing faulted ONTs on the same basis. This strategy is primarily reactive – first, to end-user demand, and also to ONT lifecycle management.

We consider it prudent to exercise caution in adjusting our current reactive ONT strategy. Our objective is to maintain option value in an ever-changing landscape, and as our understanding of ONT reliability evolves. In the meantime, we will meet end-user demand on request while carefully balancing expenditure to keep costs down for end-users and avoiding unnecessary work for service technicians.

With that in mind, and considering stakeholder feedback, we have decided it is not economically efficient to proactively replace ONTs at this stage or to alter our demand-led deployment of XGS-PON ONTs. We will keep this position under review and may alter our approach during PQP2 if circumstances change – for example, if there is an increase in actual or expected ONT failure rates, or if there is strong demand for XGS-PON services (our analysis indicates some proactive XGS-PON ONT deployment is likely to be economically efficient – for example, by deploying XGS-PON ONTs when an ONT needs either replacing due to a fault or when we do a first-time installation).

STAY REACTIVE

On balance, we have determined that maintaining a reactive replacement approach is the right course of action for PQP2.

Overall, this means our ONT deployment strategy will remain reactive and in line with our current practice. Broadly speaking, we will continue to:

- install GPON ONTs in the network when doing a first-time fibre installation
- replace ONTs when they fail (with GPON ONTs)
- only upgrade to XGS-PON ONTs upon end-user requests
- monitor market developments (demand and supply side) and ONT fault rates to identify when adjustment to our primarily reactive strategy may be warranted.

Managing our ONT fleet is challenging, as ONTs are installed in end-users' premises, which is disruptive for end-users and costly for Chorus. For these reasons, we seek to minimise non-essential and avoidable visits to end-user premises (which we refer to as 'truck-rolls') by only accessing end-users' premises where they request a new installation or upgrade or require repair of a fault. Under this strategy, we do not approach end-users to replace current generation ONTs that are still in good working order.

The table below outlines the key elements of this strategy and its respective drivers.

TABLE 16.1: CURRENT REACTIVE ONT DEPLOYMENT STRATEGIES AND RESPECTIVE DRIVERS.

DEPLOYMENT STRATEGY	DRIVER
Installing an ONT when we do a first-time installation. First-time installations can be to remaining premises in UFB areas or in response to network extension activity such as laying fibre into new property developments.	Installations demand The driver of new ONT investment is our best estimate of demand for new installations, informed by Statistics NZ, MBIE and independent market research and Chorus analysis of market factors (refer to the Demand report in Our Fibre Plans).
Replacing ONTs when they fail. We run the existing ONTs deployed in the network until they fail, and do not proactively replace ONTs to reduce future failure risk. This strategy reflects a view that it would not be prudent to proactively replace ONTs in the network with new ONTs as the failure rates are low and only one end-user is impacted if an ONT fails, meaning ONTs have a comparatively low criticality. This strategy may evolve if failure rates increase or for reasons such as technical obsolescence.	Asset failure The driver of ONT replacement is our best estimate of future ONT failure volumes, informed by historical failure rates.
Installing an XGS-PON ONT when an end-user wants to upgrade to Hyperfibre services. Hyperfibre is our cutting-edge product that allows for very high speeds. It requires an XGS-PON ONT to be installed in an end-user's premise.	Customer demand for Hyperfibre. The forecast driver is our best estimate of demand for Hyperfibre services. We forecast demand for Hyperfibre. A corresponding narrative describing our forecasting approach is included in our Demand report in Our Fibre Plans.

We are proposing to continue to deploy a GPON ONT whenever we are required to incur a truck-roll to either replace a faulty ONT or do a first-time installation. We have considered an alternative approach where we would proactively install an XGS-PON ONT in these instances. We are currently not pursuing this option due to a lack of strong stakeholder support, limited capacity for discretionary investment and desire to minimise costs for end-users. We note that changes to provisioning systems are required to switch to proactive XGS-PON installation (and are not currently scheduled). These options are assessed below.

TABLE 16.2: POTENTIAL OPTIONS FOR PARTIALLY PROACTIVE ONT DEPLOYMENT STRATEGIES AND RESPECTIVE DRIVERS

OPTION	COMMENTS
Continuing to install GPON ONTs every time we incur a truck-roll. This is our proposed option.	Frees-up discretionary capex that drives other outcomes There is no strong stakeholder feedback suggesting discretionary capex should be aimed at bringing forward next generation technology. In the absence of such clear feedback, we consider it prudent to err on the side of caution and target our limited discretionary capex at outcomes that have stronger stakeholder support such as a more resilient network or laying fibre into more rural communities. Timing uncertainty There is also timing uncertainty as to when necessary changes to our provisioning systems could be implemented to allow for a switch to XGS-PON technology. Whole-of-life cost However, end-users would pay higher whole-of-life costs and would incur greater disruption as two truck-rolls would be required if/when the end-user eventually requires an upgrade to XGS-PON technology.[154]
Installing an XGS-PON ONT every time we incur a truck-roll (Provided the end-user's premises is already connected to an XGS-PON port at the exchange so no additional capex is required further upstream to access the XGS-PON ONT's full capability). This is an alternative option we are likely to adopt during PQP2 if/once there is stronger stakeholder support, more headroom for discretionary spend and we have implemented the necessary IT systems to provision the next generation of XGS-PON ONTs.[155]	Primary driver is lowest whole-of-life cost Economic analysis suggests we should adopt this option as it produces the lowest whole-of-life cost outcome. That is because, while we accelerate replacement of a GPON ONT and bring forward investment in an XGS-PON ONT, we avoid a second truck-roll when: • the customer upgrades to Hyperfibre, or • XGS-PON becomes mainstream (which historical trend analysis strongly suggests is likely within the next ten years). Secondary driver is minimising end-user disruption. As discussed, getting access to end-users' premises is difficult, disruptive and costly if not end-user-initiated. The whole-of-life-cost analysis does not factor in end-user disruption impact from two truck rolls (and therefore is conservative).

16.4 Prudency and efficiency of our strategy

16.4.1 Prudency assessment

We consider the above strategy, including our preferred option, to be prudent for the following reasons.

154 We also note that incurring more truck-rolls can cause deliverability issues, particularly if a significant number of end-users wanted to upgrade to XGS-PON ONTs in parallel.
155 The imminent release of the 2nd generation XGS-PON ONT type will require changes to our provisioning systems, which we expect to be implemented over the next couple of years.

We give effect to end-user price-quality trade-off decisions by:

- installing an ONT in an end-user's premises whenever they want to connect to our fibre network
- deploying XGS-PON ONTs only when end-users want to upgrade to Hyperfibre services
- avoiding discretionary spend on next generation technology and instead targeting our limited discretionary capex at outcomes that have the strongest stakeholder support, such as a more resilient network or the extension of our fibre network into more rural communities. This gives immediate effect to what we heard through stakeholder consultation on our PQP2 proposal.

We minimise whole-of-life-cost by:

- avoiding/deferring proactive ONT replacement capex. Our strategy for ONT replacement at this point is reactive, i.e. replacement at failure. Given our current understanding of ONT reliability this is prudent because:
  - ONT failure rates are very low, and, at this point, we observe no fleet-wide failure modes in the different generations of ONTs
  - ONT asset lives are likely to exceed accounting life, potentially significantly
  - individually, ONTs have a low asset criticality (as an ONT directly affects service for an individual end-user but does not impact more widely).

Taken together, a reactive ONT replacement approach that defers investment is likely to better meet the price-quality trade-off for end-users rather than a costly proactive age-based replacement ahead of ONT failure. However, we acknowledge our understanding of ONT reliability will evolve as the average fleet life increases. If our views on ONT performance, failure modes and expected lives change we might adjust our ONT deployment strategy and, if prudent, consider seeking additional regulatory funding via an individual capex proposal provided for under the Fibre Input Methodologies (Fibre IMs). This might entail:

- implementing a proactive replacement programme if circumstances make this prudent and efficient. This may be for asset health, obsolescence, deliverability, end-user demand, or a combination thereof; and/or
- switching, when the time is right, from GPON to XGS-PON ONTs as our default ONT – i.e. once there is stronger stakeholder feedback and the abovementioned funding headroom and provisioning system constraints have been resolved. Once XGS-PON ONTs become our default ONT we would:
  - avoid incurring two truck-rolls in upgrading the existing ONTs fleet to XGS-PON technology

LOWER COSTS FOR CONSUMERS

Our preferred option of reactive replacement gives effect to price-quality trade-offs identified through the stakeholder consultation processes.

- limit end-user disruption by minimising Chorus technician visits at their premises. This has the additional side benefit of minimising stress on our service companies, in turn promoting deliverability of our overall work programme.

16.4.2 Efficiency assessment

We use a price (P) x quantity (Q) approach to forecast ONT capex for PQP2.

The quantities we input in our capex modelling reflect the drivers discussed in Table 16.1 (above). More specifically:

- our installations forecast drives first-time installation ONT capex
- historical ONT failure rates inform forecast failure rate assumptions
- the Hyperfibre demand forecast drives end-user-initiated XGS-PON ONT deployment.

We have contractual arrangements that lock in the key unit cost for ONTs and truck-rolls.

We have supply contracts with **CCI [ ]** that specify the unit cost for ONTs:

- The current unit cost for 4th generation GPON ONTs is **CCI [ ]**
- The current unit cost for XGS-PON ONTs is **CCI [ ]**, affecting our forecast ONTs capex **CCI [ ]**.

We cannot precisely forecast movements in unit cost from the currently contracted prices as these are mass market products that follow global trends. In our modelling, we assume unit cost for:

- GPON ONTs will remain stable, as they are a mature product
- XGS-PON ONTs will follow a similar trajectory to what we have seen for GPON ONTs. Unit cost for GPON ONTs started high and dropped frequently and sharply in the early years until they reached a steady state. In considering this regression analysis for our PQP2 proposal, we forecast one further drop in unit cost by **CCI [ ]**, but otherwise assume unit costs for XGS-PON ONTs have now passed the point of more frequent and sharp decreases.

We cannot use international benchmarking to assess the reasonableness of our pricing agreements with **CCI [ ]**, as supply contracts between fibre network and vendors are commercially sensitive. However, **CCI [ ].**

We have contracts with our service companies in place that fix our truck-roll cost. These contracts are subject to competitive tenders. The current unit cost is **CCI [ ]**, increasing by CPI each financial year.

CLEAR CONTRACTUAL COSTS

Forecasting costs for ONTs is relatively straightforward, as both the hardware and truck-roll costs are based on fixed contracts with field service providers and suppliers.

16.5 Our forecast at a glance

Our ONT capex forecast for PQP2 is $71.1m. As shown in Table 16.3 below, 17% of this is captured in the Installations category (i.e. ONTs deployed when connecting a new premises to our fibre network) and 83% of this is captured in the Network Capacity category (i.e. ONT replacements and upgrades).

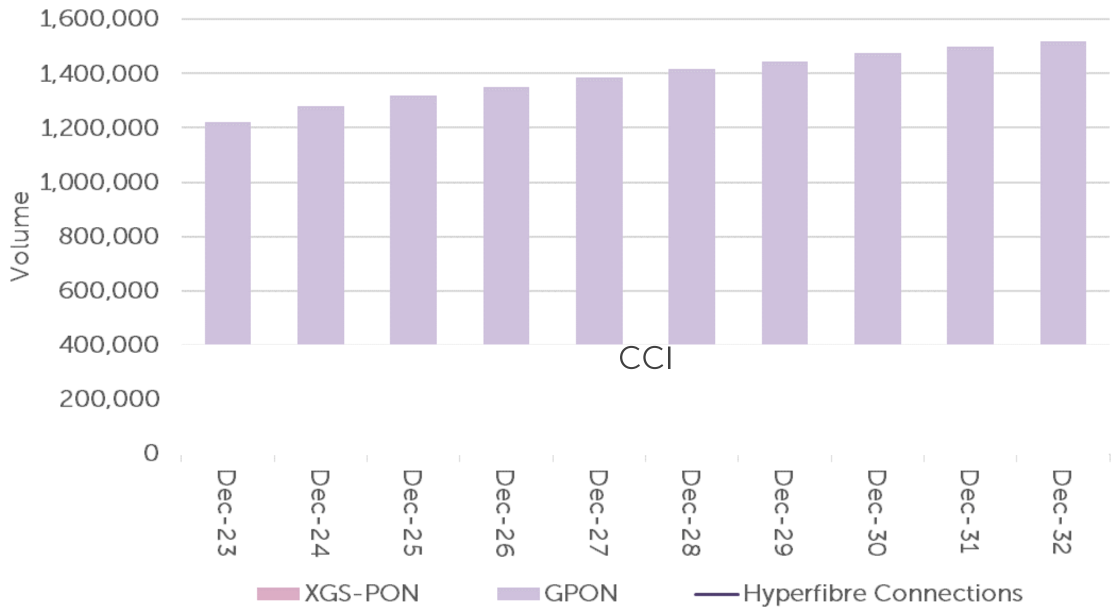
TABLE 16.3: ONT CAPEX (PQP2 PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

ONT CAPEX ($M)	2025	2026	2027	2028	TOTAL PQP2
Installation capex	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]
Network capacity capex	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]	CCI [ ]
TOTAL	13.1	16.8	24.1	17.1	71.1

As can be seen in Figure 16.1 below, the preferred deployment strategy discussed above will result in a moderate transition to XGS-PON ONTs, **CCI [**

].

FIGURE 16.1: FORECAST TOTAL ONTS DEPLOYED IN THE NETWORK



As shown in Figure 16.2 below, our total capex requirements will be moderate over the next decade, with the bulk of the spend falling into the PQP2 period.

CCI [

].

FIGURE 16.2: TOTAL ONT CAPEX (NOMINAL) BY TRUCK-ROLL AND HARDWARE EXPENDITURE

CCI [

]

16.5.1 Scenario analysis

In the Options Assessment section later in this document we discuss a range of ONT deployment strategies that we initially considered, some of which are significantly more proactive strategies, hence risking 'overbuilding' and bringing forward expenditure inefficiently.

The two remaining credible options we have identified only vary in one point, being the type of ONT we deploy when we have to incur a truck-roll to either replace a faulty ONT or to do a first-time installation.

Essentially, in these instances we could:

- continue to deploy GPON ONTs (Option 1 – preferred option), or
- proactively install XGS-PON ONTs (Option 2 – alternative option).

As shown in Table 16.4, our preferred option involves spending $11m less than the alternative option during PQP2. Realistically though, we are likely to change from the less capital intense option - our proposed option – to the initially more costly alternative (but with lower whole-of-life-cost) when the time is right in PQP2 (see section 16.4.1). Part of the resulting regulatory funding gap would be mitigated through the connection capex mechanism, which corrects our funding for the actual volumes of GPON and XGS-PON ONT installations.

ONT CAPEX AVOIDED DURING PQP2

Our business plan originally recommended Option 2. After re-considering the deployment options, accounting for stakeholder feedback, we reduced our PQP2 capex forecast by

$10.9m

TABLE 16.4: ONTS CAPEX FORECAST BY SCENARIO (PQP2 PQ FFLAS) ($M IN 2022 CONSTANT PRICES)

ONTS CAPEX	2025	2026	2027	2028	TOTAL PQP2
Option 1 (preferred option)	13.1	16.8	24.1	17.1	71.1
Option 2 (alternative option)	15.1	19.9	27.3	19.7	82.0
Difference (Option 2 – Option 1)	2.0	3.1	3.2	2.6	10.9

16.6 Strategic considerations

A key benefit of our fibre network is the ability to support enormous capacity growth through upgrades to electronics and optics. As new generations of fibre technology emerge and mature, the cost of upgrades is low relative to the cost of deploying the fibre network. Those upgrades allow for:

- product performance – the performance (including speed) available at individual premises
- improved efficiency – greater capacity and a lower 'cost per bit'
- more efficient deployment and less disruption for end-users
- network capacity – our ability to provide a congestion-free network.

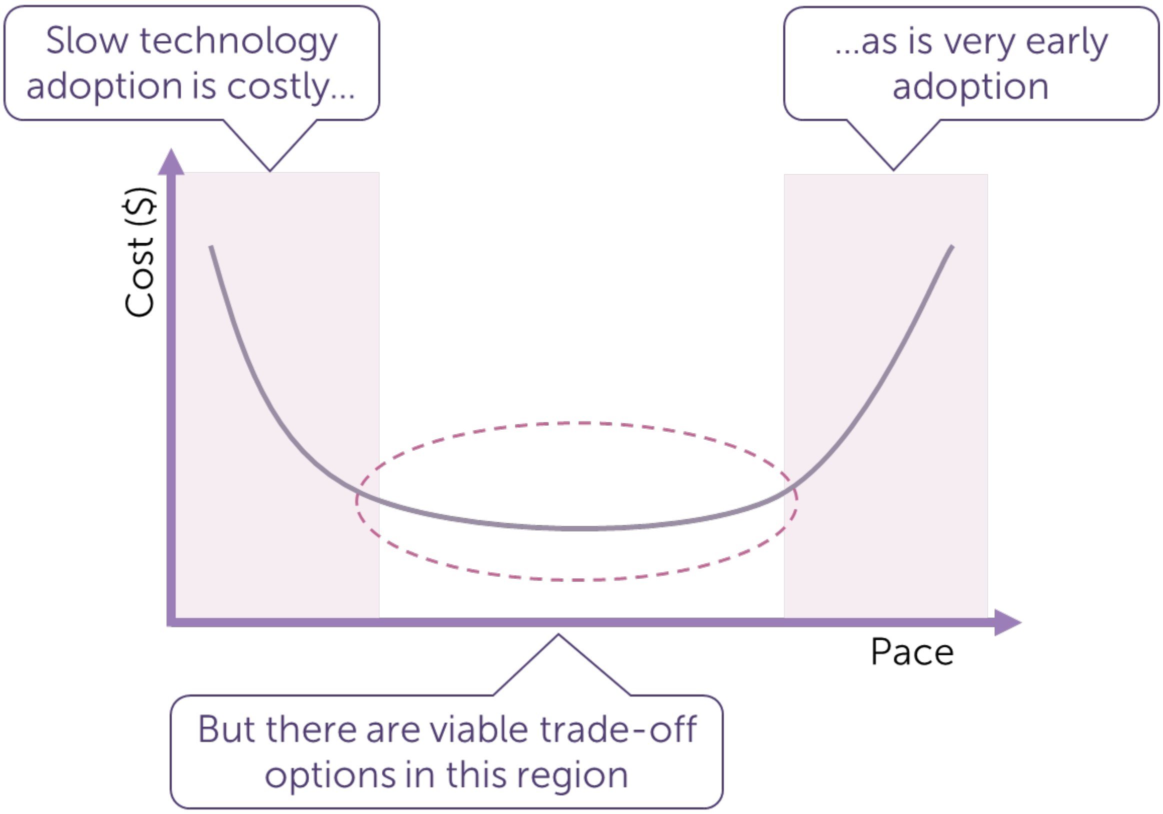
There is a pace for adopting and implementing new generations of fibre technology that makes sense even if cost optimisation is our only consideration. This is because new technology moves from leading edge to mainstream over time, while previous generations eventually move out of support and cannot be expanded to support growth. The mainstream technology of the day tends to deliver additional capacity at the lowest cost and lowest energy consumption.

ENSURING FIBRE SERVICE EVOLVES TO MEET END-USER NEEDS AND DEMANDS

"Because more technology is evolving - internet capacity and capability needs to keep up with the pace."

Stakeholder feedback

FIGURE 16.3: TECHNOLOGY ADOPTION



Installing a modern GPON ONT has been a key feature of our deployment strategy so far, offering great value for money and allowing broadband speeds that satisfy the needs of the vast majority of New Zealanders.

We have begun deploying next generation XGS-PON broadband technology which allows for much faster speeds. While still in the early stages of the product lifecycle, we are seeing growing demand.

It is prudent now to reconsider our strategy, given an increase in demand for faster broadband speed products, which is expected to make the current GPON technology obsolete at some point in the future. Also, some of our earliest ONTs installed in the fibre network are now reaching ten years of age, raising questions as to whether the low failure rates we have observed historically are likely to ramp up, possibly warranting an early replacement programme to maintain a positive customer experience.

XGS-PON TECHNOLOGY

We began offering our next generation XGS-PON broadband technology with our Hyperfibre product two years ago, allowing for much faster speeds.

16.7 ONTs are the on-premises piece of fibre technology

An ONT is an Optical Network Terminal. It is the device that connects the fibre that has been wired to the outside of a premises to the modem inside the premise.[156]

156 The ONT is a small white plastic box (180mm x50mm x 120mm) that is placed on the internal wall of an end-user premise.

FIGURE 16.4: OPTICAL NETWORK TERMINAL[157]

During the UFB rollout, capacity expansion was the major driver for ONT installations in end-users' premises. We have now installed around 1.2 million ONTs in a similar number of premises.

There continues to be demand for ONTs from new installations. However, as uptake matures, end-of-life replacements are expected to become a larger driver of ONT investment. More broadly, the move to the next generation of fibre broadband is becoming an increasingly prominent driver for our ONTs deployment strategy. Either way, careful planning is required to identify the pace at which we should bring new generations of technology into our network to deliver a solution with the lowest cost and least disruption.

Predominantly, the ONTs installed in the fibre network use GPON technology allowing for speeds of up to 1Gbps, capable of supporting the current anchor service (100Mbps) and our mainstream services (300 Mbps and 900Mbps).

Two years ago, we launched Hyperfibre products capable of 2Gbps, 4Gbps and 8Gbps speeds. This service relies on XGS-PON technology, which is the successor to the current GPON technology.

ONTS

ONT installations in end-users' premises has been primarily driven by installation growth during the UFB rollout.

1.2m

16.8 We are preparing our network for the transition to Hyperfibre

To transition an end-user to Hyperfibre, not only must an XGS-PON ONT be installed in an end-user's premises, but the upstream infrastructure must also be ready to enable faster broadband speeds. Predominantly, this requires an XGS-PON line card to be installed in the local exchange to which the end-user wanting to upgrade to Hyperfibre is connected.

When Hyperfibre originally launched in 2020, the product was leading-edge internationally. It was a deliberate decision by us to bring leading-edge technology to Aotearoa and ensure Kiwis that wanted access to this technology could do so. The market demand for the product at the time was low so we only deployed a small number of cards in each exchange across the country.

As we discuss further below in the section on technical obsolescence, the current GPON technology has matured and progressed in its lifecycle. We

157 Picture showing a 2nd Generation XGS-PON (Hyperfibre) ONT.

anticipate the broadband market will continue to advance in line with historical trends, and that it is now ready for Hyperfibre, with RSP 2degrees now offering this service to its customers at competitive rates.

To ensure we can cater efficiently for the increasing demand we anticipate over PQP2 and beyond, we have been rolling out XGS-PON capable cards more widely across Aotearoa.

When we launched Hyperfibre, the plan was to install one card per exchange. This meant that when customers ordered Hyperfibre, our technicians would need to visit the local exchange to either perform a splitter port move or a splitter port upgrade so that the customer could switch from the old GPON card to an XGS-PON capable card.

On average, this 'reactive' process took around 26 days in 2022. We would then send an XGS-PON ONT to the end-user, taking a further approximately 18 days on average. This meant that Hyperfibre connections took around 44 days on average to complete, which was a poor consumer experience and dampened demand.

We reviewed our Hyperfibre strategy to support connection growth and improve end-user experience. We now identify exchanges where we expect Hyperfibre demand to eventuate and proactively swap out access equipment at the exchange from GPON cards to XGS-PON cards, ahead of end-users placing an order.

Our proactive Hyperfibre card deployment will conclude before the end of PQP1. We expect to have upgraded CCI [ ] of the network by late 2024, which will enable CCI [ ] of Hyperfibre orders to benefit from the new and improved process by that time. In PQP2, we will continue investing in XGS-PON cards to keep pace with demand, and we expect to have upgraded CCI [ ] of the network by the end of PQP2 to XGS-PON line cards, with the remainder being deployed beyond 2028. By the end of PQP2, this planned investment will enable CCI [ ] of end-users ordering Hyperfibre to go through the new process and have a connection experience, in terms of time to connect, similar to the current GPON provisioning experience.

CUSTOMER EXPERIENCE

We've reviewed our processes to enhance the customer experience of Hyperfibre upgrades since we launched the product.

16.9 Our ONT deployment strategy has been reactive

To date, our ONT deployment strategy is reactive and demand led. We replace GPON ONTs like-for-like when they fail and upgrade to XGS-PON ONTs on request. We think this is appropriate at this point. However, as the ONT fleet ages and XGS-PON technology becomes more mainstream, our current strategy risks:

- increasing failure rates, resulting in loss of service for end-users and pressure on field technicians and supply chains
- being forced into a large-scale, reactive replacement programme with consequent labour force, supply chain and reputational issues
- GPON ONTs not meeting the required product speeds (and possibly not being technically supported) anymore as the move to the next generation of broadband technology unfolds
- CCI [

].

16.10 Key assumptions informing our ONT deployment strategy

There are a range of assumptions we have taken into account in determining our ONT deployment strategy. This is not a comprehensive summary, but we list the key assumptions below:

- **ONT failure rates** – the current failure rates for ONTs installed in the fibre network and any judgement around how it might change as the average ONT age continues to rise
- **Technical obsolescence** – the speed and timing of the move to the next generation of broadband technology
- **Hyperfibre uptake** – the rate at which customers begin to demand our Hyperfibre products and how this is expected to change going forward. CCI [ ]
- **Truck roll volumes** – the cost and availability of service technicians. Every time a new ONT is installed at an end-user's premise, our service technicians need to be present (doing a so-called 'truck-roll'). We must consider:
    - how the availability of service technicians in the market might constrain the number of truck-rolls we can do
    - the truck-roll cost for our service technicians. Proactively using XGS-PON ONTs now for new installations would avoid incurring this cost twice as it would otherwise be the case if we continue with our reactive ONTs deployment strategy
    - whether there is going to be appetite by end-users to self-install ONTs at their premises. Truck-rolls might become less of a deliverability consideration and cost driver if increasingly more end-users agree to self-install (or replace) ONTs in their own premises
- **XGS-PON ONT prices** – the price for XGS-PON ONTs, and any changes to the price during PQP2 as these ONTs become the mainstream product globally.

RANGE OF FACTORS

There are a range of factors we've taken into account and tried to balance when determining our ONT deployment strategy.

16.11 Our judgments and uncertainties

16.11.1ONT failure rates

There is no evidence at present that ONT failure rates will significantly increase as the average ONT age increases, so we do not consider it would be prudent to undertake a proactive GPON ONT replacement programme to mitigate the risk of ONT failure.

The average age of our ONT fleet is 4 years, with the first generation of ONTs installed in our fibre network now being ten years old. The failure rate we have been observing so far is around 0.8% of ONTs failing per annum and there is no evidence suggesting failure rates are strongly correlated to an ONT's age. It appears that ONT failure is rather related to external factors such as temperature, dust, moisture, vibration, trafficked area and exposure to light/UV.[158]

All ONTs that we have installed in our fibre network are designed to remain reliable well beyond their current accounting life of ten years (ignoring external aging factors and technological obsolescence). Components that are likely to fail earlier are minimised or eliminated to ensure a design that is deliberately simple and with no unnecessary elements.

A known issue in the electronics supply industry is the use of counterfeit components – i.e. electronic parts whose origin or quality is deliberately misrepresented, which can be hard to identify in an ONT (or any other electronic product) if purchased on the mass market. To mitigate the risk of such poor-quality components unknowingly being installed in our ONTs, we purchase directly from reputable suppliers **CCI [** **]**.

AGE

ONTs are inherently reliable and appear to remain reliable as they age. Therefore, we do not consider replacement based on age to be prudent.

However, there remains a risk that ONT reliability is different from what we currently assume. ONTs are still a relatively new piece of electronic equipment and the historical information that is available (globally) might not necessarily be a sufficiently accurate indicator for the expected reliability later in an ONT's life. We will continue to monitor ONT reliability and would be prepared to adapt our ONT deployment strategy as new information becomes available.

In the meantime, we believe it is prudent to rather align our ONT deployment strategy with our views on when this generation of broadband technology becomes technically obsolescent, rather than based on failure rates.

Accepting the risk of ONT failure rather than mitigating it proactively is also prudent from a criticality point of view. Asset criticality is low as only one end-user would be affected by an ONT failure (unlike other more critical network assets that serve a much higher number of end-users).

16.11.2 Technical obsolescence

It is broadly accepted that GPON technology will become obsolete over the next decade with XGS-PON becoming the new broadband technology standard.

On these grounds it is likely that XGS-PON ONTs – where a corresponding XGS-PON line card is already installed at the exchange – will become the default ONT for all new ONTs installed in the network.

In this context, we note the below initiative announced by the Singaporean government. Whilst a similar initiative has not yet been announced in

TECHNICAL OBSOLESCENCE

We expect XGS-PON to become to new broadband technology standard within the next decade.

158 At time of installation, consideration is given to these factors but often they cannot be fully mitigated.

Aotearoa, it demonstrates the trajectory developed countries with good fibre coverage are on.[159]

FIGURE 16.5: SINGAPORE GOVERNMENT NEW DIGITAL CONNECTIVITY BLUEPRINT

Seamless end-to-end 10 Gbps connectivity within the next five years

Digital connectivity has become essential to our daily lives – people on the move rely on mobile networks, while households and enterprises rely on fibre broadband and Wi-Fi for fast and reliable Internet connections. Our connectivity infrastructure must be built to support consistent user experience in terms of speeds and latencies, so that devices are 'handed over' in real-time, across indoor and outdoor settings and across the different connectivity modalities of fibre, mobile cellular and Wi-Fi. This seamless connectivity will pave the way for future enterprise applications, such as pervasive autonomy. Doing so requires both enhancing and harmonising across the different network components.

Singapore's past investments in the NBN have laid the foundation for our Smart Nation and the transformation of our digital economy. Today, 98% of all homes have broadband access, with 1 Gbps speeds as the norm.

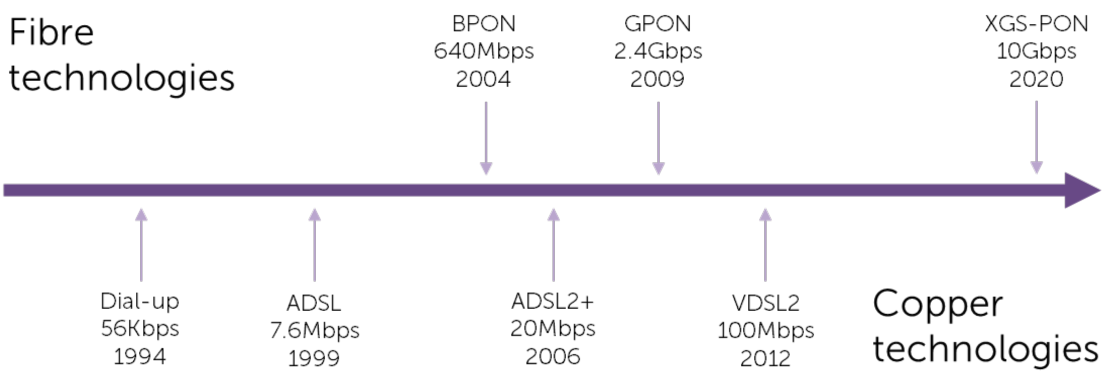
Looking ahead, Singapore will embark on a nationwide upgrade of our existing NBN infrastructure in partnership with the industry and facilitate a ten-fold increase in speed in the next five years. Broadband speeds of up to 10 Gbps, alongside Wi-Fi 6E and our 5G SA networks, will provide end-to-end 10 Gbps connectivity. We will initiate a call for collaboration with the industry and aim to commence the upgrade in mid-2024.

Technical obsolescence typically occurs when a product is no longer needed or wanted even though it might still be in good working order. This can occur when it is superseded by a newer technology that better responds to the evolving end-user demands. For broadband technology, an important implication of technical obsolescence is technical equipment falling out of manufacturer support.

Historically, broadband technology has broadly followed a five-to-ten-year life cycle. From the initial Dial-Up service in the early 1990s to the first fibre PON service in the early 2000s and XGS-PON now we have seen several broader technology changes over 30 years (noting that copper and fibre development overlapped to some extent as both were needed during thefibre rollout period).

159 https://www.imda.gov.sg/-/media/imda/files/programme/digital-connectivity-blueprint/digital-connectivity-blueprint-report.pdf

FIGURE 16.6: HISTORICAL BROADBAND TECHNOLOGY LIFECYCLE



Broadband is a relatively new technology which is still undergoing rapid development. As seen in most other and more mature technology markets, at some point in the future the rate of broadband technology advancement will slow and the technology used will have a much longer life. However, there is no sign of this occurring in the medium term. Given where we are in the lifecycle of GPON technology – and when considering the historical broadband technology lifecycle – it is conservative to assume the transition to XGS-PON broadband technology will occur gradually over the next decade.

We believe it is prudent to support this transition. While our proposal is to continue deploy GPON ONTs as our default ONT, we expect to transition to XGS-PON ONTs from some point in PQP2 (see section 16.4.1). This will future-proof end-users' premises in the least disruptive way and, most importantly, will be the most cost-efficient deployment strategy.

We consider there is a low risk of current GPON ONTs falling out of manufacturer support over the next decade. Whilst GPON broadband technology is expected to become technically obsolete in Aotearoa, many developing countries are just in the process of rolling out this technology for cost reasons. On that basis, ONT manufacturers are likely to continue to support GPON technology long into the future.[160]

Given the uncertainties around the speed of broadband technology development it would not be prudent to proactively replace functioning GPON ONTs with XGS-PON ONTs in anticipation of increasing technical obsolescence risk. However, we will continue to monitor the market and global developments and adapt as necessary.

160 Our ONT supplier **CCI [ ]** made the deliberate choice to not have an end date for GPON ONTs and the needed software.

16.11.3 Hyperfibre uptake

We forecast different types of demand growth, as demand is a driver of our work plans and resulting expenditure forecasts (to various degrees). One output from our demand forecasting function is future demand for Hyperfibre products.

Our ONTs deployment strategy is to respond to Hyperfibre demand as it arises – i.e. our forecasts assume an XGS-PON ONT is installed for every new Hyperfibre connection that we forecast.

Please refer to the Demand chapter of Our Fibre Plans for more information on our demand forecasting approach for Hyperfibre.

DEMAND GROWTH

Our forecast for ONT capex assumes one XGS-PON ONT is required for every Hyperfibre connection demanded by customers.

16.11.4 Truck-roll volumes

The current practice is that every time a new ONT is installed at an end-user's premises, our service technicians need to be present (both for new installations and replacements.

Our ONT deployment strategy and PQP2 proposal assume truck-rolls will continue to be required. This has important implications, as the current truck-roll unit cost is **CCI [ ]**, making up around **CCI [ ]** of the total installation cost for GPON ONTs and just under **CCI [ ]** for XGS-PON ONTs.

As demonstrated by our whole-of-life-cost analysis, the lowest whole of life cost strategy is to install an XGS-PON ONT every time we do a truck-roll to an end-user's premises, even if ONT failure or technical obsolescence of GPON technology is not expected anytime soon.

As explained in more detail in our Delivery report in Our Fibre Plans, we have recently experienced a shortage of service technicians. While this shortage is now largely resolved, the experience has required us to thoroughly assess our work plans and take greater account of deliverability when planning major work programmes.

In combination, the above considerations reassure us in our approach:

- not to proactively replace any functioning GPON ONTs as this would put unnecessary stress on our service technicians
- when the time is right in PQP2 (see section 16.4.1), to only install XGS-PON ONTs when we are required to do a truck-roll anyway, to avoid having to do two truck rolls to upgrade these premises to XGS-PON broadband.

TRUCK-ROLLS

The lowest whole-of-life cost strategy is to install an XGS-PON ONT every time we do a new truck-roll to an end-user's premises.

We note we are currently trialling an initiative that would encourage end-users to self-install the ONT at their premises either when their current ONT is due for replacement or for new installs. This is an opportunity for us reduce cost, but it is an untested area. Whilst replacing or installing an ONT would not require much technical expertise, we expect many if not most end-users would be reluctant to agree to this process. Consequently, and as outlined above, for our proposal we have assumed all ONT replacement and new installs would require a truck-roll. However, we note that for the purposes of the whole-of-life-cost analysis a moderate uptake of self-installs would not change any of our conclusions.

SELF-INSTALL

We are currently trialling a self-install initiative for ONTs, which may be more cost-efficient in future.

16.11.5 The difference in ONT unit cost

ONTs are a mass market product, with unit costs following global market trends akin to commodity markets.

There is currently a significant difference in unit cost between GPON ONTs and XGS-PON ONTs. The contracted unit cost for our current type of GPON ONTs is **CCI [**], which is just under **CCI [**] of what we currently pay for XGS-PON ONTs (**CCI [**]).

These unit costs have informed our ONTs deployment strategy as well as the whole-of-life-cost analysis below and are also the basis for our PQP2 proposal. However, while we assume unit cost for the mature GPON ONT technology will largely remain stable we expect the unit cost for XGS-PON ONTs will drop further – albeit at a slower rate than so far – as the technology becomes more mainstream and is rolled out globally at scale. We cannot predict the speed and timing of this transition with much certainty, but consistent with historical unit cost trends for GPON ONTs,[161] for PQP2 we assume to see another drop in XGS-PON ONT unit cost by **CCI [ ],** reducing forecast unit cost to **CCI [**].

Due to the small size of the market in Aotearoa, rolling out XGS-PON ONTs would not have an impact on the price we pay for ONTs on the global market, even if our rollout was at a much bigger scale than assumed for our PQP2 proposal.

UNIT COSTS

XGS-PON ONTs are more expensive than GPON ONTs. However, we expect costs to fall as the technology becomes more mainstream.

16.12 Whole-of-life-cost

When deploying ONTs, a key choice we will have to make when having to do a truck-roll (to either install a new ONT or replace an ONT that has failed) is whether:

- we install a GPON ONT initially and do another truck-roll and upgrade to an XGS-PON ONT later when GPON technology becomes either obsolete or the end-user wants to upgrade to Hyperfibre, or
- we immediately install an XGS-PON ONT to avoid having to do an upgrade later requiring another truck-roll.

We have done a simple whole-of-life-cost analysis to understand the benefits/drawbacks of these deployment strategies relative to each other, using the assumptions outlined below:

- Every time we install a new ONT or replace an ONT that has failed we have to do a truck-roll, currently costing **CCI [**] per truck-roll and increasing at CPI per year
- The GPON ONT unit cost is **CCI [**] and the XGS-PON unit cost is **CCI [**], dropping to **CCI [**]

161 Unit cost for GPON ONTs were high initially, followed by frequent sharp drops before they reached a steady state.

- The starting year for the analysis is 2025, which coincides with when the alternative ONT deployment strategy could practically take effect
- The costs are expressed in present value terms, using a discount rate of 7%.[162]

This analysis does not cover (and does not suggest) upgrading GPON ONTs that are in good working order to XGS-PON ONTs. As explained in this document, we would only do this upon an end-user's request.

The conclusions are rather unambiguous. If XGS-PON becomes the mainstream technology at some point over the next 10 years, it would make economic sense to start deploying XGS-PON ONTs from the start of PQP2 for new installs and fault replacements. The present value of the cost associated with this deployment strategy is significantly less relative to incrementally upgrading to XGS-PON, driven by the truck-roll cost which we would incur otherwise twice.[163]

The analysis is summarised in Figure 16.7 below. The straight line is the present value of costs incurred when an XGS-PON ONT is installed in 2025. All other lines assume a GPON ONT is installed in 2025 and then replaced with an XGS-PON ONT at some point over the ten-year planning horizon.

WHOLE-OF-LIFE COSTS

If XGS-PON technology becomes mainstream within the next 10 years, it would be more economical to deploy XGS-PON ONTs from the start of PQP2.

162 There is no specific discount rate mandated in the Fibre IMs. 7% is the mandated value Transpower must use when undertaking similar types of analysis.
163 See section 16.4.1 why we are continuing to deploy GPON ONTs in the interim.

FIGURE 16.7: WHOLE-OF-LIFE-COST FOR ONTS DEPLOYMENT OPTIONS WHEN REQUIRED TO INCUR A TRUCK-ROLL

CCI [

]

In order to stress-test our conclusion, we have run the below whole-of-life-cost sensitivity using significantly more aggressive assumptions.

In particular, we varied some of the more uncertain assumptions, such as:

- uptake rates of end-users agreeing to self-install ONTs at their premises over that period. We have increased our moderate uptake assumption built into our base case of 10% by 2033 to 30%, significantly decreasing the capex when upgrading the GPON ONT subsequently to an XGS-PON ONT
- future XGS-PON ONT unit cost dropping further and earlier than we have assumed.

The present values of the preferred and alternative options only move towards neutrality in the final years of the analysis. As such, our conclusion to proceed with our preferred option is robust.

FIGURE 16.8: WHOLE-OF-LIFE-COST FOR ONTS DEPLOYMENT OPTIONS WHEN REQUIRED TO INCUR A TRUCK-ROLL (SENSITIVITY)

CCI [

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16.13 Options assessment

To inform our ONT deployment strategy we undertook an early options assessment.

Basically, we considered a range of options, ranging from very reactive deployment approaches that largely mirror our current practice to highly proactive approaches that would deploy XGS-PON ONTs ahead of demand and at scale.

With the exception of Option 5, all options leverage opportunities when access to premises is end-user initiated. Option 5 would be the most difficult to execute in practice, as we would have to approach end-users to get access to their premises.

The intention was not necessarily to then identify one of these options as our future ONTs deployment strategy but to rather understand where our new strategy should sit within the broad range of options.

We have considered the following options:

- **Option 1** – very reactive (current practice and proposed option) – When an ONT fails or when we do a new install at an end-user's premise, GPON ONTs continue to be deployed over the ten-year planning horizon. XGS-PON ONTs are only deployed when and where customers request a Hyperfibre product.
- **Option 2** – alternative ONTs deployment strategy – Option 1 + XGS-PON ONTs are used from July 2025 for all ONT replacements and new ONT installs (where this is possible).[164]
- **Option 3** – Option 2 + every time an ONT's power supply unit (PSU) fails we do a truck-roll and install an XGS-PON ONT. Currently when a PSU fails we mail the replacement part instead of doing a truck-roll, but we could use the interaction with the end-user as an opportunity to visit the premises and proactively install an XGS-PON ONT.
- **Option 4** – Option 2 + every time there is a new connect (or reconnect) for a 1G service we do a truck roll and install an XGS-PON ONT. Currently GPON ONTs are able to support a 1G service so a truck-roll is not needed, but we could use the interaction with the end-user as an opportunity to visit the premises and proactively install an XGS-PON ONT.
- **Option 5** – Option 2 + all GPON ONTs are replaced at the end of their accounting life (10 years) with an XGS-PON ONT. As the assessment below shows, this option results in by far the most XGS-PON ONT installations.

OPTIONS ANALYSIS

We considered five different options as part of our early options analysis.

5

As discussed earlier in this document, we have identified Option 1 as our preferred ONTs deployment strategy for PQP2, however anticipate moving to Option 2 at some point in PQP2 (see section 16.4.1). Overall, transitioning from Option 1 to Option 2 strikes the right balance between remaining cautious in an ever-changing landscape and keeping the cost low and minimising pressure on our service technicians, whilst starting to enable the transition to the next generation of fibre technology where this is economically efficient.

The key insights from the options assessment – carried out by financial year ending in June – are the following:

As shown in Figure 16.9, all options would (by design) meet demand for Hyperfibre. All options with a proactive element would deploy XGS-PON ONTs ahead of demand, hence better mitigating the uncertainty around the speed and timing at which GPON technology will become technically obsolete. On the other hand, the options that involve replacing GPON ONTs that are still in good working order with XGS-PON ONTs (i.e. Options 3-5) would risk overbuilding.

BALANCE

Overall, transitioning from Option 1 to Option 2 strikes the right balance between caution and keeping the cost low, as well as minimising pressure on technicians.

164 The upstream technology – largely at our exchanges – must already be upgraded to XGS-PON too.

FIGURE 16.9: XGS-PON ONTS DEPLOYED IN THE NETWORK BY OPTION

CCI [

]

Figure 16.10 highlights how the forecast capex for these options can vary greatly and could ramp up to as much as almost $80m per annum if we deploy XGS-PON ONTs at scale ahead of demand.

However, the incremental capex in Option 2 (compared to Option 1) is relatively limited ($11m in PQP2), and, as demonstrated by our whole-of-life-cost analysis, would be economically efficient.

FIGURE 16.10: TOTAL CAPEX BY OPTION BY TRUCK-ROLL AND ONTS CAPEX

CCI [

]

Figure 16.11 shows the number of truck-rolls per annum for each option. Options 1 and 2 reflect the bare minimum of truck-roll requirements. By design, all options that involve replacing GPON ONTs that are in good working order (i.e. Options 3-5) require an increasing number of truck-rolls. These can ramp up fairly quickly to possibly unsustainable levels, considering current and future service technician constraints, and would require significant interaction with end-users which is likely to be disruptive.

FIGURE 16.11: NUMBER OF TRUCK-ROLLS BY OPTION

CCI [

]