

TRANSPower



Securing our Energy Future

2020 – 2025

Regulatory Control Period 3

RCP3 Proposal

November 2018



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Executive Summary

Our approach to the RCP3 proposal

Our RCP3 proposal reflects the importance of managing transmission costs while sustaining capability in the National Grid to support future opportunities for New Zealand. Our proposal builds on progress we have made in the way we operate and has been formulated through a robust and transparent business-driven approach.

Improved business capability and planning

Since developing our RCP2 proposal in 2013, we have made substantial improvements in our approach to risk, asset and cost management, together with a maturing of our strategic planning capability.

Our risk and asset management practices are now consistent with good electricity industry practice and include systematic tools such as our asset health and criticality frameworks, targeted tools such as risk bow-tie analysis and processes for clearly linking decision-making through from strategy to planning and into delivery. Similarly, our Information and Communications Technology (ICT) management and forecasting represent good industry practice with methods such as business capability mapping and risk buy-down analysis. Overall, we have made good progress in terms of our asset management and ICT practices, and we will continue to improve these during RCP3.

These improvements have supported us to develop a robust, well-targeted baseline plan as the foundation for our proposal. The baseline plan also picks up and carries forward gains we have achieved in cost management, including the benefits of two major phases of our transformation programme.

We have developed our proposal through a robust, transparent process. Our plan has been shaped and refined through senior management challenge and peer review, deliverability testing, price-quality testing, consultation and engagement, and independent verification.

These steps have all added value and influenced the shape of our proposal, which we are confident strikes an appropriate balance of careful cost management, prudent risk management, and strategic readiness.

Changes since our RCP3 consultation paper

Since consulting on our proposal in August this year, we have taken on board submissions and completed the other strands of our proposal development to reach a final proposal. The key outcomes are listed below.

- Based on feedback from stakeholders that they would prefer us to build workforce capacity during RCP3 rather than reduce planned work, we have reduced the scale of deliverability adjustments for secondary systems and grid maintenance.
- We have responded to stakeholder preferences for a slightly tighter price-quality position by reducing forecast capex enabled by reviewing the standards and specifications that guide the quality of grid assets to reduce costs.
- We have made minor adjustments to reliability and availability output measures to address specific stakeholder feedback and have modified our proposed measure for return to service to adopt a tighter buffer.

Based on feedback from the independent verifier, we have reviewed planned benefits-driven ICT investment and removed some capex. We have also adjusted grid capex and opex in anticipation of cost reductions we might achieve through benefits-driven ICT investment.

Updates to proposed opex and capex, together with updated modelling (including an updated forecast of allowable return) has reduced forecast RCP3 revenue (excluding unapproved major projects) by \$247 million (5 percent).

Revenue and price path

We forecast revenue of

\$4,419 million (nominal)

for the RCP3 period (excluding unapproved major projects), comprising \$501 million for HVDC services and \$3,918 million for the balance of our network and operations. This is a 6.6 percent decrease compared to RCP2.

Our revenue forecast is sensitive to the allowable return the Commerce Commission will set after August 2019, so the forecast set out in this proposal is for indicative purposes only.

We propose the Commerce Commission smoothes the HVAC and HVDC revenue paths so that revenue, before adding listed and major projects, increases at a steady and predictable rate through RCP3. Following consultation, we consider this more predictable pathway is in the overall interests of our customers and end consumers.

Transpower's
revenue forecast over
2020 – 2025 is expected to be

\$4,419 m

compared to \$4,732 million
for 2015 – 2020

↓ 6.6 %

We forecast an HVAC revenue growth rate of

1.3 percent per year (nominal)

during RCP3 prior to adding listed or major projects. With the addition of listed projects, the average annual growth rate is taken to 1.5 percent. This is lower than current consensus forecasts of inflation. Taken together with reductions in the last two years of RCP2 (of 1 percent and 2.6 percent) we forecast 2024/25 revenue will be 16.8 percent lower than 2017/18 revenue in real terms.

Capital expenditure

For capital expenditure, we propose the Commerce Commission approve funding of

\$1,202 million (constant 2017/18 dollars)

as base capex, with a further \$135 million listed for later evaluation and approval. The proposal excludes \$178 million major capex that we will separately seek approval for if required. Listed capex consists of four North Island reconductoring projects. Compared to RCP2, our proposal is a 7 percent increase (assuming listed projects proceed and excluding unapproved major capex).

Renewal of grid assets makes up 78 percent of our RCP3 capex forecast. The renewal share of base capex is expected to continue to trend upward longer term, reflecting our ageing grid.

We plan to shift investment from substations to lines as part of a trend that we expect will accelerate beyond RCP3. This is driven by a steadily increasing volume of towers requiring a regime of painting and recoating (after their original galvanising has aged) and, more significantly, by a wave of conductors on lines built during the 1960s to 1980s nearing the end of their life. Servicing the growing conductor work programme will require an increased lines mechanic workforce in the future. This workforce will take time to build and train, so we have reflected this in our plan for RCP3.

We plan to increase work on control and communications technology during RCP3, including replacing protection systems and power electronics reaching end-of-life. These technologies have pulses of investment that can be challenging to resource. We have worked to soften the projected pulse during RCP3, but nonetheless anticipate that building up the required protection technician workforce will take time and have reflected this in our plans.

Transpower forecasts a

7% ↑

increase in capital expenditure for RCP3 – from \$1,248 million in RCP2 to

\$1,337 m

in RCP3.

Made up of

Base capex

\$1,202 m

(for approval)

Listed Projects

\$135 m

(list of projects for later evaluation)

These increases are offset by a planned reduction in substation investment. The main drivers of this reduction are the benefits of a more refined approach to transformer investment, and a reduction in indoor switchgear investment as we near the end of a safety-driven programme of converting outdoor switchyards. We also forecast reduced investment in ICT, in part because we have been able to defer significant lifecycle investment in our TransGO fibre network.

More broadly, our capex plans capture and carry forward the benefits of ongoing innovation and improvements in risk, asset, and cost management. More than 87 percent of our investment is directed at renewal of our grid and ICT assets to sustain performance, maintain compliance and manage longer-term cost profiles.

Operating expenditure

For operating expenditure, we propose the Commerce Commission approve funding of

\$1,343 million (constant 2017/18 dollars)

Compared to RCP2, we are proposing a 2.9 percent increase. The composition of planned opex for RCP3 is not materially changed from RCP2. Grid opex, i.e. Maintenance opex and Asset Management and Operations opex, makes up 62 percent of expenditure.

We plan to increase grid maintenance activity in RCP3 but anticipate this could be restricted by deliverability constraints. To address this, we are proposing funding that is lower than the anticipated cost. We will endeavour to overcome deliverability constraints and fund increased work through reinvestment of future efficiency gains.

The biggest single driver for increased maintenance is a step up in testing and inspection of conductors aimed at providing information to support planning and refinement of the potentially large reconductoring programme forecast beyond RCP3. There is also work arising due to deliberate deferral of asset replacements (where we have assessed deferrals as driving acceptable risk outcomes and superior lifecycle cost outcomes), safety programmes and some ageing asset profiles.

Based on expert actuarial advice, we forecast insurance costs will increase materially as insurance market conditions tighten. We forecast a reduction in Business Support opex, and small increases in ICT opex and Asset Management and Operations opex.

Transpower forecasts a

2.9% ↑

increase in operational
expenditure for RCP3 – from
\$1,300 million in RCP2 to

\$1,343 m

in RCP3.

The ICT increases include costs that support deferral of TransGO capital investment, costs relating to increasing adoption of cloud services, and enhancements to cyber-security risk reduction.

Our planned Asset Management and Operations opex maintains capacity to address management challenges and opportunities such as optimising and preparing to deliver the growing capital programme beyond RCP3, adapting to changes in the energy sector that will impact operations and may begin to drive increased generation connection, and further developing our risk, asset and cost management.

Output targets and incentives

We propose the Commerce Commission establishes financial incentives with an economic value of up to plus or minus

\$64.5 million (post-tax)

for network performance against 14 targets. These include reliability targets for the number and duration of interruptions, and availability targets for our HVDC link and key HVAC assets. The incentive is 2 percent of forecast revenue.

We have designed the proposed RCP3 incentives to build on arrangements in place during RCP2, with enhancements developed through stakeholder consultation. Key improvements include revising point of service categories with a stronger economic basis and setting targets that predominantly seek to sustain performance at historical levels. This reflects that the role of network performance incentives is to support fine tuning of performance during RCP3 (recognising the limited scope to shift network performance within a five-year period).

We propose the Commerce Commission establishes a financial incentive with an economic value of up to plus or minus

\$26.4 million (post-tax)

for asset health against five targets. To mitigate the risk of perverse outcomes, we propose the incentive should not apply when departures from the target are well justified. In like-for-like terms, the incentive is 0.8 percent of forecast revenue and 6.8 percent of proposed capex for the applicable assets.

Outputs and incentives

Transpower proposes financial incentives on performance against output targets, with a post-tax economic value of up to (plus or minus)

Network Performance

\$64.5m

Asset Health targets

\$26.4 m

in RCP3.

The proposed incentives are new for RCP3 and represent an improvement on the less sophisticated asset replacement incentives in place during RCP2. The incentives should improve transparency of our asset management and reinforce good asset management practices.

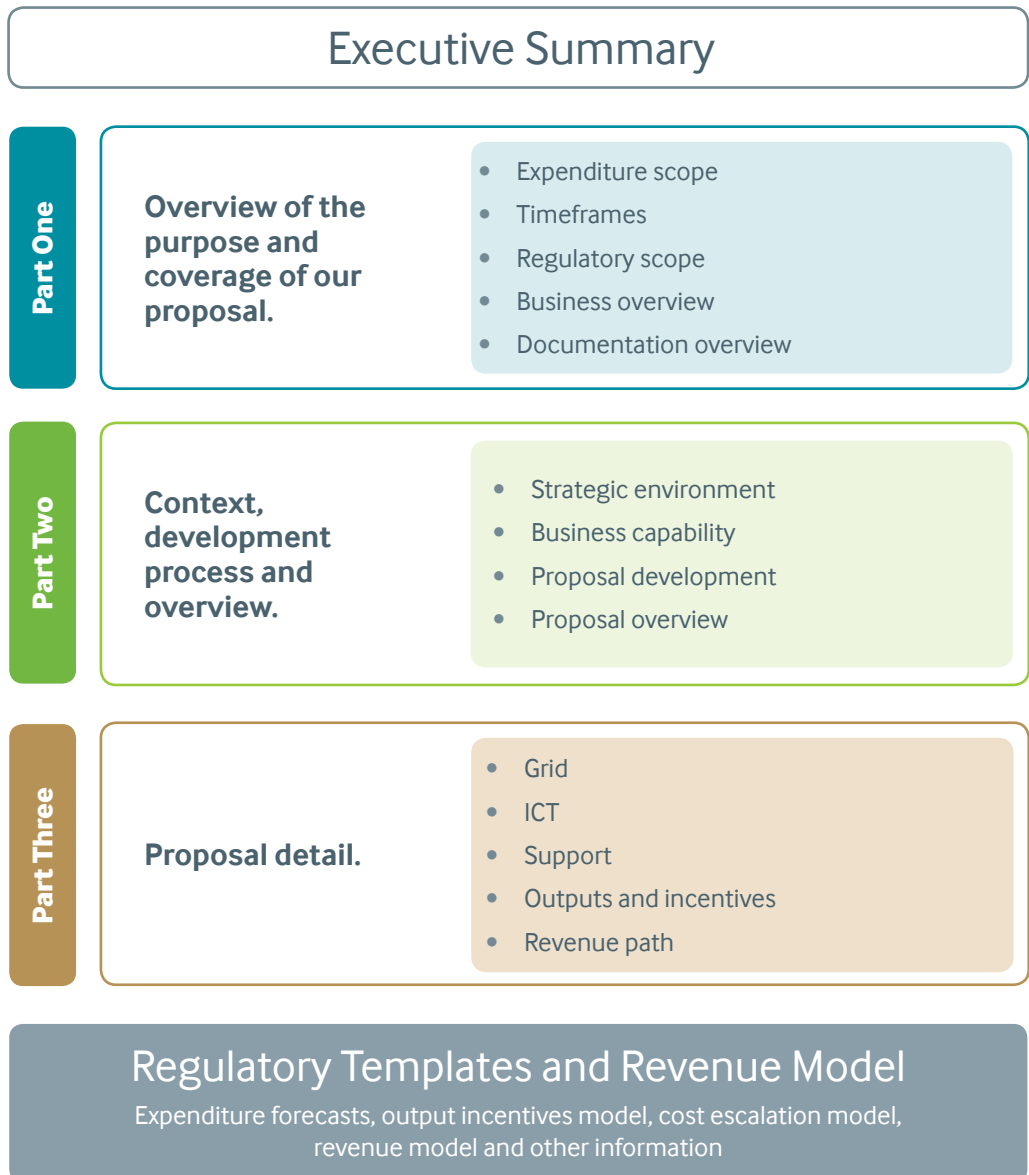
The network performance and asset health incentives are designed to strike the right balance between incentives to invest and incentives to reduce costs.

Business priorities

To support our RCP4 proposal in 2023 we will continue to improve our business. Key improvement priorities are:

- *lines investment* – we forecast that required investment in tower painting and reconductoring will grow further and will pose challenges in terms of cost, deliverability and system impact. The potential scale of this programme means it is important to invest in information, modelling, strategies, technologies and planning to optimise the way we validate, refine, plan and deliver this work.
- *strategic readiness* – our strategic environment presents uncertainties, challenges and opportunities, including the opportunity to play an enabling role as New Zealand transitions to a more electrified low-carbon economy. It is important for us to build on what we have already achieved through our Transmission Tomorrow, business transformation and Te Mauri Hiko work. This includes further enhancing our strategic analysis, playing an active role in the sector, planning for anticipated changes (such as increasing generation connection and demand for tailored services) and leveraging new technology opportunities (such as transmission alternatives and artificial intelligence) as they become viable.
- *risk-based asset and cost management* – we are confident that our risk and asset management represent Good Electricity Industry Practice (GEIP) but can improve further. Similarly, we have achieved significant cost management gains during RCP2 and understand the value of continuing to challenge ourselves to extend the gains we have already made.

Document Overview





PART 1

Proposal scope

Part 1 explains the scope of our proposal in terms of the types of expenditure and outputs covered, timeframes, and alignment with wider regulatory arrangements. It also provides an overview of our network, and the suite of related proposal documents.

Chapter 1: Scope of network and proposal

1.1 Business overview

Our proposal covers enhancement, renewal, maintenance, operation and support of the New Zealand high voltage electricity grid, which includes:

- North Island and South Island HVAC networks,
- Inter-Island HVDC link, and
- Supporting communications network.

The New Zealand grid is not connected to any other countries and, by international standards, has a strongly renewable generation mix in place, a relatively high volume of connection points, low energy density, and includes relatively low capacity circuits (down to 50 kV).

The HVDC link has two poles and includes 40 km of sub-sea cables beneath Cook Strait and over 500 km of overhead circuits. The central role of the HVDC link in our power system is unique.

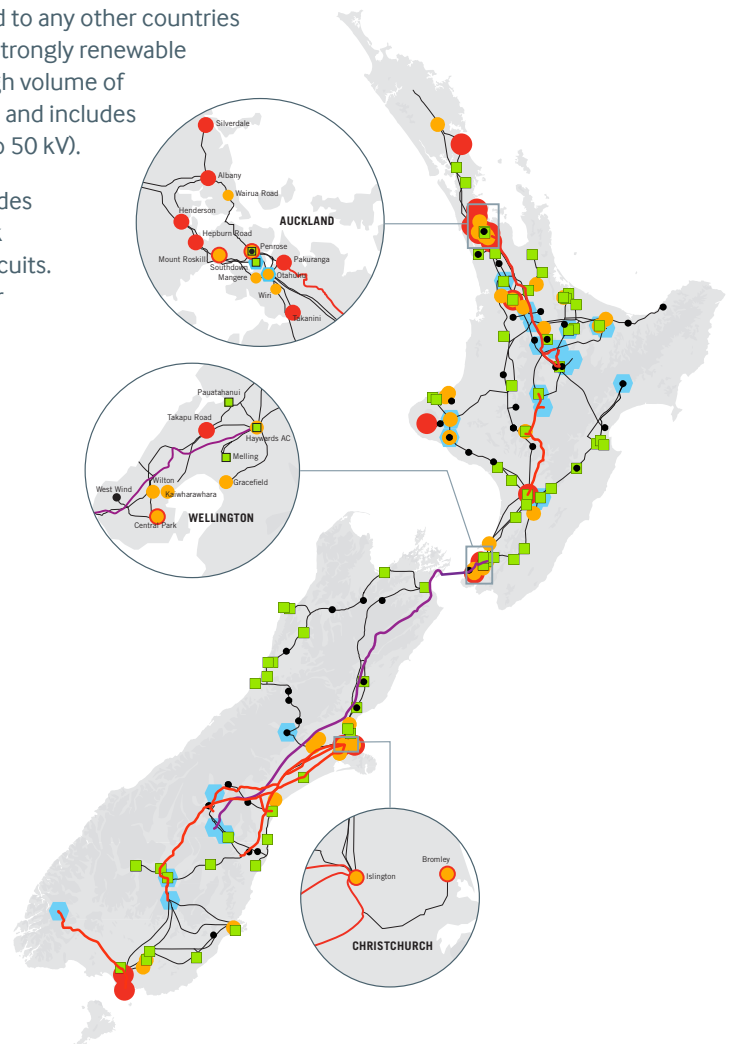
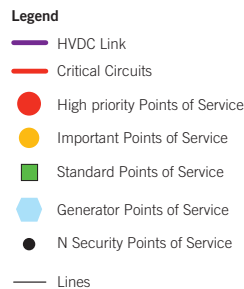


Figure 1: The New Zealand high voltage electricity grid

Our transmission network connects to large generators and carries energy to distribution networks and some large directly-connected industrial customers. Distribution networks carry energy at lower voltages to homes, businesses and other energy users.

Most consumers source their energy via a retailer who bundles energy, transmission, distribution and other charges into a single bill. Transmission charges comprise around 10.5 percent of an average household electricity bill.^{1 2}

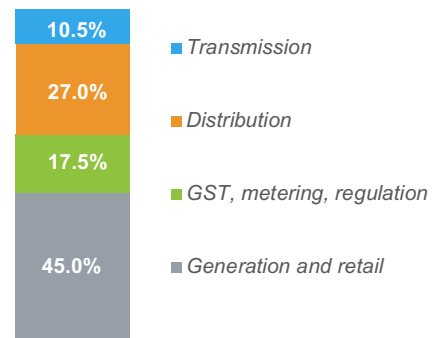


Figure 2: Composition of the average household electricity bill

HVDC value Value of our dedicated HVDC assets (at 30 June 2018)	\$0.6 b
HVAC value Value of the balance of our regulated asset base (at 30 June 2018)	\$4 b
Network length Route length of our HVAC and HVDC transmission lines (at 30 June 2018)	10,969 km
Substations Number of substations, including the two HVDC substations (at 30 June 2018)	171
Peak demand Maximum system demand ever supplied by the grid (occurred in 2011)	6.9 GW
Annual Energy Amount of energy supplied in the year ended 30 June 2018	39.2 TWh

Table 1: Key network attributes

1.2 Proposal expenditure coverage

We are proposing capex and opex levels, output targets and incentive settings for our activities as grid owner. Our proposal does not cover our system operator activities, or grid connection and relocation activities funded through investment contracts with customers or third parties.

Our proposal excludes operating expenditure that sits outside our regulatory incentive arrangements and major capital projects subject to individual approval. To provide a complete picture, revenue forecasts include the impact of this expenditure. Our proposal identifies projects that should be listed for later consideration and approval.

¹ Electricity Authority (2018). Electricity in New Zealand. Section: Consumers, Pricing Arrangements, p13. This publication is available for download on the Electricity Authority's website at <https://www.ea.govt.nz/about-us/media-and-publications/electricity-nz/>.

² The break-down of the average residential bill into the component industry parts makes assumptions about the pass through of transmission costs by electricity distribution businesses to different customer segments. Our analysis suggests that residential customers are, on average, facing a higher transmission cost pass through than commercial or industrial customers.

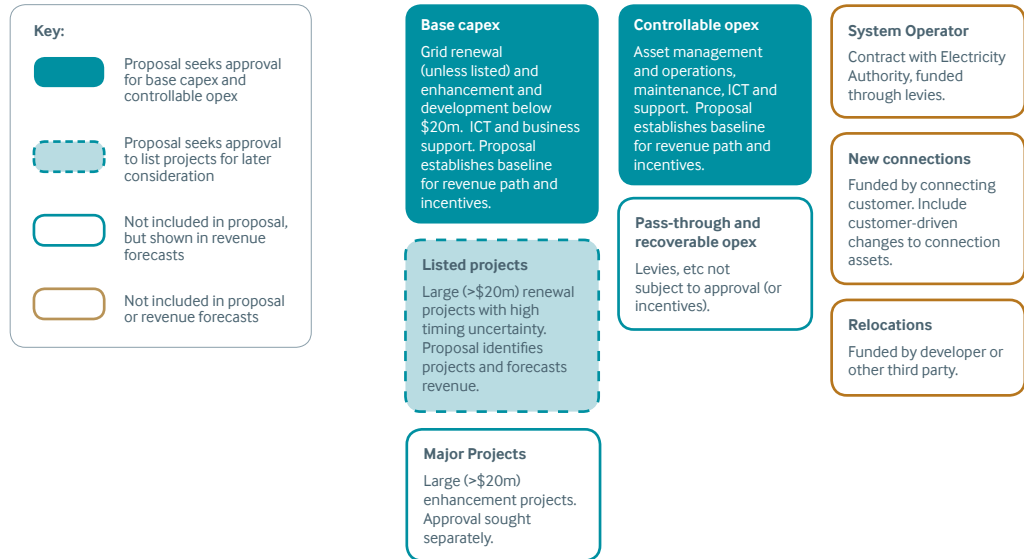


Figure 3: The scope of our RCP3 proposal – expenditure

Throughout this document we present forecast expenditure using the conventions that are specified in detail in section 3.1. In particular, expenditure is stated in constant 2017/18 prices. This means the figures are not adjusted for forecast cost escalation or general inflation, assisting with expenditure comparisons across time.

1.3 Proposal regulatory scope

Our proposal presents our best view of prudent and efficient levels of opex and capex. It also covers output incentives for network performance and asset health and provides an indication of key business improvement priorities.

The Commerce Commission will evaluate and consult on our proposal and determine capex and opex allowances. It will also set our revenue path, based on our forecasts and other inputs such as an allowable rate of return.

We have discretion to reprioritise expenditure, including between capex and opex, to optimise our total expenditure. We also have discretion to exceed our allowances, although we can only partially recover such expenditure.

The Commerce Commission does not regulate the transmission pricing methodology or network planning standards.

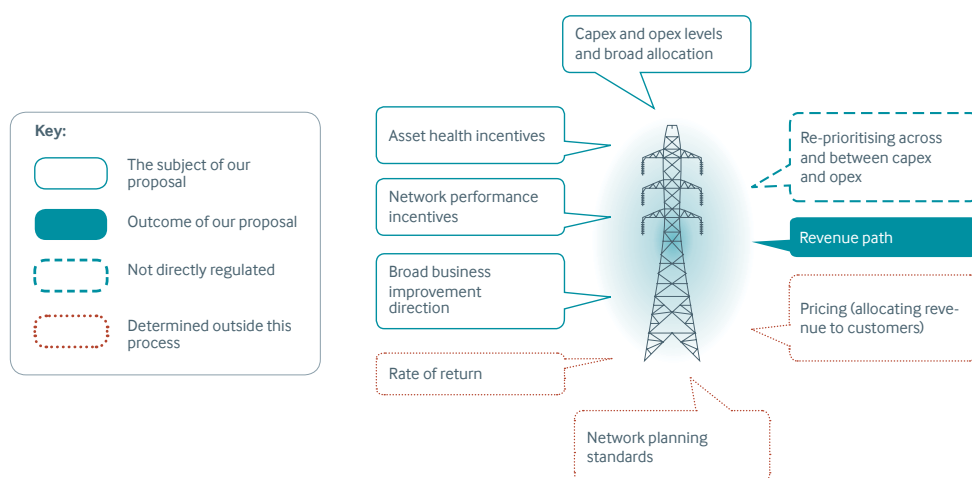


Figure 4: The scope of our RCP3 proposal - regulation

We have developed our proposal to comply with requirements of the Commerce Commission’s *Transpower Input Methodology* (for general accounting requirements) and *Capex Input Methodology* (for information requirements specific to capital expenditure) and an information gathering notice issued by the Commerce Commission under section 53ZD of the Commerce Act on 15 May 2018 (for opex and other information requirements).

1.4 Third control period

Our proposal covers expenditure for the regulatory control period from 1 July 2020 to 30 June 2025 (RCP3). The Commerce Commission will evaluate and consult on our proposal as part of determining the revenue path that will apply to transmission services from 1 April 2020 to 31 March 2025.

The Commerce Commission is required to reach a final decision by November 2019. We will then determine transmission charges, before advising customers and the public of the charges in December 2019.

This will be our third regulatory control period and it will have features that build on earlier periods, as summarised in the following table.

RCP1	RCP2	RCP3	RCP4	RCP5
2013 to 2015	2016 to 2020	2021 to 2025	2026 to 2030	2030 to 2035
First control period	Current control period	Subject of our proposal	Full forecast for context	Forecasts for some assets
Opex incentives introduced	Opex incentives improved	Opex incentives continue		
	Capex incentives introduced	Capex incentives continue, low-rate option added		
	Listed projects introduced	Listing mechanism continues		
	Output incentives introduced	Service incentives continue, asset health incentives added		

Table 2: RCP3 main features

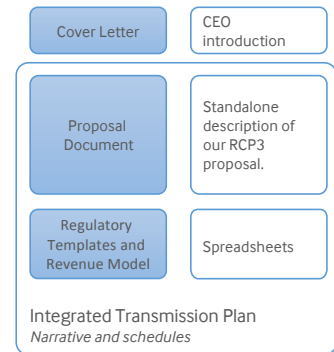
RCP2 was our first control period with comprehensive expenditure and output incentives in place. Arrangements for RCP3 are very similar to RCP2, so there is good continuity across the control periods with no sharp demarcation in terms of how we execute our work programme or carry forward business improvement gains and ongoing initiatives.

1.5 Proposal documentation

This proposal document provides a complete, standalone explanation of our RCP3 proposal and is supported by documents that provide more in-depth information.

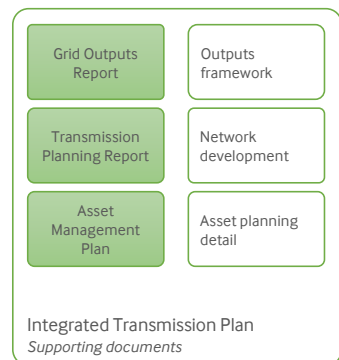
The proposal document also includes information we usually provide in our annually disclosed Integrated Transmission Plan (ITP) Narrative.

The spreadsheets accompanying the proposal document are consistent with regulatory templates agreed with the Commerce Commission and also covers the ITP schedules' information requirements.



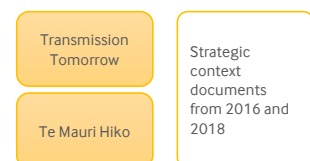
We also provide three supporting documents as part of the wider ITP suite.³

- *2018 Grid Outputs Report* – describes grid output targets and how these fit with our planning and operations. Includes detail on proposed output incentives.
- *2018 Transmission Planning Report* – identifies grid configuration issues that could arise over the coming 15 years due to changes in demand and generation. Includes detail on grid enhancement and development scenarios.
- *2018 Asset Management Plan* – describes how we plan grid and support expenditure and provides information on each asset portfolio.

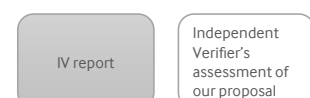


The ITP documents are complemented by two further documents.

- *Transmission Tomorrow* – a long-term strategic scan prepared ahead of RCP3 planning. Informs strategic priorities used in preparing our proposal.
- *Te Mauri Hiko* – updated long-term forecast scenarios. Reinforces the Transmission Tomorrow view that the grid has a long-term future, the sector is evolving, and demand growth beyond RCP3 is likely.



Our proposal includes an independent verification report. The report was prepared by Synergies Economic Consulting and GHD Advisory, who we engaged to verify our proposal under terms of reference developed by the Commerce Commission in consultation with Transpower (discussed further in section 2.3.8).



³ The 2018 ITP Compliance Report describes how this proposal document, along with the supporting documents, meet the Integrated Transmission Plan information requirements.



PART 2

Proposal context and overview

Part 2 provides context on our RCP3 proposal.

- *Strategic environment* – discusses the current business environment, how we see the business changing in the future and our strategy for development to meet those changes.
- *Business capability* – describes how we have developed our business capabilities during RCP2 to match our strategic vision for RCP3 and beyond.
- *Proposal development* – describes how this proposal has been developed and refined.
- *Proposal overview* – describes our proposed RCP3 allowances, targets and incentives, and provides a summary of our expenditure proposal.

Chapter 2:

Our context, business and RCP3 proposal

2.1 Strategic environment

This section describes our operating environment and strategic outlook, focussing on six areas that provide context on our RCP2 performance and RCP3 plans.

- *The grid has a long-term role* – we are investing to sustain the capability and condition of the grid. This is consistent with a view that the grid has a vital role to play in the New Zealand economy beyond RCP3.
- *The grid has a stable outlook* – demand growth continues to be low but could accelerate towards the end of RCP3. Consequently, we are proposing limited growth related investment during RCP3.
- *Technologies are evolving* – technologies such as electric vehicles, photovoltaics, batteries, and automation are becoming increasingly attractive and widespread. We need the capacity and skills in our business to understand, facilitate, leverage and react to these changes.
- *Asset renewal demands are increasing* – programmes of work such as tower painting, reconductoring and grid maintenance will grow in RCP3 and beyond due to the age and condition profile of lines built during the network expansion after the 1950s. We need to invest during RCP3 to optimise work beyond RCP3.
- *Workforce capacity constraints are emerging* – we anticipate that our work programme in RCP3 will encounter capacity constraints in the lines mechanic, protection technician and maintenance areas, and have amended our proposal accordingly. We will need to resolve these constraints to support asset renewal demands beyond RCP3.
- *The cost of electricity remains important* – the cost of electricity is a critical issue for our customers and wider stakeholders. We have a part to play in managing our expenditure and supporting the efficiency of the wider power system. Our proposal builds in the benefits of cost reduction initiatives and explicitly considers the balance between the price and quality of our services.

2.1.1 Grid outlook

We are confident that the grid has a long-term role to play. The near-term outlook is for relative stability in terms of overall demand and generation mix, but there is the prospect of demand beginning to grow strongly towards the end of RCP3.

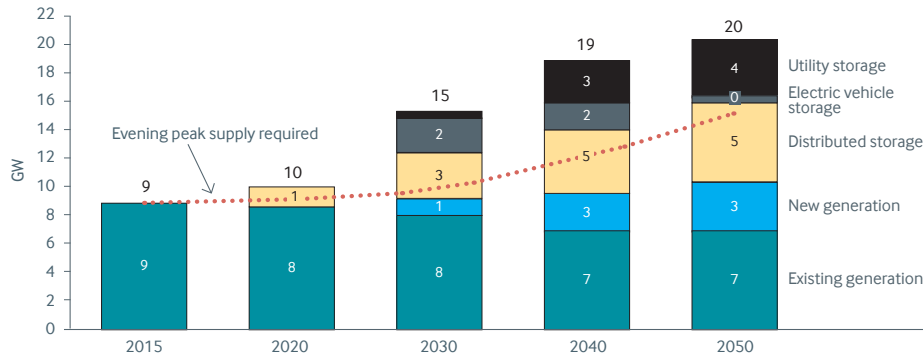


Figure 5: Estimated winter peak supply and supply requirement

Meanwhile, technologies are developing rapidly. Some technologies such as electric vehicles and solar generation will impact grid demand. Other technologies such as artificial intelligence, remote sensing and utility batteries could provide opportunities to improve how we operate the grid.



Figure 6: Identified technologies impacting New Zealand's energy system

This outlook means that it is prudent for us to invest to sustain the capability and condition of the grid, as well as capacity and capability within our business. This stance is reflected in our proposal, which includes stable network performance targets and reduced grid enhancement capex, increased grid renewal and maintenance, and stable investment in our asset management capability.

Aside from sustaining capability and condition of the grid, we are not directly proposing expenditure to support increased grid connections or specific innovation activity to assist with tackling longer-term challenges.

If grid connection activity does increase towards the end of RCP3 we will recover direct costs from the connecting parties. Otherwise, our stance of sustaining capability should provide the capacity to accommodate the indirect costs and pressures of increased activity.

2.1.2 Asset renewals and resource constraints

We expect renewal investment activity to grow beyond RCP3, driven most strongly by the need to replace conductors.

This growth in asset renewal investment contrasts with a period of heightened grid expansion activity prior to RCP2, and the relatively stable overall renewal investment profile across RCP1 to RCP3.

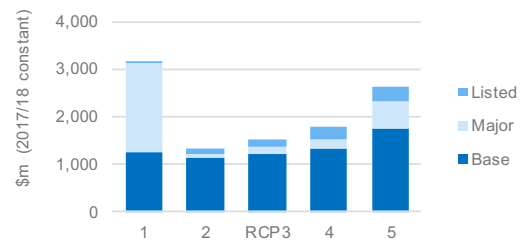


Figure 7: Historical and forecast renewal investment

The potential scale of conductor investment beyond RCP3 makes managing lines renewal a key strategic priority. Our proposal directly includes funding to support increased condition assessment activity during RCP3 and, more generally, sustains our level of investment in asset management capability. This will enable us to refine our plans for the period beyond RCP3, and ensure that we are using the best strategies and techniques and are well set up for delivery.

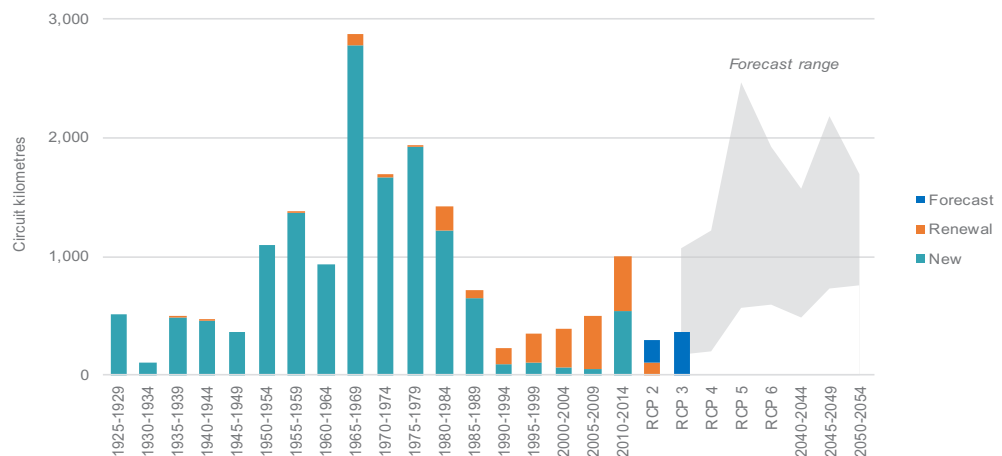


Figure 8: Historical and forecast conductor investment

While our overall investment in grid renewal is stable across RCP1 to RCP3, the investment mix is changing, and we anticipate protection technician and lines mechanic workforce constraints arising during RCP3. We are continuing to enhance our long-term forecasting of workforce requirements and are considering ways to ensure that our procurement practices support sustainable investment in key skills and capabilities.

Beyond RCP3, the increasing volume of reconductoring will require further lines mechanic resources and will also require careful management of network outages. This work may coincide with a period of increased generation connection activity and demand growth, plus deferred investment in our TransGO fibre network. These factors reinforce the importance of addressing lines renewal as a key strategic priority.

2.1.3 Cost of transmission services

We are aware that the cost of electricity is always a key issue for our customers and for end users. Transmission makes up around 10.5 percent of a typical residential electricity bill.⁴ The cost of the HVDC link is also a significant business expense for our HVDC customers.

Historically, our transmission revenue has fallen in real terms, but reset upwards due to the grid expansion programme immediately prior to RCP2. Revenue in the final year of RCP2 will be lower in real terms than in the first year (by 4 percent for HVAC and 9 percent for HVDC) but has been higher through the middle of RCP2. We have several strategies for managing ongoing cost.

- *Revenue smoothing* – we propose that the Commerce Commission should smooth our RCP3 revenue path to improve predictability and reduce volatility.
- *Cost efficiency* – in general, electricity prices are lower if we carefully manage our costs. Our cost management activities include strategic and cultural emphasis on value for money, cost-focussed transformation initiatives and cost-focussed innovation.
- *Asset management capability* – our asset and risk management capabilities support well targeted investment designed to optimise lifecycle costs. This includes a balanced approach to opex versus capex decisions and invest-now versus invest-later decisions.
- *Matching build to need* – while the above strategies ensure that we have an efficient underlying cost base that is passed through to electricity prices, overall transmission costs are strongly influenced by the timing and sizing of big capacity expansion and renewal decisions. As such, matching build to need is a strategic priority.

The above strategies are fully reflected in the forecasting that underpins our proposal. Our proposal development process has also been designed to reinforce these strategies by employing:

- transparent revenue information, in which we have developed and shared our revenue forecasts throughout our process, and
- price-quality testing, through which we have explicitly tested and consulted on the overall price-quality balance for RCP3.

Overall, we expect consistent below-inflation revenue growth across RCP3 with transmission prices moving in line with HVAC revenue. Individual charges can vary due to transmission pricing methodology effects, and the price of transmission per unit of energy is lower if there is demand growth (because our revenue is capped rather than our prices).

2.2 Business capability

Our RCP3 proposal builds on and reinforces improvements that we have made in our business since developing our RCP2 proposal in 2013. Key improvements include:

- cost efficiency, where our forecasts capture and carry forward the benefits of significant and ongoing efficiency initiatives and cost management,

⁴ Transmission makes up a larger proportion of the electricity cost for our directly connected customers. However, directly connected customers do not pay distribution charges.

- strategy and risk management, in which we have developed increasingly sophisticated and integrated methods for understanding and managing strategy and risk across our business,
- grid renewal and maintenance, where our forecasts benefit from significant and ongoing efforts to improve asset management and work programme delivery,
- ICT, where we have matured our strategy, planning and delivery frameworks, and
- improvement priorities, where developments to date clarify future improvement priorities.

2.2.1 Approach to efficiency and innovation

The regulatory framework provides cost efficiency incentive mechanisms designed to operate continuously across the regulatory cycle and to be balanced across capex and opex. We have developed our proposal to be consistent with these arrangements by capturing and rolling forward our current level of cost efficiency. This approach involves:

- using the latest available cost estimates and asset strategies when forecasting grid capital and maintenance programme volumes and costs, and
- in general, adopting a base-step-trend approach for opex, which explicitly uses actual 2017/18 costs as a starting point for our forecasts.

This approach means that our proposal captures the benefits of efficiency and innovation initiatives achieved to date.

Efficiencies and innovations achieved to date

There have been several efficiency and innovation initiatives across the business that have generated savings in RCP2:

- renegotiation of grid service provider contracts with fewer service providers and improved cost transparency and efficiency incentives,
- operating model changes, cultural transformation and leadership development,
- improved business performance monitoring and analysis, procurement, and process management,
- a more top-down approach to budget setting, including centralisation of consulting budgets,
- a transformation programme, Transformation 1, designed to close an approximately 7.5 percent gap between our 2014 forecast of RCP2 capital programme costs and our RCP2 allowances, as well as reducing our operating expenditure costs, and
- the Transformation 2 programme, which reduced our opex by \$6 million during 2017/18 and carries forward this significant saving into RCP3 (i.e. \$30 million across the five years of RCP3).

We have invested significantly to achieve these cost savings and to innovate. In the first three years of RCP2 we have invested approximately \$15 million in opex and \$5 million in capex in cost saving and innovation initiatives.

Unlike in our RCP2 proposal, we are not proposing specific innovation expenditure. Innovation activities are embedded across our organisation and are part of the way we operate. Our proposal sustains current levels of activity overall, effectively carrying forward the capacity to continue innovating.

Our forecasts reflect expected efficiency savings

Three exceptions to our general approach to efficiency and innovation described above are that we have:

- removed direct business transformation costs of \$5.2 million from our base year opex, in effect removing this type of activity from our proposal. This is because our incentive arrangements enable us to share the benefits of cost savings, so we are not including the direct costs of achieving these cost savings in our proposal,
- adjusted expenditure forecasts in anticipation of cost reductions stemming from planned benefits-driven ICT investment. This achieves a balanced cost and benefits-sharing position for this type of investment, and
- proposed grid maintenance funding at a level that will require realisation and reinvestment of efficiency gains to achieve our intended work programme. This approach achieves a balanced allocation of risk associated with deliverability and sets a favourable benefits-sharing position for customers.

More generally, our incentive arrangements support ongoing innovation to find the most optimal way of cost effectively delivering grid services. The incentive arrangements ensure that ongoing improvements are continuously passed through into transmission prices.

See 3.4 for further detail on our treatment of cost efficiencies within our forecasts.

2.2.2 Improvements in strategy and risk management

Since 2013 we have put in place more structured strategy and risk frameworks and we have also improved our management tools in these areas.

Key strategy improvements include:

- experience with developing and engaging on significant strategic studies, such as Transmission Tomorrow and Te Mauri Hiko, including development of forecasting tools and techniques,
- linking of strategic priorities to asset and business management, including through our Strategic Asset Management Plan, to create an improved line of sight from strategy through to detailed decision-making,
- processes for the ongoing monitoring of our strategic environment and for shaping annual and longer-term business priorities,
- formation of clear strategic asset management (grid) and strategy and architecture (ICT) functions and investment in refreshed strategy documents, including grid asset strategies and ICT capability mapping, and
- improved systems and processes for directing and tracking business performance, including centralised data warehouse and business intelligence systems.

The benefits of these improvements are improved decision-making clarity and coordination, including an improved ability to recognise and address important trends and decision points.

Our five strategic priorities, which guide our detailed strategies and underpin our decision making, are to:

- play an active role in enabling New Zealand’s energy future,
- sustain our social licence to operate,
- match our infrastructure to need over time,
- evolve our services to meet customers’ needs, and
- accelerate our organisational effectiveness.

We have developed our capex and opex forecasts to reflect the efficient costs of a prudent supplier, having regard to Good Electricity Industry Practice (GEIP). Our grid strategic objective areas and goals are detailed in section 3.2.5 of our 2018 Asset Management Plan and these have provided guidance for establishing specific objectives for each asset class.

Key risk management improvements include:

- improved risk and assurance management policy, processes and guidelines based on AS/NZS ISO31000:2009,
- bowtie-based risk assessments providing a strong focus on management and critical controls, and on improvement opportunities to further mitigate risks,
- the use of semi-quantitative risk assessments as a method to estimate the annualised loss expectancy for key risks,
- Board-approved risk appetite statements providing management with guidance for risk / reward trade-off for business planning and decision making, and
- robust management oversight and Board governance over the risk and assurance function.

The above improvements ensure that risk management is a key consideration for all decisions through which we can:

- balance and calibrate investment across disparate areas based on a more holistic view of the potential impact of decisions and unforeseen events,
- identify best-value interventions,
- prevent and mitigate adverse events, and
- respond to an increasingly changing environment.

2.2.3 Improvements in grid planning

The grid endures for generations; electricity is an instantaneous service. The very long and very short timeframes involved influence how we plan and manage the grid. Some of the elements factored into our planning are listed below.

- *Grid complexity* – the grid is a complex system engineered to deliver reliable services within a larger scheme managed by multiple parties.
- *Risk management* – because our grid underpins the country’s economic activity, we remain aware of the need to manage risk while also taking a cost balanced approach. The complete elimination of risk is unaffordable and ultimately unachievable, so finding a compromise between affordability and quality of service is a key part of our role.
- *Understanding timeframes* – we have an essential infrastructure stewardship role, managing assets that were built over decades, operate across generations, and service the whole of New Zealand society.
- *Maintaining flexibility* – the components of the grid were built in waves, so the investment required to renew or replace assets can be similarly uneven.

During RCP2, we have improved our efficiency and asset management capabilities considerably. Our RCP3 proposal reflects these capability improvements.

- *A new grid operating model* – Transpower now operates under a single grid operating model, which streamlines and optimises the core business activities around grid management.
- *Improved asset information* – we have invested in improving our collection and management of asset data, so that we can make decisions based on data that is more complete and easily accessible.
- *An asset planning decision framework* – the decision framework takes a structured approach that enables us to make effective, consistent, repeatable asset planning decisions that balance risk, service levels and investment. We use it to determine, plan and justify all grid capex and opex, and for managing trade-offs between the two to ensure we manage our assets at least whole-of-life cost. Central to the decision framework are asset health data and models, and asset criticality.
- *Asset health modelling* – we have matured our approach to data quality, modelling, and use of asset health over the last few years. We continue to evolve in our understanding and application of modelling and model calibration. We regularly review and target maturity for asset health across identified asset classes. We regularly re-calibrate our models based on our current knowledge and target maturity, new information, and forensic investigations of good, and poor, performing assets.
- *A 15-year planning horizon* – we now plan to a 15-year horizon as part of our business-as-usual activities, which allows us to better understand the impact of our current plans on the future needs of the grid.
- *Cost estimation* – we have improved our systematic approach to estimating the cost of works.

2.2.4 Improvements in ICT planning

Our information and communications technology (ICT) investment is driven by business requirements, enabling us to balance our investment as we innovate and transform our functions to deliver long term digital business outcomes.

- *Lifecycle investments* – these are mandatory investments made to meet regulatory requirements, manage risk, and maintain the value of our existing productive assets.
- *Risk mitigation investments* – these either reduce or minimise the impact of identified risks.
- *Compliance investments* – these are required by regulations, standards, legislation or social responsibility initiatives.
- *Benefits driven investments* – these deliver business benefits and value to Transpower in the form of new capabilities that reduce costs or enhance the value of grid services.

For our RCP3 proposal, we have developed our ICT forecast using a *capability* and *outcomes* based planning approach. We use capability assessment models to provide a structured map of all the key capabilities required to effectively enable business functions and processes.

Our approach to ICT investment is to use emerging trends in the market. Overall, we consider there is significant potential in future years to further enhance our business and processes by incorporating, for example, the use of cloud-based services, enhanced use of big data and analytics and, as they become sufficiently advanced, adopting intelligent systems, industrial digital platforms, and pervasive networking.

2.2.5 Improvement priorities

To support our next proposal in 2023 we will continue to improve our business, and regulatory planning will be driven by our ongoing business needs. Key improvement priorities are listed below.

- *Lines investment* – we expect investment in tower painting and reconductoring to grow beyond RCP3 and this will pose challenges in terms of cost, deliverability and system impact. The potential scale of this programme makes it important to invest in information, modelling, strategies, technologies and planning to optimise the way we plan and deliver this work.
- *Strategic readiness* – our strategic environment presents uncertainties, challenges and opportunities, including the opportunity to play an enabling role as New Zealand transitions to a more electrified low-carbon economy. It is important for us to build on what we have already achieved through our business transformation work, to further enhance our strategic analysis, and to continue to play an active role in the sector, planning for anticipated changes and leveraging new technology opportunities as they become viable.
- *Risk-based asset management* – our risk-based asset management represents Good Electricity Industry Practice but can improve further. We will continue to explore new technologies and processes to improve our understanding of asset condition and develop our asset health and criticality modelling. Further developing our decision-making processes and tools will make scenario testing for risk-based decisions and capex/opex trade-offs faster and more accessible.
- *Cost management* – we have achieved significant cost management gains during RCP2 and understand the value of continuing to challenge ourselves to extend our gains. We will continue to rely on third party service providers to deliver our work, and to improve our contracting approach to ensure that our service providers are incentivised to deliver work as efficiently and cost effectively as possible.

We anticipate further enhancements to our proposal development process for RCP4. The process we have undertaken to develop our RCP3 proposal has involved several new steps that have strengthened the robustness of this proposal (these are described in detail in section 2.3), and we expect to retain and further advance these steps.

Independent verification has strengthened our RCP3 proposal significantly. We anticipate that we will work with the Commerce Commission to engage an independent verifier for our RCP4 proposal, and we will give effect to lessons learned during the development of the RCP3 proposal to integrate this step into our future proposal development process.

Stakeholder consultation has also been an important step, and one that we anticipate repeating for our RCP4 proposal. In addition, in September 2018, we established a Consumer Advisory Panel as a forum for regular, long-term dialogue with electricity consumers. The Panel comprises representatives from consumer interest groups who speak for a diverse cross-section of consumers, including the vulnerable. The Panel will provide us with regular advice and input about consumers' needs and perspective and engage in two-way dialogue on emerging issues. We will use the Panel's advice and insights to better inform our business planning and decisions.

We intend to engage closely with the Panel on strengthening our consultation process for RCP4. Our first meeting in November 2018 included a reflection on our process for RCP3 and began a discussion on ensuring that consultation for RCP4 will involve engaging more widely and closely with consumers, including through the Consumer Advisory Panel.

2.3 Proposal development

We used the following process to develop our RCP3 proposal.

- *Initial baseline* – the business improvements discussed above provided the foundation for developing a robust baseline forecast.
- *Internal challenge* – we refined our baseline forecast through multiple internal challenge processes, including a deliverability review.
- *Price-quality testing* – we tested our baseline plan to understand areas where we could shift the price-quality balance.
- *Transparency and engagement* – throughout the forecast development process we have engaged with customers and stakeholders, which included consulting on our forecasts and output measures.
- *Independent verification* – we engaged an expert independent third party to review our proposal and to provide an independent verification report to the Commerce Commission.

The key stages of our RCP3 forecast as we refined it are set out in Figure 9.

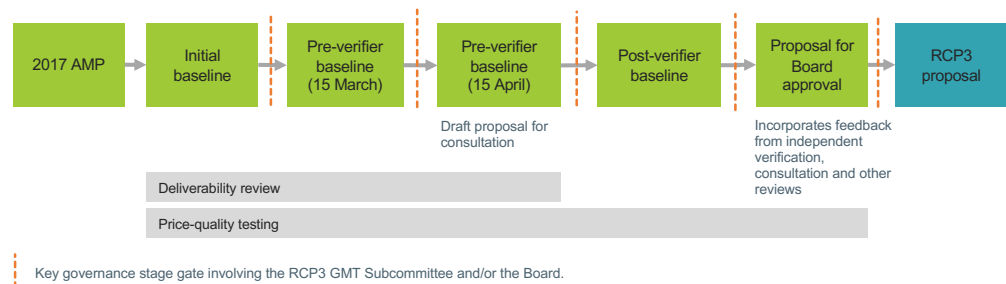


Figure 9: RCP3 proposal development - key stages

2.3.1 Initial baseline

The 2017 Asset Management Plan (AMP) includes a bottom-up expenditure forecast by expenditure type, which was adopted as the starting point for proposal development. The AMP forecast reflected the improvements we have made to our grid and ICT planning approaches, described in sections 2.2.3 and 2.2.4.

Ongoing refinement of the 2017 figures has occurred through our business-as-usual, continuous capex forecasting processes. In normal years, our business plan and AMP are key milestones for refining and presenting our baseline. As part of the development of our RCP3 proposal, we developed an earlier view of our baseline for the independent verifier (discussed in more detail in section 2.3.7).

The remainder of this section describes the steps that we have taken to refine the initial baseline, and the adjustments we have made as a result.

2.3.2 Management and Board challenge and governance

The development of our RCP3 proposal was guided by a core group of general managers, the General Management Team (GMT) RCP3 Subcommittee, who met regularly as the proposal was developed to provide governance oversight.⁵ Other general managers were regularly briefed as required.

The forecast development and challenge process involved the key stages as described in Figure 9, and involved the Board, the Chief Executive, general managers and subject matter experts. To keep the Board informed, it was briefed throughout the forecast development process.

2.3.3 Solution prioritisation

As part of the grid expenditure forecast development, in early 2018 we prioritised investment solutions through a cross-portfolio peer challenge process. Solution prioritisation applies a detailed portfolio level review of the expenditure forecasts to refine them based on various factors including asset knowledge, expenditure linkages and risk.

The solution prioritisation process involved subject matter experts and senior managers to identify the critical components within each portfolio. The critical components were assessed (including by assessing different scenarios and modelling impacts) to optimise the overall cost of the grid expenditure forecast.

The solution prioritisation process also generated some of the options that were considered in our price-quality testing stage as described in section 2.3.6.

2.3.4 Deliverability review

We also tested the deliverability of our RCP3 forecast. Assessing deliverability is about understanding the issues and risks that affect our ability to complete work to plan and creating a strategy that helps us to manage these risks. The purpose of the deliverability review was to identify key risks to deliverability and identify adjustments to ensure our RCP3 forecast is deliverable. The insights gained will also help us with the detailed planning for the successful delivery of RCP3.

Assessing for deliverability is not a clear-cut exercise, but making adjustments early helps to ensure that our plans are achievable, and that funding is set at an appropriate level. More detailed refinements to our work programme will occur through continuous and annual business planning processes.

The deliverability review identified five broad delivery risks.

- In several portfolios, forecast work volumes increase to a level that we consider will exceed service provider capacity to deliver.
- Some portfolios have low forecast certainty in later years of RCP3 due to the nature of their risk or condition-based replacement strategies. While this supports efficient investment and provides flexibility to refine our plans closer to the need date, it makes it more difficult to forecast where and when resources will be required.
- Our service provider workforce has been reducing over recent years, which has reduced capacity to respond to peaks or spikes in workload.
- There is a risk that reducing workload in some portfolios could result in service provider workforce reductions overcompensating and creating new resource shortages in future.

⁵ The GMT RCP3 Subcommittee included the GM Grid Development, GM Customers and Projects, GM Grid Service Delivery, GM Information Services and Technology and the Chief Financial Officer.

- Substantial regional shifts in work, coupled with demand for skills from industry peers, could create shortages where service providers are unable or unwilling to shift resources to where they are needed.

Our initial response to the identified delivery risks in our draft proposal for consultation was to:

- reduce forecast base capex by \$65 million, and
- reduce forecast grid maintenance by \$37 million.

However, in consultation submissions, some stakeholders told us that they would prefer us to build workforce capacity during RCP3 rather than reduce planned work. In response, we have reduced the scale of deliverability adjustments for secondary systems and grid maintenance to set a more balanced position. As a result, in our proposal we have revised the above adjustments to reach the following position.

- Reduced forecast base capex by \$58 million (\$7 million capex added back in for protection assets).
- Reduced forecast grid maintenance by \$29 million (\$8 million opex added back in).

To assist with managing our workload, we have also re-phased the spend profile for grid renewal capex to rebalance work towards the later years of the RCP3 period. This is to provide a more manageable 'ramped' profile and allows for reduced work during service provider re-contracting, which we anticipate occurring during years one and two of RCP3.

2.3.5 Delivery planning

The following areas of work will help enable successful delivery for Transpower during RCP3.

- *Planning optimisation* – we are looking at ways for the organisation to create efficiencies in the planning and delivery process that allow a greater throughput of works.
- *Strategic contracting approach* – we are looking to develop future commercial arrangements that are aligned with current planning.

We have also factored in two key lessons learnt from RCP1 and RCP2.

- *Ensuring continuity of planning and delivery processes* – having this continuity between control periods avoids a 'stop-start' effect. We had high delivery in the final year of RCP1 and low delivery in the first year of RCP2. This was challenging for our service providers and has had a flow-on impact on the profile of our work programme across RCP2. Ensuring we achieve a 'running start' in RCP3 will be important.
- *Managing top-down adjustments carefully* – we allocated our 7.5 percent productivity adjustment for RCP2 down to project level, which prompted re-planning activity that proved disruptive to delivery. For RCP3 we have a better toolset for managing substitutions and understanding forecast uncertainty and will more carefully shift whole-of-programme adjustments down to specific projects and programmes over time.

We need to maintain flexibility to respond to changing condition information and to optimise the scheduling of work. Our programme management plans do not cover the full period up to the end of RCP3.

For grid renewal, programming and scheduling work is undertaken so that works are grouped efficiently and to ensure deliverability. The detailed scheduling work covers the short-term planning horizon for the next 24 months, and the high-level programming on works deliverability covers the 24-month to 10-year planning horizon. Most of RCP3 falls outside of our current detailed planning cycle and planning work for the RCP3 period is to commence in due course.

For grid maintenance, we develop a 24-month works plan to allow for outage planning, with four-month-ahead work schedules, comprising one-month-ahead approved work and three months of scheduled work. Again, detailed planning work for the RCP3 period is to commence in due course.

2.3.6 Price-Quality testing

Balancing cost with quality is built into our planning, through risk analysis, economic testing and incentives to improve efficiency. Our proposal process has also used multiple top-down review steps to challenge and modify the result of bottom-up planning activities. The above considerations, in combination, should result in a proposal that strikes an appropriate balance between overall cost and quality. However, we wanted to take our planning one step further and test how overall price and quality change as we modify expenditure choices for RCP3.

Price-quality testing is a challenging exercise due to the scale of our work programme, the complexity of the grid and its supporting systems, and the uncertainty involved in estimating costs and risks. We are also mindful that reducing investment in one period can lead to increased costs or deteriorating quality in the future.

The approach taken to deal with the above challenges focused on qualitative assessment of relative changes in quality, coupled with an assessment of long-term price impacts.

Quality indicators

We developed 14 quality indicators covering the various ways that altering expenditure choices can impact quality across asset quality, asset risk, network service and organisation capability. We used these indicators, together with written descriptions of quality impacts, to assess and communicate changes in specific expenditure areas, and the impact of combining several changes, into an overall price-quality position.

The quality indicators complemented analysis of the price-path impact of altering expenditure choices. We used a range of pricing indicators to illustrate the differing impacts of capex and opex changes, and to show how impacts can accumulate or reverse over time.

For more detail, see the price-quality balance chapter of our proposal consultation paper.⁶

Impact on our process

We identified expenditure areas and developed overall price-quality positions ahead of consulting on our draft proposal in August 2018. This work was completed after solution prioritisation, and in parallel with deliverability testing, ICT scenario testing and independent verification.

Solution prioritisation and ICT scenario testing provided targeted, structured and quantitative inputs to price-quality testing. Price-quality testing helped identify how reconditioning deliverability adjustments could be made and provided a framework for testing stakeholder views on the merits of the full suite of deliverability adjustments.


Price-quality testing proved an important component to our internal challenge and governance processes and formed a key part of August 2018 consultation on our draft proposal. The price-quality framework and submissions on price-quality balance were key inputs to decisions on our final proposal.

⁶ Transpower (2018). *Securing our energy future 2020-2025, Regulatory Control Period 3: Draft proposal for consultation*. URL: <https://www.transpower.co.nz/resources/securing-our-energy-future-rcp3-consultation-document>, pp43-51.

Outcomes of price-quality testing

Our consultation paper identifies seven expenditure areas where we could strike a different price-quality balance by increasing or reducing expenditure relative to our draft proposal. For more detail, see Appendix 5 of our draft proposal consultation paper.⁷

The seven expenditure areas cover most aspects of our proposal, while focussing on items large enough to make a measurable difference to forecast price path and quality outcomes. Table 3 summarises consultation and outcomes for each of those areas, plus a further area which was developed via consultation.

Area	Consultation	Outcome
 <p>Solution Prioritisation</p>	<p>Our grid renewal planning included a 'solution prioritisation' step that identified a list of items we could potentially remove from our proposal. The forecast included in our RCP3 consultation paper removed some of these items, but left items in the forecast that would be riskier to remove.</p> <p>We tested options for removing more items.</p>	<p>No change.</p> <p>No direct feedback on the solution prioritisation areas identified, so it was preferable to follow engineering judgement.</p>
 <p>Tower Painting</p>	<p>Tower painting is our biggest base capex work programme and is designed to manage long-term cost pressures (i.e. we paint to avoid escalating corrosion management costs rather than imminent failure).</p> <p>This area had options for accelerating or reducing tower painting.</p>	<p>No change.</p> <p>Testing highlighted how the proposal optimises deliverability to achieve a prudent price-quality outcome.</p> <p>Longer-term work to continue testing and refining the tower painting programme given its growing scale.</p>
 <p>Reconductoring</p>	<p>Reconductoring is the largest investment area overall and is projected to grow further beyond 2025. The draft proposal restricted proposed funding due to concerns about line mechanic availability.</p> <p>This area had options for relaxing or extending initial restrictions.</p>	<p>No change.</p> <p>There was some support for tackling deliverability concerns and relaxing restrictions, but no change was made to the base capex proposal due to the potential volume of listed reconductoring work.</p>
 <p>Standards and Specifications</p>	<p>We use more than 340 standards and specifications to guide the quality of the grid assets we build. We are already working to find efficiency gains, in effect amending standards to achieve broadly the same outcome at lower costs.</p> <p>This area had an option to push cost reductions further by tolerating less robust grid assets.</p>	<p>Tightened. Removed \$10 m capex.</p> <p>There was support for moderate tightening of our investment position overall. Standards and specifications provides a suitable area to achieve this.</p>
 <p>ICT</p>	<p>Our ICT planning developed scenarios for restricting lifecycle and benefits-driven investment.</p> <p>This area had options for two levels of restriction relative to our draft proposal.</p>	<p>Tightened.</p> <p>Interaction with independent verifier draft report, which prompted further review of ICT benefits-driven investment. More detail on the independent verifier is set out in section 2.3.8.</p>

⁷ Transpower (2018). *Securing our energy future 2020-2025, Regulatory Control Period 3: Draft proposal for consultation*. URL: <https://www.transpower.co.nz/resources/securing-our-energy-future-rcp3-consultation-document>, pp81-90.




Area	Consultation	Outcome
 <p>Grid Maintenance</p>	<p>The draft proposal restricted forecast grid maintenance due to concerns about the ability to achieve a material uplift in maintenance activity.</p> <p>This area had options for relaxing or tightening restrictions.</p>	<p>Relaxed restrictions. Added \$8 m opex.</p> <p>There was some support for tackling deliverability concerns and relaxing restrictions.</p> <p>Restrictions reduced from \$37 m to \$29 m.</p>
 <p>Asset Management</p>	<p>The draft proposal for consultation held funding for Asset Management and Operations opex constant, to sustain progress with asset management improvements, and to prepare for the challenges of a changing sector and increasing tower and lines work.</p> <p>This area had options for increasing or reducing asset management funding.</p>	<p>No change.</p> <p>Support for Transpower sustaining the capability to support sector transition over the coming years.</p>
 <p>Protection</p>	<p>In our consultation forecast we applied a deliverability adjustment of \$14 m due to the risk of protection technician workforce constraints but did not explicitly test price-quality balance in this area.</p>	<p>Reduced the size of the deliverability adjustment. Added \$7 m capex.</p> <p>There was some support for tackling deliverability concerns instead of reducing our forecast.</p> <p>Deliverability adjustment reduced from (-\$14 m) to (-\$7 m).</p>

Table 3: Consultation outcome for each expenditure area

Overall, price-quality testing has improved understanding, including within our business, of how changes in expenditure can impact price and quality over time and has helped us to rebalance and finalise our proposal.

2.3.7 Transparency and engagement

Our proposal process, and supporting business processes, are upheld by high levels of transparency and engagement. This has contributed additional rigour to our planning and enhanced our ability to ensure that services broadly reflect consumer demands. Engagement spans proposal inputs, analysis and overall outcome. Key components are listed below.

- *Surveys* – surveys, and interviews for direct-connect customers, have been used to help estimate the economic impact of interruptions, or value of lost load (VoLL) for various end users. These estimates are used as inputs to our criticality framework, point of service categorisation and economic analysis.
- *Joint planning* – regional network development is jointly planned with our distributor and direct-connect customers. This includes engagement through our annual *Transmission Planning Report* process on forecasts, system needs and potential solutions, regional forums for specific multi-party development challenges, and commercial engagement on potential investments.

- *Disclosures* – each year since 2015 we have published an updated Integrated Transmission Plan Narrative and Asset Management Plan. These provide transparency regarding our evolving planning capability and our forecasts. We have included price path forecasts and capex reduction targets in these publications. We also published an Initiatives Plan in 2015 to provide transparency on business improvement priorities, and have updated progress, including on asset health modelling annually in our regulatory disclosures.⁸ We have reinforced these publications with stakeholder engagement, including regular updates at industry forums.
- *Engagement on strategic environment* – during RCP2 we published two major studies on strategic context for the New Zealand power sector – *Transmission Tomorrow*⁹ and *Te Mauri Hiko*¹⁰. Both studies were accompanied by extensive engagement activities aimed at stimulating discussion, challenging our thinking, and helping to refine our understanding. *Transmission Tomorrow* was linked through to the strategy and planning frameworks used to build our forecasts. *Te Mauri Hiko* provides an updated view of our long-term scenarios for New Zealand’s energy future. We have used this additional context to finalise and communicate our proposal. Both studies are consistent with the view that there is long-term value in the grid and that growth pressures are likely to intensify towards the end of RCP3 as electrification accelerates.
- *Auckland Strategy* – in addition to studies on our broader strategic environment, we have developed a strategy focussed on Auckland. We developed Powering Auckland’s Future through extensive engagement with Auckland stakeholders, including our customers, iwi and hapū, local government and other Auckland infrastructure providers.¹¹
- *Output measure development* – we have refreshed our service measures for RCP3 and developed targets through a series of focus group meetings and engagement papers published in October 2016, April 2017, and June 2018.¹² We have developed asset health outputs through a pilot reporting programme that included consultation in October 2017 and June 2018 and disclosures in 2017 and 2018.
- *Proposal consultation* – we consulted on a draft of our proposal in August 2018. The aim of the consultation was to seek broad input on the proposal overall and targeted input on price-quality balance, grid outputs, and regulatory choices.¹³ Stakeholder submissions helped us finalise our proposal.

⁸ The Initiatives Plan, Integrated Transmission Plan, along with other updates and disclosures, are available on our website at: <https://www.transpower.co.nz/industry/regulatory-control-periods/rcp2/updates>.

⁹ Transpower (2016). *Transmission Tomorrow: Powering New Zealand Today and Tomorrow*. URL: https://www.transpower.co.nz/sites/default/files/plain-page/attachments/Transpower%20-%20Transmission%20Tomorrow26052016_0.pdf More information on *Transmission Tomorrow* is available on the Transpower website at: <https://www.transpower.co.nz/about-us/transmission-tomorrow>.

¹⁰ Transpower (2018). *Te Mauri Hiko Energy Futures*. Transpower white paper. URL: <https://www.transpower.co.nz/sites/default/files/publications/resources/Securing%20Our%20Energy%20Future%20-%202022%20August%202018%201500.pdf> More information on *Te Mauri Hiko* is available on the Transpower website at: <https://www.temaurihiko.co.nz/>.

¹¹ Transpower (2018). *Keeping you connected; our Auckland Strategy*. URL: <https://www.transpower.co.nz/sites/default/files/publications/resources/Transpower%20Auckland%20Strategy%20Final%20Report%20DIGITAL.PDF> More information on our *Auckland Strategy* is available on the Transpower website at: <https://www.transpower.co.nz/keeping-you-connected/auckland-strategy/our-auckland-strategy>.

¹² The service measure refresh process is documented on the ‘Transpower services refresh for RCP3’ page our website at: <https://www.transpower.co.nz/transpower-service-level-refresh-rcp3>. Additional material on asset health is available on the ‘2015–2020 Transpower individual price-quality path’ page on the Commerce Commission website at: <https://comcom.govt.nz/regulated-industries/electricity-lines/electricity-transmission/transpowers-price-quality-path/20152020-transpower-individual-price-quality-path?target=documents&oot=80393>.

¹³ Our consultation paper, focus group slides and submissions are available on the ‘Securing our energy future 2020 – 2025’ page on our website. <https://www.transpower.co.nz/keeping-you-connected/industry/rcp3/securing-our-energy-future-2020-%E2%80%93-2025>.

The specific engagement components above are complemented by numerous other activities and relationships that connect our planning and operations to our customers and wider stakeholders. Our proposal is built from our underlying business processes, and benefits from the breadth of this engagement.

Outcomes of engagement

Table 4 provides an overview of the key outcomes from our engagement process, focussing on areas where the result is directly observable rather than embedded in the way we plan and operate.

Area	Comment	Outcomes
Joint planning	We have used a scenario-based approach to grid Enhancement and Development capex forecasting, which is an integral part of our Transmission Planning Report.	We are proposing less capex than proposed or approved for RCP2, with better information on the potential range of outcomes.
Disclosures	Our 2016 Integrated Transmission Plan set a target to reduce forecast RCP3 base capex to \$1.3 b (2015/16 constant prices). ¹⁴	We are proposing base capex of \$1,202 m (2017/18 constant prices).
Output measures	We have conducted VoLL surveys and engaged extensively on how we should refresh output measures.	Measures have been streamlined, point of service categorisation has been revised and new return to service measures have been developed for trial, as summarised in section 2.4.2.
Proposal consultation	Engagement on price-quality balance, overall draft proposal and regulatory options.	Expenditure has been rebalanced, with tightening of standards and specifications, and relaxed deliverability restrictions for grid maintenance and secondary systems, as summarised in section 2.3.6. ¹⁵

Table 4: Key outcomes from our engagement process

In our RCP3 consultation, we asked several specific questions about regulatory options.

- *Proposed revenue smoothing for RCP3* – revenue smoothing is discussed in more detail in section 2.4.3.
- *Financial incentives to meet Transpower's performance targets* – stakeholders were generally supportive of our proposed design of output incentives. We have reflected stakeholder feedback in the proposed output incentives set out in section 2.4.2.
- *The refinement of incentives for expenditure areas with high levels of uncertainty* – we sought feedback on our use of the listing and low incentive rate mechanisms. Stakeholders indicated support for listing reconductoring projects and for listing the HVDC Pole 2 replacement. However, the scope and need for this work is sufficiently certain that we have included it in our base capex proposal for RCP3. This is discussed in further detail in section 5.7.

Further information on our analysis and response to submissions is provided in our submission analysis document.¹⁶

¹⁴ Note, our 2016 ITP was presented on a commissioned rather than spend basis.

¹⁵ As part of our consultation we provided information on three revenue impact assessments: base, base and not-yet-approved listed, and base and not-yet-approved listed and major capex. We did not receive specific feedback on these revenue impact assessments.

¹⁶ Information is available on the 'RCP3 submissions' page on our website at: <https://www.transpower.co.nz/keeping-you-connected/industry/rcp3/rcp3-submissions>

2.3.8 Independent verification

In late 2017 we agreed with the Commerce Commission to trial independent verification of our RCP3 proposal as an additional measure alongside consultation, self-certification and post-submission evaluation. This has involved engaging an independent expert to scrutinise our proposal as it is developed and provide a report that assists the Commerce Commission to streamline and target its evaluation.

Independent verification is required for customised price-quality path applications and has been used previously by Orion and Powerco for their proposals. The process was adapted for our use. The terms of reference were tailored to fit with our individual price-quality path regulation, including replacing the “expenditure objective” test used for customised price-quality paths with an “expenditure outcome” test. The terms of reference also cover the information requirements specific to RCP3, and pick up on focus areas from the Commerce Commission’s RCP2 decision.¹⁷

The independent verifier’s draft report was shared with the Commerce Commission. The aim was to allow the Commerce Commission to provide early comments on the format and coverage of the report to increase the usefulness of the report as an input to its evaluation.

We engaged Synergies Economic Consulting (Synergies), working in partnership with GHD Advisory (GHDA) as our independent verifier. Under a tripartite deed between Transpower, Synergies/GHDA and the Commerce Commission, the independent verifier has a duty of care to act as an independent expert and with reasonable care.

We have submitted the Synergies/GHDA independent verification report alongside our proposal.

Independent verification process

The independent verification process operated in parallel with the challenge, price-quality testing and consultation stages of our proposal preparation.

Key milestones included an introductory workshop in April, a week-long series of detailed workshops in mid-May, and follow-up workshops in mid-July. The workshops complemented regular meetings, documentation sharing via an electronic data room, and written information requests and responses during May to July. We shared more than 200 documents and responded to 24 detailed information requests. We also held several three-party meetings involving Synergies/GHDA, the Commerce Commission and Transpower during the verification engagement to share progress and test areas of interpretation.

We received the draft verification report in July 2018 and the final report on 12 October 2018.

Synergies/GHDA commented in its report that

“[i]n carrying out our verification work, we note the high degree of assistance and cooperation both Transpower and the Commission have provided to us. We consider this has enhanced the information upon which we have relied for our verification review and consequently the robustness of our analysis.”¹⁸

¹⁷ The independent verification terms of reference and tripartite deed are available on the ‘Setting Transpower’s price-quality path from 2020’ page on the Commerce Commission website at: <https://comcom.govt.nz/regulated-industries/electricity-lines/electricity-transmission/transpowers-price-quality-path/setting-transpowers-price-quality-path-from-2020?target=documents&root=91269>.

¹⁸ Synergies Economic Consulting (2018). *Independent Verification Report – Transpower’s RCP3 Expenditure Proposal (2020-25)*. Section 1.5 (Summary of our verification review process), page 33.

Summary of outcomes of independent verification

We consider the verification process has added value to our preparations and expect it should provide reassurance to stakeholders and should assist the Commerce Commission to operate an effective and efficient evaluation.

The verification report summarises the status of expenditure areas using a two-part classification:

- *Verified* – indicates the verifier has tested the expenditure area, and
- *Satisfies GEIP* – indicates the verifier is satisfied the expenditure area meets the expenditure outcome, which includes considering whether forecasts are consistent with Good Electricity Industry Practice (GEIP).

The independent verification covered 86 percent of our RCP3 base capex (\$1,036 million of a total \$1,202 million) and 100 percent (\$1,343 million) of our RCP3 opex forecast. The coverage of the verification was based on the criteria for identified programmes (described in section 3.2). The verifier chose also to include additional expenditure categories in its review (i.e. 'non-identified programmes'), based on its understanding of the Commerce Commission's areas of interest.

Overall, Synergies/GHDA concluded that:

- 100 percent of the verified base capex satisfied GEIP, and
- approximately 92 percent of verified opex satisfies GEIP.

Verification feedback incorporated into our RCP3 proposal

We made several refinements to our RCP3 proposal as a result of the independent verifier's feedback. The changes are summarised in the table below.

Independent verification feedback	Transpower's response
<p>E&D capex</p> <p>Synergies/GHDA noted that Transpower's E&D forecasting methodology for RCP3 is more robust than the one used to develop its RCP2 forecasts. However, as part of its review it recommended that Transpower should develop business rules for the development of the high and low scenario estimates.</p> <p>Synergies/GHDA accepted the new RCP3 forecasting methodology and business rules.</p> <p>(In the final report, Synergies/GHDA noted the Transpower business rules supporting the development of the RCP3 forecast, which it considers will provide a sound approach to forecasting with good consideration of the inherent uncertainties in E&D projects).</p>	<p>Our proposal includes business rules to support the high and low scenario expenditure estimates, justifying the value and reasons for any unidentified Enhancement and Development project allowances (refer to chapter 4).</p>
<p>ICT capex</p> <p>Synergies/GHDA suggested that Transpower quantifies the expected cost savings from benefits driven ICT capex to assist in assessing the efficiency and cost effectiveness of these initiatives.</p> <p>(In the final report Synergies/GHDA noted that Transpower has provided good high-level preliminary estimates of benefits to support assessment of efficiency and cost effectiveness).</p>	<p>We assessed all benefits driven ICT capex and quantified the expected cost savings (discussed in sections 3.4 and 7.2.1).</p> <p>In addition, as discussed in section 2.2.1, we applied the expected cost savings in our forecasts.</p>

Independent verification feedback	Transpower’s response
<p>Renewal capex</p> <p>Given the large predicted uplift in tower painting and reconductoring, Synergies/GHDA recommended that Transpower consider the longer deliverability implications (RCP4 and beyond) of the future painting and reconductoring programme.</p>	<p>We have started our early longer-term resource planning, which we shared with Synergies/GHDA. We will continue to develop and refine our approach to ensure we are able to deliver the large uplifts in painting and reconductoring renewal programmes during RCP4 and beyond.</p>

Table 5: Independent verification feedback and our response

Areas where our views differ from those of the independent verifier

Our view differs from that of the independent verifier in two areas, as summarised in table 6 below.

Independent verification feedback	Transpower’s response
<p>Synergies/GHDA considers that the proposed HVDC upgrade is prudent and satisfies GEIP. There is potential for this project to satisfy the Capex IM’s listed project criteria.</p>	<p>The HVDC upgrade is included in our base capex proposal as the scope and need for the work is sufficiently certain. Our next step is to develop a business case.</p>
<p>In its expenditure outcome assessment of Asset Management and Operations opex, Synergies/GHDA finds that it:</p> <p><i>“Accept[s] base year 2017/18 consistent with later year allowances in RCP2, ha[s] no view on step changes as not quantified, agree[s] with trends proposed for growth in ancillary services, staff productivity and Benefits-Driven ICT capex (which is reflected in ICT capex). As base-step-trend forecast, accept forecast is in accordance with GEIP.”¹⁹</i></p> <p>The report also recommends that we do the following:</p> <p><i>“Transpower implemented GOM [the Grid Operating Model] in 2016 with greater focus on maintenance. We believe Transpower needs to make case for the number of FTEs involved in maintenance support, their role and the expected long-term benefits from this extended planning and investigative work.”²⁰</i></p> <p>And as potential area of improvement:</p> <p><i>“Given change in operating model in 2016, consistency with past year expenditures in itself is not sufficient justification for base year as basis for RCP3 forecast. Transpower should outline how activities provide monetary benefits to maintenance programmes.”²¹</i></p>	<p>We consider the Transpower information Synergies/GHDA has used in its assessment requires further context.</p> <p>The Asset Management and Operations portfolio relates to our workforce required to enable all work on our network, i.e. asset management and planning, network operations and service delivery.</p> <p>The changes we have implemented since 2016 with the introduction of the Grid Operating Model (GOM) involved a comprehensive restructure of the asset management and service delivery part of our organisation. As part of this restructure we made a range of changes to processes, policies, service provider arrangements etc.</p> <p>While the introduction of GOM resulted in changes to our maintenance approach, only a subset of the GOM relates to maintenance. The verification report focuses on changes to maintenance planning activities as a driver for Asset Management and Operations FTEs.</p> <p>We note the GOM was implemented several years ago and is now well established.</p> <p>We also note that our justification for choosing 2017/18 as base year does not only rely on an assessment of consistency with past year expenditure. As outlined in the explanation of our Asset Management and Operations forecast (section 6.2) we also normalise for changes in work focus (due to reduced focus on large capital delivery and more focus on asset management which involves opex). In addition, the verifier’s benchmarking indicates that our FTE: opex ratio is comparable to a relevant peer organisation.</p>

Table 6: The areas where Transpower's view differs from that of the independent verifier

¹⁹ Synergies Economic Consulting (2018). Independent Verification Report -Transpower's RCP3 Expenditure Proposal (2020-25). Chapter 8 (Opex forecast verification), section 8.6.6, page 336 (table 99).

²⁰ Ibid.

²¹ Ibid.

Unverified areas of our proposal

The independent verifier also commented on two areas that were not verified (i.e. the expenditure area could not be tested by the verifier). These are summarised in the table below.

Independent verification feedback	Transpower's response
<p>Insurance opex</p> <p>Synergies/GHDA reviewed our insurance forecast but considers that an actuarial expert opinion is required to assess the efficiency of the proposed step change in RCP3 insurance opex.</p> <p>(\$88 m during RCP3)</p>	<p>We have obtained actuarial and insurance broker expert opinions. We are providing these to the Commerce Commission as an input to its evaluation of the RCP3 proposal. As agreed with Synergies/GHDA and the Commerce Commission, assessment of the expert opinions was outside of the scope of the independent verification.</p> <p>The use of expert opinion to support our insurance opex forecast is consistent with the approach for our RCP2 proposal.</p>
<p>Predictive maintenance</p> <p>Synergies/GHDA was only able to verify \$36.2 m of predictive maintenance step changes, of an overall \$62.2 m. \$26 m of step changes are unverified as Synergies/GHDA was unable to verify the efficiency of the allowances against reference documentation.</p> <p>For three step changes, Synergies/GHDA recommends that Transpower provide clearer information on the source for the step changes (asset health step change; capex/opex trade-off relating to RCP3 and RCP4 programme support; a capex/opex trade-off relating to Auckland work).</p> <p>(\$26 m during RCP3)</p>	<p>We can provide additional information on these step changes if required, and will work closely with the Commerce Commission as it undertakes its evaluation.</p>

Table 7: Unverified areas of our proposal

Additional observations

In addition, Synergies/GHDA was able to observe several aspects of our proposal development process while they were underway. These are discussed in the table below:

Independent verification feedback	Transpower’s response
<p>Stakeholder engagement</p> <p>Synergies/GHDA considers that the extent of our stakeholder engagement on the RCP3 proposal has been adequate and has been moderately effective. It considers that the content and methodology for engagement was sound. Documenting engagement objectives upfront would assist with better assessing the effectiveness of consultation in the future.</p>	<p>We expect to develop our ability to engage meaningfully with stakeholders for our RCP4 proposal, in particular our customers, but also end-consumers through our newly established Consumer Advisory Panel.</p>
<p>Price-quality testing</p> <p>Synergies/GHDA considers our price-quality testing to be a well-intentioned initiative in reviewing at a relatively high-level, the scope for expenditure and service performance trade-offs in RCP3, as well as in the longer-term. However, it notes that the current approach only identifies any risk impacts qualitatively.</p> <p>Synergies/GHDA believes the price-quality testing is likely to be better utilised as in input to options assessments analysis rather than as a final expenditure gateway.</p>	<p>We acknowledge that more work may be required to quantify the additional risk arising from price-quality trade-offs.</p> <p>We intend to build on lessons learnt from our RCP3 price-quality testing for the RCP4 proposal.</p>
<p>Grid output measures</p> <p>Synergies/GHDA is satisfied that our grid output measures meet the relevant expenditure outcome. The measures address the areas of service performance that it considers are likely to be of most concern to energy consumers.</p> <p>The incorporation of the Value of Lost Load (VoLL) into the service performance incentive arrangements to proxy the value that customers place on a reliable electricity supply improves upon the RCP2 incentive arrangements.</p> <p>The only caveat relates to the details of the new asset health measures, as the details of the associated incentive arrangements were still being finalised as Synergies/GHDA completed its verification.</p>	<p>Our proposed grid output incentive arrangements, including for the asset health measures, are noted in section 2.4.2, and in more detail in the Grid Outputs Report. We have reflected feedback we received on these measures when we engaged with stakeholders in June and August 2018, and prior.</p> <p>We will work closely with the Commerce Commission as it evaluates our proposed grid output measures.</p>

Table 8: Independent verifier’s additional observations

2.3.9 Audit and assurance

Our proposal development was supported by robust external and internal assurance processes. The regulatory rules require at least two directors certify, having made all reasonable enquiries, that:

- the base capex proposal complies, in all material respects, with the requirements of clause 7.3.1 of the Capex IM and the information requirements set out in the 53ZD information notice,²² and
- the information presented as part of the submission was derived from and accurately represents, in all material respects, the operations of Transpower.

²² Transpower’s Capital Expenditure Input Methodology and 53ZD Information Gathering Notice (Opex).

To provide directors with appropriate information for their RCP3 proposal certification we implemented a management representation process and engaged independent assurance advice.

Complementing our ongoing quality and sign-off processes, senior managers briefed their respective general manager on the activities undertaken to ensure the information in the proposal represents Transpower’s operations and complies with regulatory requirements. In addition, general managers provided letters of representation to the Chief Executive, and the Chief Executive provided an overall letter of representation to the Board.

KPMG and PwC provided independent assurance to directors on the RCP3 proposal as follows:

- KPMG undertook a review to provide an opinion that confirmed the proposal documentation (other than the revenue modelling) is compliant with regulatory requirements and represents Transpower’s operations.
- PwC reviewed our revenue modelling to provide an opinion that confirmed it is compliant with relevant regulatory requirements and represents Transpower’s operations.

In addition, many of the systems and processes used to produce the information in our proposal are subject to regular assurance processes.

2.4 Proposal overview

This section provides an overview of our RCP3 proposal – opex and capex allowances, output targets and incentives, and forecast transmission price path. We provide a full summary of our proposed expenditure in Part 3.

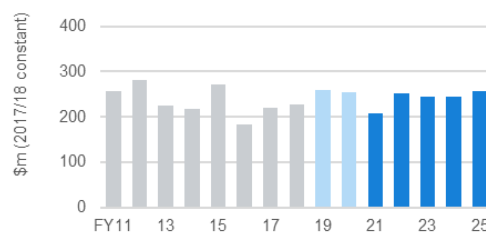
2.4.1 Expenditure

Capital expenditure

Our proposed base capex for RCP3 is \$1,202 million, compared with RCP2 base capex of \$1,144 million.

Figure 10 sets out the RCP3 forecast in the context of RCP1 and RCP2. To give a broader context of the longer-term needs, the right-hand panel shows the base capex outlook up to RCP5.

Annual overall base capex profile



Longer-term overall base capex profile

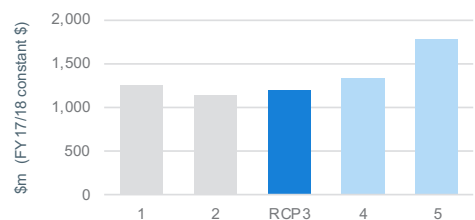


Figure 10: Historical and forecast overall base capex

Table 9 discusses key trends in our capex forecast.

Area	Trend
<p>Reconductoring and other lines work (includes base and listed projects reconductoring)</p> <p>\$226 m</p> <p>58% increase (\$83 m) from RCP2</p>	<p>We are entering a phase of conductor replacement for lines built from the 1950s to the 1980s. We expect more than half of North Island lines, and around one third of South Island lines, to reach end-of-life and require replacement over the next 30 years.</p> <p>We have reduced the volume of reconductoring proposed for RCP3 due to concerns about access to key resources. Proactively managing the potential expansion of reconductoring work is a key priority for the coming years. This includes the challenges of:</p> <ul style="list-style-type: none"> • working on asset management and construction techniques improvements to reduce the extent, cost and network impact of reconductoring, • ensuring there is workforce capacity to deliver increasing volumes of reconductoring work, and • identifying opportunities to optimise the grid as the reconductoring progresses.
<p>Tower Painting</p> <p>\$238 m</p> <p>19% increase (\$38 m) from RCP2</p>	<p>A growing number of transmission towers supporting almost 11,000 km of lines are transitioning to a phase of their lifecycle where the original galvanising has deteriorated, requiring a regime of painting and recoating to protect the steel. The timing for the transition to painting is based on minimising lifecycle costs. (i.e. not too early, but not so late as to require too much costly surface preparation work).</p> <p>We have resolved initial programme delivery challenges encountered in the earlier years of the tower painting programme and are now well placed to expand the programme. We forecast this volume of work to increase across RCP3 and beyond as more towers shift into the window where painting is required, and as painted towers come up for recoats.</p> <p>Good relationships and longer-term contracts with our contracting suppliers have been the key to innovation in this area, driving efficiencies and significantly improving safety.</p>
<p>Control and Communications</p> <p>\$335 m</p> <p>45% increase (\$136 m) from RCP2</p>	<p>Comprised of:</p> <ul style="list-style-type: none"> • ICT telecoms: \$49 m. A 25% decrease from RCP2, • ICT transmission systems: \$47 m. A 49% increase from RCP2, • Secondary assets: \$200 m. A 60% increase from RCP2, and • Reactive assets: \$40 m. A 321% increase from RCP2. <p>Information technology-based assets (hardware and software) span and connect the grid in areas such as electronic protection, telecommunication and grid operation. Compared to primary grid equipment, these assets have shorter lives and tighter age distributions, in line with more rapid technology improvement cycles. Consequently, investment and reinvestment comes in shorter, sharper pulses, and forecasting beyond a few years can be uncertain.</p> <p>Investment peaks can arise when several different short-lived asset types need replacement simultaneously. Our earlier forecasts had a large pulse of investment during the RCP3 period. We have refined our forecasts to spread this work more evenly across the coming decade, principally by scaling back forecast protection work within our secondary assets portfolio, and extending the life of our fibre network beyond RCP3 within our ICT telecoms portfolio. Scaling back protection work also addresses delivery risk relating to protection technician availability, although we have not scaled back to the extent initially intended as stakeholders indicated that they preferred us to find solutions to delivery constraints during RCP3.</p>

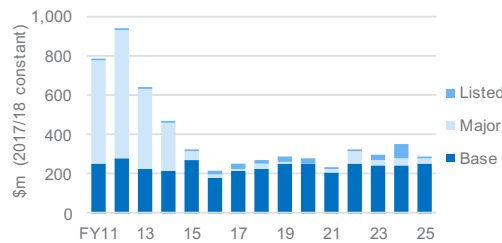
Area	Trend
<p>Large Substation Equipment</p> <p>\$146 m</p> <p>45% decrease (\$121 m) from RCP2</p>	<p>We forecast that capital investment in primary substation equipment will reduce significantly during RCP3 and RCP4, before increasing again from RCP5. Reductions are across most classes of large substation equipment, with the most significant drivers being:</p> <ul style="list-style-type: none"> our safety-driven programme of replacing outdoor switchgear with indoor switchgear is nearing an end, with only small sites remaining, a revised strategic approach to transformer replacement. We now use an asset health model to select the best risk-based solutions for individual transformers, with greater use of life-extension maintenance and fewer replacements, and better risk evaluation means that we no longer replace transformers based on age, although we may choose to if it is the least whole-of-life cost option. The use of options other than total replacement has led to a lower risk profile at lower cost because more assets can be targeted.

Table 9: Key trends in our capex forecast

Overall capex

Figure 11 sets out our total annual capex for RCP3 and the corresponding annual spend. Again, to give a broader context of the longer-term needs of our grid, we also show our proposed capex from RCP1 to RCP5. Note that the annual profile uses a 5-year average.

Total annual capex profile



Longer-term total capex profile

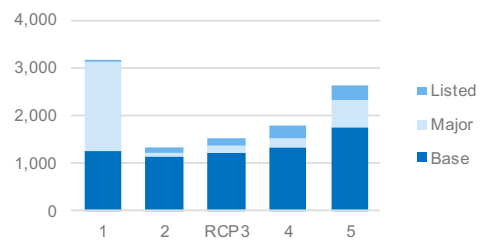


Figure 11: Historical and forecast total capex

In addition to base capex, the overall capex figure includes listed projects and capex on major projects. Major projects are grid enhancement projects with a forecast cost of more than \$20 million. Listed projects are large renewal projects expected to cost more than \$20 million, and have significant uncertainty around timing and costs, and which therefore do not fit well within the base capex category.

There is a separate approval process for listed and major projects, but we show them in our proposal for context. To provide an overall view, some of the revenue impact illustrations of our RCP3 plans reflect the expected expenditure on listed and major projects (see section 2.4.3).

Table 10 sets out our current view of capex on major projects during RCP3 and RCP4.

Major capital projects under development	Estimated project capex (\$m, constant FY17/18)	Estimated project delivery
Waikato and Upper North Island voltage management	276.0	2020 to 2030
South Island reliability – HVDC 2 replacement cables and 1 new cable	309.9	2029 to 2033
Upper South Island voltage stability – switching station at Rangitata and new line to Islington	283	2022 to 2035
Lower South Island reliability (Clutha – Waitaki)	23	2035

Table 10: Our current view of capex on major projects during RCP3 and RCP4

Table 11 sets out our current view of expenditure on listed projects during RCP3.

Listed project	Estimated project capex (\$m, constant FY17/18)	Estimated project delivery
Bombay – Otahuhu A Reconductoring	42.7	2022 to 2024
Brunswick – Stratford A & B Reconductoring	46.9	2020 to 2024
Otahuhu – Whakamaru A & B Reconductoring	28.2	2023 to 2024
Bunnythorpe – Wilton A Reconductoring	17.6	2023 to 2025

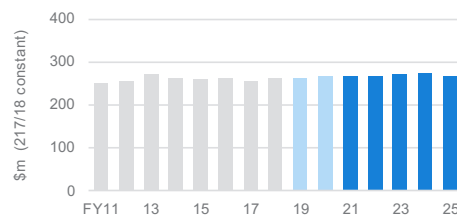
Table 11: Our current view of capex on listed projects during RCP3

Operating expenditure

Our proposed base opex for RCP3 is \$1,343 million, a 2.9 percent uplift compared to RCP2 opex of \$1,306 million.

Figure 12 sets out RCP3 opex forecast in the context of RCP1 and RCP2. To give a broader context of the longer-term needs, the right-hand panel shows the opex outlook up to RCP5.

Total annual opex profile



Longer-term total opex profile

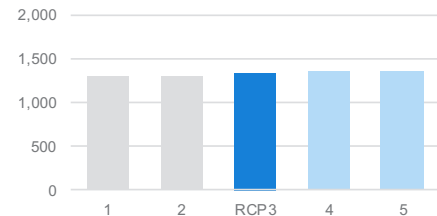


Figure 12: Historical and forecast total opex

Table 12 below discusses key trends in our opex forecast.

Area	Trend
Maintenance \$523 m 4% increase (\$21 m) from RCP2	<p>We forecast an underlying increase in maintenance activity of \$50 m (10%), but propose a funding increase of only \$21 m (4%). The reasons include:</p> <ul style="list-style-type: none"> • uncertainty – maintenance activity is inherently uncertain over an extended forecast horizon and long-term maintenance forecasts are less mature than our grid capex forecasts, • deliverability – we are not confident that a \$50 m uplift in maintenance activity would be deliverable, and • efficiency – unlike other opex areas, we have assumed we will redirect possible future efficiency gains back into our maintenance programme (instead of reducing costs). <p>The underlying increase is driven by extra work to support efficient deferral of some capital works such as transformer replacements, work to address the condition of some ageing assets including line components and substation structures, and investment in acquiring additional conductor condition information to support enhanced planning for reconductoring beyond RCP3.</p> <p>Our proposal to limit funding increases means that we have challenged ourselves to deliver these outcomes with an appropriate level of risk.</p>
Insurance \$88 m 22% increase (\$16 m) from RCP2	<p>To mitigate financial risks, we procure around \$1 b of insurance cover annually through a mix of external insurance and self-insurance.</p> <p>Global financial conditions have meant the cost of insurance has been relatively low in recent years. A key driver of our forecast increase is an assumption that costs will return to historic averages. We have obtained expert actuarial advice confirming this assumption.</p> <p>Other drivers of the forecast increase are changes to the Fire Service Levy and forecast asset growth.</p>
Asset Management and Operations \$310 m 2% increase (\$7 m) from RCP2	<p>We forecast a slight increase in Asset Management and Operations opex, which covers strategic, tactical and operational management of the grid. Opex has increased in this area in recent years as the balance has shifted from capitalised work supporting large projects towards non-capitalised work improving asset management and supporting a more diverse capital programme.</p> <p>Our forecast carries forward the current (2017/18) level of expenditure in this area, with a forecast \$3.3 m increase in ancillary services costs offset by a forecast \$3.1 m productivity improvement across our employees, consultants and contractors and reduction of \$5 m due to expected costs savings from benefits-driven ICT capex.</p> <p>Our forecast assumes that we sustain our level of investment in asset management and engineering, with effort shifting from establishing core systems and capabilities to addressing changes in our strategic environment and the challenge of a coming wave of reconductoring.</p>
Business Support \$226 m 5% decrease (\$11 m) from RCP2	<p>Business support covers non-network costs including information services and technology staff, corporate services, and governance.</p> <p>Our forecast carries forward the current (2017/18) level of expenditure after removing \$5.2 m of one-off transformation costs. These costs relate directly to improving efficiency and are self-funding under our incentive arrangements.</p> <p>We applied a productivity improvement adjustment of \$2.3 m to our forecast, consistent with the historical productivity improvement rate in New Zealand's professional, scientific and technical services sector.</p>
ICT opex \$196 m 2% increase (\$4 m) from RCP2	<p>We forecast a small increase in ICT opex, continuing the RCP2 trend of flat opex. The ICT opex increase includes costs that support deferral of TransGO capital investment, costs relating to increasing adoption of cloud services, and enhancements to cybersecurity risk reduction.</p>

Table 12: Key opex forecast trends

2.4.2 Output measures, targets and incentives

This section covers our proposed service and asset health measures and targets, and the financial incentives we propose to link to our measures. For more detail, see our 2018 Grid Outputs Report.²³

For RCP3, we have refreshed our measures, through a series of engagements with our stakeholders and customers, to ensure they reflect what our customers and stakeholders have told us they consider meaningful and valuable.

Service performance measures

Overview

Our service performance measures aim to refine our performance by ensuring that we are delivering services and outcomes that our customers and stakeholders value. They also ensure that we balance our efforts to be cost-effective by incentivising us to maintain service quality.

For RCP3, we propose a refined set of measures from those we have had in place for RCP2. Overall, we have kept the broad reliability and availability measures from RCP2. This is because they remain appropriate indicators of transmission service performance that are used across our industry in different jurisdictions. In response to our programme of stakeholder engagement, our measures continue to reflect what our customers and stakeholders consider meaningful and valuable.

We have refined our Point of Service (PoS) categories over RCP3. Our PoS categories enable us to better target performance to the need of the grid and our customers.

For our proposed grid reliability measures (GP1 and GP2) we have accounted for the results of our recently completed Value of Lost Load (VoLL) study, and spent time considering how to group points of service. For the refresh of the HVAC availability measure (AP2) and the new return to service time measure (AP3), we have updated the list of selected HVAC assets to those that could have the most market impact when out of service in RCP3.

We consider that the proposed measures and targets are challenging and realistic, but not unachievable. The RCP2 targets were aspirational and have proved too challenging.

Proposed service measures

For RCP3, we propose seven service performance measures, four of which are revenue-linked, as shown in table 13.

Our performance for the revenue-linked measures is judged against a target. The proposed targets are intended to be challenging, but reasonably achievable, in RCP3.

²³ This annual report was previously titled the Services Report. Its name has been changed to reflect its scope more accurately.

Category	RCP3 code	Revenue linked	RCP3 service performance measure
Grid performance (reliability)	GP1	Yes	The number of unplanned interruptions across all points of service in a sub-category during a disclosure year (where each of the six sub-categories has a separate measure of grid performance).
	GP2	Yes	The average duration of unplanned interruptions greater than one minute, across all points of service in a sub-category during a disclosure year (where each of the six sub-categories has a separate measure of grid performance)
Asset performance (availability)	AP1	Yes	The energy availability (%) of the inter-island high-voltage direct current (HVDC) system
	AP2	Yes	The average percentage of time particular high-voltage alternating current (HVAC) assets are available during a disclosure year
	AP3	No	Return to service time The extent that Transpower keeps to planned outage times in relation to selected HVAC assets
	AP4	No	Return to service time communications The extent that Transpower communicates delays to planned outage return times in relation to selected HVAC assets
CS1		No	Customer service/event communications Existing post-event survey. Focuses on timely information provision and communications

Table 13: Proposed service performance measures for RCP3

GP1 and GP2 establish the reliability experienced by five defined point of service categories. For GP1 and GP2 we have refined the PoS categories according to their level of security, (i.e. N-1 or better²⁴ and N security categories), and refined the sub-categories using different levels of demand and a qualitative evaluation of economic consequence from an unplanned interruption, (i.e. 'High' and 'Material' economic consequence). Generator PoS are separated into sites with N-1 security and sites with N security.

This results in some PoS shifting from their RCP2 category. The proposed PoS allocations to each sub-category can be viewed in the 2018 Grid Outputs Report.

We propose to discontinue GP3, the RCP2 P90 reliability measure. In practice, the number of events in several of the categories is too small for a robust P90 calculation. Moreover, as large events are very rare we do not consider there is sufficient baseline data for the P90 value to be meaningful. Experience has also shown that during very long outages, specific circumstances typically drive the outage length.

As part of the refresh we have also updated the list of selected HVAC circuits for measures AP2 to include the circuits and assets that could have the most market impact in RCP3 when out of service. This list has increased from 27 circuits in RC2 to 71 assets in RCP3.

The other key change for RCP3 is that we are proposing two new, non-revenue linked trial measures in response to feedback received from our customers. Availability measures AP3 and AP4 focus on the timely return of assets back into service following a planned outage and how effectively we communicate any delays.

²⁴ N-Security is when a connection is served by a single line or a single transformer and so any fault on that connection leads to a power outage. Most of our customers have N-1 security, which means they will only experience an interruption at their PoS if there are concurrent equipment outages. This can happen when there are multiple equipment failures, or a single equipment failure at a time when other equipment is out of service for maintenance.

Asset health measures

Overview

We have significantly redesigned our asset health measures for RCP3. Our new proposed asset health grid outputs now provide an effective measure of the condition of our assets in five selected asset classes. Our proposed asset health measures are based on the asset health index methodology that we use in our business to make asset maintenance decisions and represent a significant improvement on the works delivery output measures that have been in place for RCP2.

Our proposed measures enable us to understand the condition of our grid assets and the probability of these assets failing today, or in the future. They help us to address potential problems caused by assets approaching end-of-life through asset refurbishment and replacement or by other means.

We consider asset health measures to be leading indicators for service performance. They provide our stakeholders with a view of the state of our assets and support the sustainable management of the grid by highlighting any potential for improvement work.

The new measures reflect a series of ongoing engagements with the Commerce Commission and consultation with our stakeholders. This includes the commencement of the pilot asset health reporting regime that we proposed in our July 2017 report²⁵ and which the Commerce Commission sent out for public consultation²⁶ on in October 2017. Our service measures and asset health engagement paper, June 2018,²⁷ and our RCP3 proposal engagement paper, August 2018,²⁸ sought feedback on the proposed asset health measures. The majority of responses were supportive.

Asset health measures and targets

Our proposed asset health measures and targets will monitor the proportion of those assets in each asset class that are assessed as having an Asset Health Index (AHI)²⁹ score of 8 or above (indicative of poor to very poor health) at the end of the RCP3 period.

Our targets are based on the following inputs:

- current asset health scores across each population of assets,
- future health scores in the absence of investment, and
- the impact of intended investment plans on future asset health.

²⁵ Transpower (2017). *Asset health pilot report; our proposal for alternative asset health grid output measures to pilot during RCP2*. This report can be accessed on the Commerce Commission website at: https://comcom.govt.nz/__data/assets/pdf_file/0028/78580/Transpowers-proposed-asset-health-pilot-report-31-July-2017-.pdf.

²⁶ Commerce Commission (2017). *Proposed amendments to pilot asset health grid output measures and asset health pilot reporting requirements – Transpower Individual Price-Quality Path Determination 2015*. Commerce Commission consultation paper. URL: https://comcom.govt.nz/__data/assets/pdf_file/0029/78581/Proposed-amendments-asset-health-pilot-reporting-requirements-Consultation-paper-25-October-2017.pdf.

²⁷ Transpower (2018). *Service and asset health engagement paper 3*. URL: [https://www.transpower.co.nz/sites/default/files/uncontrolled_docs/Engagement Paper 3 \(June 2018\).pdf](https://www.transpower.co.nz/sites/default/files/uncontrolled_docs/Engagement Paper 3 (June 2018).pdf).

²⁸ Transpower (2018). *Securing our energy future 2020-2025, Regulatory Control Period 3: Draft proposal for consultation*. URL: <https://www.transpower.co.nz/resources/securing-our-energy-future-rcp3-consultation-document>.

²⁹ An AHI score of 0 or 1 indicates a new asset. Over time, an asset deteriorates and moves through the asset health scores in the index until it is given a score of 8 or above, indicating that it is near the end of its useful life and that the probability of failure (which may cause an interruption to service) increases. This is generally when we decide to actively manage the asset.

We selected five asset health output measures to revenue-link over RCP3, (see table 14). Our rationale for selecting these asset classes is that they:

- are asset classes with stable and mature asset health models,
- cover a diverse range of asset types and portfolios,
- contain large and small asset classes by expenditure and population, including volumetric and non-volumetric asset classes, and
- are not subjected to large variations with project changes.

The proposed five measures ensure an appropriate coverage of our grid renewal programme. The current total value of expenditure of the five asset classes is \$383 million or 39 percent of all grid renewal expenditure for RCP3. The proposed targets are outlined in table 14, which shows the percentage of the assets with an AHI equal to or greater than 8 in each of the RCP3 years.

Asset Class	Forecast 2020/21 %	Forecast 2021/22 %	Forecast 2022/23 %	Forecast 2023/24 %	Forecast 2024/25 %	2024/25 no RCP3 investment %
Power Transformers	1.64	2.10	3.27	6.54	8.88	13.08
Outdoor Circuit Breakers	1.34	1.41	4.24	5.72	5.85	9.08
Insulators	0.54	1.10	1.81	2.71	3.50	12.65
Tower Grillage Foundation	5.75	5.69	4.72	2.95	3.43	11.48
Tower Protective Coating	4.72	4.66	4.81	4.48	4.18	11.88

Table 14: Percentage of assets with an AHI equal or greater than 8 in RCP3

Our preferred approach for the revenue-linked asset health output measures for RCP3 is non-mechanistic. This means that the methodology or mechanism for assessing whether a target has been met (or whether an incentive should be attached) allows for variations between the actual and forecast asset health scores where there are justified reasons for the change. The principle behind this approach is an incentive regime that should encourage and reinforce a regulated supplier to undertake behaviours and actions in the interest of consumers (i.e. it should reinforce doing the right thing). A non-mechanistic approach allows for material changes in the grid such as divestments or new assets, as well as improvements on the health modelling and condition assessment techniques that can improve the accuracy of our predictive deterioration rates.³⁰

Grid output incentive settings

We have developed incentive settings to align with regulatory requirements and the service performance and asset health output targets included in our consultations.

The total revenue at risk for RCP3 is \$126 million, or 2.8 percent of total forecast revenue, comprising \$89.5 million for service performance and \$36.7 million for asset health performance. This compares to \$89 million (1.8 percent) for RCP2. This increase reflects maturing of the incentive regime and compares to an international context of 1 to 4 percent.

³⁰ Our assessment of the first full year of the asset health pilot illustrates that the current Capex IM Grid Output Adjustment calculation – with a simple target, collar, cap – is too mechanistic to be applied to RCP3 asset health targets. Many of the changes between the 2016/17 and 2017/18 forecasts of 2019/20 asset health are driven by modelling and input changes, not changes in asset health. For a summary of changes refer to the explanatory notes relating to clause 28.1.8 in sheet 24 in the 2018 IPP disclosure. www.transpower.co.nz/sites/default/files/uncontrolled_docs/IPP%20Disclosures%202017-18%20%28final%20published%29.xlsx

	RCP2	RCP3
Service Performance		
Annual revenue at risk	\$13.9 m	\$17.9 m
5-year revenue at risk	\$69.4 m	\$89.5 m
Percentage of forecast revenue	1.4%	2.0%
Asset Health		
5-year revenue at risk	\$19.9 m	\$36.7 m
Percentage of forecast revenue	0.4%	0.8%
Total		
5-year revenue at risk	\$89 m	\$126 m
Percentage of forecast revenue	1.8%	2.8%

Table 15: Incentives summary

For service performance, we have developed a regime that is well justified, which follows a systematic approach and represents an improvement over RCP2. We have ensured that reliability incentives are proportional to the economic cost of interruptions.

Service performance incentives are intended to help balance other incentives to reduce costs. In our view, service incentives should:

- reinforce our strategic focus on delivering the best possible balance of service and cost,
- focus management attention on aspects of service that matter most,
- complement asset health incentives, and
- not override other considerations (i.e. incentives should not drive perverse behaviour).

The above considerations mean that incentive rates should be designed so that they:

- are strong enough to be meaningful in management decision making, but
- not too strong relative to the economic benefit of improved performance.

The caps and collars represent a result where no further financial penalty or gain applies. It is important that the cap and collar cover a reasonable range of possible outcomes for the incentive mechanism to be meaningful. In setting the caps and collars, we also considered the variation of historic performance, the appropriate stringency of the targets, and the strength of the incentive for each measure. This is because increasing the range of the caps and collars dilutes the incentive rate (assuming total revenue at risk is kept constant).

Table 16 below shows the targets, caps, collars and incentive rates for the service performance targets. We consider the proposed incentive settings to be appropriately designed to ensure that we are under the right incentives to deliver performance on measures that matter to our customers and stakeholders.

Measure Category	Cap	Target	Collar	Incentive rate	Maximum post-tax value at risk over 5 years (\$ m)
GP1: number of interruptions (per annum)				\$ per event	
N-1 Security high economic consequence	0	7	14	421,429	14.75
N-1 Security material economic consequence	7	24	41	50,000	4.25
N Security high economic consequence	4	6	8	325,000	3.25
N Security material economic consequence	9	23	37	53,571	3.75
N-1 Security Generator	5	9	13	62,500	1.25
N Security Generator	6	12	18	41,667	1.25
GP2: average duration of interruptions (mins)				\$ per min	
N-1 Security high economic consequence	30	92	154	47,581	14.75
N-1 Security material economic consequence	36	61	86	34,000	4.25
N Security high economic consequence	0	103	206	6,311	3.25
N Security material economic consequence	0	140	280	5,357	3.75
N-1 Security Generator	50	174	298	2,016	1.25
N Security Generator	11	93	175	3,049	1.25
AP1: HVDC availability (%)				\$ per 1%	
Either: HVDC Availability (non-Pole 2 years)	99.5%	98.5%	97.5%	500,000	2.50
Or: HVDC Availability (Pole 2 years)	98.8%	97.8%	96.8%	500,000	2.50
AP2: HVAC availability (%)				\$ per 1%	
HVAC availability	99.5%	98.9%	98.3%	1,666,667	5.00
Annual total					64.50 ³¹

Table 16: Service Performance incentive settings for RCP3

We have allocated more of the incentive pool to the reliability measures (GP1 and GP2) than the availability measures (AP1 and AP2), reflecting the higher economic impact of interruptions. Within the reliability measures, we have allocated more of the pool to high economic consequence sites.

Statistically we expect the collar for at least one GP1 or GP2 targets will not be met each year during RCP3. It is appropriate non-conformance with a collar results in financial implications, but non-conformance does not necessarily mean we are not providing a quality service. We appreciate that the Commerce Commission should be discussing with us further when there is a material number of non-conformances in any one year or across the regulatory control period.

³¹ For AP1, only one amount of \$0.5 m is counted to reach the annual total, as the first amount relates to non- Pole 2 years and the second amount relates to Pole 2 years.

Our proposed asset health incentives, shown in table 17, work to reinforce service performance incentives and balance cost reduction incentives. In comparison to service measures incentives, they are:

- more focussed – they target one driver of grid performance only,
- more immediate – our forecast investment will change asset health directly, and
- less objective – asset health is a modelled attribute rather than a measurable outcome.

Asset Class	Cap (%)	2024/25 target (%)	Collar (%)	Incentive rate (\$m per percent) at 20% strength	Maximum post-tax value at risk over 5 years (\$ m)
Tower Grillage Foundation	1.02	3.43	5.85	1.23	2.98
Tower Protective Coating	1.87	4.18	6.49	7.10	16.40
Insulators	0.76	3.50	6.25	0.76	2.09
Power Transformers	7.62	8.88	10.14	3.26	4.10
Outdoor Circuit Breakers	4.88	5.85	6.82	0.82	0.79
Total					26.36

Table 17: Caps, collars and incentive rates by asset class

We have designed the asset health output incentives to:

- reflect the cost of proposed work in each respective asset class and the associated forecast change in asset health,
- be proportional to the forecast expenditure value of the asset class, and
- partially offset any gain (penalty) from the base capex incentive mechanism due to non-delivery (over-delivery).

2.4.3 Transmission price path

Our overall revenue for RCP3 is forecast to be \$4,419 million (nominal), compared to \$4,732 million for RCP2 (a reduction of 6.6 percent).

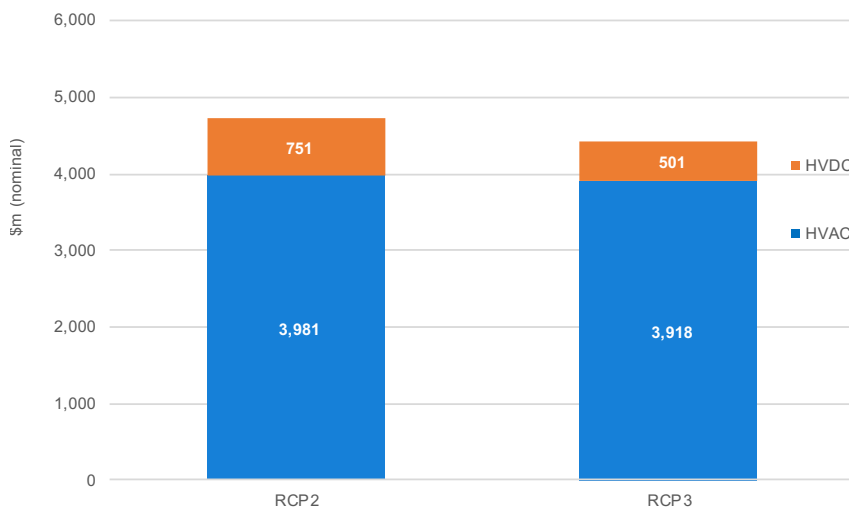


Figure 13: Comparison of RCP2 and RCP3 nominal revenue

When forecasting revenue, we use the following conventions:

- *Pricing years* – revenue is shown by March pricing year. For example, 2020 refers to the year 1 April 2019 to 31 March 2020. Revenue in the 2020 pricing year is calculated from costs in the 2020 financial year.
- *Nominal prices* – revenue is usually presented on a nominal or ‘dollars-of-the-day’ basis, including cost escalation.
- *Allocation* – revenue is either presented at a total level or broken down into HVAC and HVDC revenue. Total revenue is the amount applied to the transmission pricing methodology, before adjusting for revenue from prudent discount agreements.

We recover HVDC revenue directly from large South Island electricity generators.

We recover all other (HVAC) revenue directly from large users, or from electricity distributors, who in turn pass their costs on to end users (directly in some cases, or via retailers for most end users). We do not have visibility as to how distributors and retailers pass on transmission charges but, all things being equal, an increase in HVAC revenue would typically translate into an increase in end-user charges.

Revenue smoothing

We seek approval from the Commerce Commission to adopt ‘revenue smoothing’ arrangements from April 2020, to remove volatility in our pricing and give our customers more stable and predictable transmission charges.³² We propose initial smoothing, to reshape our revenue path to have a consistent growth rate across each RCP. We also propose deferred updates, carrying revenue updates across RCPs rather than applying annually.

We sought feedback from our customers and stakeholders on this approach when we consulted on our RCP3 proposal in June 2018, and received feedback that was generally supportive.

To ensure transparency, in our consultation paper we also described potential annual disclosures relating to revenue smoothing.³³

- The economic value (EV) adjustment (wash-up and incentive) calculation for the disclosure year.
- The effect of this EV adjustment on the annual revenue in the following control period (which would be the same amount for each year of the following control period).
- The net/aggregate annual EV adjustment in the following control period. This would be the aggregate of the EV adjustments accumulated since the start of the control period.
- The current forecast of the smoothed revenue for each year of the following control period.

These disclosures would give customers advance warning of the revenue impact of accumulated EV account entries and of the resulting revenue that is likely to be applied under the transmission pricing methodology.

³² We propose to apply smoothing to total forecast revenue, rather than forecast maximum allowable revenue (MAR). Most of our revenue is represented by our MAR, but the additional components (pass-through and recoverable costs) can contribute significant volatility.

³³ Transpower (2018). Securing our energy future 2020-2025. Regulatory Control Period 3: Draft proposal for consultation. URL: <https://www.transpower.co.nz/resources/securing-our-energy-future-rcp3-consultation-document>, p92.

Revenue relating to the HVAC network

The following chart shows how our forecast HVAC revenue will track across the coming decade, including actual data as to how it has tracked across RCP2 to date.

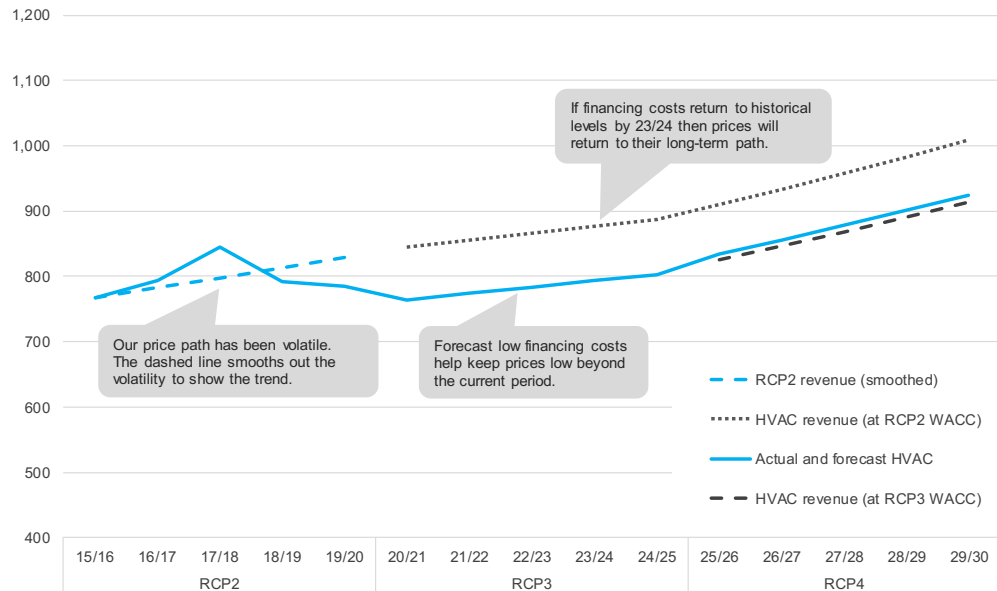


Figure 14: Historical and forecast HVAC revenue

Table 18 compares the estimated average annual rate of change in revenue in nominal and real price terms across three RCPs. Simplifying assumptions have been made to provide the estimates for each regulatory period.³⁴

For RCP3, revenue relating to the HVAC network is expected to grow at around 1.3 percent per year after an initial drop from the end of RCP2. The forecast decrease from the end of RCP2 is driven in part by a lower forecast WACC for RCP3. For RCP4 an increase in real terms is forecast. In RCP4, the impact of growing investment in tower painting and reconductoring is forecast to push up the growth rate to 2.6 percent, or 0.6 percent in real terms.

Period	Revenue Path Growth Rate (%)		
	RCP2	RCP3	RCP4
Nominal	1.9	1.3	2.6
Real	0.2	-0.7	0.6

Table 18: Revenue path growth rate, RCP2 to RCP4

³⁴ Comparison considers underlying trend by removing the effect of changes in allowable return between periods, and of price path volatility during RCP2

Revenue relating to the HVDC link

Figure 15 shows how forecast HVDC charges will track across the coming decade.

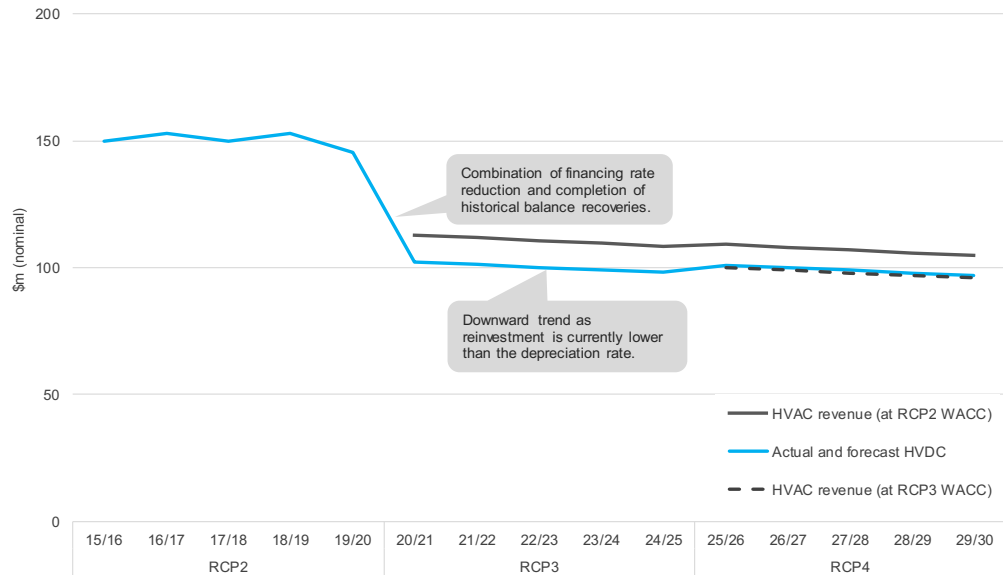


Figure 15: Historical and forecast HVDC revenue

HVDC revenue will step down in 2020 as we complete a nine-year period of recovering earlier unpaid charges from large South Island generators. The overall trend during RCP3 is for decreasing prices, even with life extension investment in Pole 2 forecast during the period.

Revenue impact of listed projects and major projects

As discussed in section 1.2, this proposal only seeks approval of base capex and opex. It excludes listed projects and major projects. Figure 16 separates out the impact of HVAC projects that will be subject to individual approval if they proceed.

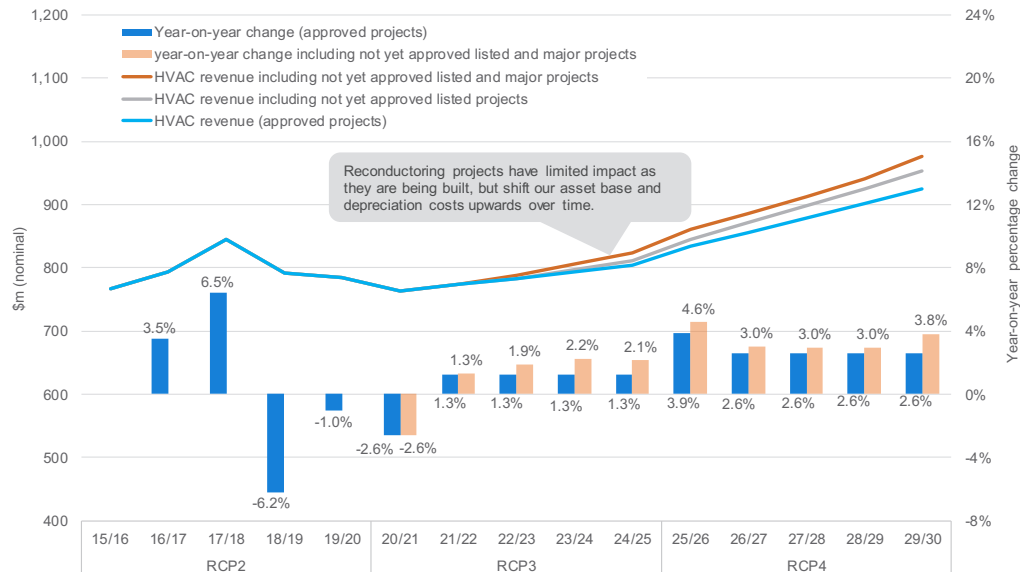


Figure 16: HVAC revenue showing the possible impact of projects not yet approved

The capital expenditure reflected in the above chart is set out in the table below.

Category	Forecast Investment, constant 2017/18 prices (\$m)	
	RCP3	RCP4
Base capex	1,202	1,336
Listed projects	135	263
Major projects	178	181
Total	1,516	1,780

Table 19: Capex amounts for base listed and major investments yet to be approved



PART 3

Expenditure

Chapter 3

Overview of expenditure chapters

Chapter 3 is structured as follows:

- Section 3.1 provides an overview of Part 3 conventions,
- Section 3.2 provides an overview of 'identified programmes' which play a key role in the independent verification and the Commerce Commission's evaluation,
- Section 3.3 provides an overview of forecasting approaches, and
- Section 3.4 summarises the cost efficiency and deliverability adjustments applied to our RCP3 forecasts.

The figure below shows the main expenditure groupings and the chapters in which we discuss them.

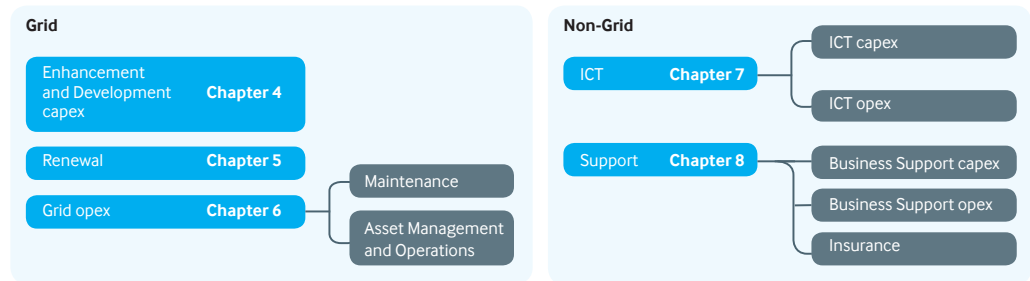


Figure 17 provides further context for our base capex profile up to the end of RCP3 and its composition up to RCP5. Renewals, broken into our five asset classes, make up 78 percent of our RCP3 capex forecast. The renewal share of base capex is expected to continue to trend upward longer term, as our grid ages.

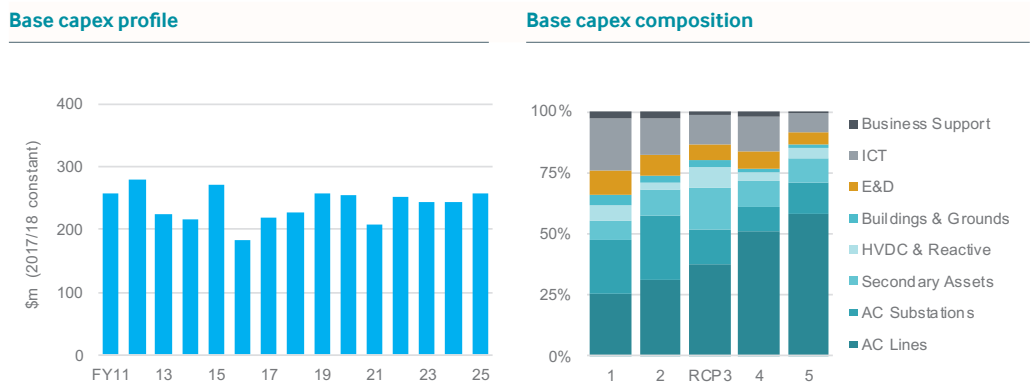


Figure 17: Base capex profile and composition

Figure 18 provides further context for our opex profile up to the end of RCP3 and its composition up to RCP5. The makeup of opex is broadly similar in RCP3 and RCP2, with some increase in Insurance. Grid opex, i.e. Maintenance and Asset Management and Operations, makes up 62 percent of expenditure.

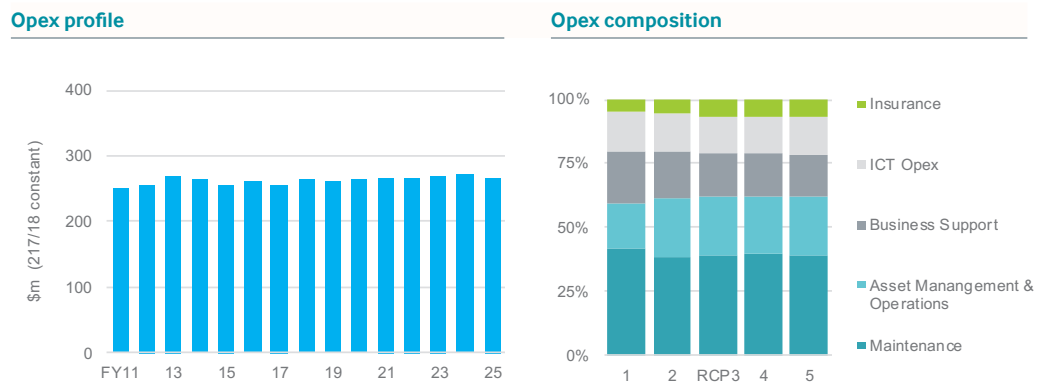


Figure 18: Opex profile and composition

3.1 Conventions

Throughout this proposal we present forecast expenditure using the following conventions:

- *Financial years* – expenditure is shown by June financial year. For example, 2020/21 refers to the year 1 July 2020 to 30 June 2021. Our financial year aligns with the disclosure year under our regulatory arrangements.
- *Constant prices* – expenditure is stated in constant 2017/18 prices. This means historical figures are adjusted to 2017/18 prices, and figures for future years are not adjusted for forecast cost escalation or general inflation. This presentation enables the comparison of trends over time.
- *Spend basis* – opex and capex is presented on a spend basis. This aligns with updated regulatory arrangements.³⁵
- *Cost allocation* – costs are presented after applying cost allocation consistent with our regulatory arrangements (e.g. we exclude costs allocated to our system operator service).
- *Cost capitalisation* – forecasts are consistent with our current approach to capitalising internal costs. This includes distinguishing between project costs booked directly to capital projects and indirect costs transferred out of operating costs and charged to capital projects.
- *Interest during construction* – project financing costs are recognised by accumulating interest during construction up to the point an asset is commissioned. All capex in the proposal includes interest during construction.

Regulatory template RT01 presents a full build-up of our forecasts including cost escalation, interest during construction and commissioned values.

With the forthcoming introduction of IFRS 16 Leases on 1 July 2019, some of the lease costs included in our Business Support opex and ICT opex will be capitalised and hence included as part of Business Support capex and ICT capex respectively. We will work with the Commission to ensure our allowance appropriately reflects the new accounting rule.

³⁵ For RCP2 we often presented capital investment on a commissioned value basis.

The Electricity Authority’s review of the transmission pricing methodology (TPM) is continuing and the outcome of the review is not yet known. Our proposed RCP3 forecasts do not include any allowances for required changes to our business processes and supporting systems to implement a new TPM. Depending on the outcome of the review, implementation of a new TPM may require significant investments in our business processes and supporting systems. If a new transmission pricing methodology is implemented during RCP3, it may be necessary to apply to the Commission to reopen our individual price-quality path to allow for TPM implementation costs.

In this proposal we generally show annual information up to the end of RCP3 (2024/25). Given the long-term planning horizons involved in prudently managing the grid we also show longer-term forecasts grouped into five-year periods up to RCP5 (2029/30 to 2034/35).³⁶

3.2 Identified programmes

We agree with the Commerce Commission criteria for determining a set of so-called identified programmes of work.³⁷ The intention of identified programmes is to allow the Commerce Commission to target its evaluation. We are required to provide more in depth qualitative and quantitative information on identified programmes.

Table 20 lists the identified programmes (capex) in the RCP3 proposal. Together the identified capex programmes make up over 81 percent of our proposed RCP3 capex.

Expenditure group		Identified programme
Renewal	Transmission Lines	Structures and Insulators Conductor and Hardware
	AC Substations	Power Transformers Outdoor 33 kV Switchyards: Outdoor to Indoor Conversion
	Secondary Assets	Protection, Battery Systems and Revenue Meters Substation Management Systems
	HVDC and Reactive Assets	HVDC Reactive Assets
Enhancement & Development		Enhancement & Development
Non-grid capex	ICT capex	IT Telecommunications, Network & Security Services
		Transmission Systems

Table 20: Identified programmes (capex) in the RCP3 proposal

Table 21 lists the identified programmes (opex) in the RCP3 proposal. Together the identified opex programmes make up over 80 percent of our proposed RCP3 opex.

Expenditure group	Identified programme
Grid opex	Preventive Maintenance
	Predictive Maintenance
	Asset Management and Operations
Non-grid opex	Business Support

Table 21: Identified programmes (opex) in the RCP3 proposal

³⁶ RCP1 spanned the four financial years 2011/12 to 2014/15. To provide meaningful trend information we use the label RCP1 to refer to the five-year period 2010/11 to 2014/15.

³⁷ This is a requirement in the capex IM.

3.2.1 Identified programme approval process

All our identified programmes have been subject to the review and challenge processes described in section 2.3.2.

Expenditure during RCP3 will be subject to Transpower internal approval processes and delegated financial authority policy. For capital expenditure we have different timings in terms of the business case approval depending on the nature of the work. For grid capital expenditure we have two approval processes depending on the complexity of the work. This determines how the work is managed with our service providers.

Yours-to-lose (YTL), is high volume lower value repetitive type work that is allocated to the incumbent service provided in the area. YTL is around 25 percent of our work programme. For this type of work, we aim to have the majority of the work approved one year before the start of the delivery year. For the first year of RCP3, the 2020/21 year which starts 1 July 2020, our target is to have 90 percent of this work approved by 30 June 2019. We currently have 20 percent of this type of work approved for 2020/21 and expect to meet our 90 percent target by 30 June 2019.

Work other than YTL is more complex in nature. The approach here is to work back from the need date factoring things such as outage availability, procurement lead time and construction time. For large projects such as power transformer replacements and ODID conversion programme, the sites have been identified and solution studies are underway with engineering under way these projects at the start of RCP3.

Table 22 below shows the progressive nature of the capital approvals process, with almost 100 percent completed for 2018/19, 80 percent for 2019/20 and 7 percent for the first year of RCP3. During the remainder of 2018/19, the percentage of projects approved in the first year of RCP3 will increase significantly.

Percentage of capex approved <small>Information as at 15/10/18</small>	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25
Renewal	100	100	92	10	0	0	0	0
Enhancement & Development	100	100	84	0	0	0	0	0
ICT capex	100	67	26	0	0	0	0	0
Business Support	100	49	0	0	0	0	0	0
Total	100	98	79	7	0	0	0	0

Table 22: Percentage approval of capex by year

3.3 Forecasting approaches

Our RCP3 forecast is based on a suite of forecasting approaches that we have been continuously developing since RCP1. Our grid and non-grid capex forecasts are generally developed using bottom-up approaches (combined with top-down planning frameworks).

Table 23 provides an overview of the approaches we applied to each expenditure category in our RCP3 proposal. We discuss the forecasting in more detail in the relevant chapters.

Expenditure category	Forecast approach
Capex	
Renewal	Bottom-up (in combination with top-down planning frameworks)
ICT capex	
Business Support capex	
Enhancement & Development	Scenario based forecasting based on bottom-up and top-down assumption
Opex	
Preventive Maintenance	Bottom-up
Predictive Maintenance	Base-step-trend
Corrective Maintenance	
Proactive Maintenance	
Asset Management and Operations	
ICT opex	
Business Support opex	Based on expert actuary and broker information
Insurance	

Table 23: Forecasting approaches used to produce our RCP3 forecasts

None of our cost estimates included a 'blanket' contingency in our cost estimates for future projects to account for uncertainty. Rather, where relevant, we determine the risks involved and make appropriate allowance for these.

Below we provide further information on bottom-up cost estimation as implemented in our grid capex forecasting and base-step-trend forecasts. For other expenditure categories, refer to the relevant chapters in Part 3 of our proposal.

3.3.1 Bottom-up cost estimation

The bottom-up cost estimates used in our grid capex renewal forecast are based on historical costs, suitably tailored to forecast scope.³⁸ We broadly distinguish between volumetric and non-volumetric cost estimates.

Volumetric works

Volumetric works are relatively low value (<\$1 million), generally routine (i.e. they do not require individual investigation), and are relatively uniform with consistent scope and consistent delivery methodology. Estimates for these works use building blocks, which are based on an average rate and an assumed scope of work.

Non-volumetric works

Non-volumetric works are generally high value and require a project specific and tailored investigation. For these projects we prepare customised cost estimates tailored to the project-specific scopes of work and apply library cost items and actual quantities.

³⁸ The grid capex cost estimates are held and regularly updated within a tool known as the Transpower Enterprise Estimating System (TEES). TEES integrates with our financial planning system (which also holds quantities) to produce expenditure forecasts

3.3.2 Base-step-trend

For most of our opex forecasts we have adopted a base-step-trend framework.³⁹ Base-step-trend forecasting is generally appropriate for expenditure that is recurring and assumes that historical 'revealed' expenditure provides a suitable starting point for a forecast requirement. The base-step-trend approach involves the following main components.

- *Base year* – identifying an efficient base year, typically the most recent year for which actual opex data is available. This includes assessing the extent to which the base year is relatively efficient.
- *Base amount* – following an assessment of the base year, the base amount is identified by adjusting the base year expenditure for any atypical cost items.
- *Step changes* – required to meet the needs of the network or to allow for external requirements, and which are not already captured within the scope of the base amount.
- *Trends* – these reflect expected changes in cost due to output growth. It can also include adjustments for ongoing productivity and/or cost efficiency.

3.4 Expenditure adjustments

As discussed in Part 2 we applied the following top-down adjustments to our RCP3 proposals:

- deliverability adjustments, which are discussed in section 2.3.4⁴⁰, and
- cost efficiency adjustments, which are discussed in section 5.1.1.

These adjustments are the result of technical reviews and our challenge process. Overall these adjustments reduced base capex by 5.3 percent and opex by 2.9 percent.

Table 24 and table 25 below provide an overview of these adjustments (with more detail in each of the relevant chapters).

The efficiency adjustment reduced base capex by 0.3 percent and opex by 0.8 percent.

Adjustment	Base capex RCP3 (\$m)	Opex
Continuing efficiency improvement		- 5.4
Cost efficiencies enabled by benefits driven ICT capex	- 4.0	- 5.0
Total	- 4.0	-10.4

Table 24: Summary of cost efficiency adjustments

The deliverability adjustment reduced base capex by 5.0 percent and opex by 2.1 percent.

Adjustment	Base capex RCP3 (\$m)	Opex
Renewal capex	-58.0	
ICT capex	-5.0	
Maintenance		-29.1
Total	-63.0	-29.1

Table 25: Summary of deliverability adjustments

³⁹ The base-step-trend approach is used by many utilities and economic regulators for forecasting recurring expenditure. The Australian Energy Regulator requires that energy network businesses apply the base-step trend approach. The approach was also used by Powerco in its recent CPP application. It is also conceptually similar to some of the opex forecasts we prepared for our RCP2 proposal. For RCP3 but we have built in this work by formalising the forecast development process.

⁴⁰ We have also applied an adjustment to our renewal forecast to ensure the work profile within RCP3 is matched to expected service provider availability. We discuss this work phasing adjustment in the renewal chapter.



Chapter 4

Enhancement and Development

This chapter sets out our Enhancement and Development (E&D) capex proposal for RCP3.

The figure below illustrates where E&D capex fits within the expenditure categories in our proposal.

The E&D portfolio includes investments that change the capability of the transmission grid to provide desired levels of service to our customers. There are two categories of E&D projects:⁴¹

- *E&D projects expected to cost less than \$20 million* – the expenditure requirement for these projects is part of RCP3 base capex approval amount.
- *Larger E&D projects over \$20 million* – being major capex projects that are considered by the Commerce Commission under a separate process on a case-by-case basis.

Grid	
Enhancement and Development capex	Chapter 4
Renewal capex	Chapter 5
Grid opex	Chapter 6
Non-Grid	
ICT capex and opex	Chapter 7
Support capex and opex	Chapter 8

The chapter is structured as follows:

- Section 4.1 summarises the system needs identification process,
- Section 4.2 sets out E&D drivers,
- Section 4.3 explains how changes in the external environment increase E&D planning uncertainty,
- Section 4.4 explains our E&D base capex forecasting approach, and
- Section 4.5 presents the RCP3 E&D base capex forecast.



For more information on our Enhancement and Development portfolio refer to Chapter 4 of the 2018 Transmission Planning Report.

⁴¹ Customer-funded investments are not included in our RCP3 regulatory submission (for the E&D portfolio or other expenditure categories). The decision to investigate and invest resides with the customer. Our view of the customer-funded E&D investments that would be required during RCP3 are set out in the relevant regional chapters of the 2018 Transmission Planning Report.

4.1 System needs identification process

E&D system needs are identified, investigated and progressed through the E&D planning process.⁴² This process connects E&D system needs to the decision framework and options assessment approach used for assessing all grid problems and opportunities inclusive of replacement, refurbishment and maintenance expenditure.

4.2 Drivers

Most E&D system needs reflect changes to electricity demand and generation development, use and retirement. Drivers of E&D system needs are varied and often complex, with several intersecting issues requiring consideration and resolution.

As the external environment changes, so too does demand and generation. This gives rise to E&D system needs as the transmission grid must change to meet agreed or mandated service, security or reliability standards.

A change may increase or decrease grid capability, depending on the driver, and could be used to elicit a range of system outcomes including:

- providing more capacity to generators or connected loads,
- matching reliability or security of supply to the required standard or agreed service level,
- maintaining or improving power quality measures, and
- managing the dynamic response of the power system to disturbances.

Asset health and criticality could also drive E&D system needs as our renewal planning may identify the need for a future grid capability change.

4.3 Changes in external environment

4.3.1 Previous E&D planning environment

Until recently, demand could be projected based on population, economic activity and intensity of use.⁴³ Changes in demand were gradual and there was a high degree of confidence in expectations about energy usage and forecasts. This, in turn, increased confidence in development or change in the generation landscape.

4.3.2 Current E&D planning environment

Our external environment is starting to change much faster. Climate change, climate policies and the expected accelerating adoption of new technologies such as photovoltaics, electric vehicles and batteries are all driving uncertainty in energy use and generation.

An accelerating future means demand forecasting is less certain. We expect more frequent regional step-changes in load and generation, with shorter notice periods for the development and retirement of generation.

⁴² For a description of the E&D planning process refer to Appendix A of the 2018 Transmission Planning Report. As part of the planning process we consider transmission alternatives. For details on our transmission alternatives consultation refer to www.transpower.co.nz/keeping-you-connected/industry/transmission-alternatives.

⁴³ For an overview of our current demand forecasts refer to chapter 3 of the 2018 Transmission Planning Report.

4.3.3 Future planning outlook

Te Mauri Hiko – Energy Futures considers the implications of the fast changing external environment for the New Zealand energy industry, including the transmission system. Our work to date has highlighted the challenges of investment planning in an environment where:

- forecasts change quickly,
- adoption of new technology is changing the energy and electricity landscape,
- public policy is influencing expectations of future growth, and
- consumer interaction with the energy industry is increasing.

Te Mauri Hiko has identified that the fast-changing external environment will challenge the ability to determine an accurate medium-term forecast for E&D system needs. Challenges and opportunities may:

- only be foreseeable in the short-term,
- be more easily deferred by technology adoption or energy use changes,
- impact power quality more than transmission capacity, and
- be unknown until commercial entities make public announcements on developments.

We consider our investment needs up to the mid-2020s, which are presented in this proposal (and in more detail in our 2018 Transmission Planning Report), will not be materially affected by Te Mauri Hiko projections, which forecast increased growth from 2030 onwards. We have started to work through the consequences of Te Mauri Hiko on longer-term system investment needs.

4.4 Forecasting approach

The higher degree of uncertainty in the external environment drives E&D investment decisions to deliver a 'least regrets' outcome. The decision to invest, defer expenditure or quickly change credible solutions must be flexible and fast responding.

The RCP2 expenditure approval process relied on a list of E&D projects that was reviewed and approved by the Commerce Commission. Our planning considers specific system needs for RCP3. Given the planning uncertainty we do not consider a 'list review' of specific investments to be made during RCP3 to be appropriate for determining the E&D base capex allowance.

Instead, we have used our current view of the E&D system needs during RCP3 to size the portfolio expenditure with the expectation that some projects may be deferred, others will have different credible or preferred solutions, and system needs will arise that are not yet foreseen.⁴⁴

Figure 19 below provides an overview of our E&D base capex forecasting approach. Note that all values are rounded.⁴⁵

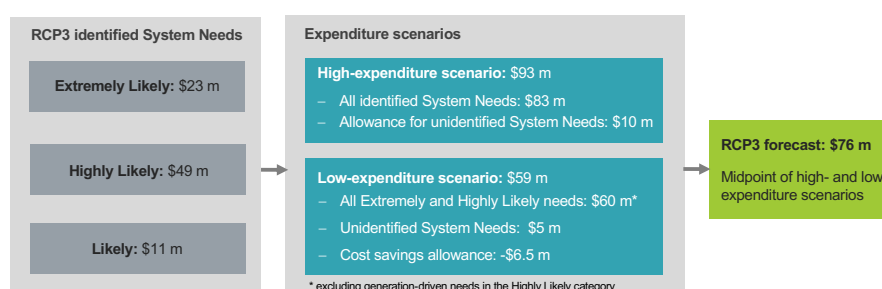


Figure 19: Overview of E&D expenditure forecasting approach.

⁴⁴ To ensure we maintain dynamic-efficiency within the E&D portfolio, we will continually review investment requirements within the period as new information becomes available. New information may change our view of certainty of expenditure requirements.

⁴⁵ Our E&D forecast does not account for any impact from possible changes to transmission pricing rules. Changes such as removing peak price signals or shifting charges to generators could alter grid usage and bring forward the need for additional investment.

We briefly discuss each of these steps below.



For a comprehensive discussion refer to chapter 4 of the 2018 Transmission Planning Report.

4.4.1 RCP3 identified system needs

We started by grouping the known system needs in RCP3 into three categories based on our view of certainty of expenditure – extremely likely, highly likely and likely. These categories reflect the detail available in current investigations, the drivers for investment and the level of confidence in early-stage credible solutions and costs.

The groupings are used to build up our view on the overall likelihood of expenditure to size the E&D portfolio.

4.4.2 Expenditure scenarios

We established two forecast expenditure scenarios: high-expenditure and low-expenditure.

High-expenditure scenario

The high-expenditure scenario considers potential investment needs and takes a relatively expansive (but plausible) view of the investment needs that will arise. It includes all identified system needs currently identified for RCP3 (\$93 million). We considered the needs of the grid, driven by fast-changing technology and external growth, the certainty of investment needs and the capex assumptions across time periods.

We also included an allowance for unidentified needs (\$10 million) that are expected to arise during RCP3.⁴⁶

Low-expenditure scenario

The low-expenditure scenario includes both extremely likely and highly likely projects, excluding generation-driven needs in the highly likely category (\$60 million), but takes a relatively cautious (but plausible) view of the other investment needs that will arise during RCP3.

We also considered the needs of the grid driven by a slower changing world with lower external growth and innovative technology adoption. Our low-expenditure scenario factors in a \$6.5 million reduction, if cost savings can be made on the preferred solutions using new technology or possible investment deferral.

We also include an allowance for unidentified needs (\$5 million) that could arise during RCP3.⁴⁷

⁴⁶ The average cost of E&D projects during RCP2 is approximately \$2.5 m. The \$10 m allowance represents the cost of four unidentified E&D system needs during RCP3.

⁴⁷ The average cost of E&D projects during RCP2 is approximately \$2.5 m. The \$5 m allowance represents the cost of two unidentified E&D system needs during RCP3.

4.4.3 RCP3 forecast

To prepare the RCP3 expenditure requirement we established an appropriate position within the range of high to low expenditure scenarios. On balance, we consider the mid-point between the high and low expenditure scenarios provides an appropriate RCP3 expenditure forecast (\$76 million). This is based on considering:

- individual project uncertainty and overall environmental uncertainty,
- the implications of too little versus too much E&D funding, and
- previous E&D capex and whether historical spend adequately represents our view of future spend.

Deliverability of E&D programme

The deliverability of the E&D programme has been considered at the asset portfolio level in the deliverability review. Given the size of the E&D programme (approximately 7 percent of the total proposal) any fluctuation due to the uncertainty of this programme will have an immaterial impact on the overall deliverability.

As the E&D projects develop, we will actively manage resourcing, by balancing grid network security/capacity risk over deliverability constraints, to ensure we can deliver both the Renewal and E&D programmes. In addition, the E&D expenditure is forecast to be similar to that of RCP2, which supports our confidence in its deliverability.

4.5 Enhancement and Development base capex forecast

Figure 20 sets out our annual forecast E&D capex for RCP3 in the context of RCP1 and RCP2 expenditure. For further context of the longer-term needs, the figure also shows the outlook up to RCP5. Note that RCP1 figures have been normalised for the change in major capex projects threshold from RCP1 (>\$5 million) to RCP2 (>\$20 million).

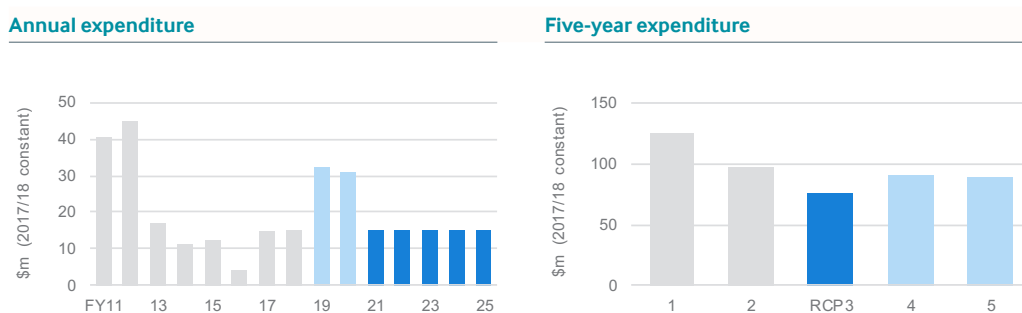


Figure 20: Historical and forecast Enhancement and Development base capex.

Our forecast RCP3 expenditure requirement of \$76 million compares to an RCP2 expenditure of \$97 million. Due to the way the RCP3 forecast is developed, the annual expenditure profile is phased evenly across the period.⁴⁸

Longer-term we expect an increase to approximately \$90 million in RCP4 and RCP5. This expected increase in expenditure is signalled through the Te Mauri Hiko work. Electric vehicle uptake and industrial conversion to electricity will speed up in the second half of the next decade and are expected to drive further E&D system needs.

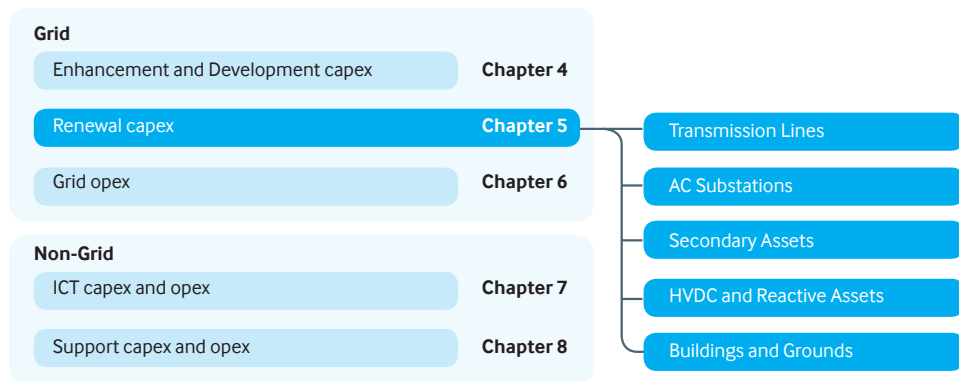
⁴⁸ While our RCP3 forecast is expressed in expenditure rather than commissioned terms, any projects yet to be commissioned in the remaining years of RCP2 that may roll into RCP3 are assumed to result in a corresponding expenditure amount to roll out into RCP4. We have adopted this treatment of potential roll ins/roll outs for all forecasts in our proposal.



Chapter 5

Renewal capex

This chapter sets out our Renewal capex proposal for RCP3. The figure below illustrates where the Renewal base capex fits within the Part 3 of our proposal and shows the asset categories that we use to explain our renewal forecast.



Grid renewal comprises five asset categories, which in turn include 16 asset groupings. Each asset category has a dedicated portfolio owner responsible for planning the required renewal and maintenance work for the assets within the category. Figure 16 below shows the correspondence between asset categories and asset groupings with identified programmes highlighted in darker blue. A more granular asset category breakdown is provided in the 2018 Asset Management Plan.⁴⁹

⁴⁹ AC Transmission asset classes are: Conductors, Structures, Insulators, Paint, Grillages, and Foundations and Access.
AC Substations asset classes are: Power Transformers, Outdoor 33 kV Switchyards: Outdoor to Indoor Conversion, Indoor Switchgear, Structures and Buswork, Outdoor Circuit Breakers, Outdoor Instrument Transformers, Disconnectors and Earth Switches, LVAC Distribution Systems, Power Cables, and Other AC Substation Equipment.
The remaining asset groupings correspond to their asset classes.

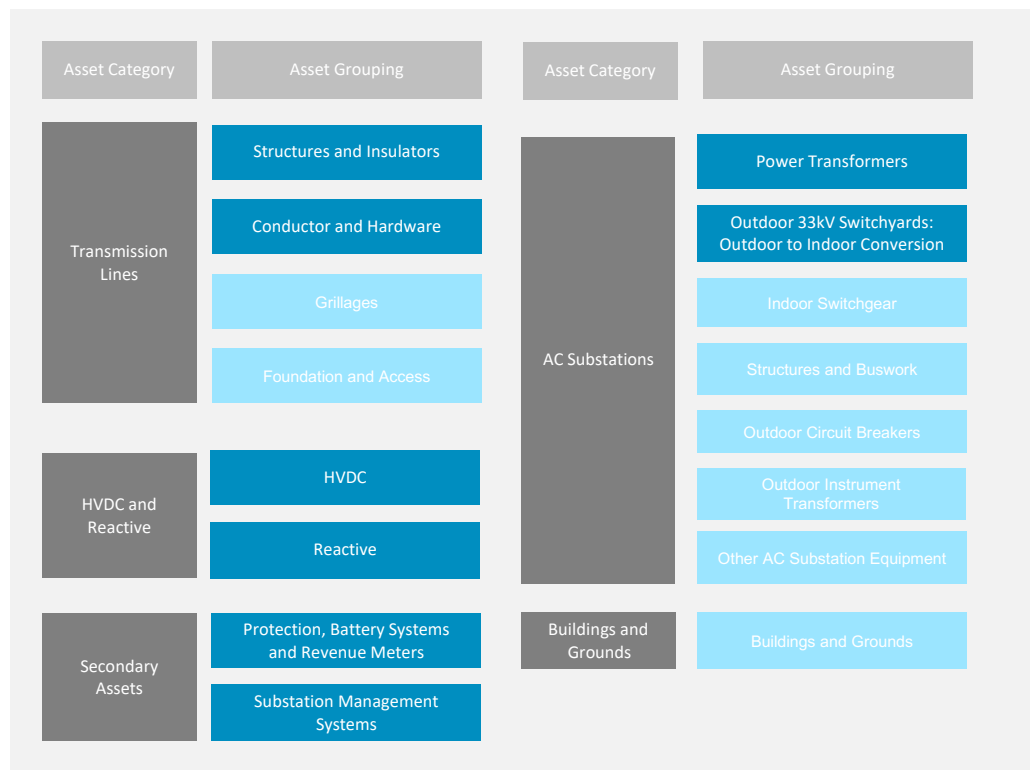


Figure 21: Asset categories and asset groupings

This chapter is structured as follows:

- Section 5.1 provides an overview of renewal capex and their drivers,
- Section 5.2 provides an overview of our asset planning decision framework,
- Section 5.3 provides an overview of the primary drivers for renewal,
- Section 5.4 provides an overview of our Transmission Lines renewal forecast,
- Section 5.5 provides an overview of our AC Substations renewal forecast,
- Section 5.6 provides an overview of our Secondary Assets renewal forecast
- Section 5.7 provides an overview of our HVDC and Reactive renewal forecast, and
- Section 5.8 provides an overview of our Buildings and Grounds renewal forecast.

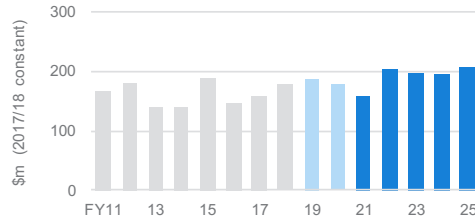
5.1 Overview

Renewal is an important asset planning intervention to ensure grid assets deliver a required level of service over their life at an efficient cost. By renewal we mean replacements as well as refurbishments of the assets on our network that extend an asset’s useful life.

With our proposed renewal we are investing to maintain a controlled level of risk to allow us to deliver our proposed levels of service. We use different methodologies to determine our renewal activities depending on the asset. One methodology is asset health, where we strive to achieve our proposed asset health targets, and we report regularly to the Commerce Commission on these. Our aim is to maintain service levels at least whole-of-life cost.

Figure 22 sets out our RCP3 forecast in the context of RCP1 and RCP2. To give a broader context of the longer-term needs of the grid, the right-hand panel shows the renewal base capex outlook up to RCP5.

Annual profile



Longer-term profile

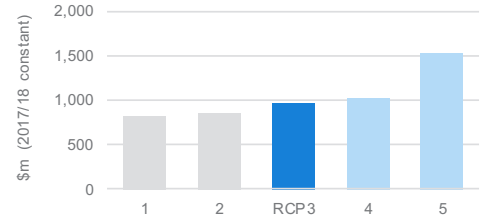


Figure 22: Historical and forecast total renewal base capex

Our proposed renewal base capex for RCP3 is \$963 million. This is an increase of approximately 14 percent compared to RCP2 expenditure of \$846 million.

Figure 23 shows historical and forecast renewal capex for each asset category.

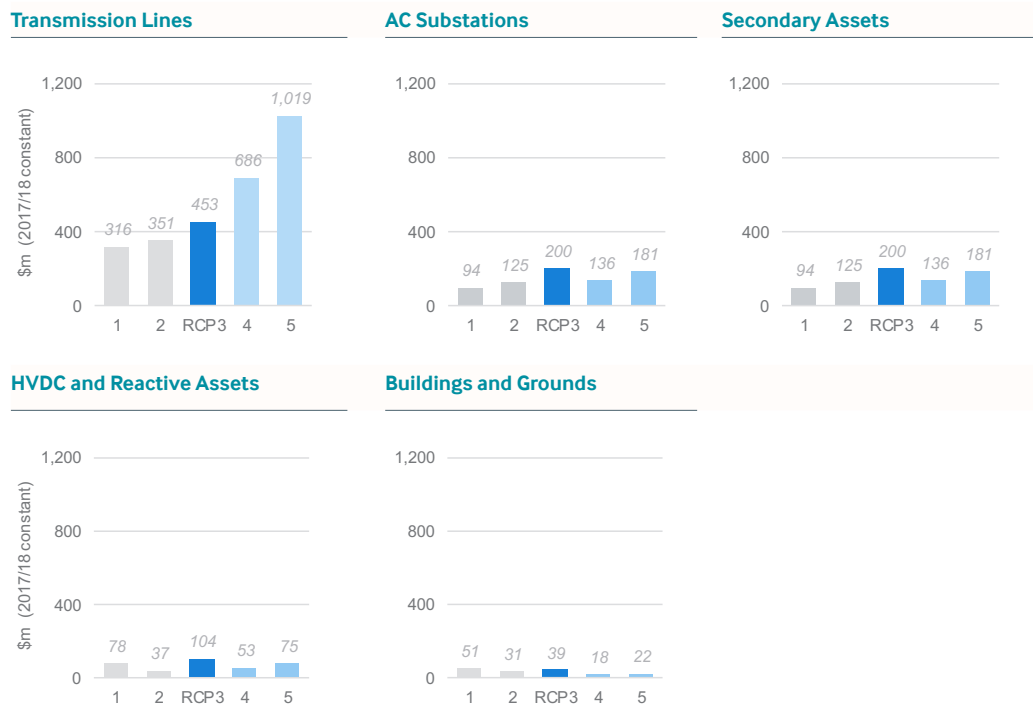


Figure 23: Renewal base capex by asset category

5.1.1 Adjustments

Our renewal forecasts are bottom-up forecasts that reflect the needs of the network. We have applied four top-down adjustments to the renewal forecast, relating to:

- deliverability,
- work phasing,
- price-quality trade-off, and
- cost efficiency.

Deliverability adjustment

As part of the RCP3 deliverability review, discussed in section 2.3.4, we identified several risks in the renewal forecast:

- service provider capacity constraints to meet future work volumes or workload spikes and peaks, and
- regional shifts in work creating workforce shortages that service providers are unlikely to meet.

Overall, we reduced our renewal forecast by \$58 million to reflect expected deliverability constraints. Table 21 summarises the adjustments.

Asset Grouping	Description	Adjustment (\$m)
Conductors and Hardware	Increased work volume over RCP3 means that more work must move to shoulder seasons, during which work conditions tend to be less optimal for reconditioning work. This is expected to reduce the potential for work to be completed.	- 41
Power Transformers	Availability of key resources could constrain our ability to accommodate unscheduled transformer replacements without adjustments elsewhere in our work programme. Reduced forecast allowance for expected but unscheduled transformer replacements.	- 10
Protection, Battery Systems and Revenue Meters	Expected constraints on technician availability	- 7
Total		- 58

Table 26: Deliverability adjustments to renewal base capex

Work phasing adjustment

The deliverability review also identified that the RCP3 renewal capex programme was front loaded towards the beginning of RCP3. We therefore applied a work phasing adjustment that rebalances the work towards the later years of RCP3.

We have not allocated the phasing adjustment to asset categories or specific work programmes. As part of our detailed work planning we will develop a delivery programme in line with our standard processes.

Price-quality trade-off adjustment

As discussed in section 2.3.6, we responded to RCP3 consultation feedback by applying a price-quality adjustment to our renewal forecast (see also Regulatory Template RT01). We have not yet allocated this to a particular asset grouping or category.

Description	RCP3 (\$m)
Price-quality trade-off applied to renewal forecast	Tighter specifications and standards -10

Table 27: Price-quality trade-off adjustment

Cost efficiency adjustment

Our benefits-driven ICT capex is expected to enable cost reductions in a range of portfolios, including in renewal. We have applied a cost efficiency adjustment to our renewal forecast (see also Regulatory Template RT01). We have not yet allocated this to a particular asset grouping or category.

Description	RCP3 (\$m)
Cost efficiencies enabled by benefits driven ICT capex	-4

Table 28: Cost efficiency adjustment



To ensure that the trend information presented in this chapter is meaningful we present trends and comparisons involving renewal asset categories and assets classes aggregated into five-year totals.

In this document we do not show annual expenditure profiles for asset category or classes.⁵⁰ The Regulatory Template RT01 includes annual expenditure with any adjustments separately shown.

Any assessment needs to consider that these top-down adjustments are not applied to individual asset groupings.

5.2 Asset planning

A central part of our asset renewal, and grid planning generally, is the asset planning decision framework. The decision framework takes a structured approach that enables us to make effective, consistent, repeatable asset planning decisions that balance risk, service levels and investment. We use it to determine, plan and justify all grid capex and opex, and for managing trade-offs between the two to ensure we manage our assets at least whole-of-life cost.

Central to the decision framework are inputs that operationalise the following primary renewal drivers:⁵¹

- asset health modelling, which helps us to understand the condition of our grid assets, and the probability of them failing, and
- asset criticality, which allows us to measure the consequence of an asset failure, expressed in dollar terms.

When applying the decision framework, we consider these alongside other renewal drivers and considerations.⁵²

Below we discuss the primary renewal drivers of our RCP3 forecast. Some asset classes have predominant drivers whereas others have multiple drivers.⁵³ In the renewal overviews of each asset category later in this chapter we indicate which of these primary renewal drivers apply.

⁵⁰ Expenditure on individual asset groupings in our regulatory templates is presented before applying phasing adjustments. We apply the phasing adjustment to the overall annual revenue forecast, at an aggregate level only.

⁵¹ We have published documents describing our asset health framework and our asset criticality framework alongside our proposal.

⁵² For example, for assets where asset health is a primary renewal driver, asset criticality is often used to prioritise the order of intervention between assets with similar intervention dates. We also consider delivery efficiencies, for example we group renewal assets (which may result in adjustments to renewal timing) where relevant to maximise delivery efficiencies.

⁵³ While not explicitly listed as drivers, Transpower and our service providers also have regard to relevant health and safety legislation, industry codes, legislation and other compliance requirements. These are reflected in asset strategies and our intervention criteria.

5.3 Primary renewal drivers

5.3.1 Asset health

Asset health is generally based on condition and reflects the remaining life of an asset and the probability of asset failure. The end of an asset's useful life is when it will need replacement or major refurbishment.

For asset types that are situated in controlled environments that do not vary from site to site, age is the primary determinant of asset health.

5.3.2 Asset risk

Asset risk is primarily based on asset health and asset criticality.⁵⁴ It also considers other risks associated with an asset's design context that could be addressed through renewal.

Asset risk is typically the key driver for higher cost assets and/or higher consequence assets, where an asset replacement is not expected to provide any benefit beyond that provided by the existing asset (e.g. no increased capacity or operability).

For assets where asset risk is the primary driver, renewal typically occurs when the benefit of risk reduction exceeds the renewal cost.

5.3.3 Additional economic benefit

Additional economic benefit can be a primary driver where an investment is expected to generate additional benefits over and above an asset risk reduction. The economic analysis incorporates not only the costs and benefit associated with the asset risk reduction, but also these expected additional benefits.

Economic benefits can arise for very high cost or highly complex asset types and systems. Examples include HVDC and transformer replacements that deliver increased capacity or reduced losses, and reconductoring that increases capacity.

5.3.4 Optimal intervention timing

For some assets the key driver for renewal is not the risk of asset failure. Instead renewal decisions are based on avoiding the economic consequence of both earlier and later renewal than the optimal intervention point. For those assets a sub-optimal intervention timing can result in significantly higher whole-of-life costs.

For example, towers are painted before the condition goes significantly beyond the economically optimum point, thereby avoiding excessive costs for maintaining overall asset health.

5.3.5 Obsolescence, or assets that represent a hazard

This driver typically applies to assets that exhibit unsustainable risks in the longer-term resulting from their inherent design and construction, and which cannot be readily changed. It also applies to assets where service provider capability and/or capacity is rapidly diminishing, and it is not feasible to sustain or increase it.

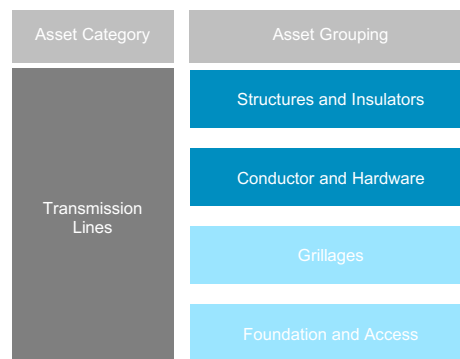
An example of an asset class with this primary driver is outdoor 33 kV switchyards where the risk cannot be readily changed. An outdoor to indoor conversion programme is underway to change the overall risk.

⁵⁴ Asset criticality represents the safety, service performance, environmental and direct cost consequences which may arise due to asset failure.

5.4 Transmission Lines

Our transmission line assets transport electricity from generation sources around the country to where it is consumed within our homes and places of business. Figure 24 shows the four asset groupings within the Transmission Lines asset category, and their contribution to the category forecast. Identified programmes are highlighted in darker blue on the left side.

Asset category overview



Renewal base capex composition

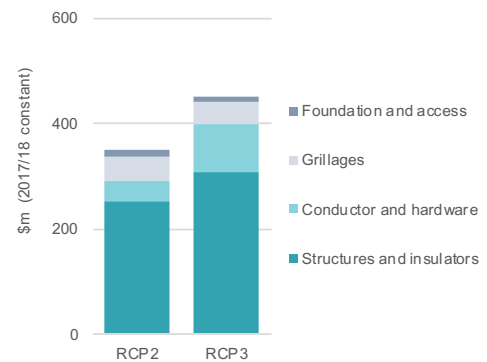


Figure 24: Overview of asset grouping in the Transmission Lines asset category

The proposed Transmission Lines renewal base capex is higher than during RCP2. This is mainly due to increases in paint and conductor renewal.

We focus our discussion on two asset groupings within this asset category.

- *Structures and Insulators* – the largest portfolio of renewal work in this asset grouping is paint, which accounts for \$238 million or 77 percent of proposed expenditure.
- *Conductor and Hardware* – the largest portfolio of renewal work over RCP3 in this asset grouping is reconductoring of aged transmission lines. Reconductoring accounts for \$69 million or 76 percent of proposed expenditure.

These two asset groupings make up 88 percent of the proposed RCP3 expenditure in the Transmission Lines asset category.⁵⁵



For further information on the asset classes within the Structures & Insulators asset grouping refer to the following sections in the 2018 AMP:
Asset Class Plan Conductors (section 4.5.4),
Asset Class Plan Insulators (section 4.5.5),
Asset Class Plan Paint (section 4.5.6),
Asset Class Plan Structures (section 4.5.7),
Asset Class Plan Grillages (section 4.5.8), and
Asset Class Plan Foundation and Access (section 4.5.9).

⁵⁵ We have proposed several reconductoring projects to be considered by the Commerce Commission under the listed project regulatory mechanism. See further discussion in section 2.4.1.

5.4.1 Structures and Insulators

This asset grouping includes the following asset classes:

- *Structures* – steel lattice towers, and concrete, wooden, and steel poles, which provide structural support to approximately 11,000 km route length of lines across New Zealand.
- *Paint* – the purpose of our painting programme is to maintain the protective coating for our steel structures where environmental conditions have, or are forecast to, reduce the mechanical capacity of these structures.
- *Insulators* – we use several types of insulators on our network (glass, composite and porcelain). It also includes phase conductor, and earth wire clamps and associated hardware.

The condition of structures and insulators is primarily influenced by the corrosiveness of the environment they are in; environmental corrosion varies widely across our network. This means life expectancy varies widely across our network.

Most of our structures are galvanised steel lattice towers. Many of our almost 24,000 towers have been installed progressively over time, with peaks in the 1930s and the 1950s to 1980s. As towers age, the original tower galvanising deteriorates due to corrosion.⁵⁶

Insulators attach electric power distribution or transmission lines to transmission towers and poles. They support and separate electrical conductors from the supporting structure, without allowing current through themselves. There are over 50,000 insulator sets in service across the transmission system.



Figure 25: Transmission tower and insulators

Below we summarise the asset management and forecasting approach for paint, which makes up \$238 million or 77 percent of the Structures and Insulators renewal forecast.

Tower painting

The purpose of our painting programme is to maintain the protective coating of our steel structures where environmental conditions have, or are forecast to, reduce the mechanical capacity of these structures. The mechanical performance of the structures is critical to ensuring public safety as well as maintaining a reliable power supply to customers.

⁵⁶ The period the original galvanising protects the steel of the towers is a low-cost phase of their life.

Asset management approach

Our asset management approach is to paint towers before significant rusting and sectional loss of metal members occurs and to re-paint prior to paint failure. Painting enables towers to reach their expected life and is a prudent low-cost strategy.

The timing for painting is based on minimising lifecycle costs, which means not painting too early, but not leaving it too late so that it does not require too much costly surface preparation work and replacement of steel members.

RCP3 work priorities

Many of our almost 24,000 towers are old or are in corrosive zones, and many of these towers are showing signs of rust. During RCP3 (and RCP4) many previously unpainted towers in the most corrosive areas of our network zones will require painting.

Renewal drivers

The primary driver of painting is optimal intervention timing. Renewal decisions are based on avoiding the economic consequence of painting both earlier and later than the optimal intervention point. Towers are painted before their condition goes significantly beyond the economically optimum point, thereby avoiding excessive costs for maintaining overall asset health.

5.4.2 Conductor and Hardware

This asset grouping includes:

- *Conductors* – also known as overhead power lines, conductors transmit electrical energy across our network. One or more conductors (commonly multiples of three) are suspended from towers or poles, and
- *Hardware* – a conductor has a range of associated assets and components (conductor joints, spacers, and dampers).

Our network has approximately 11,000 km route length of transmission lines. Several conductor types are currently in service due to the changes in the type of conductors deployed over time. Copper conductors were primarily used before the 1950s, but from the mid-1950s, Aluminium Conductor Steel Reinforced (ACSR) conductors have been used. Since 2010, All Aluminium Alloy Conductor (AAAC) conductors are also considered for new transmission lines and are used for most major conductor replacements.

The expected life of conductors ranges between 17 and 100+ years, depending on their type and construction and the environment in which they are installed. Like our towers, the corrosiveness of the atmosphere significantly influences conductor condition and life expectancy.



Figure 26: Reconductoring in progress

Below we summarise the asset management and forecasting approach for reconductoring, which makes up 76 percent of the Conductor and Hardware renewal forecast.

Reconductoring

Most of our network was built from the 1950s to the 1980s. This is reflected in the age of our conductors, with 10 percent being installed before 1950, and more than 60 percent installed between 1950 and 1980. Our ongoing programme to replace much of the conductor on our network is expected to continue for several decades.

Our current estimates show that more than half of North Island lines and approximately one third of South Island lines may reach end-of-life and require replacement during the next 30 years. While replacement work is expected to peak around 2030 to 2035, it is expected to continue beyond then. Reconductoring is discussed further in section 2.1.2.

Asset management approach

Our asset management approach for conductor is to build new lines, to ensure that the required capacity and reliability is achieved whilst minimising lifecycle costs.⁵⁷ We repair conductors when analysis shows that localised sections have reached end of life and replace them when ongoing management costs and risk are unacceptably high.

RCP3 work priorities

During RCP3 we aim to complete approximately 360 circuit km of reconductoring, up from approximately 300 circuit km during RCP2.⁵⁸

Renewal drivers

The primary drivers of our Conductor and Hardware renewal forecast are:

- asset health,
- asset risk, and
- additional economic benefit.

5.4.3 Transmission Lines renewal base capex forecast

Figure 27 below sets out the RCP3 Transmission Lines renewal forecast in the context of RCP1 and RCP2. To provide broader context of the longer-term needs of the grid it also includes the outlook up to RCP5.

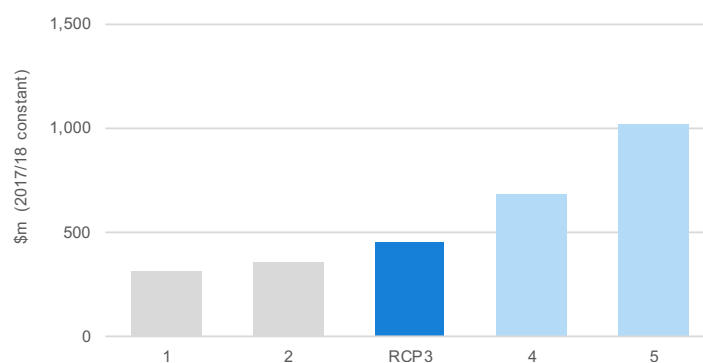


Figure 27: Historical and forecast renewal base capex on Transmission Lines

⁵⁷ Our asset management approach for conductor also includes uprating of existing lines, where there is a System Need. Uprating of existing lines is part of the Enhancement and Development portfolio.

⁵⁸ These quantities include listed and major reconductoring projects.

RCP3 expenditure is above RCP2, mainly due to the required increase in tower painting and reconductoring work. We expect that further substantial increases in these two activities will be required in RCP4 and RCP5.

Figure 28 below shows historical and forecast expenditure for each of the asset groupings that make up the Transmission Lines asset category.

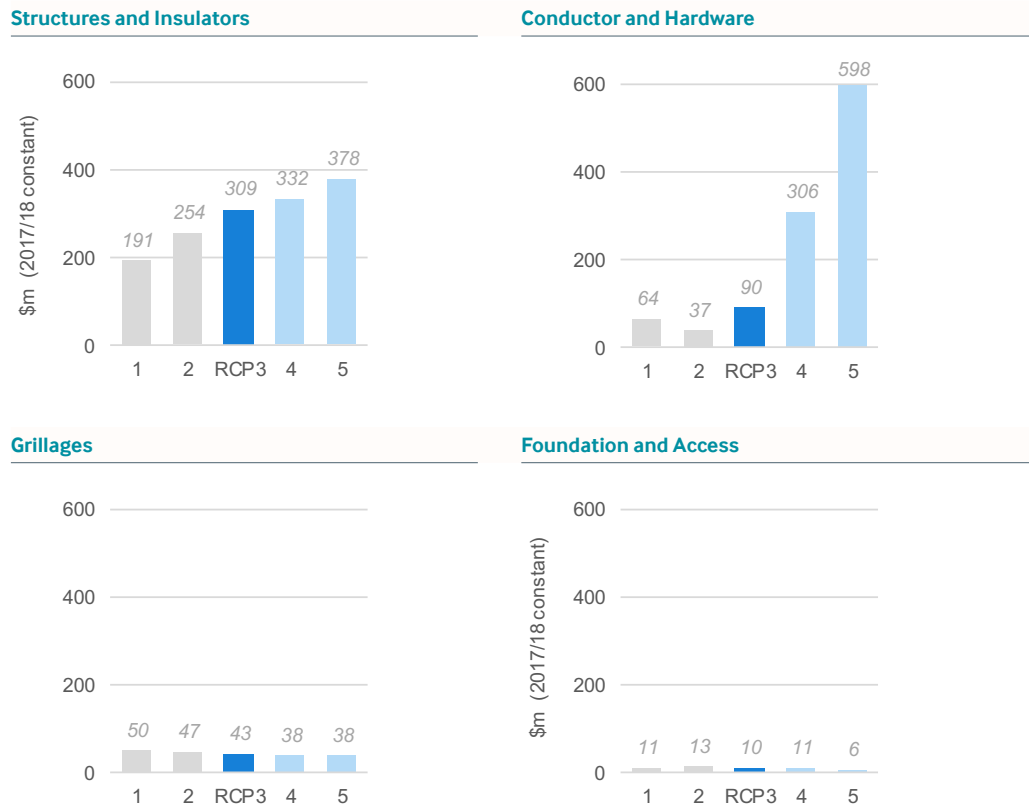


Figure 28: Historical and forecast renewal base capex on Transmission Lines asset groupings

In summary:

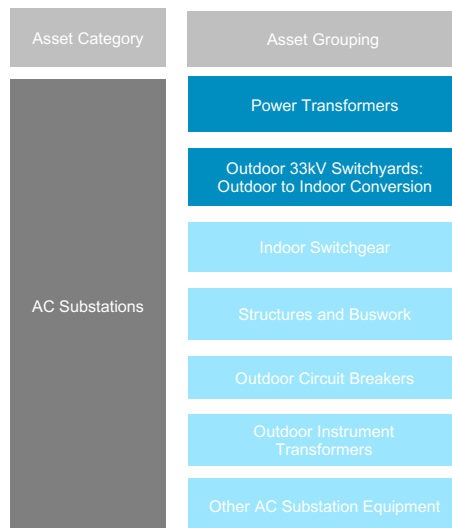
- *Structures and Insulators*—our expenditure requirement for RCP3 is \$309 million, which is 21 percent higher than RCP2 expenditure of \$254 million. This uplift is mainly driven by required increases in tower painting.
- *Conductor and Hardware*—our expenditure requirement for RCP3 is \$90 million, which is 145 percent higher than RCP2 expenditure of \$37 million. This uplift is mainly driven by required increases in reconductoring work.
- *Grillages*—our expenditure requirement for RCP3 is \$43 million, which is 8 percent lower than RCP2 expenditure of \$47 million.
- *Foundation and Access*—our expenditure requirement for RCP3 is \$10 million, which is 20 percent lower than RCP2 expenditure of \$13 million.

5.5 AC Substations

A substation contains a set of equipment, including power transformers, required to transform energy between voltage levels. A substation without power transformers and operating only at a single voltage level is called a switching station. Our substations have power system equipment that operates at 220, 110, 66, 33, 22 and 11 kV.

AC Substations encompass all the electrical equipment within a substation boundary. Figure 29 below shows the seven asset groupings within the AC Substations category, and their contribution to the asset category overall. Identified programmes are highlighted in darker blue.

Asset category overview



Renewal base capex composition

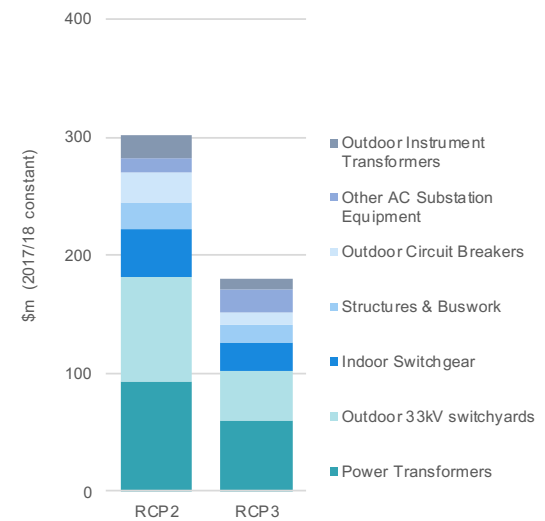


Figure 29: Overview of asset classes in the AC Substations asset category

Our proposed AC Substations renewal base capex is approximately 40 percent lower than during RCP2. This is mainly due to reductions in Power Transformer, Outdoor to Indoor Conversion and Indoor Switchgear investment.

The asset groupings we focus our discussion on within this asset category are:

- *Power Transformers* – the portfolio of renewal work over RCP3 in this asset grouping accounts for \$60 million or about one third of the AC Substations asset category.
- *Outdoor 33 kV Switchyards: Outdoor to Indoor Conversion* – the portfolio of renewal work over RCP3 in this asset grouping accounts for \$42 million or about one quarter of the AC Substations asset category.

Combined these two asset groupings make up almost two thirds of the proposed RCP3 expenditure in this asset category. Below we discuss these.



For more information on the asset classes within the Substations asset grouping refer to the following sections in the 2018 AMP:

Asset Class Plan – Power Transformers (section 4.3.4),

Asset Class Plan – Indoor Switchgear (section 4.3.5),

Asset Class Plan – Outdoor Circuit Breakers (section 4.3.6),

Asset Class Plan – Outdoor Instrument Transformers (section 4.3.7),

Asset Class Plan – Power Cables (section 4.3.8),

Asset Class Plan – Outdoor Disconnectors and Earth Switches (section 4.3.9),

Asset Class Plan – LVAC (section 4.3.10),

Asset Class Plan – Structures & Buswork (section 4.3.11),

Asset Class Plan – Other AC Substation Equipment (section 4.3.12), and

Asset Class Plan – Outdoor 33 kV Switchyards: Outdoor to Indoor Conversions (section 4.3.13).

5.5.1 Power Transformers

A power transformer is a static electrical device that transfers electrical energy between two or more circuits. This asset grouping encompasses power transformers operating at system voltages of 11 kV and above, as well as supply and interconnector transformers in the main AC transmission network and the small auxiliary earthing and local service transformers.

Since the high voltages carried in the transmission lines are significantly greater than what is needed by most of our customers, transformers are used to decrease (or step-down) the supply voltage to a level suitable for the low voltage circuits they contain. Transformers are used to increase (or step-up) voltage before transmitting electrical energy over long distances through wires.

Major power transformers are generally bespoke, with only a small number of identical units built for each design (the main transformer population originates from 41 different manufacturers). We have about 360 major power transformers in service, with a mix of three-phase types, and mostly older banks of three single-phase units. Large power transformers are usually the most expensive individual assets in an AC substation.



Figure 30: A typical three-phase transformer

Below we summarise the asset management and forecasting approach for power transformers.

Asset management approach

We have a need to manage ageing 1960s and 1970s single-phase transformer banks, primarily 110/33 kV units. We use asset health indicators and relevant asset feedback to identify the need for intervention, before evaluating and selecting preferred solutions for existing power transformers.

Improved asset health information has enabled us to change our strategic approach to transformer replacement. We now use asset health as an input to a solution centred on a risk-based options' analysis. This approach means we no longer replace transformers purely based on age, although we do choose replacement if it is the least whole of life cost option, when compared with other options.

Our use of options other than total replacement has led to a more targeted replacement programme. However, although this approach defers capex, it often requires a maintenance intervention to extend life. Examples are bushing replacements, major refurbishment to mitigate corrosion and/or leaks, or high moisture levels, and retrofitting firewalls between closely-spaced transformers.

Our 2016 nationwide survey of the external condition of major substation equipment found significant issues with corrosion and oil leaks on many power transformers. These findings have been incorporated into our ongoing transformer maintenance work requirements (see below).

RCP3 work priorities

In RCP3 we will continue the lifecycle extension approach we adopted in RCP2 to this asset class.

Renewal forecast inputs

The primary driver of our Power Transformer renewal forecast is asset risk (which includes asset health modelling of individual transformers).

5.5.2 Outdoor 33 kV Switchyards: Outdoor to Indoor Conversion

Switchyards are points of interface between the transmission system and distribution network customers. The Outdoor 33 kV Switchyards asset class comprises a range of assets including:

- support structures,
- buswork,
- circuit breakers,
- disconnectors and earth switches, and
- other equipment such as instrument transformers, surge arrestors and local service supply components.

No outdoor 33 kV switchyards have been constructed since 1984 due to the availability of safer, more economic and reliable alternatives, such as indoor switchgear. There are safety issues inherent in the design of many of these outdoor switchyards, in addition to poor reliability and vulnerability to outages and interruptions. Many outdoor switchyards contain near-end-of-life equipment that is expensive to maintain.

Since 2009, Transpower has been undertaking an outdoor to indoor (ODID) switchgear conversion programme.⁵⁹ By 2025 only 19 of the original 75 outdoor switchyards will remain.

⁵⁹ Our nationwide Outdoor to Indoor Conversion programme is a portfolio of solutions, not a portfolio of assets. An ODID is a project which replaces an outdoor 33 kV switchyard with indoor 33 kV switchgear.

A total of 16 smaller switchyards will not be converted because, due to their design, they do not represent significant hazards to workers.⁶⁰

Carrington Street 33 kV pole mounted structure



Paraparaumu 33 kV fixed pattern, vacuum circuit breaker, SF6 insulated busbar



Figure 31: Examples of indoor and outdoor switchyards

Below we summarise the asset management and forecasting approach for our ODID programme, which makes up 23 percent of the AC Substations asset category renewal forecast.

Asset management approach

Our overall approach is to decommission all outdoor 33 kV structures that have inadequate safety clearances and reliability characteristics, and replace with a modern equivalent indoor switchboard. All outdoor 33 kV switchyards are considered as need cases, so prioritising the intervention is the key issue. The highest priorities for conversion are switchyards with small safety clearances, complicated structures and buswork, and aged bulk oil circuit breakers.

Where appropriate, we replace equipment (based on condition) in remaining outdoor 33 kV switchyards to extend life of the overall installation.

RCP3 work priorities

Twelve ODIDs⁶¹ are planned for RCP3, down from 14 during RCP2. By the end of RCP3 there will be no need to manage the ODID as a programme of work as there will only be three sites remaining for conversion.

Renewal drivers

The primary drivers of the ODID programme renewal forecast are:

- obsolescence, or assets that represent a significant and/or unsustainable hazard,
- health and safety risk, and
- asset risk.

5.5.3 AC Substations renewal forecast

Figure 32 below sets out the RCP3 AC Substations renewal forecast in the context of RCP1 and RCP2. To provide broader context of the longer-term needs of the grid it also includes the outlook up to RCP5.

⁶⁰ The remaining have suitable safety clearances and assets in reasonable condition or are N security sites where maintenance is undertaken during a shutdown.

⁶¹ Most of the large switchyards were converted in RCP1 and through to the end of RCP2. The sites for conversion during RCP3 will be mostly smaller ones, which contributes to the reduced RCP3 expenditure in this asset class.

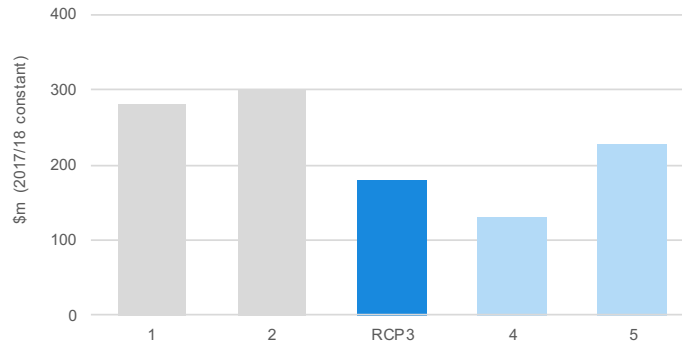


Figure 32: Historical and forecast renewal capex on AC Substations

Proposed AC Substations expenditure is significantly lower than RCP1 and RCP2 expenditure.

Figure 33 below shows historical and forecast expenditure for each of the AC Substations asset groupings,



Figure 33: Historical and forecast renewal capex on AC Substations asset groupings

In summary:

- *Power Transformers* – our expenditure requirement for RCP3 is \$60 million, which is 35 percent lower than RCP2 expenditure of \$93 million.
- *Outdoor 33 kV Switchyards: Outdoor to Indoor Conversion* – our expenditure requirement for RCP3 is \$42 million, which is 53 percent lower than RCP2 expenditure of \$89 million.
- *Indoor Switchgear* – our expenditure requirement for RCP3 is \$24 million, which is 40 percent lower than RCP2 expenditure of \$40 million.
- *Other AC Substation Equipment* – our expenditure requirement for RCP3 is \$20 million, which is 60 percent higher than RCP2 expenditure of \$12 million.
- *Structures and Buswork* – our expenditure requirement for RCP3 is \$15 million, which is 34 percent lower than RCP2 expenditure of \$23 million.
- *Outdoor Circuit Breakers* – our expenditure requirement for RCP3 is \$11 million, which is 57 percent lower than RCP2 expenditure of \$26 million.
- *Outdoor Instrument Transformers* – our expenditure requirement for RCP3 is \$9 million, which is 55 percent lower than RCP2 expenditure of \$19 million.

5.6 Secondary Assets

Our Secondary Assets category comprises Protection, Battery Systems and Revenue Meters, and Substation Management Systems. Figure 34 below shows the two asset groupings within the Secondary Assets category, and their contribution to the asset category forecast. Both asset groupings are identified programmes.

Overview

Asset Category	Asset Grouping
Secondary Assets	Protection, Battery Systems and Revenue Meters
	Substation Management Systems

Renewal base capex composition

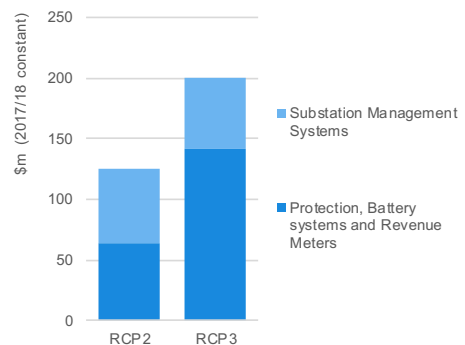


Figure 34: Asset groupings in the Secondary Assets asset category

Proposed Secondary Assets base capex is higher than during RCP2. This is mainly due to a number of assets approaching end of life and that will need to be replaced in RCP3.

In the discussion that follows we cover both asset groupings within Secondary Assets:

- *Protection, Battery Systems and Revenue Meters* – the portfolio of renewal work over RCP3 in this asset class accounts for \$142 million or 71 percent of the Secondary Systems Asset Category.
- *Substation Management Systems* – the portfolio of renewal work over RCP3 in this asset class accounts for \$59 million or 29 percent of the Secondary Systems Asset Category.



For further information on asset classes within the Secondary Assets asset category refer to the following sections in the 2018 AMP:

Asset Class Plan – Protection, Station DC Systems and Revenue Meters (section 4.8.5), and

Asset Class Plan – Substation Management Systems (SMS) (section 4.8.6).

5.6.1 Protection, Battery Systems and Revenue Meters

This asset class comprises a diverse range of assets:

- *Protection schemes* – used throughout the grid to detect and initiate isolation of electrical faults, protect primary equipment, and ensure people’s safety.⁶²
- *Station DC systems* – provide power (even when the local AC service supply has failed) to protection schemes, circuit breaker trip and close coils, control, and metering.⁶³
- *Revenue meters* – supply electricity volume information and are used for wholesale market reconciliation and billing.

The expected life for these assets ranges widely, from 8-12 years for station batteries, to 25 years for duplicated line protection relays. The combination of these wide ranging expected lives means that required work volumes in this asset grouping fluctuate over time.



Figure 35: Battery chargers and fuse boxes, with battery banks in the foreground

⁶² We use either main (single) or duplicate protection, depending on the application. Special Protection Schemes (SPS) enable greater power flow in the existing primary equipment when the power flow is higher than equipment rating. Outdoor Junction Boxes (ODJBs) marshal the secondary cabling between the primary equipment and the protection equipment.

⁶³ DC supplies typically consist of batteries, battery charging systems, fuse boxes, primary DC panel, secondary DC panels, and any associated assets like the DC condition monitoring relays.

Below we summarise the asset management and forecasting approach for our Protection, Battery Systems and Revenue Meters.

Asset management approach

Our objective for these assets is that they operate reliably, and meet our operational needs, at least lifecycle cost. Different assets have different replacement approaches.

- *Protection, revenue metering and (in most cases) station DC system assets* – the only option is to replace the asset, as refurbishment is not cost effective. Due to the function and importance of these assets, they are regularly monitored, tested, and replaced as required. Replacements are age-based.
- *Station DC chargers and revenue meters* – replacement is driven by obsolescence, condition, age and functionality.
- *Relays* – replacement is based on obsolescence or endemic failure.
- *Station DC batteries* – replacement is driven by age and functionality (i.e. larger capacity batteries required).
- *Outdoor junction boxes* – replacement is driven by condition.

RCP3 work priorities

The work priorities for RCP3 are to replace old technology relays, install additional bus protection and focus on assets that are critical to reliability and safety.

Renewal drivers

The primary driver of the Protection, Battery Systems and Revenue Meters renewal forecast is asset health.

We rely on data sets that contain lists of the assets under each portfolio and asset attributes (e.g. age, asset type, health, whether protection is duplicated or not, etc.) to build a forecast of the required investment.

5.6.2 Substation Management Systems

The operation of the grid increasingly requires a range of advanced capabilities that demand enhanced communications and data management functions at substations.

A substation management system (SMS) is a telemetry system based on computers and Local Area Networks (LANs) that have been designed to operate in electricity utility environments.

These systems enable the remote control and real-time monitoring of our substation and are essential to maintaining visibility and control of the transmission network.

SMSs comprise a range of assets:

- remote terminal units (RTUs),
- substation management platforms (SMPs), input/output modules, human machine interfaces (HMIs), and
- GPS clocks.

There are two main types of SMS currently in service: legacy remote terminal units, and ethernet-capable SMPs. The SMP is a modern technology and includes:

- Remote Engineering Access (REA), which allows us to interrogate and manage secondary systems without needing to be on site, and
- HMI capabilities, which provide local and situational awareness and direct control over the site's assets.

The older legacy RTUs are being phased out and will be replaced with modern SMP-based systems.

Legacy RTU units



Modern SMP



Figure 36: Legacy and modern substation management systems

Below we summarise the asset management and forecasting approach for our Substation Management Systems.

Asset management approach

Our legacy RTUs are now obsolete, do not meet our operational needs, are no longer supported by manufacturers, and we cannot get spares. Additionally, legacy RTU technology limitations mean there are very few sites able to provide service providers with visibility of equipment status. Our existing I/O module assets are failing more frequently, and our current GPS clock technology will not meet future time-synchronisation needs.

We replace assets where either the increased probability of failure, or technical obsolescence, poses an unacceptable operational risk. Because of the operational criticality of our SMS assets, this means in practice we primarily use an aged-based⁶⁴ replacement strategy (asset age is a proxy for asset health).

⁶⁴ 15 years of age for legacy RTUs and I/O modules (although we will allow a tolerance of five years either side of that, to enable delivery efficiencies through project bundling or for prioritisation of replacement expenditure based on asset criticality).

RCP3 work priorities

Our main focus over RCP3 is to complete the replacement programme of legacy RTUs and Input/output modules and replacing these with new ethernet-capable SMP systems.⁶⁵

We expect to deploy SMP at our remaining 71 sites by the end of 2025. We will carry out REA installation work at the same time as SMP deployment or legacy I/O replacements to reduce overall costs by avoiding double handling and rework.

Renewal drivers

The primary drivers of the Substation Management Systems renewal forecast are:

- asset health, and
- obsolescence, or assets that represent a significant and/or unsustainable hazard.

5.6.3 Secondary Assets renewal forecast

Figure 37 below sets out the RCP3 Secondary Assets renewal forecast in the context of RCP1 and RCP2. To provide broader context of the longer-term needs of the grid it also includes the outlook up to RCP5.

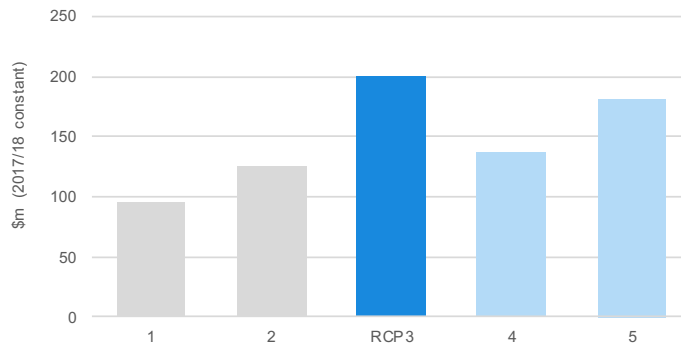


Figure 37: Historical and forecast renewal base capex on Secondary Assets

Figure 38 below shows historical and forecast expenditure for the asset groupings that make up Secondary Assets.

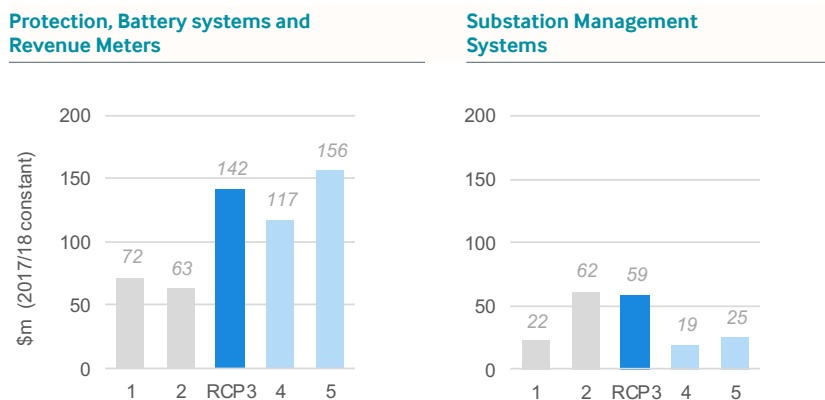


Figure 38: Historical and forecast renewal base capex on Secondary Asset groupings

⁶⁵ The work programme started in RCP1.

In summary:

- *Protection, Battery Systems and Revenue Meters* – our expenditure requirement for RCP3 is \$142 million, which is 124 percent higher than RCP2 expenditure of \$63 million.
- *Substation Management Systems* – our expenditure requirement for RCP3 is \$59 million, which is 5 percent lower than RCP2 expenditure of \$62 million.

5.7 HVDC and Reactive Assets

Our HVDC system is the only transmission connection between the North and South Island power systems. Reactive power is needed in an alternating-current transmission system to support the transfer of real power over the network. Figure 39 below shows the two asset classes within the HVDC and Reactive asset category, and their contribution to the asset class category overall forecast. Both asset groupings in this asset category are identified programmes.

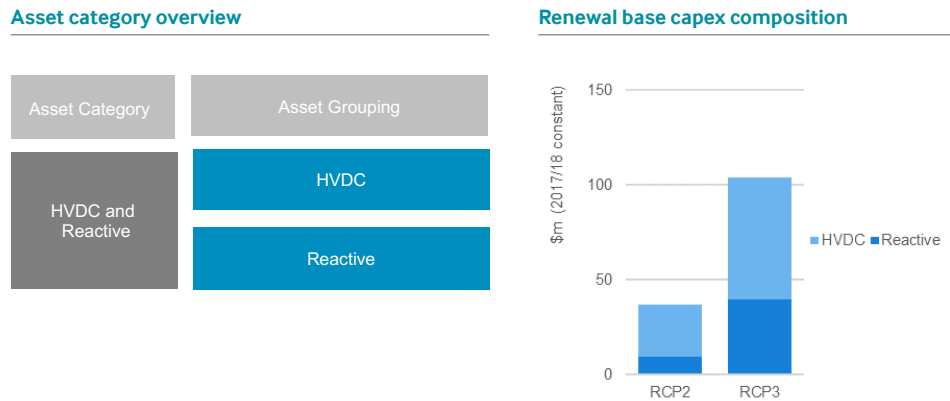


Figure 39: Overview of asset classes in the HVDC and Reactive asset category

Proposed HVDC and Reactive renewal base capex is significantly higher than during RCP2. This is mainly due to the required Static Var Compensators and synchronous condenser refurbishment projects (Reactive) and the life extension work on our Pole 2 (HVDC).

Reactive assets account for \$39 million or about one third of this asset category’s forecast over RCP3. HVDC accounts for \$65 million.



For further information on asset classes within the HVDC and Reactive Asset grouping refer to the following sections in the 2018 AMP:

Asset Class Plan – HVDC (section 4.6.3), and

Asset Class Plan – Reactive Assets (section 4.7.3).

5.7.1 HVDC

The High Voltage Direct Current (HVDC) inter-island link is a critical part of the network.⁶⁶ It enables the North Island to access South Island hydro-electricity generation, and the South Island to access North Island thermal electricity generation. The link is also critical to the operation of an efficient national electricity market.

Due to network changes such as the closure and reduction in the use of North Island base load thermal plants, dry year supply risks, and the possibility of Tiwai Point smelter exiting New Zealand, it is expected that the market will increasingly rely on the availability and security of the HVDC link.

The HVDC link comprises a range of assets, including:

- converter stations (valves, converter transformers, DC yard equipment, and AC switchyard equipment),
- submarine cables and cable stations (submarine cables, cable terminations, and buildings), and
- electrode stations (earthing electrodes, isolating switches, roof bushings and buildings).

The HVDC system is highly sophisticated, requiring complex controls to ensure it operates optimally and safely. The system includes two reactive power control (RPC) systems, one at Benmore and one at Haywards.

The HVDC system comprises of assets that are unique, and the New Zealand system has been specifically customised for our operating conditions and environment. In contrast to the AC system, the HVDC link consists of assets that:

- are often unique, with small and diverse populations,
- require highly specialised design and materials,
- require highly specialised knowledge to operate and maintain, and
- have limited data on failure modes, even internationally.

These characteristics are challenging when it comes to managing HVDC equipment. For example, asset health modelling is not applicable or practical. The unusual characteristics of many of these assets require us to consider a diverse range of asset management risks and issues when managing the system as a whole. This makes the retention of key skills important, as is maintaining good relationships with suppliers and service providers (commonly overseas-based).

The system is operated and maintained according to both the design parameters and international asset management practices specified by the equipment manufacturers. The majority of the assets that comprise the HVDC system are tested on a regular routine basis, which provides a constant view of condition and integrity. This, combined with telemetry data in real time, enables the expert internal asset team to make timely decisions regarding both maintenance and replacement investment. Short planned outages of the HVDC system are precisely coordinated with both the market and specialist service providers.



Figure 40: Pole 2 Valve Hall showing the star bushings on the right

We have a specialist in-house team with expertise in HVDC and Power Electronics, who determine condition and if interventions are required. Technical advice is often sought from the suppliers in addition to collaboration with an international network of HVDC asset owners.

⁶⁶ The HVDC link is subject to a grid performance measure - AP1, which measures the energy availability of the HVDC system.

Below we summarise the asset management and forecasting approach for our HVDC assets.

Asset management approach

Our asset management approach for the HVDC link seeks to achieve continued high levels of availability and reliability on a sustainable and safe basis while achieving least whole-of-life cost.

Our long-term replacement and refurbishment plans are informed by expected lives, which are based on manufacturer recommendations and international best practices. Interventions (and their timing) are triggered by specialist condition assessments. Scheduled, interval-based condition monitoring is carried out to provide information for analysis and planning. In addition, a range of other inspections and monitoring activities are undertaken on specific assets.

RCP3 work priorities

Our focus for RCP3 is Pole 2, as many of its component assets require midlife extension works. We are undertaking a programme of work on Pole 2 that will take it from a 30-year design life to a 50-year operating life. This approach is more cost-effective than complete replacement.

RCP3 is the prudent time to invest in carrying out equipment replacements for equipment with a design life of 30 years. Delaying investment into RCP4 would result in the new equipment being underutilised and the old equipment being pushed past its design life, increasing the risk of failure.

Our Pole 2 works are focussed around refurbishing converter transformers including transformer bushings replacement, replacing wall bushings (both AC and HVDC), replacing/refurbishing HVDC primary assets, refurbishing secondary and auxiliary systems, improving seismic performance of HVDC buildings and refurbishing AC filter banks.

Also, enhancements to other HVDC assets (e.g. improving HVDC local supply security, and fire system upgrades) will be carried out in RCP3.

Renewal drivers

The primary drivers of the HVDC renewal forecast are:

- obsolescence, or assets that represent a significant and/or unsustainable hazard, and
- asset risk.

5.7.2 Reactive Assets

Reactive power is needed in an alternating-current transmission system to support the transfer of real power over the network. We use a combination of static and dynamic plant to supply the reactive power needed by the power system. The reactive power fleet ensures the stability of the power system and maintaining reliability of supply to customers.

Reactive Assets comprise a range of assets, including:

- capacitor banks,
- reactors,
- synchronous condensers (eight functioning, two mothballed),
- three Static VAR Compensators (SVCs),
- Static synchronous compensators (STATCOMs), and
- control and protection systems, auxiliary systems, and primary assets.

Synchronous condensers are large, long-lived (60+ years) rotating electrical machines that provide highly flexible reactive power for voltage control and dynamic reactive support for the transmission system, as well as contributing to system stability by increasing the available short circuit capability. A wide range of ancillary equipment is associated with each condenser.

A Static Var Compensator is a set of electrical devices for providing fast-acting reactive power on high-voltage alternating current (AC) electricity transmission networks and used to regulate the transmission voltage. A capacitor bank is a group of several capacitors of the same rating that are connected with each other to store electrical energy. The bank is then used to regulate and stabilise the AC power supply.

Haywards SC10 synchronous condenser



Islington SVC9



Figure 41: Reactive assets

Below we summarise the asset management and forecasting approach for our reactive assets.

Asset management approach

For reactive assets, our key driver is to operate the assets safely and reliably, at least lifecycle cost.

Due to significant work done in RCP1, the next major refurbishment of our Haywards synchronous condensers is not due until around 2035. In the interim, we will undertake major condition-based overhauls to extend their life. A condition-based approach also guides the replacement of primary and auxiliary equipment associated with each synchronous condenser, whereas a risk-based approach guides replacement of control, protection, and monitoring systems.

Our very small synchronous condenser fleet (coupled with the complex and bespoke nature of each condenser), means it is essential we retain continuing access to relevant external expertise, and retain an appropriate level of specialist maintenance skills in the workforce.

For SVCs, we undertake half-life refurbishments to ensure the main plant can operate reliably until the end of its life. Our three SVCs vary widely in age, technology and condition. One SVC is in very poor condition, and the control systems of all our SVCs are becoming obsolete and unreliable and need replacing.

RCP3 work priorities

Our synchronous condensers and SVCs are a major focus of our planned work during RCP3.

RCP3 sees us having to undertake relatively large expensive SVC and synchronous condenser refurbishment projects. Work and spending will vary quite widely, by year, across RCP3. We also plan to carry out condition assessment work during RCP2 and RCP3, which will help us refine the currently high-level work planned for RCPs 4 and 5.

Two of our synchronous condensers will undergo secondary and auxiliary systems refurbishments in RCP3, as well as other improvements across the condenser fleet as a whole.

We plan to refurbish two of our three SVCs to extend their life expectancy. In addition, we plan to replace three system-critical capacitor banks, and undertake condition assessment of all the capacitor banks, to reduce risks to the banks fleet.

For RCP3 we have assumed no demand change. However, as highlighted in Te Mauri Hiko, we expect that as New Zealand moves towards a lower carbon future, with the resulting changes to energy flow on the grid, there will be a greater need for reactive assets to counter-balance the changing energy sources and demand. This type of investment, in our view, is a key area for innovation and development and is likely to be signalled through the E&D planning process.

Renewal drivers

The primary drivers vary by asset type and application of the assets. The primary drivers of the Reactive Assets renewal forecast are:

- asset health,
- asset risk,
- additional economic benefit, and
- obsolescence, or assets that represent a significant and/or unsustainable hazard.

5.7.3 HVDC and Reactive Assets renewal base capex forecast

Figure 42 below sets out the RCP3 HVDC and Reactive Assets renewal forecast in the context of RCP1 and RCP2. To provide broader context of the longer-term needs of the grid it also includes the outlook up to RCP5.

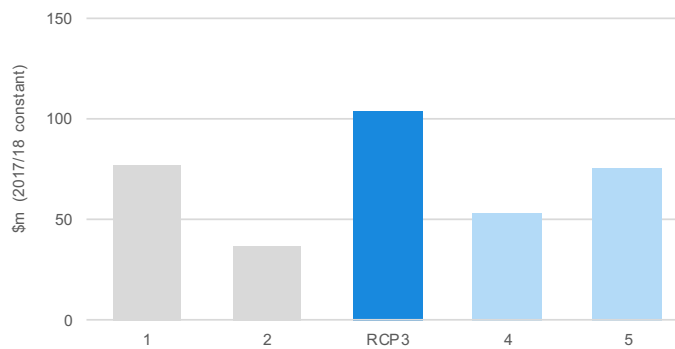


Figure 42: Historical and forecast renewal base capex on HVDC & Reactive Assets

Figure 43 below shows historical and forecast expenditure for each of the asset groupings that make up the HVDC and Reactive asset category.

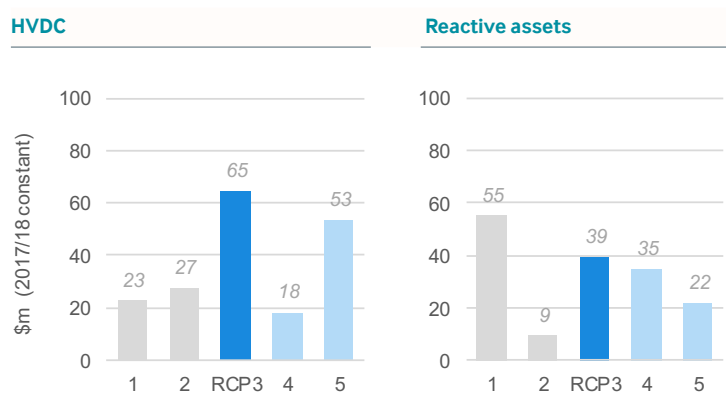


Figure 43: Historical and forecast HVDC and Reactive renewal capex

In summary:

- *Reactive Assets* – our expenditure requirement for RCP3 is \$39 million, which is four times the RCP2 expenditure of \$9 million.
- *HVDC* – our expenditure requirement for RCP3 is \$65 million, which is over twice the RCP2 expenditure of \$27 million.

5.8 Buildings and Grounds

Our Buildings and Grounds comprises approximately 750 buildings across 200 sites, and includes buildings, National Grid Operating Centres, building services, site infrastructure, and fencing.

Our buildings and grounds assets provide accommodation, services, and physical security for critical grid equipment and systems. Our objective is to ensure substation primary and secondary network assets are properly secured against physical and environmental risks, at least whole-of-life costs.

Figure 44 below shows compares the Buildings and Grounds RCP3 renewal forecast to RCP2 expenditure.

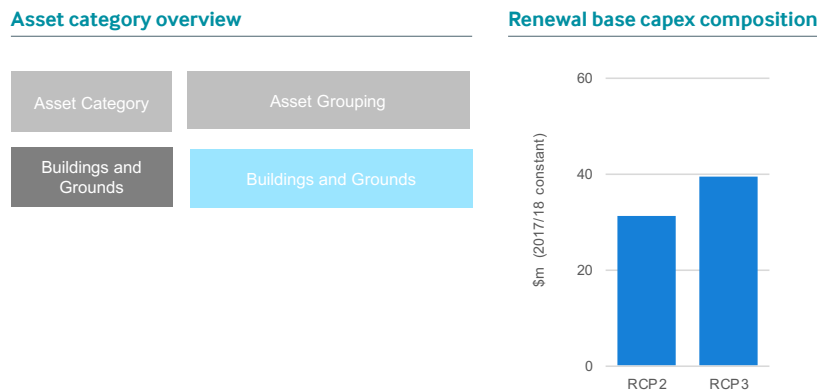


Figure 44: Overview of asset classes in the Buildings and Grounds asset category

Proposed Buildings and Grounds renewal base capex is higher than during RCP2.



Figure 45: Example of Buildings and Grounds issue: deteriorating mesh

Below we summarise the asset management and forecasting approach for our Buildings and Grounds assets.



For further information on our Buildings and Grounds refer to the following section in the 2018 AMP: Asset Class Plan – Buildings and Grounds (section 4.4.3).

5.8.1 Buildings and Grounds

Asset management approach

The key components of our asset management approach are:

- condition-based replacement of major asset types (based on factors such as corrosion zone and building function), and
- maintaining assets to ensure ongoing acceptable performance in safety and reliability, and to extend their life where appropriate

RCP3 work priorities

RCP3 priorities will be fencing, switchyard metalling and replacing/refurbishing roofs, and the start of the replacement of cable trench lids and underground infrastructure. Our forecasts also include relevant costs for asbestos management.

Earthquake-strengthening investigations will be undertaken on buildings (especially those constructed or reinforced in the 1990s) to assess what works are required.

Renewal drivers

The primary driver of the Buildings and Grounds renewal forecast is asset health.⁶⁷

5.8.2 Buildings and Grounds renewal capex forecast

Figure 46 below sets out the RCP3 Buildings and Grounds renewal forecast in the context of RCP1 and RCP2. To provide broader context of the longer-term needs of the grid it also includes the outlook up to RCP5.

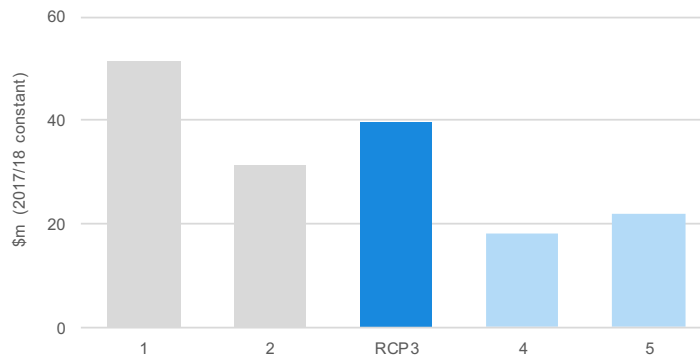


Figure 46: Historical and forecast renewal capex on Buildings and Grounds

For Buildings and Grounds, our expenditure requirement for RCP3 is \$39 million, which is 26 percent higher than our RCP2 expenditure of \$31 million.

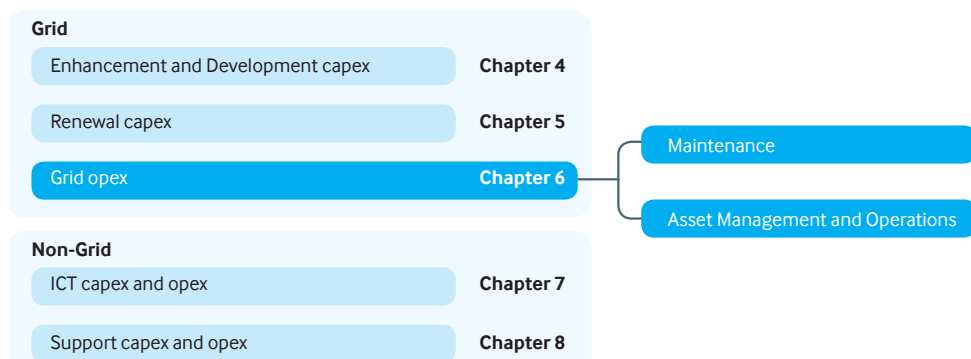
⁶⁷ Work is prioritised based on overall site criticality.



Chapter 6

Grid opex

This section provides an overview of our grid opex proposal for RCP3. The figure below shows the expenditure groups discussed within this section.



Grid opex encompasses Maintenance opex, and Asset Management and Operations opex.

Section 6.1 covers Maintenance. Section 6.2 covers Asset Management and Operations.

6.1 Maintenance

In this section we provide an overview of our maintenance approach and forecasts. This section is structured as follows:

- Section 6.1.1 to 6.1.4 summarises the four types of maintenance, provides context for our maintenance forecast, summarises our forecast approach, and sets out the adjustments applied to our forecast,
- Section 6.1.5 presents the RCP3 forecast in the context of RCP2,
- Section 6.1.6 is a discussion of how we go about assessing the appropriateness of the base year,
- Section 6.1.7 provides an overview of Predictive Maintenance,
- Section 6.1.8 provides an overview of Preventive Maintenance,
- Section 6.1.9 provides an overview Corrective Maintenance,
- Section 6.1.10 provides an overview Proactive Maintenance, and
- Section 6.1.11 presents our Maintenance opex forecasts.

We maintain the grid to meet network, operational, and security requirements, whilst considering safety, statutory compliance, sustainable operations, and overall cost.

We maintain our assets throughout the asset lifecycle to ensure that they remain fit for purpose, enabling them to operate safely and effectively at their designed capacity and performance over their full, reasonably anticipated lives. The maintenance process continues until assets are replaced or removed from service. The maintenance approach will evolve as the condition, performance, or functional requirements of the assets change over time.

We undertake maintenance to prevent faults and failure, to maintain functionality to provide proposed service levels and to extend the life of our assets so we can defer capex.

6.1.1 Maintenance types

In our asset management system, we distinguish between four types of maintenance work, based on how the work is initiated.

Maintenance type	Scope
Preventive	Routine servicing or inspections to prevent failure or understand asset condition.
Predictive	Maintenance performed based on known equipment condition before its condition deteriorates into an unsatisfactory state (e.g. outside service specification). Unlike corrective maintenance, this work occurs prior to failure
Corrective	Fault response or maintenance work undertaken on equipment or systems to return it from an unsatisfactory or failed condition back to a serviceable condition (e.g. within specification).
Proactive	Activities driven by either tactical or strategic reliability analysis

Table 29: Definition of maintenance types

When previously presenting maintenance opex information to our stakeholders, we provided information at a disaggregated level. For RCP3, starting with our July 2018 customer consultation paper, we aligned the way we categorise expenditure with our maintenance definitions.⁶⁸

Our new classification makes it easier to explain broad trends in network maintenance. It is also consistent with our approach to forecasting, where we have adopted a base-step-trend approach for three of our maintenance opex categories.

6.1.2 Evolution of our maintenance approach

Our long-term goal is to proactively maintain our assets using a risk-based approach to maintenance, which considers factors such as current asset condition, historical reliability, and asset criticality. The evolution of our maintenance approach began in RCP1 and will continue into RCP3 and beyond.

RCP1

In RCP1 we followed a predominantly time-based approach to maintenance. Most maintenance work was preventive, with reactive management of defects and failures. RCP1 focussed on developing a solid foundation for future maintenance work.

RCP2

In RCP2 we began implementing risk-based maintenance strategies based on failure modes for many of our asset types. However, in our view, time-based preventive maintenance is the preferred approach for some asset types such as power transformers and circuit breakers.

We also reviewed the scope and frequency of time-based preventive work for assets as appropriate. Other key initiatives included identifying a prioritised list of assets we intend to transition to a risk-based approach.

RCP3

Our intention during RCP3 is to build on the work of RCP2 by continuing to roll out reliability informed maintenance, increasing the proportion of work we carry out proactively, and increasing the use of condition-based predictive maintenance.

⁶⁸ These changes were agreed with the Commerce Commission when developing the regulatory templates setting out the quantitative and qualitative information we are required to provide in our RCP3 proposal.

There will also be a need for additional predictive maintenance activities during RCP3, including:

- investment to better understand asset health and to identify critical asset data,
- additional maintenance of conductor hardware, and
- investment in proactive activities to better manage health and safety hazards associated with our assets.

6.1.3 Forecast approaches

Table 30 summarises the forecast approaches we use for the four types of maintenance.

Maintenance approach	Forecast approach
Preventive Maintenance	Bottom-up
Predictive Maintenance	Base-step-trend
Corrective Maintenance	Base-step-trend
Proactive Maintenance	Base-step-trend

Table 30: Forecast approach by maintenance type

6.1.4 Adjustments to expenditure forecast

Our RCP3 deliverability review identified that, over a typical period, there are likely to be constraints or specific circumstances in delivery that mean we cannot complete all specified maintenance work. Accordingly, we have applied a deliverability adjustment to our RCP3 maintenance forecast.

As we plan RCP3 maintenance works, we intend to deliver our work based on identified need. We will manage constraints during the period as required, to minimise impact on overall risk levels.

We intend to rely on a combination of the following approaches to deliver the full scope of the required maintenance work:

- reinvesting efficiency gains achieved during the period to deliver the required scope of work, and
- re-prioritising the planned work to balance risk and affordability, based on risk and criticality considerations.

Table 31 below shows the deliverability adjustment.

Adjustment	\$m (real)
Deliverability adjustment	-29

Table 31: Deliverability adjustment applied to overall maintenance forecast

An implication of applying a deliverability adjustment to the overall maintenance forecast is that the expenditure forecast for each of the four maintenance expenditure categories presented in this proposal are pre-adjustment figures.⁶⁹ As such, the stated expenditure amounts and trends need to be interpreted accordingly.

In the remainder of this section we provide an overview of our maintenance forecast.



For further information on maintenance refer to section 4.2 in the 2018 Asset Management Plan.

⁶⁹ The expenditure figures in RT01 Expenditure Forecasts are pre-adjustment. The deliverability adjustment is identified as a separate item.

6.1.5 RCP3 forecast in the context of RCP2

Figure 47 below shows the four maintenance opex portfolios and their contribution to overall RCP2 and RCP3 expenditure. The RCP3 forecast is pre-deliverability adjustment. Identified programmes are highlighted in darker blue.

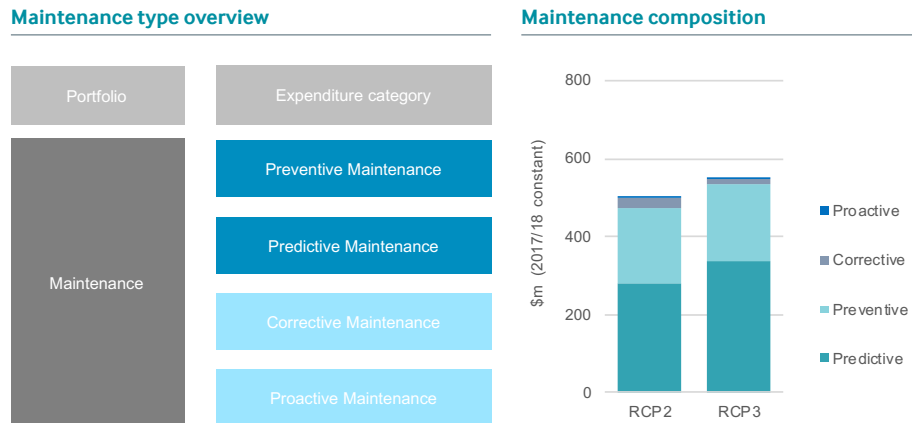


Figure 47: Overview of maintenance

Our total maintenance expenditure requirement for RCP3 is \$523 million. This compares to approximately \$502 million during RCP2.

Of that total, predictive and preventive maintenance make up most of the maintenance forecast.

6.1.6 Assessing the appropriateness of the base year

A key requirement of the base-step-trend forecasting framework is that the base amount included in the forecast must be representative of the future expenditure requirement and is cost efficient.

Based on our assessment of the base year we consider that overall 2017/18 is an appropriate base year for forecasting RCP3 maintenance opex requirements.

Maintenance overall

We have assessed the efficiency of the base year 2017/18 of maintenance overall and for each maintenance type, with reference to historical expenditure. Assessing the appropriateness of maintenance overall is important due to the linkages between the four types of maintenance.

Figure 48 below shows historical maintenance opex. Since 2010/11 our maintenance opex has trended downwards.

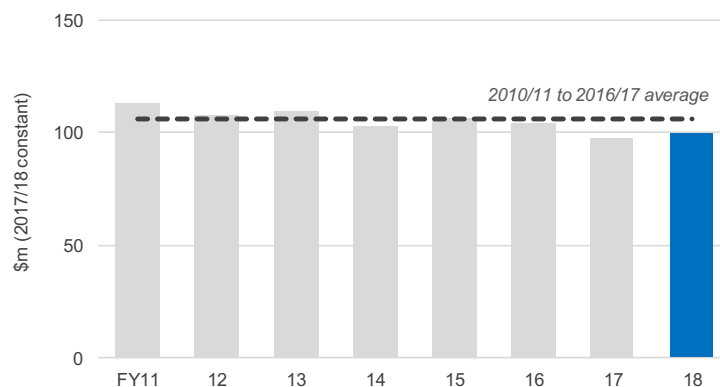


Figure 48: Historical trend in overall maintenance opex

Figure 48 also shows that 2017/18 is lower than average expenditure between 2010/11 to 2016/17. Part of this is due to efficiency improvements achieved over that period, such as preventive maintenance optimisation and reliability informed maintenance, and year-on-year fluctuations due to work scheduling.

We also note the cost benchmarking undertaken by the independent verifier, which noted that:

“...relative to the selected comparison networks, Transpower’s direct opex is in between ElectraNet and TasNetworks (\$1,300 per km below ElectraNet and \$1,700 above TasNetworks).”⁷⁰

This suggests that our current maintenance expenditure is comparable to relevant Australian comparators. Note that direct opex in the independent verification report has a similar scope as our maintenance opex.

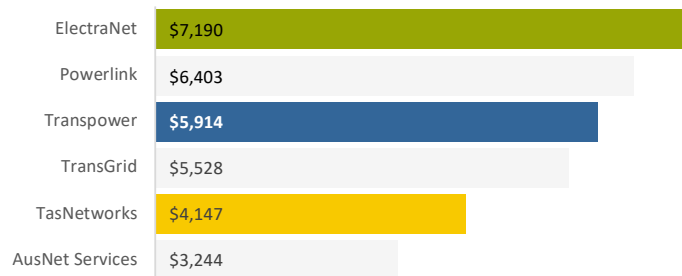


Figure 49: Direct opex per km (2013-17 average)

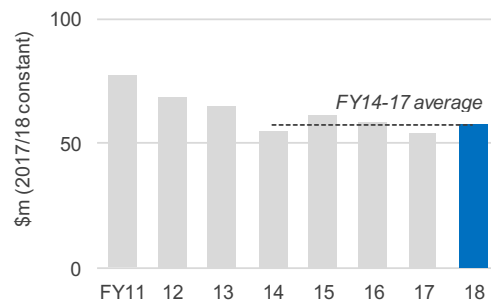
The independent verifier urged caution in drawing firm conclusions from the benchmarking results due to the very small sample size. However, they consider that the results provide insight about the way Transpower is investing in and operating its network:

“This result could indicate that capex-opex trade-offs are an important component of Transpower’s investment governance process, with whole-of-life cost considerations often resulting in opex to extend life as the preferred and most economic option in lieu of capital investment.”⁷¹

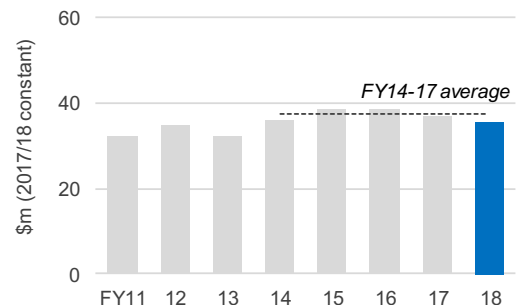
Base year assessment by maintenance type

The charts below summarise our historical trend analysis for predictive, corrective, proactive, and preventive maintenance.

Predictive Maintenance



Preventive Maintenance



⁷⁰ Synergies Economic Consulting (2018). *Independent Verification Report -Transpower’s RCP3 Expenditure Proposal (2020-25)*. Chapter 3 (Economic benchmarking performance), Section 3.3.2, page 69.

⁷¹ Synergies Economic Consulting (2018). *Independent Verification Report -Transpower’s RCP3 Expenditure Proposal (2020-25)*. Chapter 3 (Economic benchmarking performance), Section 3.4, page 76.

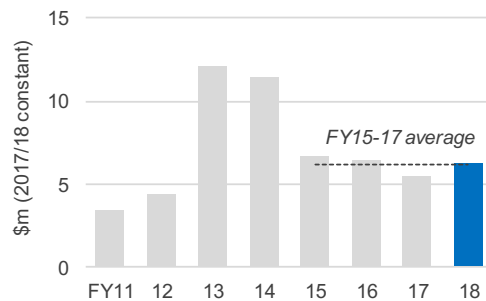
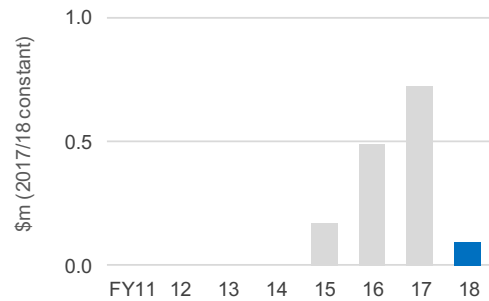
Corrective Maintenance**Proactive Maintenance**

Figure 50: Trends in historical maintenance opex

The trend analysis by maintenance type confirms that, overall, 2017/18 is an appropriate base year. Due to the nature of corrective maintenance (i.e. typically reactive in response to external events), and the emerging nature of proactive maintenance as a discipline and expenditure category, we have adjusted the base year for these two expenditure categories as explained below.

6.1.7 Predictive Maintenance

Predictive maintenance addresses defects identified through the preventive maintenance and asset feedback processes, i.e. in response to condition-based inspection and monitoring programmes. Predictive work is carried out prior to failure or before asset condition deteriorates to an unsatisfactory state.

Drivers

The main drivers of predictive maintenance activities are:

- asset condition,
- asset criticality, and
- compliance with safety regulations.

Work activities

The main Predictive Maintenance activities are:

- *Rectifying defects* – repairing assets or replacing minor components to correct defects, address wear and tear or repair damage, or to return the asset to a condition that complies with a defined standard.
- *Targeted condition monitoring* – using specialised test equipment to validate condition or predict the likelihood of failure.
- *Vegetation control* – cutting and/or trimming vegetation to maintain electrical clearance standards.

Work volumes

We typically address around 15,000 defects per year. While in any given year more defects than this might be identified, maintenance intervention timing is optimised.

Our relationship with our service providers has evolved during RCP2 and we have developed better understanding of each other's business models. This has resulted in many additional predictive maintenance work records being added to our asset management system. Previously, these records were retained by service providers. We are assessing these additional predictive maintenance work records to determine the appropriate action.

Predictive Maintenance forecast summary

Our RCP3 pre-adjustment expenditure requirement for predictive maintenance is \$335.9 million. The base-step-trend forecast components are summarised in the table 32 below.

Component	Description	RCP3 (\$m)
Base amount	We used 2017/18 as base year (\$57.4 m), which is broadly in line with historical expenditure. We identified a non-recurring amount of \$3.7 m relating to a one-off provision for aerial lines survey. The resulting base amount is \$53.7 m.	268.5
Steps	We have identified the need for a range of additional predictive maintenance activities during RCP3. Refer to table 30 below for details.	67.4
Trends	We have applied a deliverability adjustment to the overall maintenance forecast.	0
Total		335.9

Table 32: Summary of Predictive Maintenance forecast components

In addition to the recurring work reflected in our base amount, we have identified the need for a range of additional predictive maintenance work programmes during RCP3. The build-up of the additional requirement of \$67.4 million is summarised in the following tables.

Table 33 provides an overview of general predictive maintenance step changes of \$60.1 million.

Step change	Description	RCP3 total (\$m)
RCP4 and RCP5 programme support	Testing and inspection regime for transmission lines, particularly conductors. This condition data collection is additional to that collected for ongoing asset health purposes.	18.5
Asset health	An increasing number of assets are nearing the condition at which maintenance intervention is required.	10.4
Maintenance of conductor hardware	Programme to address condition issues with swinging gear, such as dampers and spacers.	9.5
Attachment points	Condition based replacement of conductor attachment points to address poor condition. This previously deferred maintenance is a prerequisite for upcoming conductor renewal.	8.9
Steel and bolt	Replacement of rusty steel and bolts on transmission towers. This work is deferred maintenance to be progressed following an in-depth strategy review which has been reflected in our standard maintenance procedures.	2.9
Earth potential rise	Work needed to manage health and safety risk at transmission towers in urban locations.	2.8
Maintenance of substation facilities	Additional maintenance of substations facilities, e.g. switchyard gravel and fencing.	2.6
Deferred maintenance	Programmes to deal with corrosion issues at substations.	2.5
Health and Safety asbestos procedures	Additional cost associated with working in an asbestos environment.	2.0
Total		60.1

Table 33: RCP3 Predictive Maintenance step changes

To some extent, maintenance opex can be used instead of renewal capex. In assessing the whole-of-life cost of potential intervention, we identified several areas where maintenance is preferable to renewal capex.⁷²

We applied these capex/opex trade-offs, \$7.3 million in total, and included them as step changes in the predictive maintenance forecast. They are summarised in table 34 below.

⁷² The renewal capex forecast of the relevant assets has been appropriately reduced to reflect these trade-offs.

Step change	Description	RCP3 total (\$m)
Earth Switches and Disconnectors	It is more cost effective to upskill maintenance staff and maintain earth switches (maintenance cost increase) than to replace those switches (involving capex).	3.0
Auckland	Some assets are nearing end-of-life. Because of potential near-term decommissioning and re-locating of lines (including towers), it is more cost effective to maintain these assets (including painting), rather than renew them.	2.3
Paint	As we complete renewal of transmission lines, painting within the minimum approach distance (MAD) zone will be completed during opportunistic outages on key structures (strains, angles etc). Where these are not associated with a project the costs will be against opex.	2.0
Total		7.3

Table 34: Predictive maintenance step changes - capex/opex trade-offs

In relation to additional predictive maintenance work records (discussed above), our RCP3 forecast assumes that no additional expenditure will be required to address these extra records. We have assumed that the additional maintenance work will be offset by better targeting of our work using our new nationwide, risk-based defect prioritisation process.

During RCP2, more stringent health and safety compliance requirements have driven up the cost of undertaking predictive maintenance work.⁷³ Our forecast does not allow for any additional health and safety compliance related cost increases above 2017/18 levels. We have assumed that any cost increases resulting from the above can be absorbed by reinvesting expected efficiencies gains from enhanced work management.

6.1.8 Preventive Maintenance

Preventive maintenance consists predominantly of delivering our time-based maintenance schedules. This work enables us to understand the condition of our assets, identify defects, undertake small servicing jobs to maintain assets, and to meet statutory and compliance requirements.

Preventive maintenance is our most regular asset intervention and is a key source of effective feedback to the overall asset management system.

Drivers

The main drivers of preventive maintenance activities are:

- asset specific characteristics including age, diversity of types, and manufacturer,
- network risk and criticality, and
- compliance with safety and other regulations.

⁷³ Examples include the requirement to use only certain elevated work platforms and new Minor Works Management processes our services providers need to follow to meet new safety rules.

Work activities

The main preventive maintenance activities are:

- *Inspections* – non-intrusive checks, patrols and functional testing to confirm safety and integrity of assets, check continued fitness for service, and identify follow-up work.
- *Condition assessments and condition monitoring* – periodic measurement activities performed to monitor asset condition and to provide systematic data for analysis.
- *Servicing* – routine tasks performed on the asset to ensure that its condition remains at an acceptable level.

Work volumes

In a typical year we undertake approximately 26,000 preventive maintenance jobs with some year-to-year variation due to the periodic nature of the work. For example, some tasks are only repeated every 4 or 8 years. Figure 51 below shows the number of maintenance tasks historically undertaken and scheduled up to 2024/25.

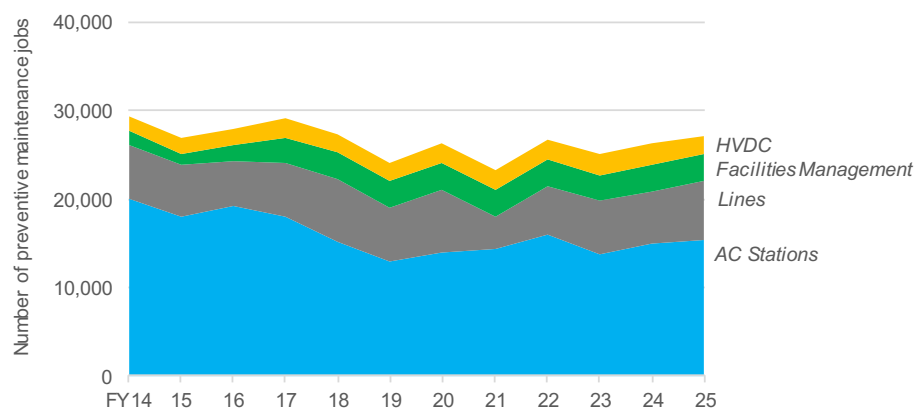


Figure 51: Preventive maintenance work volumes

Forecasting approach

Reflecting the need to incorporate the fluctuating volume and type of preventive maintenance tasks in our forecast, we have used a bottom-up approach to forecast preventive maintenance expenditure. Our asset management system (Maximo) contains annual work volumes for each job type, specified according to our standard maintenance procedure. We used these scheduled work tasks to forecast RCP3 work quantities. To obtain the expenditure forecast, we multiply the work volumes by the relevant unit rates.⁷⁴

In addition to field-work, the preventive maintenance forecast includes non-field work components. The components are Management Services Fee, Grid Skills, Utilities, and Other Maintenance Services. The forecast for these non-field work cost components is based on 2017/18 expenditure.

⁷⁴ The unit rates are based on those currently agreed with our service providers.

Preventive Maintenance forecast summary

Table 35 below summarises our preventive maintenance bottom-up forecast. Our RCP3 requirement for preventive maintenance is \$198.8 million (pre-deliverability adjustment).

Component	Description	RCP3 (\$m)
Field work	Preventive maintenance field work	127.0
Management Services Fee	Service providers’ back-office effort (covered by maintenance contracts)	44.6
Grid Skills	Training costs associated with having a competent technical work force.	17.7
Other Maintenance Services	Costs related to service providers back office work (not covered by maintenance contracts)	6.8
Utilities	Electricity and other utility costs incurred at substations.	2.7
Total		198.8

Table 35: Summary of Preventive Maintenance forecast components

Figure 52 below illustrates the forecast composition by comparing RCP3 average expenditure to that of 2017/18.

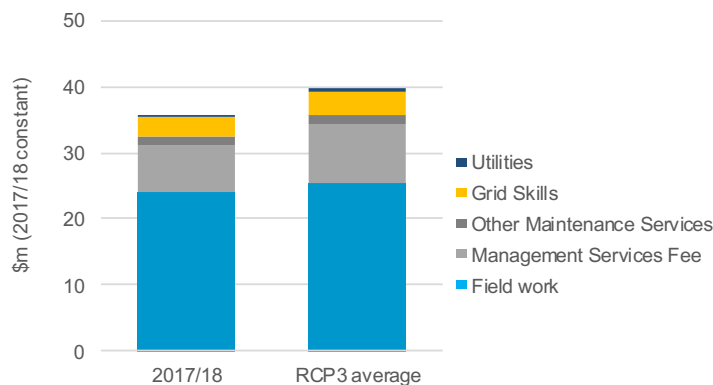


Figure 52: Composition of predictive maintenance forecast

6.1.9 Corrective Maintenance

Corrective maintenance involves fault response activities or maintenance work undertaken on equipment to return it from an unsatisfactory or failed condition back to a serviceable condition.

Corrective maintenance restores an asset to service, makes it safe or secure, or prevents an imminent event that will likely cause damage, degradation, or an operational failure. Such work is usually identified because of a fault or during inspections.

Drivers

The key drivers of corrective maintenance are:

- safety, and
- reliability.

Work activities

The main corrective maintenance activities are:

- *Fault restoration* – immediate response to repair a fault that has safety, environmental or operational implications.
- *Repairs* – work necessary to repair damage, or to prevent the failure or rapid degradation of equipment that is in an unsatisfactory condition.
- *Inspections* – information gathering that is not directly related to the fault restoration activity itself.

Work volumes

The volume of corrective work undertaken depends on the number of faults and/or safety critical events that require attention. Corrective maintenance is safety critical and therefore mandatory.

Work volumes depend on the number and severity of events that require corrective maintenance and may vary significantly from year-to-year.

Corrective Maintenance forecast summary

Our RCP3 pre-adjusted expenditure requirement for corrective maintenance is \$15 million. The base-step-trend forecast components are summarised in table 36 below.

Component	Description	RCP3 (\$m)
Base amount	We used 2017/18 as base year (\$6.2 m). While being broadly in line with historical expenditure, we are planning a range of asset reliability improvements. Accordingly, we have adjusted our base year (-\$3.2 m), resulting in a base amount of \$3 m.	15
Steps	We have not identified any step changes	0
Trends	We have not identified any step changes	0
Total		15

Table 36: Summary of Corrective Maintenance forecast components

6.1.10 Proactive Maintenance

Proactive maintenance is improvement work initiated by formal analysis and investigation by the engineering or reliability teams. It is used to prevent the failure of equipment in the future by determining potential root causes of failure, and dealing with those issues before problems arise.

Drivers

The key drivers of proactive maintenance are reliability or cost improvements.

Work activities

The main proactive maintenance work activities are:

- *Special inspection* – special reliability engineering inspections to further determine fault causes or validate findings.
- *Reliability driven corrective work* – improvement modifications, design changes, or adjustments undertaken as scheduled activities that are planned and scheduled in advance to address reliability concerns.
- *Condition monitoring* – one-off condition monitoring using specialised test equipment to further determine fault causes or to validate findings for root causes analysis or reliability engineering purposes.

Work volumes

Current work volumes categorised as proactive maintenance are low. The process for categorising work as proactive maintenance is not yet well established, and this work has generally been categorised as predictive maintenance in the past.⁷⁵ As our categorisation processes mature, we expect proactive maintenance expenditure to increase, with predictive work reducing accordingly.

Proactive Maintenance forecast summary

Our RCP3 requirement for proactive maintenance is \$2.5 million (pre-deliverability adjustment). The base-step-trend forecast components are summarised in table 37 below.

Component	Description	RCP3 (\$m)
Base amount	We used 2017/18 as base year (\$0.1 m). This is atypically low compared to historical expenditure and reflects work priorities specific to 2017/18. We have applied an adjustment of \$0.4 m, bringing the base amount to \$0.5 m in line with historical expenditure.	2.5
Steps	We have not identified any step changes	0
Trends	We have not identified any step changes	0
Total		2.5

Table 37: Summary of Proactive Maintenance forecast components

6.1.11 Maintenance opex forecast

Figure 53 sets out our annual forecast maintenance opex for RCP3 in the context of RCP1 and RCP2 expenditure. For further context of the longer-term needs, the right panel also shows the outlook up to RCP5.

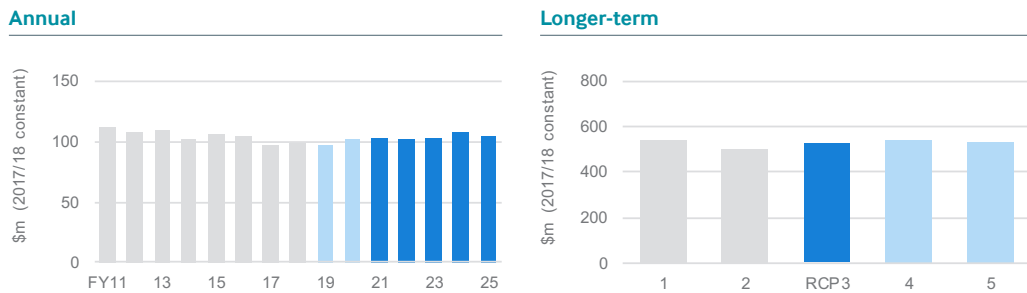


Figure 53: Historical and forecast maintenance opex

Our total maintenance expenditure requirement for RCP3 is \$523 million. This compares to a requirement of approximately \$502 million during RCP2. This increase is mainly driven by the need for additional predictive maintenance.

Figure 54 below shows our historical and forecast maintenance expenditure for each maintenance type. The figures are pre-deliverability adjustment and hence are not directly comparable to the overall maintenance forecast presented above.

⁷⁵ Usually these are delivered as so-called 'maintenance projects', which are a sub-set of predictive maintenance.

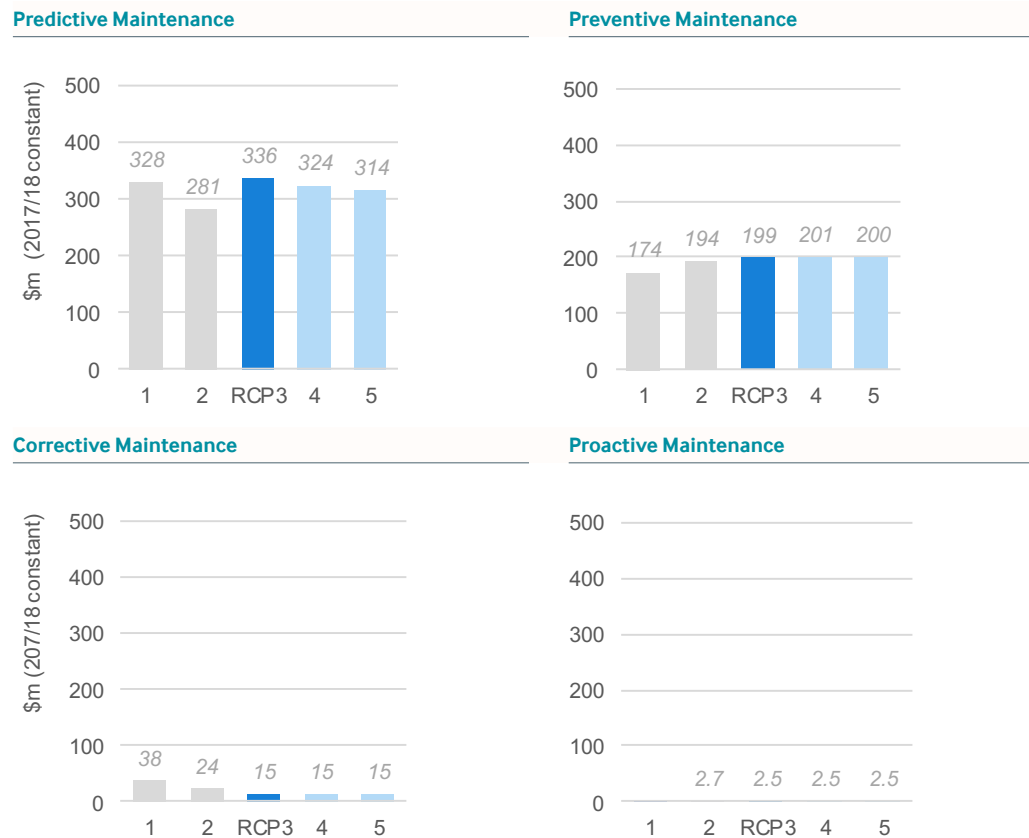


Figure 54: Historical and forecast maintenance opex by type

In summary:

- *Predictive Maintenance* – our expenditure requirement during RCP3 is \$336 million, compared to \$281 million during RCP2.
- *Preventive Maintenance* – our expenditure requirement during RCP3 is \$199 million, compared to \$194 million during RCP2
- *Corrective Maintenance* – our expenditure requirement during RCP3 is \$15 million, compared to \$24 million during RCP2.
- *Proactive Maintenance* – our expenditure requirement during RCP3 is \$2.5 million, compared to \$2.7 million during RCP2.

6.2 Asset Management and Operations

Asset Management and Operations primarily encompasses the staff and consultancy costs associated with work activities in our grid divisions, including strategic and tactical asset planning, and grid project management.⁷⁶

This portfolio includes the cost of grid investigations into potential improvements to the grid or business processes.

This portfolio includes the ancillary services of black start, over frequency reserves and reserves event charges.⁷⁷

⁷⁶ Asset Management and Operations is a new portfolio for RCP3. In RCP2 these costs were previously included as part of a broader category called 'Departmental', which also included Business Support opex.

⁷⁷ Black start is the first step in the process of island wide power restoration. Over frequency reserves are provided by generating units that can be armed when required and automatically disconnected from the power system due to sudden rise in system frequency.

Work in this portfolio includes the delivery of capital projects. The costs relating to capital works, for example project manager salaries, are capitalised in accordance with our capitalisation methodology. This means the costs in this portfolio only relate to operational expenditure.

Work in the Asset Management and Operations expenditure category enables all work on the grid. As explained below, the key focus areas adapt over time according to grid need, for example, delivering major capital projects during RCP1 and delivering asset management maturity improvement during RCP2.

6.2.1 Work activities

The key Asset Management and Operations activities are:

- long-term strategic planning for network assets while providing the required service levels,
- tactical planning to develop solutions to maintain and enhance the asset base in line with the long-term development strategies,
- programming and scheduling of works based on the portfolio plans developed in the decision framework,
- safe and efficient delivery of project-based enhancements, refurbishments and renewals,
- interfacing with service providers for scheduling and efficient delivery of maintenance programmes, and
- efficient day-to-day grid operation and real-time management of operating centres.

6.2.2 Work priorities during RCP1, RCP2 and RCP3

While the range of activities in this portfolio for RCP3 is similar to those in RCP1 and RCP2, the focus of activities is evolving.

During RCP1 we delivered large capital projects. We also insourced responsibility for a range of operational control activities, which up to then were carried out by service providers.

RCP2 introduced new asset management tools and processes, and our focus shifted from delivering projects to optimising our asset management processes. This change meant that an increasing proportion of work involved operational expenditure rather than capital expenditure (see also discussion below).

During RCP3:

- We will continue to embed and evolve our asset management tools and processes to improve our asset management capability, to improve cost effectiveness and efficiency. The overall effort in this area is expected to reduce in RCP3 compared to RCP2.
- We expect to increase the number of strategic investigations and expect them to become increasingly complex. The focus on strategic asset management will ensure we can respond in a timely manner to the changing energy futures set out in Transmission Tomorrow and Te Mauri Hiko. The strategic investigations are required partly in response to our changing external environment, and partly because our improved asset management capability will be directed towards longer-term asset management challenges such as Auckland Strategy work, reconductoring and tower painting.
- We will also require an increase in pre-capex investigations to deliver the larger renewal capex programmes from RCP4 onwards.

While the mix of activities in this portfolio is expected to change, we expect the overall volume of work (and hence expenditure) during RCP3 to be similar to our current volume of work.

6.2.3 RCP3 forecast in the context of RCP2

Figure 55 below compares our Asset management and Operations opex during RCP3 to that of RCP2.

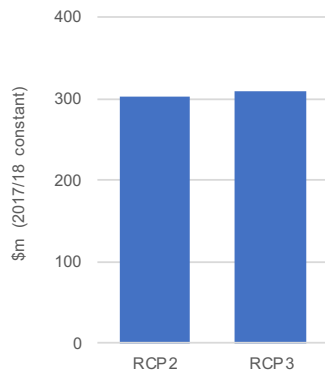


Figure 55: Comparing RCP2 and RCP3 Asset Management and Operations opex

Our Asset Management and Operations opex requirement for RCP3 of \$310 million is in line with RCP2 expenditure of \$303 million.

Below we provide further context for our forecast assumptions.

6.2.4 Assessing the appropriateness of the base year

A key requirement of the base-step-trend forecasting framework is that the base amount included in the forecast must be representative of the future expenditure requirement and is cost efficient.

Based on our assessment of the base year we consider that overall 2017/18 is an appropriate base year for forecasting RCP3 Asset Management and Operations opex requirements.

We have assessed the efficiency of the base year 2017/18 with reference to historical expenditure. Figure 56 below shows historical Asset Management and Operations opex.

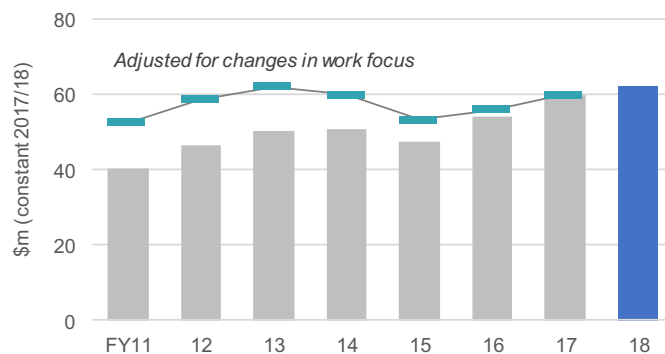


Figure 56: Trends in historical Asset Management and Operations opex

Asset Management and Operations opex has steadily increased from FY10/11 onwards. However, during the period the work focus changed, with earlier years focused on the delivery of several large projects.

The increase in Asset Management and Operations opex from 2010/11 to 2012/13 reflects the delivery of several large projects, resuming operational control of a number of activities, preparing the business for meeting its RCP2 commitments, and introducing a range of new asset management processes and tools.

The trend in historical expenditure on its own can therefore not be used meaningfully to assess the appropriateness of the base year because the amount of work in this portfolio that is capitalised has changed over the period. To enable a trend analysis, the figure above also shows an expenditure line adjusted for the changes in work focus, consistent with the 2017/18 capitalisation rate.

Noting that our forecast does not project any increases in FTEs during RCP3, the independent verifier undertook high level benchmarking with Australian Transmission businesses of FTEs normalised by network overhead personnel costs (which is broadly comparable to our Asset Management and Operations portfolio). We have reproduced the figure 57 below:

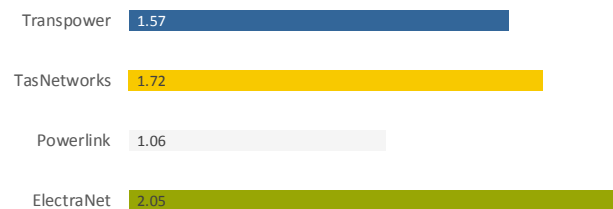


Figure 57: Independent verifier's comparison of network overhead personnel per \$ million of opex (\$2017/18)

The figure indicates that our FTE: opex ratio is comparable to a relevant peer organisation. The independent verifier concludes that the figure:

*"[s]hows that Transpower is comparable with TasNetworks, which has similar network characteristics as described in the benchmarking section 3 with regards boundary with electricity distribution, and who have a relatively small in-house workforce and therefore need to plan work for external service providers."*⁷⁸

Assessed against the adjusted trend line in figure 56 and with the independent verifier's benchmarking as context, we consider that 2017/18 expenditure of \$62.2 million is in line with previous years and therefore an appropriate starting point for the RCP3 forecast.

6.2.5 Asset Management and Operations forecast summary

Our RCP3 expenditure requirement for Asset Management and Operations is \$309.5 million. The forecast components are summarised below.

Component	Description	RCP3 (\$m)
Base amount	We used 2017/18 as base year (\$62.2 m). After adjusting for atypical amounts (+\$0.6 m), the base amount is \$62.9 m. The adjustments are: <ul style="list-style-type: none"> • Atypical vacancies (+\$0.1 m) • Investigations unusually low (+\$0.4 m) • Atypically low ancillary services cost (+\$0.1 m) 	314.3

⁷⁸ Synergies Economic Consulting (2018). Independent Verification Report -Transpower's RCP3 Expenditure Proposal (2020-25). Chapter 8 (Opex forecast verification), Section 8.6, page 334.

Component	Description	RCP3 (\$m)
Steps	As discussed above, while the mix of activities in this portfolio is expected to change, we expect an overall similar level of activity (and hence expenditure) during RCP3 as currently.	0
Trends	<p>We have allowed for the following four trend factors, which result in an overall adjustment of -\$4.8 m:</p> <p><i>Ancillary services</i></p> <ul style="list-style-type: none"> • Growth factor for increased cost in black start and over frequency services (+\$2.7 m) • Event charges (+\$0.6 m) <p><i>Ongoing productivity improvement</i></p> <ul style="list-style-type: none"> • We have applied productivity trend factor 0.2% (-\$3.1 m).⁷⁹ <p><i>Efficiency enabled by benefits driven ICT capex</i></p> <ul style="list-style-type: none"> • Our benefits driven ICT capex is expected to enable cost reductions in this portfolio (-\$5 m). 	-4.8
Total		309.5

Table 38: Summary of Asset Management and Operations forecast components

Asset Management and Operations forecast

Figure 58 below sets out our annual forecast Asset Management and Operations opex for RCP3 in the context of RCP1 and RCP2 expenditure. For further context of the longer-term needs, the right-hand panel also shows the outlook up to RCP5.

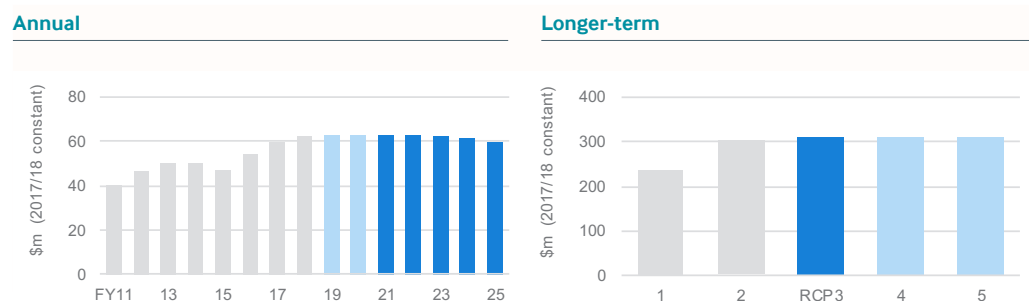


Figure 58: Historical and forecast Asset Management and Operations

Our RCP3 expenditure requirement of approximately \$310 million, compared to \$303 million during RCP2.

⁷⁹ This productivity factor is based on estimated historical improvements in the labour productivity of New Zealand’s professions, scientific and technical services sector. Source: Statistics New Zealand, Productivity Statistics: 1978-2017 – productivity by industry table: www.stats.govt.nz/information-releases/productivity-statistics-19782017



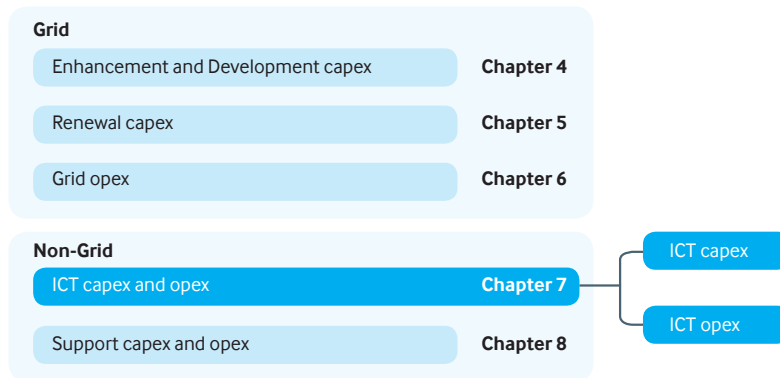
Chapter 7

ICT capex and opex

This chapter sets out our Information and Communications Technologies (ICT) capex and opex proposals for RCP3.

ICT capex and ICT opex forecasts are presented together because they are closely interrelated and have similar governance and cost drivers.

The figure below illustrates where the ICT capex and opex fit within the overall expenditure categories in our proposal.



The chapter is structured as follows:

- Section 7.1 provides an overview of ICT strategic goals, our investment focus, drivers, adjustments and forecast development,
- Section 7.2 summarises our ICT capex forecast, and
- Section 7.3 summarises our ICT opex forecast.



For further information on our ICT capex and opex forecasts, refer to the following sections in our 2018 Asset Management Plan

For summarised plans:

ICT capex (2.3.1)

ICT opex (2.3.2)

For ICT capex portfolio plans:

Portfolio plan overview (5.1)

Portfolio plan - Asset Management Systems (5.3)

Portfolio plan - Transmission systems (5.4)

Portfolio plan - Corporate systems (5.5)

Portfolio plan - Shared services (5.6)

Portfolio plan - Telecommunications, Network and Security systems (5.7)

7.1 Overview

Our ICT investment and operational activities support the infrastructure, server hardware and applications that interface with the grid and support our corporate processes and systems.

7.1.1 ICT strategic goals

Our ICT capex and opex RCP3 proposals focus on the delivery and development of organisational capability required to achieve our strategic objectives.

Our five ICT strategic goals are to:

- implement business focused solutions,
- ensure reliability and resilience,
- utilise strategic sourcing,
- apply excellence in information management, and
- ensure security.

7.1.2 Investment focus over RCP3

Our investment focus has shifted from building new capability to improving capabilities while ensuring continued support and maintenance of our existing systems. We will continue to adopt new technologies and innovation in response to industry trends where relevant to Transpower. Relevant industry trends include mobility, analytics, machine learning, virtual and artificial reality. As the pace of technology innovation continues, we will need to respond to rising demand for new services.

The themes for our ICT forecast are:

- prioritising business capabilities and outcomes required to support delivery of Transpower's objectives and the challenges presented in Te Mauri Hiko,
- standardising and integrating systems and data to further streamline our processes and reduce the need for investing in parallel systems,
- refreshing (to lifecycle) our key systems and infrastructure. As cloud-based services mature we will look to implement Software as a Service (SaaS) where appropriate,

- continuing to enhance infrastructure security, focussing on risk-based cyber security investments,
- focussing on reducing opex through infrastructure rationalisation, improving capacity planning and introducing open source technologies, and
- continuing to monitor technology trends and adopt where appropriate.

7.1.3 ICT investment and value drivers

ICT expenditure is driven by business requirements. We must be flexible, changing our ICT investment direction to support innovative and more digital capabilities and business models.

Our ICT investments use a balanced investment portfolio as we innovate and transform our functions to deliver long-term digital business outcomes.

For ICT planning we use a project classification framework helping us target an appropriate investment mix. Table 39 summarises this classification.

Project Type	Definition
Lifecycle	These projects are those where the asset capability is still required for business operation but the underlying asset, hardware or software is no longer vendor supported and the risk of operating out of support or the impact on operational costs are not acceptable.
Risk Mitigation	These projects implement controls identified by semi-quantitative risk assessment (SQRA) analysis, and lower Transpower's total annualised loss expectancy (ALE). The controls may either reduce the threat or minimise the impact of a risk.
Compliance	These are 'must do' projects required because of regulations, standards (major standards that Transpower elect to adopt or are prescribed) or legislation. This category includes social responsibility initiative-related projects.
Benefits Driven	These are benefits driven projects that provide operational savings, allow for capital deferral or improve stakeholder and customer relations.

Table 39: ICT project classification

7.1.4 Adjustments applied to expenditure forecast

We have applied a ICT capex deliverability adjustment, shown in the table below.

Adjustment	RCP3 (\$m)
Deliverability adjustment	- 5

Table 40: Deliverability adjustment applied to ICT capex

We have not applied any top-down adjustments to the ICT opex forecast.

7.1.5 Forecast approach

Table 41 sets out the ICT expenditure forecast approaches. ICT capex relies on a capability-based planning approach and considers industry trends. Cost estimation relies on bottom-up estimates. The ICT opex forecast relies on the base-step-trend forecasting approach.

Portfolio	Forecast approach
ICT capex	Capability based planning considering industry trends combined with bottom-up cost estimates
ICT opex	Base-step-trend

Table 41: ICT Forecasting approaches

7.2 ICT capex

We manage our ICT investments as five ICT capex portfolios:

- *IT Telecommunications, Network and Security Services* – encompasses the network and cyber security assets needed to deliver a secure, high capacity, national communications network. These assets also provide data communications connecting all our sites, as well as locations for providing corporate services, grid operations, critical switching, and grid protection.
- *Transmission Systems* – used to operate our assets to meet network, operational and asset performance requirements, taking account of asset reliability, cost, safety and environment. These systems allow us to effectively manage incidents and events as well as any follow-up analysis and actions. They are essential capabilities, allowing security of supply, proactive operational risk management and restoration of services after an incident.
- *Asset Management Systems* – support the physical assets, systems and processes required to provide transmission services. They support our high-level organisation policy, strategic plan and the daily activities of asset management.
- *ICT Shared Services* – provide enabling platforms for business solutions and development and oversight of corporate information management. The services include design, build and maintenance of core technologies comprising hardware, operating systems, middleware technologies, and our two data centres.
- *Corporate Systems* – support operation of our core day-to-day business functions, providing shared capabilities across all business teams.

To develop our ICT plan we:

- identified business outcomes and capability requirements for each portfolio,
- identified the lifecycle needs of existing systems,
- developed a ICT Roadmap using a bottom-up build approach,
- challenged the deliverability of the ICT Roadmap,⁸⁰ and
- ensured proposed benefits-driven ICT capex investments pass a rate of return threshold.

Figure 59 shows the five ICT capex portfolios and their contribution to overall RCP2 and RCP3 expenditure. Identified programmes are highlighted in dark blue.

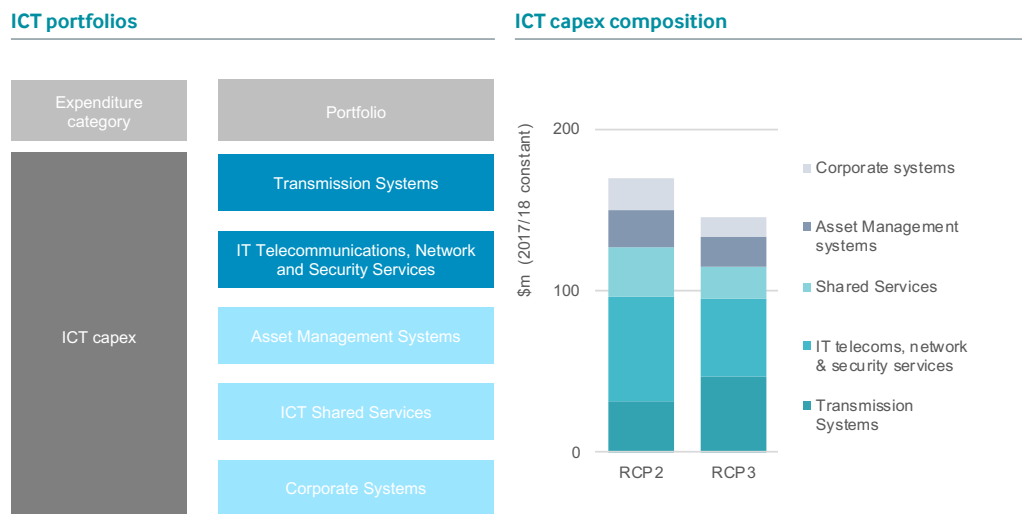


Figure 59: Overview of ICT capex portfolios

⁸⁰ The ICT roadmap provides an integrated picture of all the prioritised and accepted initiatives.

Our ICT capex requirement for RCP3 is lower than for RCP2, with reductions in all portfolios except for Transmission Systems.

Identified programmes in the ICT capex expenditure category are:

- *Transmission Systems* – this portfolio accounts for \$47 million (approximately 32 percent) of our RCP3 ICT capex requirement.
- *IT Telecommunications, Network and Security Services* – this portfolio accounts for \$49 million (approximately 33 percent) of our RCP3 ICT capex requirement.

7.2.1 Benefits driven ICT projects expected to drive efficiencies

In section 2.2.1 we explain we have undertaken a quantitative assessment of expected cost savings enabled by our benefits driven investments and reflected these in our expenditure forecasts (refer to section 3.4).

For context, our proposed RCP3 ICT capex targets an investment mix of approximately 75 percent lifecycle, risk mitigation and compliance projects, and 25 percent benefits driven projects. Figure 60 shows the ICT capex forecast by project type.

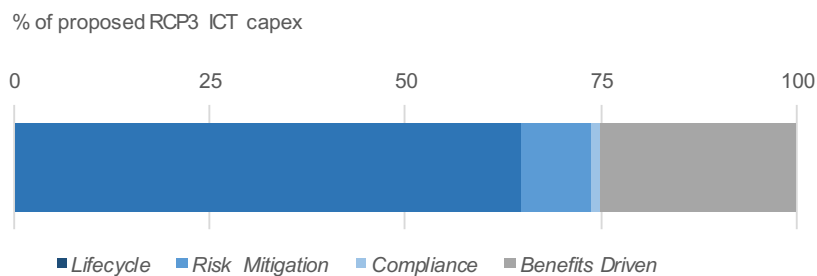


Figure 60: ICT capex forecast broken down by project type

In the following sections we summarise the key RCP3 investment focus for each ICT capex portfolio.

7.2.2 Transmission Systems

We plan to continue reducing SCADA/EMS upgrade costs and complexity. We will invest in standardising and integrating operational data, which will enable more sophisticated real-time grid monitoring, through situational intelligence and effective decision support.

We plan to streamline processes and tools, including outage planning and switch management. This will ensure we have a well-integrated, end-to-end solution to reduce operational risks and enable effective coordination between outage planning, grid and system operator activities.

7.2.3 IT Telecommunications, Network and Security Services

We will maintain service delivery levels through continued lifecycle management of our existing network assets and systems, while deferring any major TransGO asset reinvestment until RCP4.

Our business requirements increasingly demand more information from and remote access to our distributed network assets. Accordingly, we will increasingly focus our TransGO network to support and provide capacity for core and critical services. Non-core services, such as corporate data, will be transferred to leased third-party networks.

We will invest in new fibre assets, collaborating with key service providers, to offset ongoing operational costs and reduce overall long-term expenditure. We will continue our risk-based approach to managing cyber security investments, to maintain an acceptable security risk level.

7.2.4 Asset Management Systems

During RCP3 we will continue improving data integration between our systems, supporting improved information workflow and avoiding duplication of data.

We will invest in new platforms to replace end-of-life systems with modern solutions, to enhance functionality and support outcomes requiring more advanced automation. Enhanced functionalities will also improve our delivery capabilities.

7.2.5 ICT Shared Services

ICT Shared Services portfolio investments are predominantly risk-driven lifecycle changes to actively maintain our ICT assets to remain fit-for-purpose.

We plan to refresh our key systems reaching end-of-life, including security, infrastructure and platforms.

We will continue to evaluate, adopt and implement cloud-delivered infrastructure and platform services, where economically viable to do so. Further, we will change organisational behaviours to enable cross-functional team collaboration through, for example, DevOps and workflow automation.⁸¹

7.2.6 Corporate Systems

We will maintain existing systems through lifecycle refreshes and consider opportunities to use Software as a Service (SaaS) delivered services to minimise system customisation and enable capability improvements.

We will refresh platforms as they reach their end-of-life with solutions providing advanced automation and analytics functionality, to support continuous performance improvement.

7.2.7 ICT capex forecast

Figure 61 sets out our annual historical and forecast ICT capex for RCP3 and, for context, the RCP2 and RCP1 expenditure. For a broader context of longer-term needs, the right-hand panel shows the outlook to RCP5.

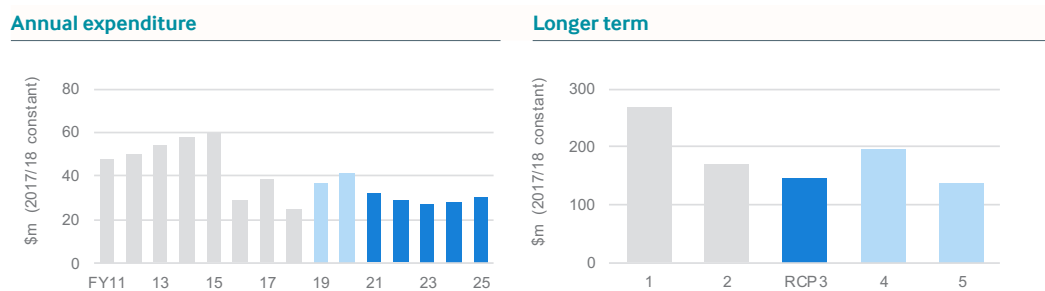


Figure 61: Historical and forecast ICT capex

Our forecast RCP3 ICT capex requirement of \$146 million is lower than the \$169 million for RCP2.

⁸¹ DevOps combines development and operations teams with a mix of philosophies, practices, and tools that increases an organisation's ability to deliver applications and services faster than traditional delivery models.

Figure 62 shows our historical and forecast ICT capex for each portfolio.



Figure 62: ICT capex by portfolio

Our RCP3 expenditure requirement for four out of five portfolios is lower than during RCP2, and is summarised below.

- *Transmission Services* – our RCP3 expenditure requirement is approximately \$47 million, compared to \$32 million during RCP2. We plan to increase investments supporting our transmission systems by replacing our outage switch management, outage planning and situational awareness systems. We have reviewed our development approach for our core SCADA/EMS systems, which looks to modularise and improve the efficiency and resilience of lifecycle replacement costs for this critical infrastructure.
- *IT Telecommunications, Network and Security Services* – planned RCP3 expenditure of approximately \$49 million compares with \$65 million during RCP2. We have deferred a major investment in the TransGO fibre network to RCP4. The RCP3 forecast reflects only lifecycle replacements of core network services that support our critical services. We will use other telco providers for corporate data traffic.
- *Asset Management Systems* – our RCP3 expenditure requirement is approximately \$19 million, compared to \$23 million during RCP2. The reduced expenditure reflects a focus on maintaining current systems.
- *ICT Shared Services* – our RCP3 expenditure requirement is approximately \$19 million, compared to \$31 million during RCP2. The reduced expenditure reflects a focus on maintaining current systems.
- *Corporate Systems* – our RCP3 expenditure requirement is approximately \$13 million, compared to \$19 million during RCP2. The reduced expenditure reflects a focus on maintaining current systems and improving business performance reporting and information management.

7.3 ICT opex

ICT opex covers the external operating costs of our ICT function and comprises six categories:

- *Outsourced Services* – costs of certain services outsourced to specialist providers.
- *Leases* – lease costs for ICT components that support core business functions, including fibre circuits and telecommunications capacity.⁸²
- *Licences* – costs of software and hardware licences.
- *Third Party Support and Maintenance* – costs relating to third-party delivered specialist outcomes, such as off-site backup of media, infrastructure support, and application support.
- *Investigations* – costs for pre-capital project option-exploration activities.
- *Communications and Control* – third-party costs to maintain the TransGO national network.⁸³

The operational expenditure related to our people (such as costs of staff, contractors, consultants and the overheads associated with these resources) is part of Business Support opex (refer to section 8.2).

Figure 63 shows the ICT opex portfolios and their contribution to overall RCP2 and RCP3 expenditure.

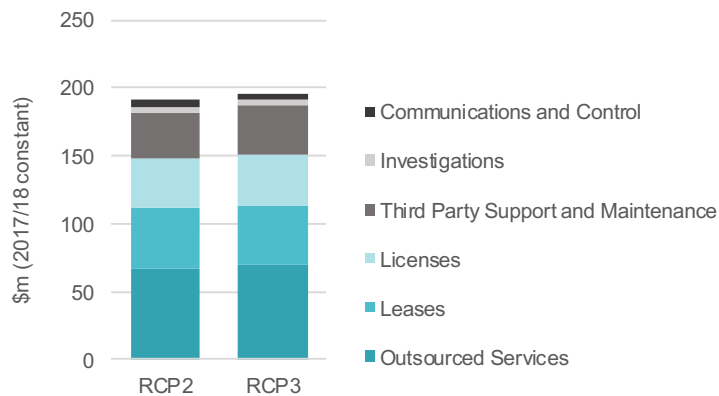


Figure 63: Comparing RCP2 and RCP3 ICT opex

Our ICT opex requirement for RCP3 of approximately \$196 million is similar to RCP2 expenditure of approximately \$192 million. The broad composition of ICT opex is not expected to change significantly during RCP3.

7.3.1 Assessing the appropriateness of the base year

A key requirement of the base-step-trend forecasting framework is that the base amount included in the forecast must be representative of the future expenditure requirement and is cost efficient.

We have assessed the efficiency of the base year 2017/18, with reference to historical expenditure and benchmarking undertaken by the independent verifier. We consider 2017/18 an appropriate base year to forecast our ICT opex expenditure requirement.

⁸² With the forthcoming introduction of IFRS 16 Leases on 1 July 2019, some of these leases will be capitalised and hence included as part of ICT capex. We will work with the Commission to ensure our allowance appropriately reflect the new accounting rule.

⁸³ The TransGO network is a high capacity, fibre optic national communications network that allows telecommunication between all our sites and locations that support grid operations, critical switching and the grid protection functions.

Figure 64 shows historical ICT opex. We have seen upwards pressure on opex arising from increased cyber security demands, growth in licence costs and the adoption of two enterprise-class data centres. Despite this upwards pressure, since 2014 our ICT opex has reduced by more than 10 percent, with reductions in the cost of leased telecommunications network services (a result of TransGO investments), insourcing of ICT functions (enterprise service bus development and support, network and security operations centres), adoption of cloud services, virtualisation and use of open-source software solutions.

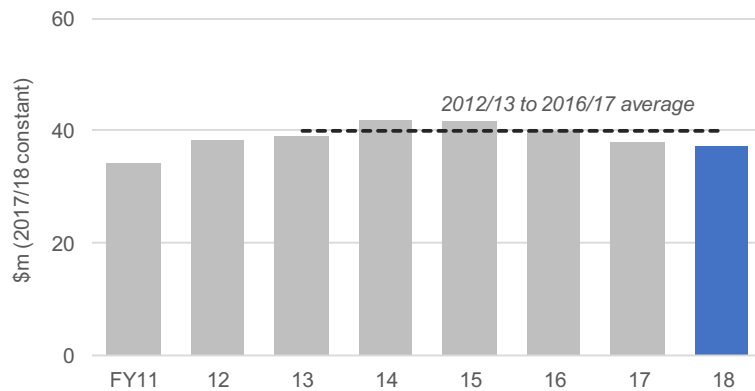


Figure 64: Historical trend in ICT opex

The above figure shows our selected base year FY17/18 is below the average expenditure between 2012/13 to 2016/17.

7.3.2 ICT opex forecast summary

The table below summarises our ICT opex.

Our RCP3 expenditure requirement is \$195.9 million. The base-step-trend forecast components are summarised below.

Component	Description	RCP3 (\$m)
Base amount	We used 2017/18 as base year (\$37.4 m). After adjusting for an atypical amount (-\$0.2 m) our base amount is \$37.2 m.	186
Steps	Several step changes are required to enable us to meet our ICT opex objectives. Further details are in Table 43.	9.9
Total		195.9

Table 42: Summary of ICT opex forecast components

In table 43, we show the step changes included in our ICT opex proposal.

Step change	Description	RCP3 total (\$m)
Leases	Additional leased network capacity to carry core data traffic and allow TransGO to support expanding substation traffic services.	2.6
	Offsetting of fibre lease costs with shared capital investment will decrease operational costs.	-1.4
Third Party Support and Maintenance	Support for an increased set of security service solutions that replace and enhance our on-premises solutions.	1.9
	Support of additional Local Area Networks (LANs) at substations.	1.0
	General support and maintenance for new and expanded ICT services required to support business outcomes using new technology solutions.	0.7
Outsourced services	Additional cloud service costs, reflecting increases in adoption of cloud services for commodity ICT. Cloud service adoption will reduce capex and the support requirement for commodity systems. We will adopt new cloud native technologies, for example, to provide advanced analytics.	1.9
	Telecommunication and network connection fees increase for connections to third party core data traffic service.	1.0
	Contracted rise in data centre electricity costs since the completion of our migration to outsourced data centres.	0.7
Licences	Microsoft licence volume increases.	1.5
Step changes total		9.9

Table 43: ICT opex step changes

ICT opex forecast

Figure 65 sets out our annual forecast ICT opex forecast for RCP3 in the context of RCP1 and RCP2 expenditure. For broader context of longer-term needs, the right-hand panel shows the outlook to RCP5.

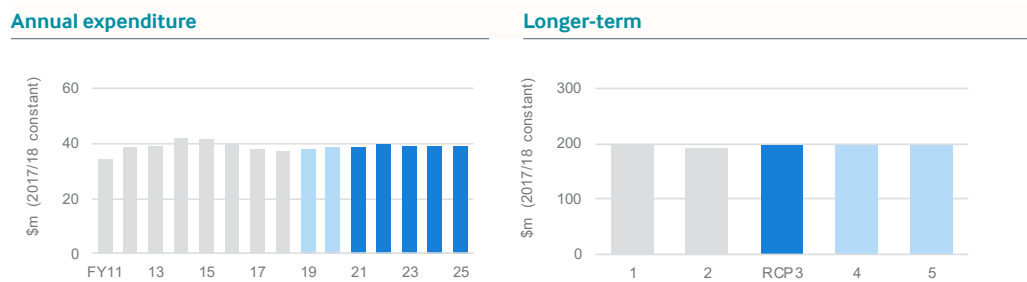


Figure 65: Historical and forecast ICT opex

Our RCP3 ICT opex requirement of approximately \$196 million is similar to RCP2 expenditure of approximately \$192 million.

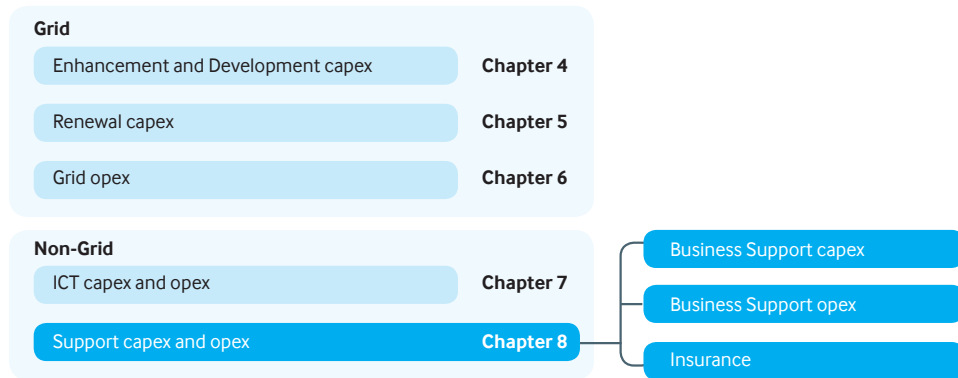


Chapter 8

Support capex and opex

This section sets out our support capex and opex proposal for RCP3. Activities in these portfolios provide essential support for all activities relating to the grid.

The figure below illustrates where the support expenditure fits within the overall expenditure categories in our proposal.



This chapter is structured as follows:

- Section 8.1 provides an overview of our Business Support capex forecast,
- Section 8.2 provides an overview our Business Support opex forecast, and
- Section 8.3 provides an overview our Insurance opex forecast.

8.1 Business Support capex

Our business support assets are diverse and are managed individually depending on their type and nature. Table 44 below provides an overview of these assets.

Business Support assets	Description
Office buildings	2 leased offices – Wellington and Palmerston North ⁸⁴ 2 owned offices – Auckland and Christchurch.
Passenger vehicles	91 passenger vehicles – used to visit our sites, landowners and customers or used as pool vehicles.
Minor fixed assets	<i>Office equipment:</i> such as office desks, chairs and meeting room furniture for all our corporate offices, and warehouses. <i>Minor IT office equipment:</i> such as including laptops, mobile phones and peripheral devices.
Residential houses	The houses are predominantly ex-substation operator houses that have been retained to act as a buffer between adjoining private properties. Some houses have been purchased as part of projects and retained as strategic landholdings for future line routes or substations. Some are used as emergency or graduate accommodation.

Table 44: Overview of Business Support assets



For further information on our business support assets, refer to section 6, 'Business Support Asset Class Plan', in the 2018 AMP.

8.1.1 Asset management approach

Our Business Support asset management approach can be summarised as follows:

- *Corporate offices* – these premises are in good condition and are maintained following good practice.
- *Passenger vehicles* – our vehicle fleet is managed by an external provider who takes a consistent and cost-effective approach to maintenance based on manufacturers' guidelines. We participate in the All-of-Government contract for the supply of motor vehicles, which is regarded as the best available price offered in the market. We use a condition-based assessment to determine when vehicles should be replaced.
- *Minor fixed assets* – office equipment is repaired or replaced as required, and redundant equipment sold or donated to charities. Minor IT fixed assets are maintained or refreshed as appropriate.
- *Houses* – these are managed by external property management companies and sold on the open market if they become surplus to our requirements.

8.1.2 RCP3 work priorities

The key priority in this portfolio for RCP2 was the head office relocation to Waikoukou in 2017/18. We have two key priorities for RCP3.

- *Office buildings* – minor refurbishment works at our Wellington, Christchurch and Auckland offices, and refurbishment/relocation of our Palmerston North office.
- *Vehicles* – moving more of our fleet to electric vehicles.

⁸⁴ Leased office buildings are included in the RCP3 proposal as part of Business Support opex. With the forthcoming introduction of IFRS 16 Leases on 1 July 2019, some of these leases will be capitalised and hence included as part of Business Support capex. We will work with the Commission to ensure our allowance appropriately reflects the new accounting rule.

8.1.3 Expenditure forecast

Figure 66 below sets out our annual forecast Business Support capex for RCP3 in the context of RCP1 and RCP2 expenditure. To give a broader context of the longer-term needs, we also show the outlook up to RCP5.

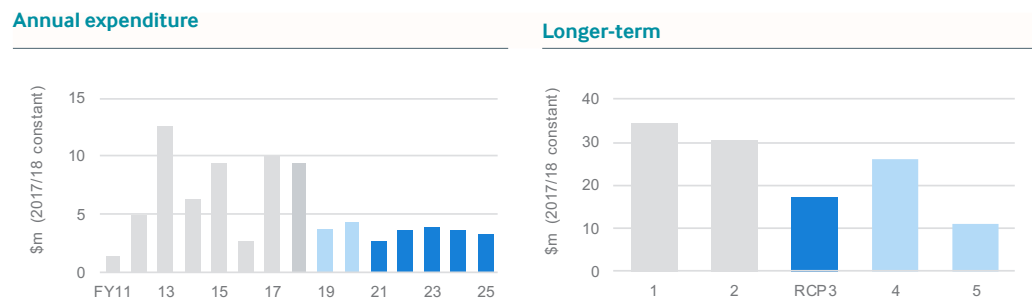


Figure 66: Historical and forecast Business Support capex

Our Business Support capex expenditure requirement of approximately \$17 million is lower than RCP2 capex of \$30 million. This is primarily due to the one-off costs involved in moving into our new head office in 2017.

8.2 Business Support opex

Business Support opex primarily encompasses the staff and consultancy costs associated with work activities in our non-grid divisions which support Transpower operations. These non-grid divisions are IST, Corporate Services, People and the Chief Executive Office.

Expenditure is closely aligned with business needs and responds to changes in Transpower's grid and non-grid activity.

8.2.1 Drivers

The Business Support opex category is largely driven by the size of work programme and activities undertaken in the grid and other non-grid (in particular ICT) parts of the business. Specific drivers include the size of the capital investment programme and maintenance activities during the relevant planning period.

During RCP3, Business Support opex will primarily be driven by:

- staff numbers and size of the work programme, which affects all elements of business support costs including staff numbers and costs, legal and contractor fees, and office rental costs,
- labour market conditions that affect the cost of labour, and
- market conditions affecting the cost of office rental, travel, contractor resources and legal advice.

8.2.2 Activities

The Business Support opex category covers a broad range of activities and functions that support Transpower to operate and maintain the National Grid. Business Support opex comprises four main functional areas.

- *Information Services and Technology (IST)* – responsible for developing and maintaining ICT systems for grid and non-network functions, enterprise information management and ICT strategy and architecture.

- *The Chief Executive office* – responsible for governance and key advisory functions across the business including corporate legal counsel, corporate communications and governance over non-recurring consultancy costs for Transpower.
- *Corporate services* – responsible for providing financial support, treasury services, strategic planning, regulatory relationship management and corporate governance to Transpower.
- *People* – responsible for Transpower’s human resources function, business health and safety advisory services, management of technical training programmes and facilities management.

8.2.3 RCP3 forecast in the context of RCP2

Figure 67 below compares our RCP3 to RCP2 Business Support opex.

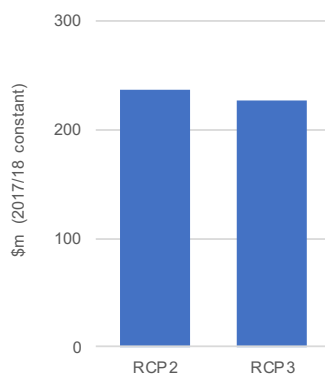


Figure 67: Comparing RCP2 and RCP3 Business Support opex

Our RCP3 Business Support opex requirement is approximately \$227 million, \$10 million lower than RCP2 opex of \$237 million.

8.2.4 Assessing the appropriateness of the base year

A key requirement of the base-step-trend forecasting framework is that the base amount included in the forecast must be representative of the future expenditure requirement and is cost efficient.

On balance we consider that 2017/18 is an appropriate base year to forecast our RCP3 Business Support opex requirement. We have assessed the efficiency of the base year 2017/18 with reference to historical expenditure. Figure 68 below shows historical Business Support opex.

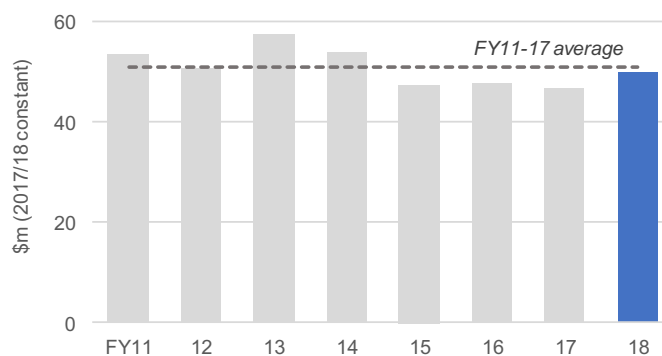


Figure 68: Historical trend in Business Support opex

Business Support opex of \$50.1 million in 2017/18 is in line with the historical average.⁸⁵ It is therefore an appropriate starting point for our forecast.

8.2.5 Business Support opex forecast summary

Our RCP3 expenditure requirement for Business Support opex is \$226.5 million. The base-step-trend forecast components are summarised below.

Component	Description	RCP3 (\$m)
Base amount	We used 2017/18 as base year (\$50.1 m). The base amount is \$45.2 m, which includes the following adjustments for atypical expenditure (-\$4.8 m): <ul style="list-style-type: none"> • one-off costs relating to current transformation programme (-\$5.2 m), • non-recurring expenditure relating to RCP3 proposal preparation (-\$1.3 m), • atypical vacancies (+\$1.4 m), and • building move (+\$0.3 m). 	226.1
Steps	Our base amount scope excludes the cost of regulatory proposals. We have included an estimate of the RCP4 proposal cost.	2.6
Trends	We have applied an annual improvement of 0.2% in productivity. ⁸⁶ We have applied productivity trend factor 0.2% (-\$2.3 m). ⁸⁷ Benefits driven ICT capex is expected to enable the productivity improvements in this portfolio.	-2.3
Total		226.5

Table 45: Summary of Business Support opex base-step-trend forecast components

Business Support opex forecast

Figure 69 below sets out our annual Business Support opex forecast for RCP3 in the context of RCP1 and RCP2 expenditure. To give a broader context of the longer-term needs, the right-hand panel shows the outlook up to RCP5.

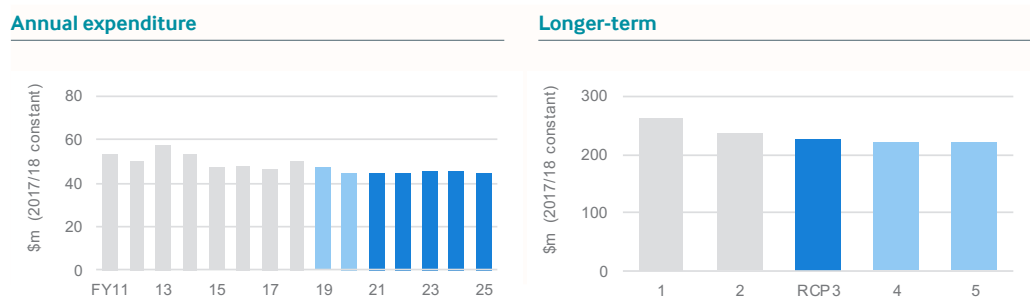


Figure 69: Historical and forecast Business Support opex

Our Business Support opex requirement for RCP3 is \$10 million lower than RCP2 opex of \$237 million. The historical downward trend in costs in RCP3 compared to previous years reflects our ongoing commitment to delivering cost efficiency improvements.

⁸⁵ To ensure historical and forecast expenditure scope are consistent, historical expenditure is adjusted to reflect changes in internal debt portfolio cost management cost categorisation. Debt portfolio management cost involve costs for obtaining ratings, listings, trustee and registry services. These costs (approximately \$2.3 m in 2017/18) have historically been categorised as Finance Costs. We have re-categorised these as Business Support opex.

⁸⁶ This adjustment is based on estimated historical improvements in the labour productivity of New Zealand's professions, scientific and technical services sector.

⁸⁷ This productivity factor is based on estimated historical improvements in the labour productivity of New Zealand's professions, scientific and technical services sector. Source: Statistics New Zealand, Productivity Statistics: 1978-2017 – productivity by industry table: www.stats.govt.nz/information-releases/productivity-statistics-19782017

8.3 Insurance opex

This portfolio includes the operating expenditure for insurance premiums for RCP3, comprising both the external insurance premiums and self-insurance premiums.

We procure approximately \$1 billion of external insurance cover annually to mitigate financial risks associated with damage to our property and liability for damage we might inadvertently cause to others in the normal conduct of our business. Insurance primarily covers financial consequence from catastrophic event risk as well as for higher frequency risks we have identified as appropriate to insure.

Our insurance comprises policies appropriate for a business of our size and type.

8.3.1 Insurance approach

We both self-insure (for risks we consider appropriate) and externally insure for those risks we consider it prudent to cover externally:

- we purchase insurance cover from external insurers for our key risks, to a prudent level and where insurance cover is available at reasonable cost, and
- we self-insure (through our captive insurer, Risk Reinsurance Limited – RRL) where risks are small, where market-based cover is unavailable or expensive, and where we think we have a better understanding of the risks than the market and can therefore price the risk more accurately and lower than an external insurer.

Our use of a captive insurer enables us to retain a reasonable amount of risk and to reduce the use and cost of transferring risk to third-party insurers. For example, our Material Damage and Business Interruption (MDBI) cover is for \$750 million. \$740 million of that cover is provided by external insurers, but we retain \$10 million of risk within RRL.

8.3.2 Supporting activities

The key work activities that support the insurance portfolio are:⁸⁸

- working to identify only those risks that are appropriate to insure,
- ensuring that appropriate cover is in place in terms of limits, deductibles, coverage terms and insurer security and diversity,⁸⁹
- engaging with the insurance market annually and undertaking a competitive tender process to achieve a low cost, competitively priced outcome, and
- annually reviewing our insurance arrangements to make sure we remain comfortable with risks and costs of arrangements.

8.3.3 Objectives

Financial resilience through insurance, including protection against financial loss and ability to finance asset repair and service recovery following a catastrophic event, helps us meet our purpose of being for New Zealand.

Our objective is to achieve prudent and competitive insurance premiums by:

- only insuring risks which are appropriate to insure, and
- ensuring that appropriate cover is in place for risks that are appropriate to insure.

⁸⁸ These activities are funded out of Business Support opex.

⁸⁹ Consistent with the two key insurance objectives as stated in Transpower's Insurance Policy.

Our overall approach (the mix of external insurance and self-insurance) keeps our insurance premiums low and transfers significant risks externally to avoid significant profit and loss volatility following catastrophic events.

We consider our use of self-insurance as part of our insurance portfolio delivers a better result for Transpower and consumers, by keeping premium costs low where premium costs of external insurances are high.⁹⁰

The procurement of adequate insurance cover means we can be confident that we can continue to deliver a reliable grid for the long term without having to unreasonably call on additional resources of our shareholder or consumers.

8.3.4 Drivers

The primary determinants of insurance opex are the insurance type and volume we purchase, and market pricing. To ensure that we insure prudently, we observe other similar-sized organisations' insurance approach and receive advice from insurance brokers.

Insurance premiums are driven by market factors such as perception of risk, loss experience and availability of capital, not simply inflationary pressure.

Premium rates can be volatile and can respond quickly to catastrophic events and market movements, such as the Canterbury and Kaikoura earthquakes in New Zealand, and hurricanes Katrina, Harvey and Irma, which affected the East Coast of the United States.

Premiums are also affected by the capital available to the market. For a time during recent years, a significant amount of new capital came into the market (because investors considered insurance to give better returns than, say, equities). This created a downward pressure on premiums. However, capital flows have been static over the past two years and are now falling, following the catastrophic events discussed above.

Our asset base affects the value of insurance required as well as the level of risk to insurers from different types of investment. The replacement value of our asset base is increasing and consequently premiums increase.

⁹⁰ Self-insurance covers only damage resulting from incidents specified in our self-insurance policies between Transpower and RRL and not specifically externally insured. It does not include wear and tear, or maintenance, or costs that may be covered in other portfolios.

8.3.5 Forecast approach

Our approach to forecasting Insurance opex, is primarily based on actuary and insurance broker expert forecasts.

Figure 70 compares our RCP3 insurance opex requirement to RCP2 expenditure.

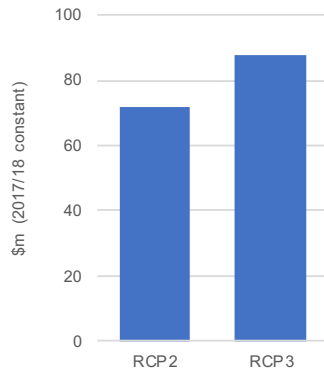


Figure 70: Comparing RCP2 and RCP3 Insurance opex

Our RCP3 Insurance opex requirement of approximately \$88 million compares to expenditure of \$72 million during RCP2.

8.3.6 Insurance opex forecast summary

Base, step and trend components, derived from actuarial and broker reports, are presented in table 46 below.

Component	Description	RCP3 (\$m)
Base amount	The 2017/18 base year actual of \$13.6 m was atypically low. An amount consistent with the historical five-year average of \$15.6 m is more representative of the RCP3 forecast expenditure requirement.	78.1
Steps	The fire service levy is expected to increase after a legislative change	2.7
Trends	Trend factors add \$7.2 m to our RCP3 insurance opex requirement. Our forecast allows for growth in our asset base of 1.5% per year. Replacement values of our insured assets used to base premiums is estimated to increase by 2% per year. Actuarial assessments of claims frequency and value are also expected to increase costs.	7.2
Total		88.0

Table 46: Summary of Insurance opex forecast components

Key assumptions

We have used expert forecasts from brokers and actuaries when determining insurance premium forecasts on external insurance policies and wholly self-insured risks with RRL.

Both advisers consider markets will remain at levels similar to the average of the past five-years, a period which has seen historically low premium pricing, but which has also included historical averages for premium pricing. However, premiums are considered unlikely to increase to levels seen in 2012 and 2013, immediately following the Canterbury earthquakes.

We do not expect we will be unable to purchase prudent levels of insurance cover. However, a catastrophic earthquake or weather event and significant claims may reduce cover.

Table 47 below sets out the key forecast assumptions for each of our insurance policies alongside their source.

Policy	Assumption	Source
Externally insured policies		
Material damage and business interruption (MDBI)	Market moves back to five-year average trend. Asset base and replacement value growth of 1.5% and 2.0% per year	Broker
Submarine cables	Market moves back to average trend and asset replacement value growth of ca. 2.0% p.a. + scheduled new fibre optic cable from 2020	Broker
General third-party liability	Market moves back towards average trend and operations growth of the business	Broker
Directors and officers	Market moves back towards average trend and operations growth of the business	Broker
Minor policies (e.g. vehicle, travel, marine cargo)	Market moves back towards five-year average trend	Broker
Self-insured policies		
Under deductible submarine cables and internal electrical breakdown	Based on Transpower and industry claims experience and actuarial calculation	Actuary
MDBI (under deductible)	Based on Transpower and industry claims experience and actuarial calculation	Actuary
Transmission Lines and Underground Cables	Based on Transpower and industry claims experience and actuarial calculation	Actuary
Consumer Guarantees Act	Based on Transpower and industry claims experience and actuarial calculation	Actuary
Cyber risk	Based on Transpower and industry claims experience and actuarial calculation	Actuary
Other		
Fire Service Levy	2017/18 expenditure and estimated increase post-legislation and regulation changes	Transpower
Broker fees	As per 2017/18	Transpower

Table 47: Key insurance forecast assumptions

Insurance opex forecast

Figure 71 below sets out our annual Insurance opex forecast for RCP3 in the context of RCP1 and RCP2 expenditure. To give a broader context of the longer-term needs, the right-hand panel shows the outlook up to RCP5.

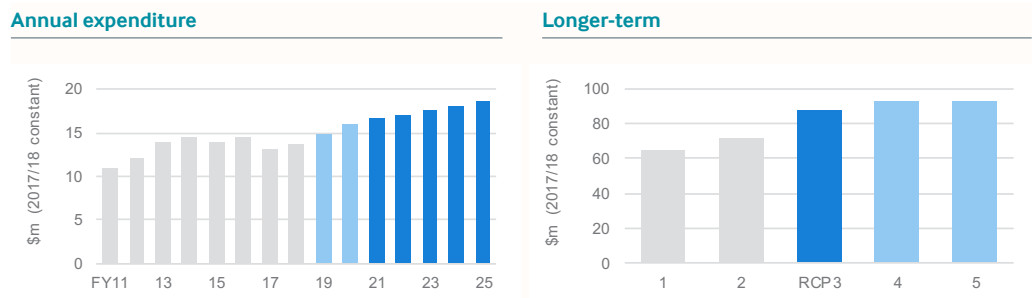


Figure 71: Historical and forecast Insurance opex

Our RCP3 Insurance opex requirement of approximately \$88 million compares to expenditure of \$72 million during RCP2. This change is primarily driven by forecast movement of premiums from historical lows back to historical averages, the impact of Transpower’s actual loss experience on actuarial forecasts and inclusion of new risks, such as cyber insurance and lower deductibles on several policies.



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