TransGrid

Revenue Proposal

2018/19 – 2022/23

CHIEF EXECUTIVE OFFICER'S FOREWORD

I'm pleased to submit TransGrid's revenue proposal for the period 2018-2023.

This proposal marks a step change for TransGrid. It is the first proposal submitted under private ownership and seeks to demonstrate a strengthening of TransGrid's commitment to customer service and meeting stakeholder expectations. This has served to influence TransGrid's approach to forecasting Revenue requirements.

We propose to deliver real price reductions for energy customers across the determination period.

TransGrid is proposing:

- Prudent and necessary augmentation capital expenditure
- Prudent replacement capital expenditure, lower than a "sustaining" level
- Strategic investment to protect the supply of electricity to Sydney's CBD
- Contingent investment on enhancing connectivity between NSW and SA
- Delivery to consumers of operating cost savings benefits generated in the current period.

Transmission in an evolving environment

Australia's electricity consumers are demanding improved performance from their electricity service providers, including network operators. Our customer consultation has shown that consumers expect innovative asset management and efficient operating expenditure resulting in network prices that are no higher than is necessary. Energy customers also expect to be offered choice in products and services, and they expect the power system to accommodate their choices, not constrain them. However, customers place a clear value on reliability and security of supply and they understand the need to efficiently invest in infrastructure to maintain the amenity provided by our power system today, particularly in NSW.

Although there is a wide range of views on carbon emissions, on balance our customers expect to see progress towards the reduction of carbon emissions from our power systems. There is strong support for Australia's power systems to be able to accommodate renewable generation at both the distributed and utility scale.

TransGrid, like many other transmission network operators around the world, is seeking to adapt its business to ensure the efficiency and sustainability electricity supply in this rapidly changing environment.

Across the globe, transmission networks like TransGrid's, are helping economies to deliver on carbon reduction targets, integrate renewable energy sources, implement new storage technologies and respond to changing demand and usage patterns. Our customers expect no less from us.

TransGrid's role

TransGrid serves Australia's largest energy market. We are responsible for ensuring the security of supply to both NSW and the ACT, including Australia's major economic and political centres, Sydney and Canberra.

Our network is at the centre of the National Electricity Market, serving the fastest growing economies in the country. We provide a stable, secure and affordable transmission network, which supports investment and innovation, leading to economic growth and prosperity in our markets.

That is why the investments detailed in this revenue proposal are critical, not just for TransGrid, but for the economy and the communities that we serve.

A prudent proposal, built on engagement

This proposal is prudent and measured. It is the right proposal for this time.

It is based on extensive engagement with our customers, supply chain partners, the communities where we operate and other important stakeholders. We have consulted extensively about how we plan to operate and maintain our transmission assets during this regulatory period. We have engaged consumers on the building blocks of our revenue base to ensure that customer and stakeholder expectations are reflected in this proposal.

While prior proposals from both transmission and distribution companies have been criticised for seeking to overinvest in network infrastructure, this proposal does not. In fact, our proposal details only modest allowances for network augmentation and asset replacement.

Prudent investment should not be deferred

By making targeted investments across the regulatory period, we seek to maintain the service levels our customers expect, as well as strengthen our infrastructure to manage the challenges of a changing generation mix and new usages of the network.

Given the current rapid transformation of the energy supply chain and the strong economic growth in NSW and ACT, we don't believe that deferral of proposed investment is in the long term interests of our customers.

This is especially the case with investments in the Powering Sydney's Future program. The proposed investment in Powering Sydney's Future presents a once in a generation opportunity to support the continued growth of the NSW economy.

Record infrastructure investment in the metropolitan area, particularly on energy intensive public transport projects, is driving the need for reliable and secure electricity supply, which can be delivered only by networks which in turn support integration of renewable energy and non-network solutions.

We believe that reinforcing the electricity supply to the Sydney CBD is vital if we are to avoid an unacceptable risk of extended power interruption.

It would also have the effect of simply deferring the price impacts associated with large scale asset replacement into future regulatory periods. Our proposal transparently details the expenditure required to secure Sydney's future power supply, and demonstrates the need for investment.

A proposal that responds to customer expectations

We know that our customers expect three things – low price volatility, continued security of supply and better environmental outcomes, and that's what this proposal will deliver.

We have attempted to respond to criticisms of previous revenue proposals, and we've acted. We believe our proposal outlines a responsible, prudent and modest return that is an adequate exchange for delivering safe, reliable and affordable transmission services.

Regulation contributes to superior consumer outcomes

TransGrid and its shareholders are committed to the principle of a strong regulatory framework to deliver superior outcomes for our customers. We respect and acknowledge the role regulation plays in monitoring the activities of a natural monopoly such as ours.

This commitment has, in part, contributed to TransGrid's proposal to accept the AER's preference for a transition to the trailing average method for estimating the cost of debt component of the Weighted Average Cost of Capital (WACC).

Conclusion

TransGrid's revenue proposal is the right proposal for these times. It stands as an example of best practice approaches to prudent expenditure and consultation, and is the first step in our transformation to a customer focussed transmission company.

We look forward to working with you to progress this process.

Paul Italiano
Chief Executive Officer
TransGrid

1. Executive Summary

TransGrid is the operator and manager of the main high voltage transmission network in NSW and the ACT, connecting distributors and major end users to generators to ensure they receive the electricity they need, when they need it.

TransGrid's network is the geographic centre of the National Electricity Market (NEM) and comprises 99 bulk supply substations and more than 13,000 kilometres of high voltage transmission lines and cables.

Interconnected to Victoria and Queensland, TransGrid plays a crucial role in supporting the economic growth of NSW and the ACT, with a highly reliable transmission network the company's assets are central to facilitating the integration of more renewable energy into Australia's generation mix.

TransGrid has taken a long term view of the evolution of the network in developing this proposal. Right now, the electricity market is in a state of transformation, and the ways that electricity is generated and consumed are being fundamentally disrupted.

Customers and consumers are changing the way they use electricity, and expect to not only access electricity from the network, but also be able to export it from their own renewable generation systems back onto the grid. Generation is evolving from very large, fossil fuel based plants to many smaller, grid-connected renewable generators resulting in changes in power flows and system operations.

In response to this new operating environment, and supported by a change of ownership in 2015, TransGrid is evolving to a more service-oriented and commercially focussed business that embraces the challenges of energy market transformation and technological intervention in the conventional energy supply chain.

This submission proposes revenues to operate and invest in a safe, reliable and sustainable transmission network. TransGrid's expenditure proposal is designed to maintain current service levels across the network, by augmenting new growth areas and replacing ageing assets in established areas in line with the improved risk assessment framework.

TransGrid has reflected in this proposal its overall efficiency and its commitment to improve over the regulatory period, ensuring customers and consumers pay no more than is necessary for transmission services.

The proposal also ensures TransGrid continues to have the ability to adapt and respond to changing electricity market conditions, and enhance the service offering to the demands of increasingly engaged electricity consumers.

1.1 Revenue

The maximum allowed revenue (MAR) is the revenue transmission network service providers are allowed to recover in each year of the upcoming regulatory control period. MAR is calculated based on the building block approach outlined in the National Electricity Rules and the AER's post-tax revenue model.

TransGrid's proposed MAR for the 2018/19 to 2022/23 period is $3,973 million ($ June 2018).

1.2 Capital expenditure

Total forecast capital expenditure for 2018/19 to 2022/23 is $1,612 million ($ June 2018). This represents a responsible expenditure program with the majority of expenditure focused on asset replacement.

This replacement trend is expected to continue for the next three regulatory periods. This is substantiated by a top down replacement expenditure model which provides a longer term outlook of capital investment requirements. A priority for TransGrid has been the development of innovative asset management methods to prudently minimise the future costs to consumers.

Peak load is growing, but as with the current period, there are only a few augmentation projects. However, the total augmentation forecast expenditure is substantially higher than the current period due to a major and complex project to service the Sydney CBD.

1.3 Operating expenditure

Total forecast operating expenditure for 2018/19 to 2022/23 is $908 million ($ June 2018). This includes management of increased risk of bush-fire from off-easement trees, as well as expected changes in labour and growth of the network. The efficiency of TransGrid's operating expenditure was assessed and accepted by the AER[1,2] in its last revenue determination, and TransGrid performed well in various independent benchmarking studies.[3,4]

TransGrid implemented a strategic program emphasising efficiency, responsiveness and innovation to continue operational improvements. The organisation has undergone a detailed review and various performance enhancing initiatives have been actioned. These initiatives have reached into all aspects of the business, and have reshaped how TransGrid delivers its transmission services with a particular focus on the customer.

This process delivered a reduction in operating expenditure, despite absorbing almost $4 million per annum in increased costs, including those needed to comply with new regulatory and statutory obligations as part of the transition to private ownership.

A total cost saving of 5% in 2016/17 will be delivered and further cost savings planned in 2017/18 will deliver an additional cost reduction of 3% compared to 2016/17. These savings have all been factored into the forecast expenditure. At the same time, the volume and quality of prescribed transmission services, by almost every measure, are expected to either increase or be maintained.

1.4 Rate of return

The proposed allowed rate of return (WACC) for the next regulatory control period is 6.6%, which is lower than the current AER approved rate for 2016/17. TransGrid recognises that stability in the WACC is a good outcome for customers as it supports stable pricing.

WACC is estimated as a weighted average of the return that would be required by the providers of equity capital and the return that would be required by the providers of debt capital. It is a key component of the AER's building block method which should ensure the efficient financing costs the business incurs are included in the revenue allowance.

TransGrid's owners are committed to working within the regulatory framework to deliver superior outcomes for customers. TransGrid has adopted the approach set out in the AER's Rate of Return Guideline, with updates for current market data.

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1 AER: FINAL DECISION TransGrid Transmission Determination 2015-16 to 2017-18 Attachment 7 – Operating Expenditure, April 2015, pp.7-20.

2 AER: Annual benchmarking Report Electricity transmission network service providers, November 2015.

3 TransGrid: Revenue Proposal 2014/15 to 2018/19, May 2014, pp.144-145.

4 ITOMS: 2015 Report, January 2016 (uses 2014 data for TransGrid) [TransGrid-UMS Group-Appendix M ITOMS blind benchmarking report-0116-PUBLIC]

TransGrid has adopted the AER's method for data sources and continued the AER's preferred transition approach from a "rate on the day" approach to the "trailing average" approach to estimate the cost of debt. Whilst TransGrid believes there is a sound basis for moving immediately to a trailing average allowance, this proposal continues the transition to trailing average that commenced in 2014/15. TransGrid recognises the positive impact this will have on consumers and that it will result in stable pricing.

TransGrid has adopted the AER's preferred model to estimate a cost of equity of 7.5%. This is based on the AER's guideline equity beta of 0.7, current market observations of the risk free rate and a market risk premium (MRP) of 7.5% which has been updated using the AER's method for current market rates.

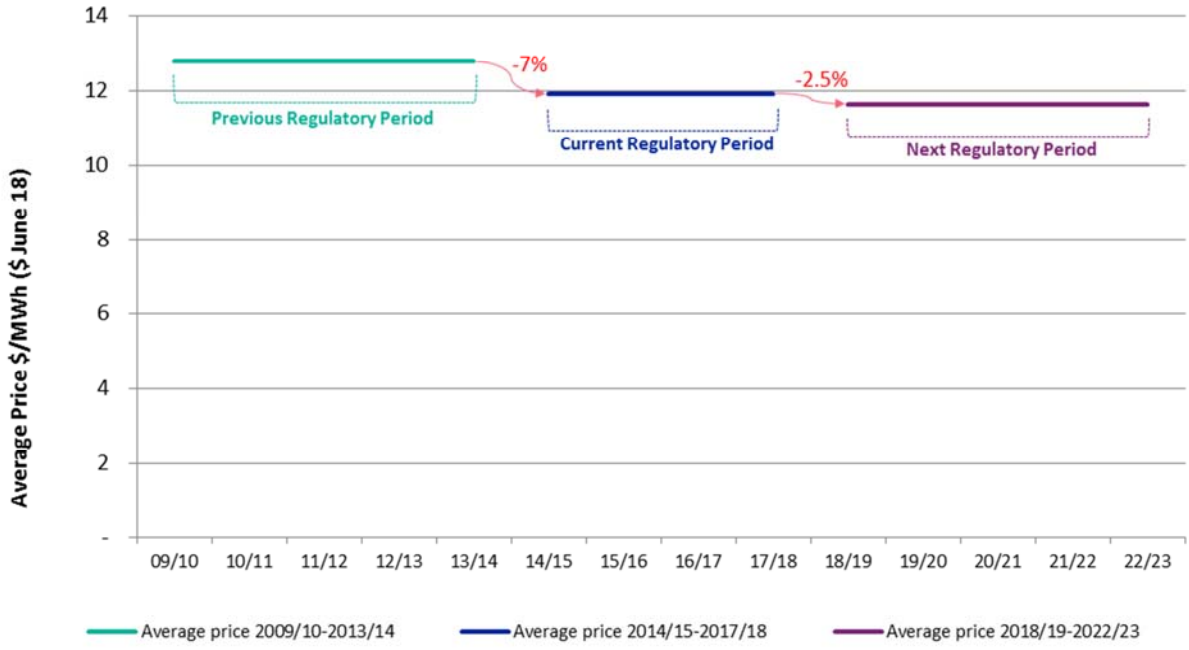
1.5 Price

TransGrid will remain a small component of a representative residential electricity bill which will continue to be around 7% for 2018/19 to 2022/23.

Figure 1.1: Impact on bill of TransGrid's revenue and TransGrid's capital expenditure

This proposal reflects the third consecutive regulatory period of reductions in average annual prices. Prices dropped by 7% from the prior regulatory period to the current period, and on the basis of this proposal will reduce again by 2.5%. The average price path over the recent and upcoming revenue periods is shown in Figure 1.2.

Figure 1.2: Average Transmission Prices 2009/10 to 2022/23



Source: TransGrid. Determined prices shown for 2009/10 to 2017/18. Forecast prices shown for 2018/19 to 2022/23

1.6 Conclusion

This revenue proposal is built upon meeting stakeholder expectations for transmission services. TransGrid has listened to feedback from customers and consumers and adapted the revenue proposal in response to that input. Forecast demand, expected changes in generation, asset risk profiles, regulatory requirements and new network reliability standards all underpin the forecasts in this proposal.

TransGrid believes that this proposal reflects the more complex operating environment, the challenges of evolving transmission services to meet the requirements from increasing renewable generation and adapting to technological innovation.

Prudent investment in new assets, upgrades to existing assets and an ongoing focus on efficiency improvement will ensure that TransGrid continues to deliver safe, reliable, sustainable and affordable transmission services to meet the long-term interests of consumers.

2. Introduction and Context

2.1 TransGrid's revenue proposal

TransGrid is committed to delivering efficient and innovative service that responds to customer and consumer needs, ensures they pay no more than is required and prudently provides for a sustainable electricity network.

In developing this proposal, TransGrid has ensured that its business plans promote the long term interest of customers and consumers. The proposal reflects:

- A customer-centric commercially driven transmission business which maintains a strong focus on safety, reliability and performance
- A strategic outlook on the future of electricity transmission, that will facilitate changes in generation while maintaining security and reliability of supply to the benefit of all customers and consumers
- An efficient business under new ownership which is setting high standards for performance and embracing innovation to deliver efficient services to customers and consumers

2.1.1 Compliant with National Electricity Law, Rules and AER Guidelines

TransGrid's revenue proposal closely aligns with the AER's preferred approach to expenditure forecasting. This ensures TransGrid will be financially sustainable over the next regulatory period while customers and consumers pay no more than is necessary for transmission services.

2.1.2 Overview

- This revenue proposal is fully compliant with all requirements of the National Electricity Law and Rules
- TransGrid has enhanced its approach to developing capital expenditure forecasts, reflecting feedback from the AER in TransGrid's last revenue decision, as well as advances in best practice asset and risk assessment
- TransGrid has closely aligned its approach to forecasting operating expenditure with the AER's preferred methodology
- TransGrid has accepted the AER's preference to transition over ten years to the trailing average method for estimating the cost of debt
- TransGrid applied the AER's preferred model to estimate the cost of equity

This approach is set out in greater detail throughout the rest of this revenue proposal.

All key aspects of this proposal have been discussed with customer, consumer and other stakeholder representatives. As a result of this stakeholder engagement TransGrid has improved and clarified the presentation of many aspects of this proposal and in some cases changed our approach to respond to feedback received.

TransGrid will work with the AER to ensure a revenue determination is made that is in the long term interests of customers and consumers.

2.2 About TransGrid

TransGrid is the operator and manager of the main high voltage transmission network in NSW and the ACT. Its network connects electricity distributors and major end users to generators, ensuring they receive the electricity they need, when they need it.

TransGrid's network is at the centre of the National Electricity Market (NEM) and comprises 99 bulk supply substations and more than 13,000 kilometres of high voltage transmission lines and cables. Interconnected to Victoria and Queensland, it plays a crucial role in supporting the economic growth of NSW and the ACT.

TransGrid's role is to provide safe, reliable and efficient transmission services. While transmission is a small component of electricity bills, around 7% for households and businesses, customers and consumers should not pay more than necessary for a reliable electricity supply. TransGrid is focused on operating its business as efficiently as possible, with an emphasis on driving down costs and providing strong customer service.

2.3 Transmission network facts

TransGrid's transmission network, shown in Figure 2.2, connects with Powerlink's Queensland network in the north, AusNet Services' network in the south and west and goes as far west as Broken Hill, over 1,000km from Sydney. It supplies higher peak loads and transmits more energy annually than any other transmission network in Australia. It:

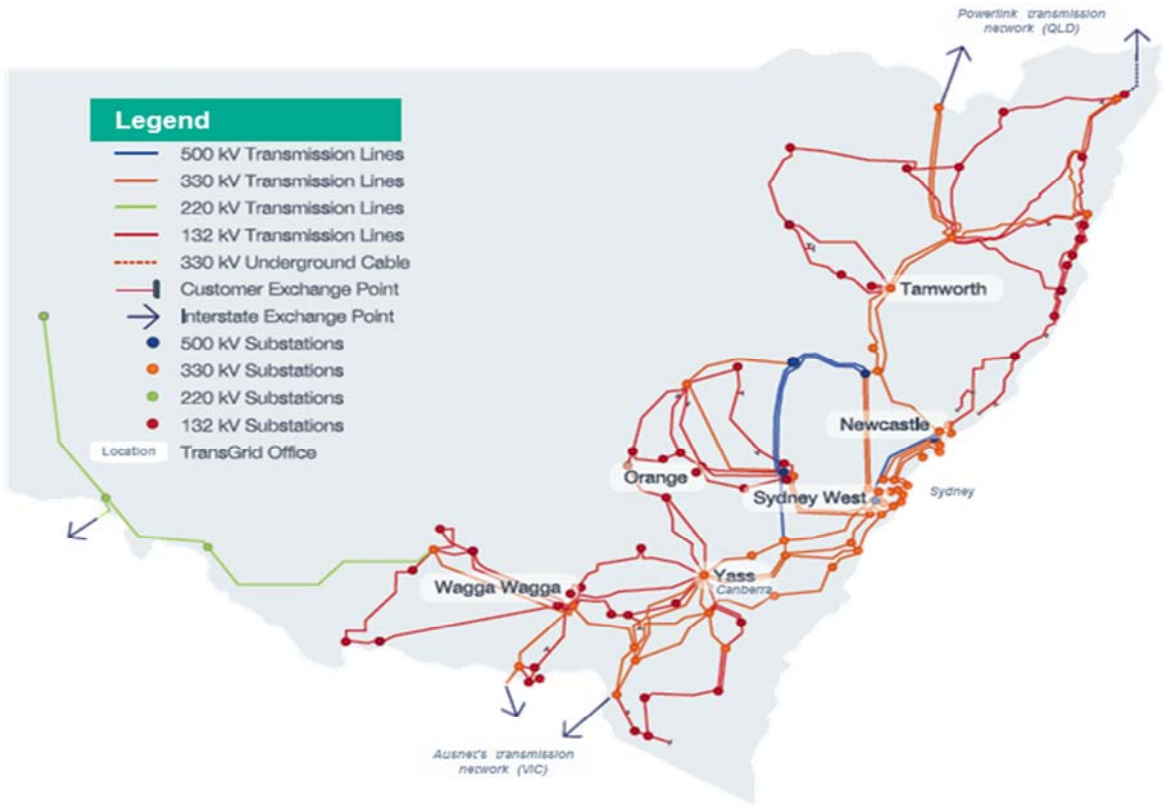
- Supports secure and reliable electricity supply to both the national capital and the largest city in Australia
- Is fundamental to the provision of electricity to over 7.5 million people
- Is central to the NEM, enabling generator competition and energy trading between the three largest states to the benefit of all NEM electricity consumers
- Facilitates grid connection for new generators, including a growing number of renewable sources.

TransGrid supports stronger interconnection across the NEM as this strengthens security of supply and reduces the final cost of electricity to consumers. Further interconnection from NSW to South Australia is currently being proposed by ElectraNet. A connection with TransGrid's network in NSW would provide South Australia with further supply diversity, strengthening reliability and reducing electricity costs for consumers in both NSW and the ACT. The related contingent project is discussed in Chapter 5.

Figure 2.1: TransGrid key statistics

- Serves over 7.5 million people across 3 million homes and 30,000 businesses
- Supports the largest state economy in Australia
- Serves 16 directly connected large customers
- Provides transmission connections and market access to 24 generators
- Includes 13,039 km of transmission lines to operate and manage
- Includes 99 substations to operate and manage

Figure 2.2: TransGrid's transmission network



2.4 TransGrid's new ownership arrangements

On 16 December 2015, a consortium of investors comprising Hastings Funds Management as manager of UTA Power Networks, Spark Infrastructure Group, Tawreed Investments Ltd (a wholly owned subsidiary of the Abu Dhabi Investment Authority), Caisse de depot et placement du Quebec (CDPQ), and Wren House Infrastructure Investments Asset Trust (a wholly owned indirect subsidiary of the Kuwait Investment Authority) entered into agreements to take control of the NSW high voltage electricity transmission network assets and operations.

These agreements consist of a 99-year Transmission Network Lease from the NSW State Government for the lease of the network assets held by the NSW Electricity Networks (NSWEN) Assets Trust, and the purchase of non-land based assets and business operations by the NSWEN Operations Trust from the NSW State Government.

NSW Electricity Networks Operations Pty Limited as Trustee for the NSW Electricity Networks Operations Trust (trading as "TransGrid") is responsible for meeting the transmission network service provider's obligations under the National Electricity Rules, being the entity holding the registration in the National Electricity Market as the Network Service Provider – Transmission and System Operator.

NSW Electricity Networks is made up of two, separate independent components. NSW Electricity Assets holds the lease of the transmission assets from the NSW Government and attends to the financing of those assets and new assets that will be added over the life of the lease. NSW Electricity Networks Operations sub-leases those assets and operates and maintains them. It is this latter organisation that trades as TransGrid, and is the entity making this revenue proposal. That said, throughout this proposal TransGrid should be taken to refer to the business as a whole.

2.5 Global and domestic trends

2.5.1 World trends

Transmission network operators around the world are adapting their businesses to ensure the efficiency and sustainability of the electricity system in a rapidly changing environment. Transmission networks are recognised internationally as key enablers of the transformation of the sector to an economically efficient renewable led industry. Transmission provides a cost-effective and essential link from renewable generators in the most resource rich sites to where customers are located.

Global trends in energy production and consumption are being largely driven by community expectations.

The International Energy Agency (IEA)[5] identifies transformative change in the energy sector as essential to reach the objectives of the Paris Agreement on Climate Change. The IEA forecasts significant changes in energy consumption in the next decade, driven by factors including access, affordability, climate change and energy-related air pollution. The generation mix will continue to evolve to include more renewable energy in both developed and developing economies.

The IEA's Medium Term Market Report for Renewable Energy[6] estimates global renewable energy capacity to grow by 42% (825GW) by 2021, with solar PV and onshore wind to lead the capacity growth. The overall proportion of renewables in energy generation is expected to rise by around 5% to 28% by 2021. This will drive an increase in the proportion of distributed energy resources.

2.5.2 Domestic trends

Global trends in the electricity industry are largely mirrored in the Australian domestic energy market. Renewable energy integration will continue to accelerate with customers expecting bi-directional electricity flows. Electricity demand will continue to grow, driven by transport, industry and lifestyle requirements but the increase delivered via networks will be partially offset by energy efficiency

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5 World Energy Outlook 2016 Executive Summary: World Energy Agency, Paris: http://www.iea.org/Textbase/npsum/WEO2016SUM.pdf; Accessed 9 January 2017 [TransGrid-IEA-World Energy Outlook 2016-0116-PUBLIC]

6 Renewable Energy Medium-Term Market Report 2016: International Energy Agency, Paris: http://www.iea.org/newsroom/news/2016/october/medium-term-renewable-energy-market-report-2016.html; Accessed 9 January 2017 [TransGrid-IEA-Renewable energy_Medium term market report 2016-0116-PUBLIC]

measures and local distributed generation. According to the Australian Energy Market Operator (AEMO)[7]:

> The energy market of today is much more complex than it was historically, with rapid growth in areas such as demand side management, rooftop PV, intermittent generation, and storage technologies. At the same time, synchronous generation is withdrawing from the market. As a result, total installed generation capacity alone becomes a less reliable indicator of supply adequacy

Against this backdrop, consumer sentiment is changing – informed energy consumers are seeking three outcomes:

1. Cost certainty through stable or declining energy costs
2. High levels of system stability and reliability
3. To reduce carbon emissions

A stable, secure and affordable transmission network provides a foundation for economic growth, opportunities for investment and a platform for grid innovation.

2.6 TransGrid ownership and value

2.6.1 Competitive transaction process

The 99 year lease of TransGrid was acquired by an Australian led consortium following a rigorous global bidding process. The ultimate shareholders represent over 4 million Australian superannuants, along with Australian and other retail investors.

There was strong competition for TransGrid, which reflected global investment conditions, the characteristics of TransGrid and its regulatory environment, as well as recognition of the critical role that transmission networks play in facilitating the transformation of the electricity and broader energy sectors into the future.

Record low interest rates and poor returns from investments such as bonds have increased demand for mature infrastructure assets from investors such as superannuation funds, where there is a stable political and regulatory environment and a track record of economic growth. Investors pay a premium for stability when deploying capital.

The consortium recognised value in both the existing operations of TransGrid within the current regulatory framework, and the potential for transmission to play a much expanded role within a future regulatory framework.

In particular, the long term value in TransGrid is reflected in the network's strategic location at the centre of the NEM. It is well placed to support growth and promote stability in the NEM as the power system changes significantly in coming years. For example:

- It can support reliability and security of supply in other States with increased interconnection, especially as the penetration of intermittent and non-synchronous low carbon generation increases
- TransGrid's stable, secure transmission network can support innovation by enabling higher levels of low carbon generation and energy storage into the NEM

[7] 2016 Statement of System Opportunity; Australian Energy Market Operator, Melbourne: http://aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/NEM_ESOO/2016/v2/2016-Electricity-Statement-of-Opportunities-Report_V2.pdf; Accessed 9 January 2017 [TransGrid-AEMO-2016 Electricity Statement of Opportunities V2-0916-PUBLIC]

- The consortium also recognised the value and growth potential of the non-regulated parts of TransGrid, including telecommunications and generator connection services
- The new owners of TransGrid are committed to delivering for its customers and consumers in terms of price and service over the long term. They are also committed to working within the regulatory incentive frameworks to improve efficiency going forward.

2.6.2 Well managed transition

TransGrid has continued to deliver on its obligations under the National Electricity Rules (Rules) and other statutory requirements. TransGrid has seen a change in the Board, a new Chief Executive Officer and restructuring and refreshing of the Executive. Robust processes and a commitment to customer service ensured that throughout this period of transition, reliability, safety and financial performance were maintained and a program of efficiency initiatives was identified and implemented.

There were necessary changes to some activities such as financial management, financial reporting and insurance, all of which have applied additional cost pressures on the business. A new NSW Transmission Operator's Licence was also put in place by the NSW Government at the change of ownership, the Licence conditions have materially increased compliance reporting activities.

2.7 TransGrid's outlook

TransGrid takes a long term view of the development of the network, particularly as the ways in which electricity is generated and used are undergoing rapid, significant change. The power system, energy markets and participant commercial models will all be impacted. Building on previous engagement activities, TransGrid continues to engage on its business plans and decision making processes to ensure it is investing in the long term interest of customers and consumers.

With over 60 years' infrastructure excellence, strong technical capabilities and location at the heart of the NEM, TransGrid is well positioned to respond to the needs of the changing energy landscape by:

- Supporting reliability and security of supply as the level of intermittent and widely dispersed generation increases to unprecedented levels
- Actively enabling the integration of new technology such as energy storage.

TransGrid is firmly focused on the future and will continue to be an efficient, top performing transmission business.

2.7.1 TransGrid's operating environment

Customers and consumers are changing the way they use electricity and increasingly expect to not only use electricity from the network but also be able to export it from their own renewable generation systems back onto the grid. Generation is evolving from very large fossil fuel based plants to many smaller-scale and more widely dispersed renewable generators. This is resulting in changes to power flows and system operations.

Reflecting these changes TransGrid is adapting to a more service-oriented and commercially focussed business that is both proactive and responsive to the needs of customers and consumers.

TransGrid has also sharpened its focus on customers and is recognised as a leader in engagement.

> In terms of genuine consumer engagement TransGrid has gone further and faster than any other network business I have experience with. They are the leading practitioners in sharing the evidence base for their proposed investment and spending plans, in sufficient detail and at an early enough stage to provide consumers with a decent opportunity to consider and provide input. I

believe the dialogue with consumers is improving the quality of TransGrid's proposals. Tennant Reed, Principal National Adviser - Public Policy, Australian Industry Group

The most material emerging issues, especially as they relate to the revenue proposal are:

- Changing customer, consumer and other stakeholder views; TransGrid's engagement activities enable the business to have a more sophisticated knowledge of customer and consumer perspectives and ensures business decisions and customer priorities are aligned.
- Significant changes to the type, size and location of generation in NSW are forecast; the precise timing and location of each investment remains uncertain but it is clear that network requirements will change. TransGrid will continue to ensure the network is able to support a well-functioning, efficient and competitive electricity market into the future.
- Demand forecasts and key drivers of growth, including the impact of locational differences and uncertainty around large spot loads.
- Security of Supply, to ensure that customers and consumers have access to electricity all of the time.

2.7.2 TransGrid's evolving role

TransGrid operates and manages the NSW high voltage electricity network, connecting generators, distributors and major end users in NSW and the ACT. The business supports a competitive wholesale electricity market through a safe, secure and reliable network which provides a level playing field for all participants, including consumers.

TransGrid is committed to delivering affordable services against a background of:

- Changing consumer expectations, with the rise in household solar PV, and significant developments in battery storage
- The increased awareness of electricity prices
- Fast-paced technology and economic developments which will continue to shape the future of the grid.

TransGrid embraces these changes and believes that the transmission network will enable new energy services, while maintaining security and reliability of supply as required. The recent system black events in South Australia are a reminder that significant changes to power systems need to be well considered.

TransGrid is committed to engaging with stakeholders and being responsive to their needs. Understanding the impact of potential implications to the power system and energy market for customers and consumers is an important consideration for the business. The continuous evolution of the new energy ecosystem brings new challenges and exciting opportunities for the power industry. TransGrid embraces these challenges and leverage opportunities which will enable the business to operate as efficiently as possible. TransGrid is dedicated to managing transmission price impacts and maintaining security and reliability of supply.

2.8 Context for the revenue proposal

This revenue proposal is built upon meeting stakeholder expectations for transmission services, informed by engagement with customers, consumer representatives and other stakeholders. Forecast demand, expected changes in generation, asset risk profiles, regulatory requirements and new network reliability standards all underpin the forecasts in this proposal.

2.8.1 2018/19 to 2022/23 regulatory period

Important changes in TransGrid's operating environment in the 2018/19 to 2022/23 regulatory period include:

- **More decentralised and intermittent generation:** Over the next five years, there will be a change in generation in NSW representing around one quarter of the current installed generation capacity. AEMO's 2016 Statement of Opportunities includes the retirement of the Liddell power station (2,000MW in March 2020) and three committed wind projects totalling 198MW and 24 proposed wind projects (total capacity 4,723MW). This will fundamentally change the pattern of power flows on the network.

  TransGrid has proposed contingent projects, ensuring that potential network impacts can be managed in the event that constraints become likely, safeguarding investment decisions in the long term interest of customers and consumers.

- **Changes in electricity consumption patterns:** A combination of improving appliance energy efficiency, continued solar uptake, some battery storage uptake and retail offerings enable greater consumer control. While NSW peak demand growth is very small, TransGrid expects demand growth in some areas, due to housing and industrial development in specific locations.

  TransGrid has adopted a probabilistic planning approach to allow for a targeted investment program. Tailored to network investment requirements as they emerge, the planning approach minimises costs for customers and consumers. This approach is described further in Chapter 4 and Appendix G.

- **Regulatory and market framework changes:** NSW electricity transmission reliability standards have changed in the month prior to submitting this proposal. A range of reviews initiated by the COAG Energy Council in October 2016[8] are underway which could also impact on TransGrid's operations.

  TransGrid has prepared the capital expenditure forecasts on the basis of the draft standards published in May 2016. Some changes have been made to the capital program as a result of differences in IPART's "Supplementary Draft" of September 2016. A review of the capital program is currently underway to assess any changes arising from the final standards published in December 2016 and TransGrid will update the AER on the outcome and provide necessary revisions as soon as is practicable. However, following publication of the final standards, TransGrid can confirm one change has already been identified. This new requirement at Broken Hill has been included as a contingent project, and is discussed further in Section 5.5.5.

- **Driving business efficiencies:** While engaging with stakeholders on the revenue proposal, TransGrid has discussed the impact of business efficiency initiatives implemented across the business.

  These initiatives will reduce expenditure in 2016/17 and are reflected in the forecasts looking forward for both operating and capital expenditure.

[8] These include: an independent review by the Commonwealth Chief Scientist to develop a national reform blueprint to maintain energy security and reliability in the NEM and an AEMC review of possible systemic issues which will influence power system security.

2.8.2 Beyond the regulatory period

TransGrid is already planning and operating the network with these more complex needs in mind. With input from stakeholders, TransGrid considered the possible impacts on planning, operating and managing the NSW electricity transmission network over the coming period. Further actions will follow over future regulatory periods as the specific shape of the energy ecosystem becomes clearer.

2.8.2.1 Electricity Network Transformation Roadmap

TransGrid is a participant in the joint CSIRO and the Energy Networks Association (ENA) project to develop an Electricity Network Transformation Roadmap. This process and findings from TransGrid's NSW Energy Forum in 2016, informed the development of TransGrid's Network Vision 2056. This document sets out a framework for preparing for the future and is used to inform planning activities now. This framework sets out a view of:

- Flexible planning - including developing the network to accommodate uncertain future conditions and diverse customer needs, using a combination of the right asset and non-network options for the most efficient outcome. This requires an in-depth understanding of end-users preferences.
- Scalable operations – where the capacity of the network and parameters of transmission services can be scaled depending on what other network users are doing.
- Efficient asset management – in light of the potential for asset utilisation profiles and therefore risk levels to change, efficiency in asset management will require more detailed asset information and analytic capability.

The Network Vision and how it applies to network planning is described in Chapter 4 and included in Appendix A. The document has been shared with customers, consumer representatives and other stakeholders and is available on TransGrid's website.

2.8.2.2 Stakeholder views on longer term issues

The Network Vision 2056 and the latest Transmission Annual Planning Report (TAPR) have been useful in facilitating engagement with stakeholders. Such engagement is especially important as it helps ensure TransGrid is flexible in its investment decisions which typically have longer term consequences to customers and consumers.

Recent engagements with customers and stakeholders regarding the longer term indicate that:

- While customers and consumers are focused on price, many are equally or more concerned about the consequences of reliability and security of supply.
- As electricity costs continue to rise, customers and consumers have a strong interest in TransGrid's plans for future maintenance and investment in the network. They want to see capital expenditure proposals tested, especially to ensure that non-network solutions are properly considered.
- Similarly, there is an interest in innovation around non-network solutions and stakeholders would like to see TransGrid further support reforms that enable a level playing field for these.
- As the energy ecosystem continues to evolve, customers and consumers are interested to see how changes in technology and consumer behaviour impacts TransGrid's long term strategy.

2.9 Changing generation patterns

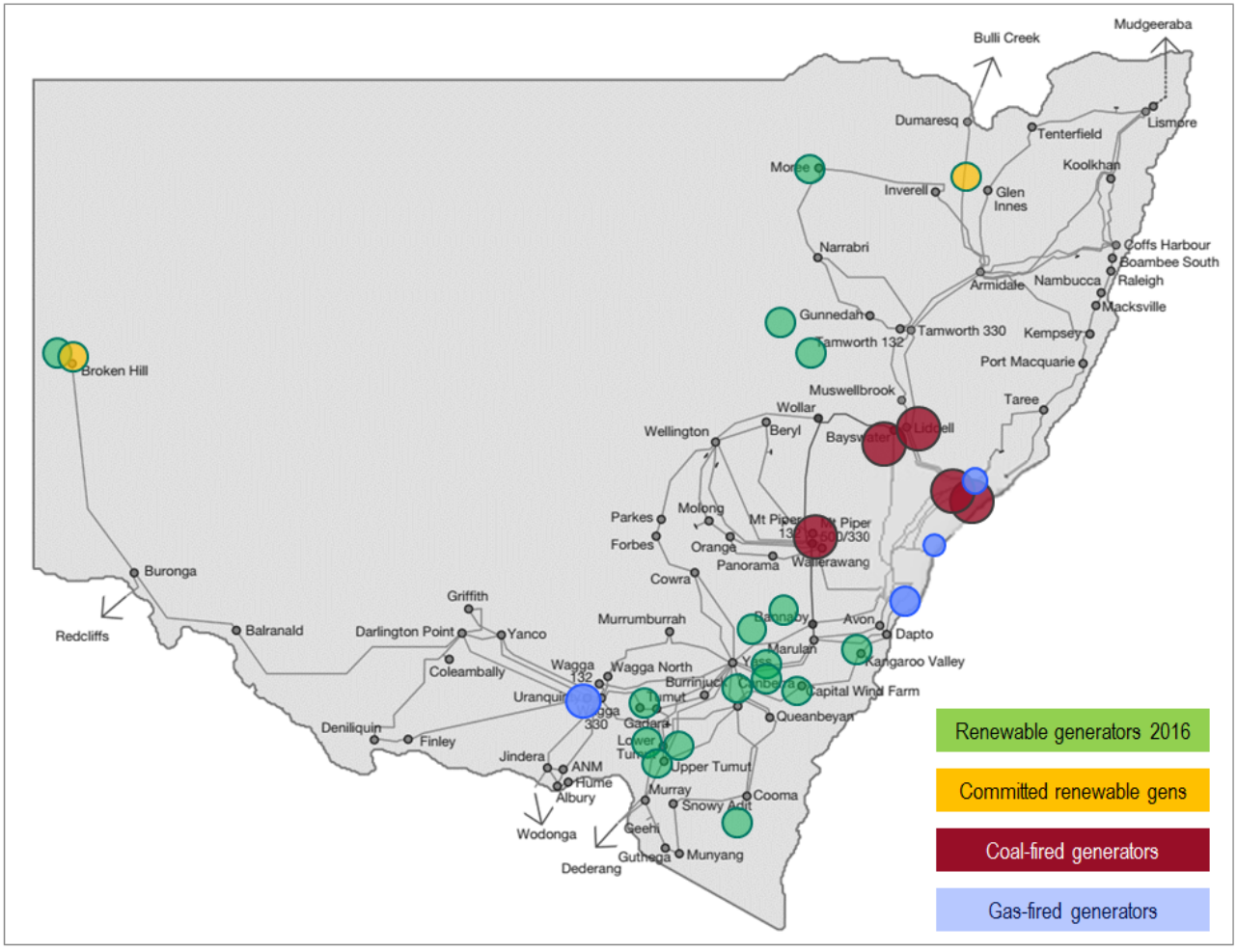
Significant changes in generator type and location are forecast in NSW and the complexity of managing the transmission network will inevitably increase. TransGrid is committed to providing new generation with access to the NEM and will work with stakeholders to maintain security and reliability of supply while managing the impact on transmission prices.

Over the next ten years, AEMO forecasts suggest a net increase in connected generation capacity of up to 3,500MW, even after two older thermal power stations are retired. The largest increase will be the amount of wind generation.

The total number of scheduled and semi-scheduled generators in NSW will increase from 23 to close to 50 by 2026, with new generators connecting in diverse locations, away from main load centres.

Figure 2.3 and 2.4 indicate the changing landscape of generation type and locations between 2016 and 2026 (the period which AEMO forecasts).

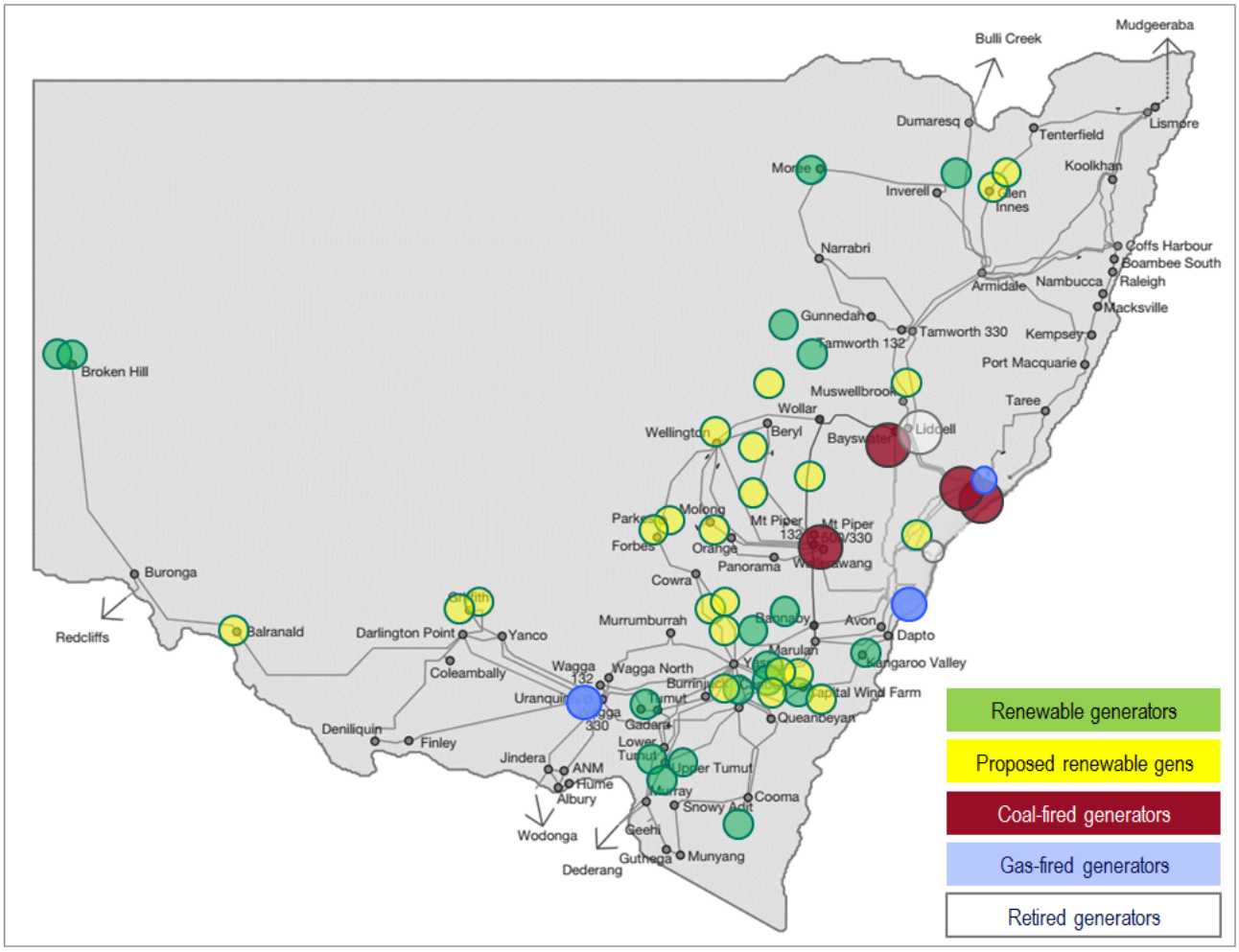
Figure 2.3: Existing and Committed Generation NSW 2016[9]



Source: TransGrid, utilising data from AEMO Electricity Statement of Opportunities (November 2016; December 2014).

[9] The terms 'committed' and 'proposed' are the terms used by AEMO in forecasting potential future generation – they relate to the likelihood of a project proceeding. Proposed generation will not all eventuate and others not yet identified may connect instead.

Figure 2.4: Existing and Proposed Generation NSW 2026[10]



Source: TransGrid, utilising data from AEMO Electricity Statement of Opportunities (November 2016; December 2014).

Generation changes of this extent will alter power flows on the transmission network and these may become less predictable due to the intermittent nature of new generation. New network constraints and other network management issues are likely to emerge. TransGrid notes that the exact cause of the system black event in South Australia in September 2016 is under investigation. Nevertheless, such events are a reminder of the need to be diligent while the power system is changing.

Through this period of change TransGrid will:

- Be responsive to customers and will facilitate new generator connections efficiently while carefully managing potential impacts on the power system and all of its users
- Engage regularly with peers and other stakeholders
- Identify and manage emerging risks, applying non-network solutions and innovation where appropriate
- Manage transmission price impacts

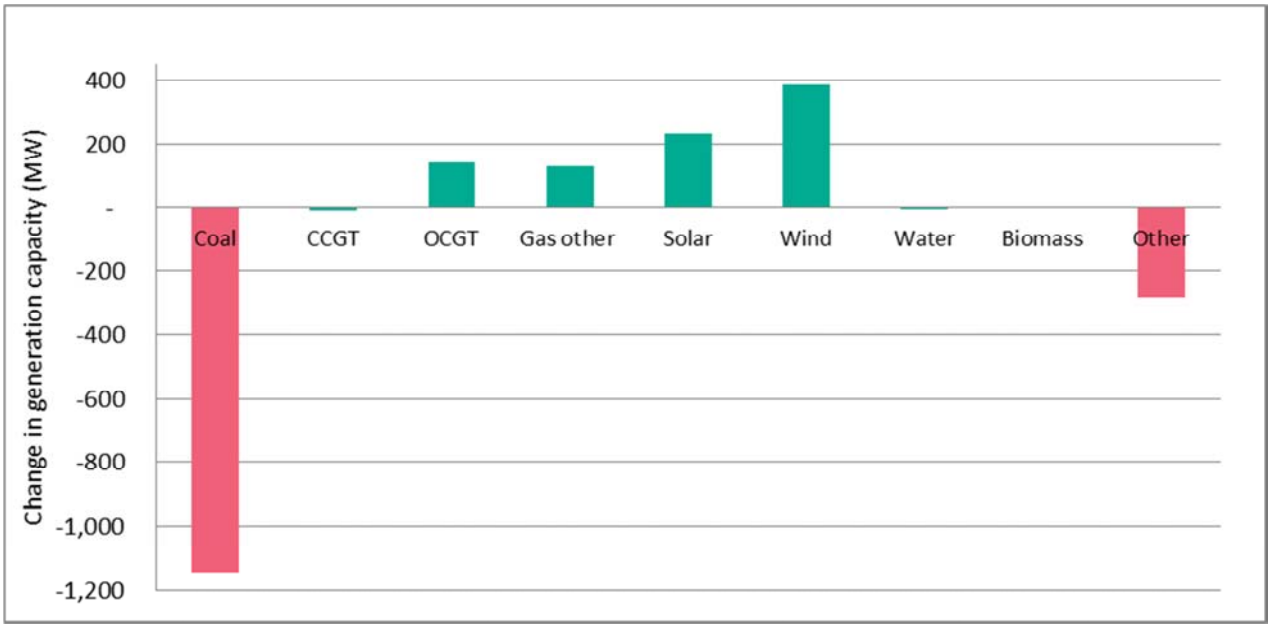
[10] The terms 'committed' and 'proposed' are the terms used by AEMO in forecasting potential future generation – they relate to the likelihood of a project proceeding. Proposed generation will not all eventuate and others not yet identified may connect instead.

There will be an increasing trend in the decentralisation of generation, particularly if energy storage allows small intermittent generators like rooftop solar to store energy for use at peak times. While the short term impacts are less of a direct issue for transmission, TransGrid will continue to monitor the impacts of this. It will also retain its involvement in grid level energy storage trials, to facilitate the wider integration of this in the future at larger scale, especially where there may be opportunities to defer network expenditure.

2.9.1 Recent generation changes

The profile of generation has already started to change with large thermal (coal and gas fired) generation being replaced with more renewable generation in diverse locations. Figure 2.5 shows the changes in generation capacity by plant type reported by AEMO since 2014. There has been a net 500MW reduction in generation capacity in the last two years. This includes the retirements of Redbank and Wallerawang coal-fired power stations with a combined capacity reduction of 1,140MW (or around 7%). An increase in other types of generation has offset this, notably an increase in wind and solar capacity of 616MW over the same period. This change has been reflected in TransGrid's connection activities, which have increased significantly.

Figure 2.5: Changes in NSW generation capacity 2014-16 (MW)



Source: AEMO Electricity Statement of Opportunities (NSW data from November 2016 and December 2014)

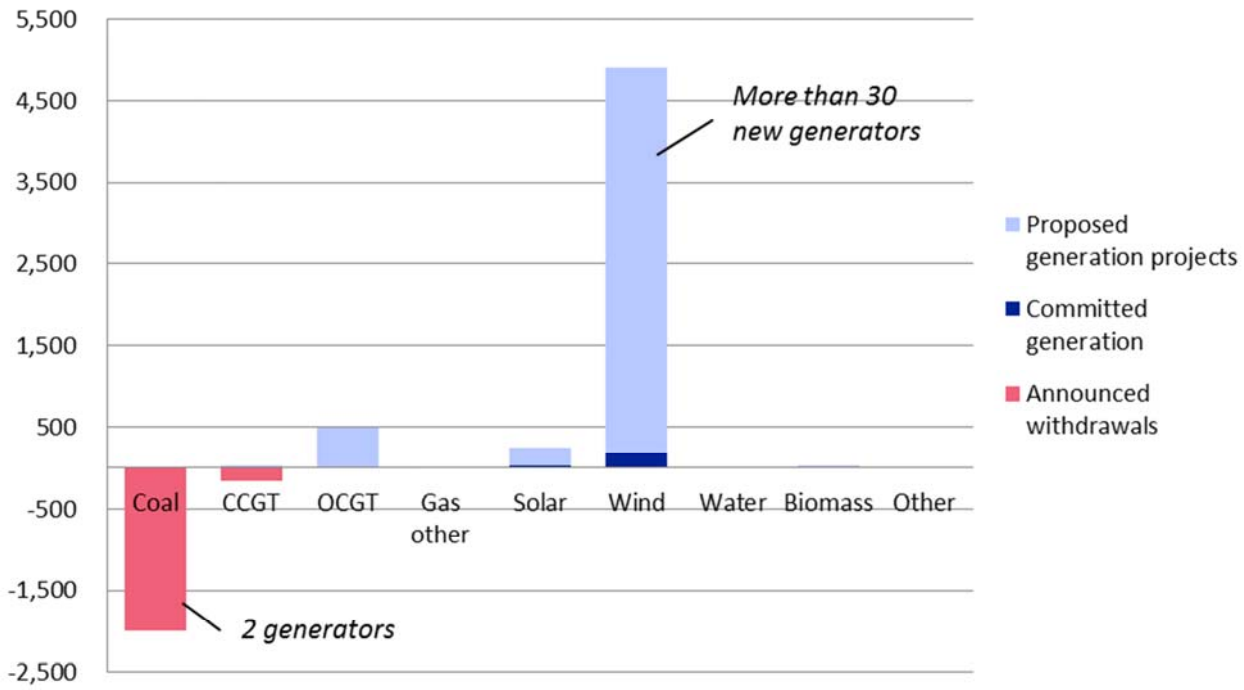
The majority of prospective wind power capacity is along the Great Dividing Range in the Southern Highlands and New England areas. Larger scale solar generation projects are tending towards western parts of TransGrid's network.

New and proposed generators are smaller in size than existing generators. They are also tending to different locations and remote from the major load centres of Newcastle, Sydney and Wollongong. The loading of the network around the new connections will increase and the power flows between those areas and the major load centres will increase. It is expected that TransGrid's network will become more complex to manage as a result.

2.9.2 Forecast generation capacity

This pattern of geographic diversity and higher numbers of connected generators is expected to continue into the future as the installed generation capacity increase significantly. Figure 2.6 shows the breakdown of a forecast net increase of 3,485MW in generation capacity over the next ten years.

Figure 2.6: Forecast changes in NSW generation capacity 2016-2026 (MW)



Source: AEMO Electricity Statement of Opportunities (NSW data from November 2016)

2.9.2.1 Large generation

The largest announced retirement is the Liddell coal-fired power station, with a capacity reduction of 2,000MW. The retirement of Smithfield CCGT has also been announced.

Through 2026, the total "proposed" new generation capacity in NSW is 5,458MW[11] – about one third of the capacity currently connected. In contrast to retirements at two locations, the capacity increase will be the result of more than thirty new generators connecting.

While not all the projects which are currently proposed will go ahead, policy support through the Renewable Energy Target will drive a large amount of new connections. The implications on TransGrid are that there is likely to be local capacity constraints to manage. The power flows towards the main load centres will change, and forecasting these at critical times may be more complex, as much of the new generation will be from intermittent sources. TransGrid has proposed three contingent projects to enable it to respond to such constraints when they become more certain.

These changes are expected to continue into the next decade, as thermal power stations reach the end of their lives and if the expected move towards lower carbon generation sources continues.

[11] This uses AEMO's standard terminology, which applies a set of criteria to generation projects for which there is a registered interest to provide guidance on their likelihood.

2.9.2.2 Distributed generation

Along with the changes described above for large generators, it is expected that an increase in small distributed generators will continue. The solar capacity forecast shown in section 2.10.5 represents the majority of AEMO's forecast for all distributed generation to 2022/23.

Distributed generation will have more of an impact after the 2017/18 to 2022/23 regulatory period, especially when advances in battery technologies are expected to lead to the increased take-up of storage options across the supply chain.

In the longer term, TransGrid believes that energy storage will be influential at transmission level. In line with this, a project is being implemented under the current Network Capability Incentive Parameter Action Plan (NCIPAP) scheme. This project seeks to investigate how well energy storage can be used to manage network constraints and its potential for "smoothing" the output of intermittent generation sources.

2.9.3 Managing generation changes

The NSW transmission system is located at the centre of the National Electricity Market with strong interconnections to the north and south. It is considered to be less susceptible to the type of event which occurred in South Australia. For example, AEMO's 2016 Electricity Statement of Opportunities concluded that there was not a credible risk of islanding of the NSW transmission system under foreseeable outage conditions.[12]

The robust nature of the TransGrid network should not allow for complacency and TransGrid considers that:

- Significant changes to a large inter-connected power system should always be considered carefully
- The central position of the NSW transmission system within the NEM could allow TransGrid's network to be the basis for relieving forecast problems elsewhere. This could include providing new or stronger interconnections.

2.9.3.1 Effective engagement

Central to TransGrid's approach to facilitating change and efficiently managing power system risks is to effectively engage with a wide range of stakeholders. This will ensure that TransGrid has the latest possible planning information and that stakeholders understand any network issues.

In 2016 TransGrid led a campaign as part of our commitment to actively advocate for stronger system security and stability. TransGrid will also continue to actively participate in regulatory, policy and market framework change processes.

TransGrid notes that the COAG Energy Council initiated a range of work programs in October 2016 to consider whether a policy response to the South Australian system black event is required.

2.9.3.2 Planning for uncertainty

TransGrid will continue to enhance network planning, so that it can efficiently respond to uncertainty in the timing location and size of new generators. Using enhanced planning information and through effective engagement with peers, generators and AEMO, TransGrid will proactively identify and respond to issues before they impact reliability and security of supply.

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[12] AEMO's report did not foresee the risk of system islanding in NSW as a result of a lack of frequency control or due to a low synchronous inertia in the system. '2016 Electricity Statement of Opportunities', Australian Energy Market Operator, Update 2 (21/9/16), p. 26 [TransGrid-AEMO-2016 Electricity Statement of Opportunities V2-0916-PUBLIC]

As an example, of this, TransGrid notes that it was in discussion with ElectraNet about potential market and system benefits of an interconnection with South Australia prior to the system black event. The proposed South Australia – NSW interconnector is included in the revenue proposal as a contingent project.

TransGrid has also identified three other contingent projects which respond to generation uncertainty. These are in the interest of consumers as they do not lead to capital expenditure unless the trigger events occur.

2.9.3.3 Wide area communications automation

The future smart network will be highly adaptable and will need to respond in real-time to consumer behaviour and intermittent generation output. To enable this, widespread high-speed communications are essential to enable the fast control schemes which will maintain grid stability.

TransGrid is in the process of enhancing its operational communication system. This envisages more real-time monitoring with integrated sensors, measurement devices and management systems in the network, supported by high-capacity, fast and reliable communications. This will enable more sophisticated demand monitoring and network control to manage the impacts of generation intermittency, for example. It will enhance reliability and security of the power system when there are unplanned outages, including when high impact, low probability events occur.

2.10 Electricity demand

2.10.1 Source of forecasts

TransGrid uses electricity demand forecasts from two main sources.

- The NSW state-wide energy and peak load forecasts developed by AEMO are published annually in its National Energy forecasting Report (NEFR) and are the primary forecasts used for TransGrid's main system planning
- The peak load forecasts for bulk supply points (BSPs) provided by the electricity distributors (DNSPs) and directly-connected customers are also used for sub-system planning and connection point planning

TransGrid reviews the AEMO state-wide forecast in conjunction with the DNSP BSP forecasts and revises them if required prior to use for NSW transmission planning and publication in the Transmission-Annual Planning Report (T-APR). TransGrid's review of 2016 demand forecasts revealed that no revision is required for state-wide demand forecast or BSP forecasts.

Differences between AEMO state-wide forecasts and the sum of bulk supply point forecasts are explained by:

- Diversity (ie, non-coincidence) of the maximum demand at the BSPs, making the maximum state-wide demand less than the sum of the maximum demand at each BSP.
- Differing locational granularity and different forecasting methods utilised by AEMO compared to bottom up forecasts. DNSPs forecasts at the BSP level are more granular and include any known changes to specific spot loads which are not specifically taken into account through the AEMO forecast.
- Weather correction approaches are different, with DNSP forecasts correcting with more granular weather data.

2.10.2 Economic outlook

Economic development indicators are integral to considering possible future peak demand and energy growth. AEMO's National Energy Forecasting Report 2015 forecast in its medium scenario that the New South Wales and ACT economy would grow at an average annual rate of 2.6% from 2017–18 to 2024–25. In 2015/16, the NSW economy experienced Gross State Product growth of 3.5% - the highest of any State[13]. The 2015/16 outcomes reflects some impact from the early stages of investment activities which will continue into the next regulatory period.

These influential drivers of economic activity in NSW and ACT include:

- A significant pipeline of land transport infrastructure investment, including the WestConnex road project, and two Sydney Metro rail links (with total forecast cost of around $20 billion[14]).
- The development of Western Sydney Airport at Badgerys Creek.
- Commercial property development, with large commercial projects in Sydney such as the Barangaroo development and the International Convention Centre Sydney.
- Population growth, with the latest NSW Department of Planning and Environment forecasting a net increase of over one million (or fifteen per cent) between 2016 and 2026.[15]
- Residential development, with general building approvals at levels which are higher than historic averages. The NSW Department of Planning and Environment has forecast the number of dwellings in NSW to increase by just less than half a million from 2016 to 2026.[16]
- A continuing shift from an energy-intensive manufacturing based economy to one with more focus on services.

2.10.3 Powering Sydney's Future

The inner Sydney electricity network supports a highly densely populated area which makes a significant contribution to Australia's economy. Powering Sydney's Future is designed to ensure a reliable and secure electricity supply to this important economic area in light of deteriorating assets and increasing levels of forecast unserved energy.

Feasible options have been identified taking account of factors including geography, cost, community and environmental impacts, planning considerations and technical feasibility. The most feasible options are considered to include a combination of non-network options (if available in the right size and location) and 330kV cables from Rookwood Road to Beaconsfield West. These are currently the subject of a regulatory investment test for transmission (RIT-T) consultation and the first round of submissions closed in January 2017. The project will evolve as a result of this and as more detailed assessment is completed. TransGrid is engaging with all stakeholders around this important project.

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13 As published by the Australian Bureau of Statistics in data series, '5220.0 - Australian National Accounts: State Accounts, 2015-16', November 2016

14 Sydney Metro City and South West Final Business Case Summary, October 2016 [TransGrid-NSW Government-Sydney Metro City and South West Business Case Summary-1016-PUBLIC]

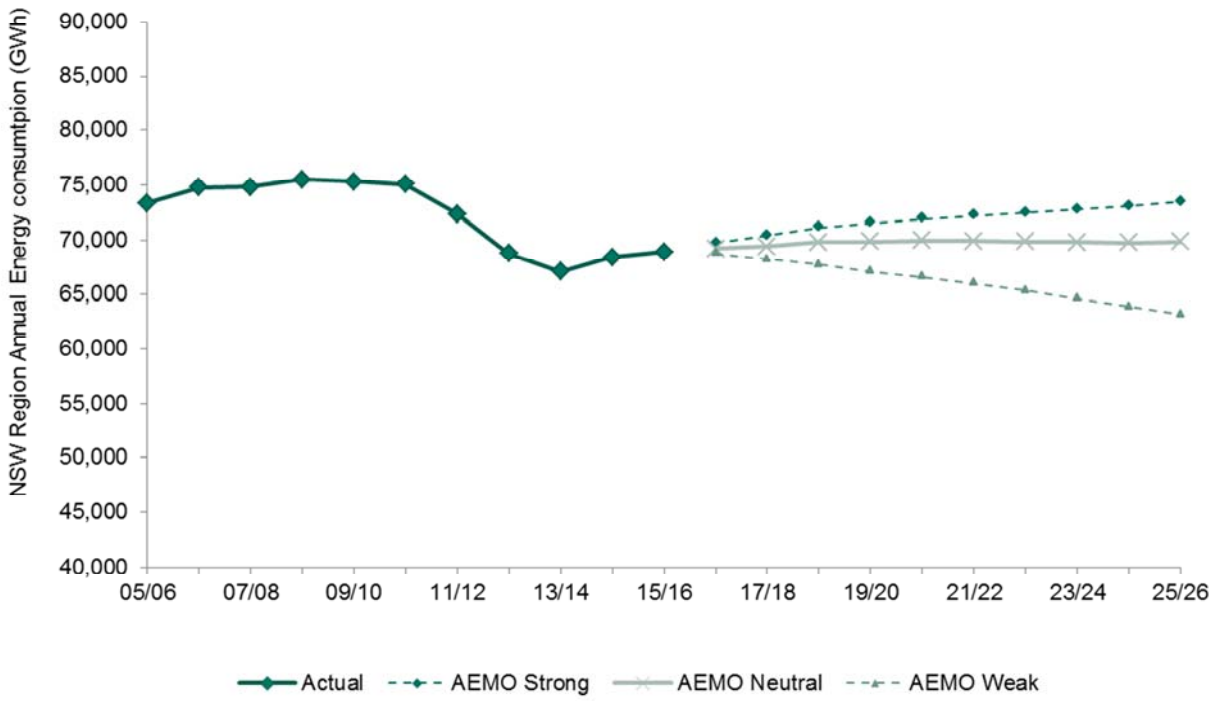
15 '2016 New South Wales State and Local Government Area Population Projections.xls', NSW Department of Planning and Environment, 1 July 2016 [TransGrid-NSW Department of Planning and Environment-NSW state and local government area population projections 2016 xls-0716-PUBLIC]

16 '2016 New South Wales State and Local Government Area Household Projections and Implied Dwelling Requirements.xls', NSW Department of Planning and Environment, 1 July 2016 [TransGrid-NSW Department of Planning and Environment-NSW state and local government area household and implied dwelling projections 2016 xls-0716-PUBLIC]

2.10.4 NSW energy consumption

Annual energy consumption in NSW fell between 2009/10 and 2014/15. This is attributed to changes in the economy noted above, improved energy efficiency and the uptake of solar panels[17].

Figure 2.7: Annual NSW electricity consumption (GWh)



Source: AEMO's National Electricity Forecasting Report 2016

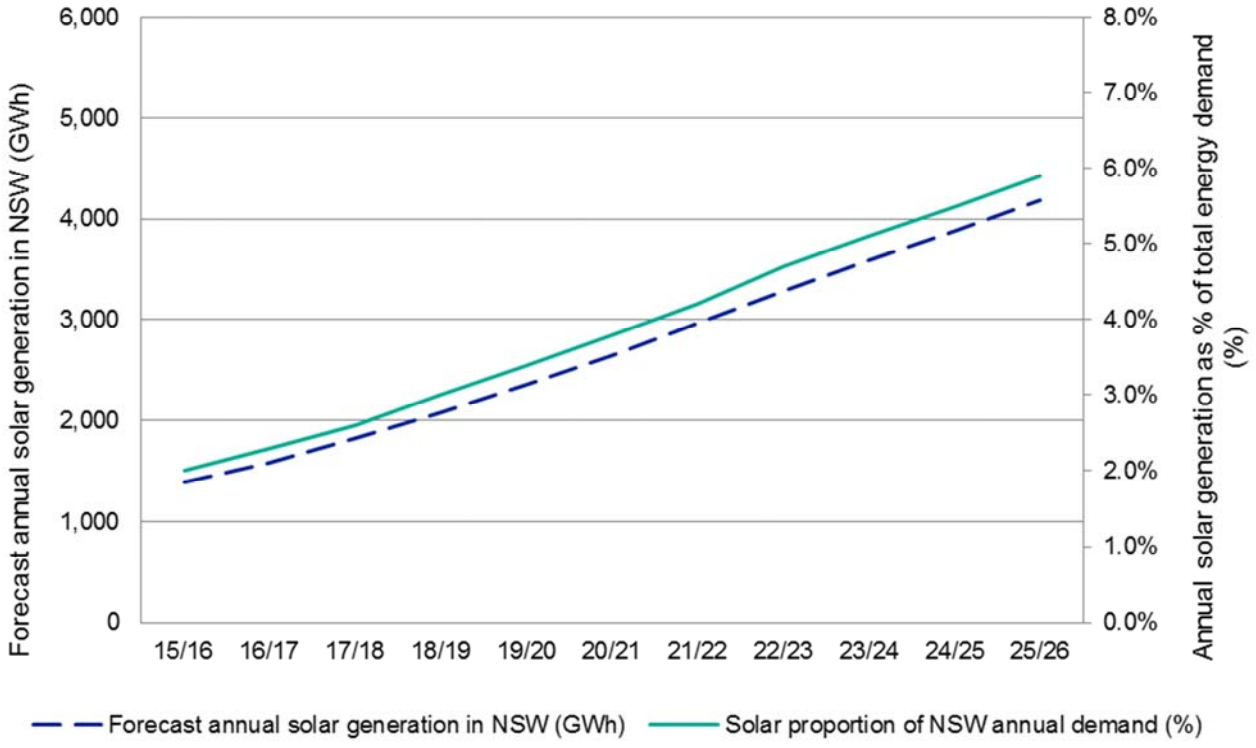
During the current regulatory period, there has been a reversal in this trend and annual consumption in NSW increased slightly in 2014/15 and 2015/16. It also appears to have increased again in 2016/17 based on year to date figures. Over the next ten years, AEMO forecasts energy consumption to grow at a modest rate. This is a result of economic and population growth, moderated by improving energy efficiency in both residential and business sectors and the ongoing uptake of rooftop solar generation.

[17] See for example 'National Electricity Forecasting Report', p17,June 2016, Australian Energy Market Operator [TransGrid-AEMO-2016 National Electricity Forecasting report-0616-PUBLIC]

2.10.4.1 Contribution of solar

As noted above, small-scale solar generation is continuing to increase in NSW and is a factor in offsetting the electricity consumption. Figure 2.8 shows the expected increase in electricity generated by small-scale solar in NSW, which will contribute about 6% of supply in the state by 2026.

Figure 2.8: Forecast solar generation in NSW and solar's increasing contribution to supply



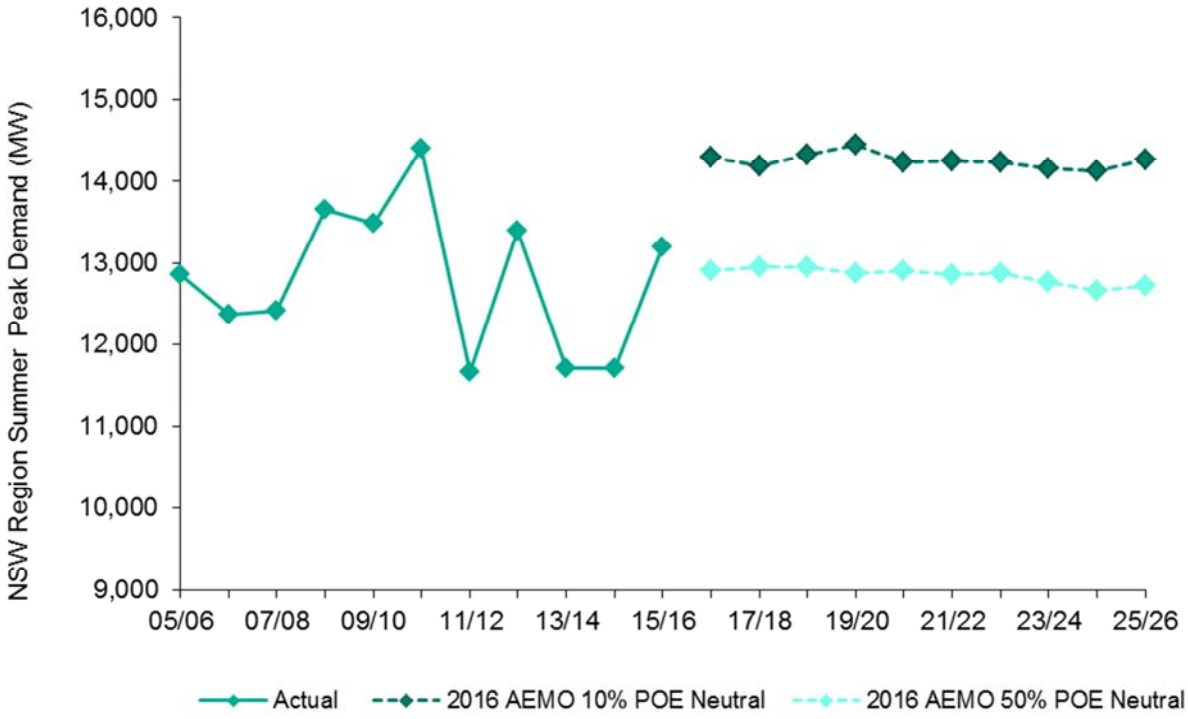
Source: AEMO National Energy Forecasting data (updated 7/9/16)

2.10.4.2 NSW peak demand

The latest AEMO neutral forecast predicts that summer peak load for NSW (50% probability of exceedance) will remain almost flat through the next regulatory period and will decline slightly thereafter.

Over the ten year forecast period, summer peak demand is forecast to fall by 1.4% in total. However, this view of state-wide average peak demand growth masks some location specific trends, some areas are expected to experience growth and some may see reducing peak demands.

Figure 2.9: AEMO forecast summer peak load for NSW (MW)

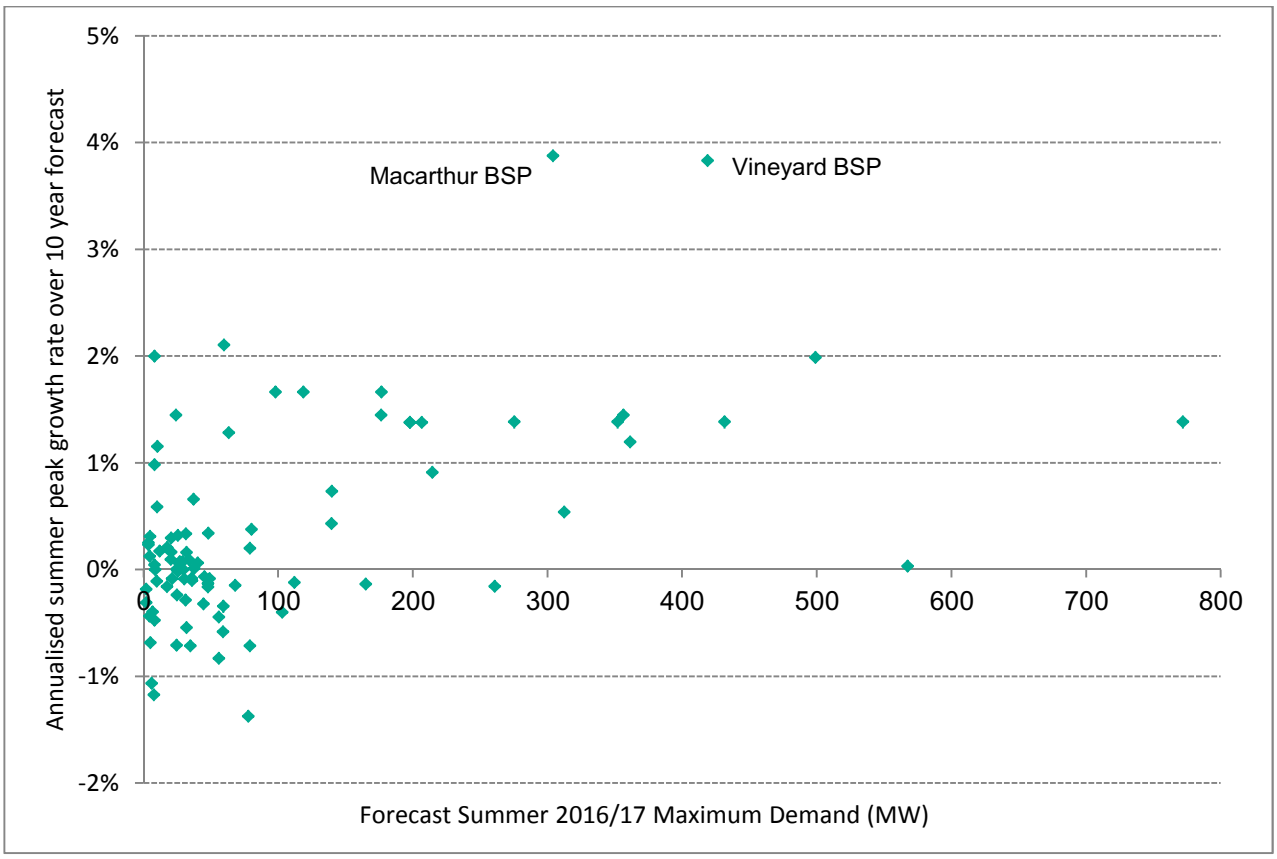


Source: AEMO's National Electricity Forecasting Report 2016

2.10.4.3 Peak demand at specific supply points

There are specific bulk supply points (BSP) which are forecast to experience growth rates different from the NSW average over the whole period. Figure 2.10 shows the ten year annualised forecast growth rates of almost 4% for Vineyard and Macarthur bulk supply points.

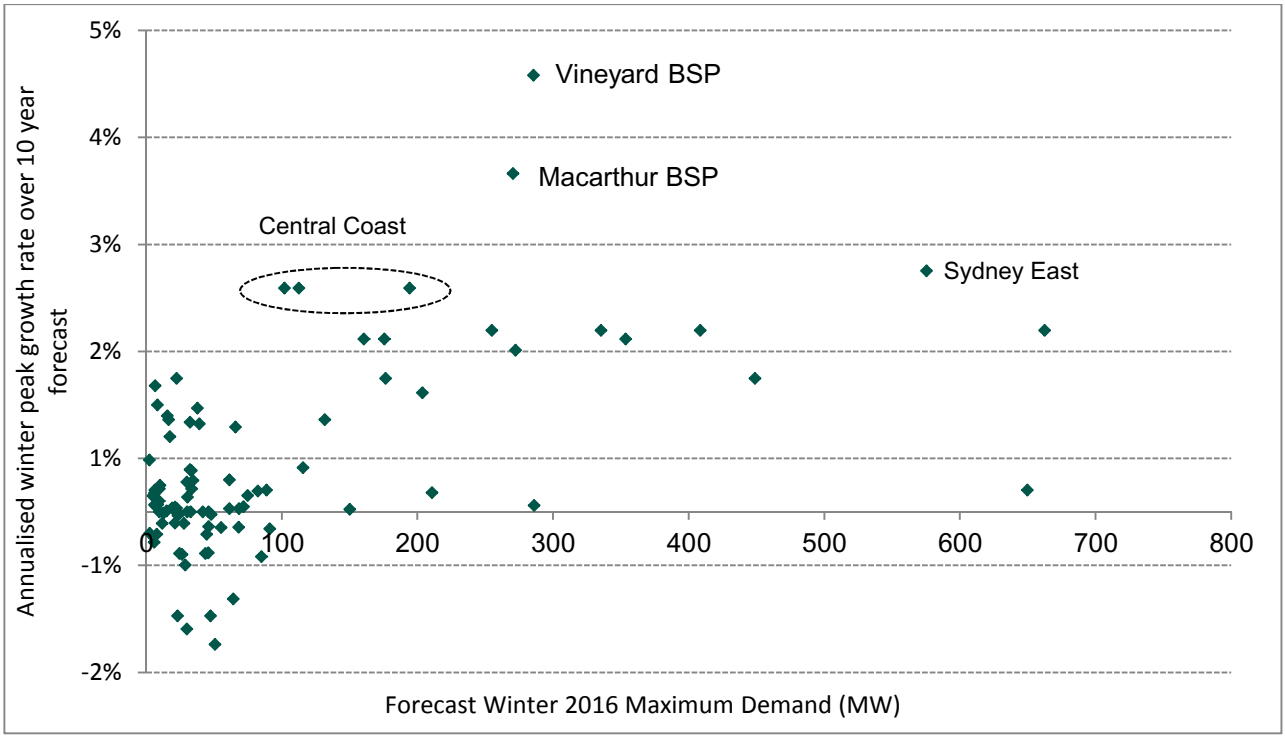
Figure 2.10: 10 year annualised summer peak growth and 2016/17 maximum demand by BSP (MW)



These supply points are related to the North West Growth Centre and the South West Growth Centres in Sydney's west. A further three bulk supply points have growth rates of 2% per annum or more.

Figure 2.12 identifies that higher growth in winter peak demand is also forecast in Sydney's growth centres as above, and at Sydney East and on the Central Coast (which encompasses three BSPs). Augmentation capital expenditure is required to cater for the growth at Macarthur and Vineyard.

Figure 2.12: 10 year annualised winter peak growth and 2016/17 maximum demand by BSP (MW)



2.10.4.4 Potential new demand

The connection of large new spot loads such as mines adds further complexity to network planning and transmission network management as this can create capacity constraints. TransGrid is responsible for meeting reliability obligations in the NSW and ACT region and accountable for all transmission planning and investment decisions. As mentioned previously, TransGrid uses AEMO state level forecasts for main system planning and DNSP forecasts for specific connection point analysis. TransGrid is aware of possible new loads within the regulatory period which have not been identified in DNSP and AEMO forecasts so an additional review has been conducted to supplement these forecasts.

TransGrid engaged Ernst and Young to identify scenarios where these new loads were likely to create network constraints and potentially drive new investment requirements. The resulting scenarios were used in a probabilistic planning analysis to forecast related capital investment[18]. The approach to probabilistic planning is summarised in Chapter 4 with more detail in Appendix G.

2.11 Revenue proposal details

2.11.1 Length of regulatory control period

This revenue proposal is for the 2018/19 to 2022/23 regulatory period, which commences on 1 July 2018 for a period of five years.

[18] These are detailed in supporting documents, 'EY, Report to TransGrid on load developments, October 2016 [TransGrid-EY-Report to TransGrid on load developments-1016-PUBLIC]' and 'EY, TransGrid load databook, October 2016' [TransGrid-EY-TransGrid load databook-1016-PUBLIC]

2.11.2 Basis of numbers

In this proposal, forecast and historical expenditure is presented in real June 2018 (2017/18) dollars to facilitate comparison of trends. The regulatory asset base (RAB) and revenue are presented in nominal dollars in alignment with the post-tax revenue model (PTRM).

2.11.3 Cost allocation

The forecast expenditure in this revenue proposal is for the provision of prescribed transmission services only. The allocation of costs has been made in accordance with TransGrid's approved cost allocation methodology.

Expenditure has been allocated to capital and operating expenditure in accordance with TransGrid's Expenditure Capitalisation procedure. A copy of this procedure has been provided to the AER as supporting information as part of this revenue submission[19].

2.11.4 Confidential information

TransGrid has not identified any aspects of this revenue proposal to be confidential. TransGrid has not identified any aspects of the appendices to be confidential with the exception of Appendix N KPMG 2016 Utilities IT Benchmarking Report.

[19] This document is supplied in the RIN supporting documentation [TransGrid-Expenditure Capitalisation-0414-PUBLIC].

3. Consumer and stakeholder engagement

TransGrid values the needs and views of its customers and electricity consumers and therefore proactively engages with a range of stakeholders including consumer advocates and representatives, local communities, small business, government bodies and regulators, in the development of its business plans and priorities.

TransGrid has embedded a best practice engagement model into network and planning processes to help deliver optimal solutions. TransGrid's engagement principles reflect a genuine desire to inform, consult and collaborate effectively, openly and in a transparent manner with interested parties. This is more important than ever with the expected changes in the industry,

A focused two-way engagement model benefits all parties:

- Through early engagement, TransGrid has an opportunity to ensure its decision making processes benefit from a wider perspective and shareholder, customer and consumer needs are balanced.
- TransGrid better understands the needs and views of customers, stakeholders and the communities in which it operates. By incorporating relevant insights, the planning and delivery of transmission services can be more effective and focused on customer needs.
- Stakeholders have access to increased transparency and can have greater confidence that TransGrid is making the right investment decisions, at the right time, and in the long term interest of customers and consumers.
- Long lasting relationships built and sustained with stakeholders, creating trust and advocacy.

This section describes:

- TransGrid's engagement activities
- Stakeholder and consumer engagement specific to this revenue proposal
- Engagement insights and how these have been applied
- Changing consumer expectations and characteristics.

3.1 Overview of consumer and stakeholder engagement

3.1.1 Focused and relevant external engagement activities

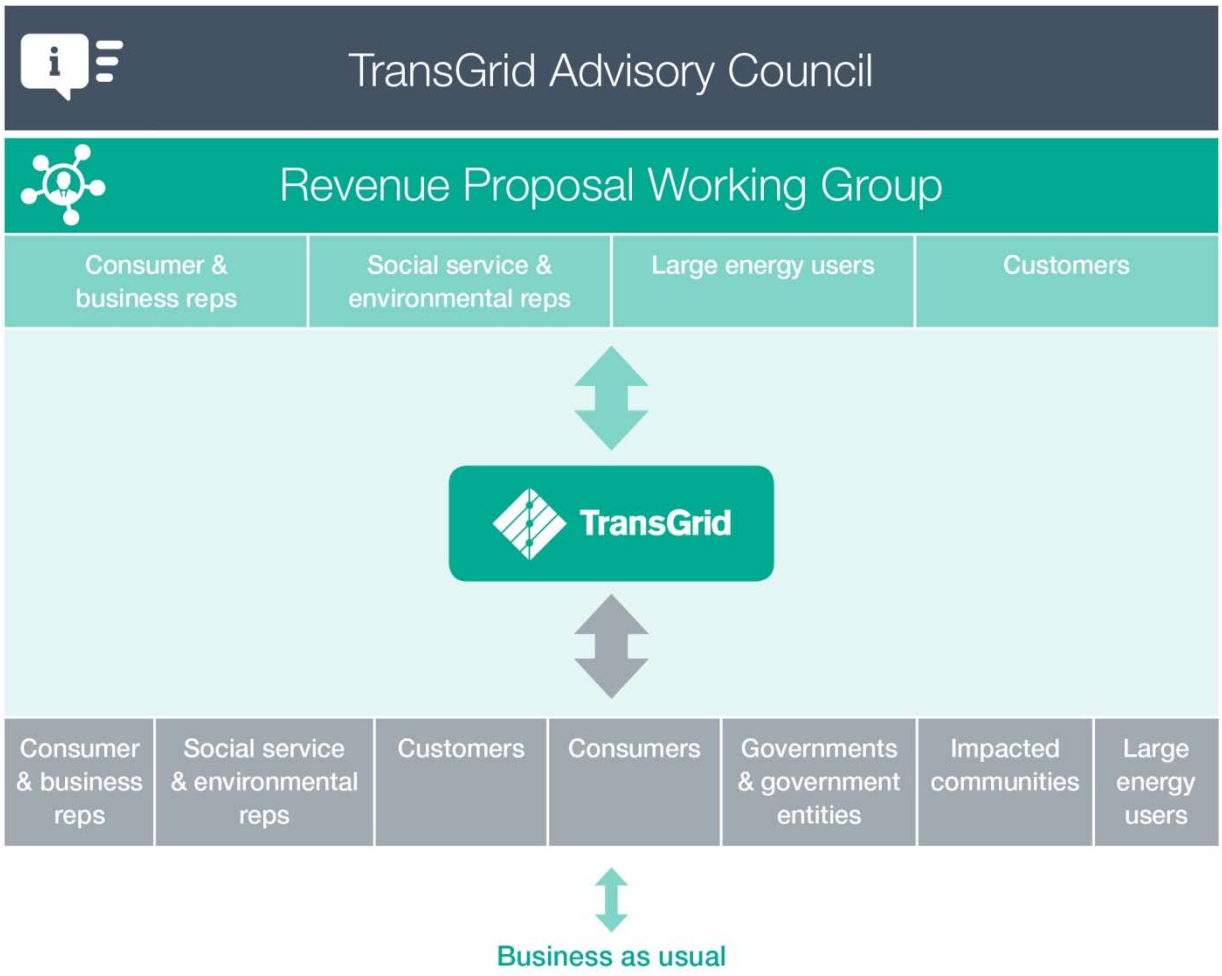
Building on previous engagement strategy and activities, TransGrid has continued to engage on its business plans and priorities and the electricity challenges faced across the NEM. TransGrid has enhanced its engagement program to deliver a streamlined, focused and strategic plan which is embedded into the business and demonstrates how feedback received is considered and reflected in its decision making.

Central to this revised approach is the establishment of the TransGrid Advisory Council (TAC). Its role is to act as a key stakeholder advisor to TransGrid, offering customer and consumer insights to improve the value of TransGrid's transmission services to NSW. The TAC forms a rich and consistent mode of engagement and comprises of executive level representatives from a cross-section of external stakeholders.

The TAC seeks to enable influential consultation on business priorities to inform business plans and operations. Noting that it is important to engage at a broader level, the TAC does not act as a substitute to other engagement activities.

TransGrid's engagement framework is summarised in Figure 3.1.

Figure 3.1: Overview of TransGrid's engagement framework



3.1.1.1 TransGrid Advisory Council and Revenue Proposal Working Group

The TAC represents a cross-section of consumer representatives, customers and stakeholders. Members were appointed based on their industry expertise and ability to advice on issues such as price, investment and innovation. The TAC meets four times a year and is chaired by TransGrid's Executive team.

Table 3.1 shows the organisations with representatives on the TAC.

Table 3.1: TAC members

Stakeholder group	Representative on TAC
Social service & environmental representatives	St Vincent de Paul NSW Council of Social Service (NCOSS) Total Environment Centre (TEC)
Consumer and business representatives	Energy Consumers Australia (ECA) Australian Industry Group City of Sydney
Customers and Large energy users	Snowy Hydro Tomago Goldwind Australia Woolworths Energy Users Association of Australia (EUAA)

The TAC's objectives are to:

- Provide advice and feedback on programs, initiatives and service issues to ensure the customer and consumer perspective is included in TransGrid decision making
- Act as a link to and from respective member organisation networks and ensure that stakeholder views are balanced with business and shareholder priorities and requirements
- Enable influential consultation on business priorities to inform business operations and plans that underpin TransGrid's 2018/19 to 2022/23 revenue proposal as well as other regulatory milestones or policy changes
- Identify an annual agreed set of priorities for discussion to guide council activities and implement success measures
- Provide a regular forum for information sharing and input on emerging issues
- Act as the point for consultation on emerging strategic policy issues and decisions
- Establish any required working groups to address issues that need more concentrated attention, on the basis that they will have a defined time and purpose.

Engagement around the revenue proposal took place through the TAC and the Revenue Proposal Working Group (RPWG). This is a temporary working group established under the TAC to ensure that customers, large energy users, consumer representatives and interested parties had an opportunity to understand and influence TransGrid's approach to the revenue proposal.

RPWG was led by TransGrid's Executive Manager, Strategy and Regulation with participation from other TransGrid Executives and senior management. External observers included staff from the AER and the Consumer Challenge Panel.

3.1.1.2 Other engagement activities

TransGrid recognises that stakeholder groups have differing levels of knowledge and interest in its business which is why it tailors its engagement program to include a variety of topics and channels. As well as the TAC and RPWG, in 2016 TransGrid launched the NSW Energy Forum to explore priorities for NSW, including how it can support a low carbon future and explore ways to shape the future of the grid. This forum invited a wide group of customers, consumers and industry stakeholders to offer thoughts and perspectives on TransGrid's operations.

Another engagement highlight was the Powering Sydney's Future forum, a joint initiative between TransGrid and Ausgrid. The forum brought together a wide variety of customers, consumer representatives and stakeholders to discuss the need and potential solutions for future reliability of the electricity supply in the Inner Sydney area. Powering Sydney's Future and the options being explored to address the identified network requirement are discussed in detail in Chapter 5 and Appendix B.

Other engagement activities offer customers and interested stakeholders the opportunity to interact and engage with TransGrid across a variety of areas including the Transmission Pricing Methodology, the NSW electricity transmission reliability standards review, ongoing face-to-face consultation on business operations and the future of the grid.

A summary of customer and stakeholder groups is provided in Table 3.2.

Table 3.2: Customer and stakeholder groups and engagement topics

Engagement issues and parties engaged	Large energy users	Impacted communities	Government & government entities	Consumers	Customers	Consumer & business reps	Environmental and social service reps
Transmission Pricing methodology	✓	✗	✓	✓	✓	✓	✓
NSW Energy Forum	✓	✗	✓	✗	✓	✓	✓
Revenue Proposal	✓	✓	✓	✓	✓	✓	✓
NSW reliability studies	✓	✓	✓	✓	✓	✓	✓
Project-specific consultations	✓	✓	✓	✓	✓	✓	✓
Easements and access	✗	✓	✗	✗	✗	✗	✗
Rule changes	✓	✗	✓	✗	✓	✓	✓
Environmental issues	✗	✓	✓	✗	✗	✗	✓
Joint planning	✗	✗	✗	✗	✓	✗	✗
Day-to-day customer service & ops	✗	✓	✗	✗	✓	✗	✗

3.1.2 Engagement effectiveness is improving

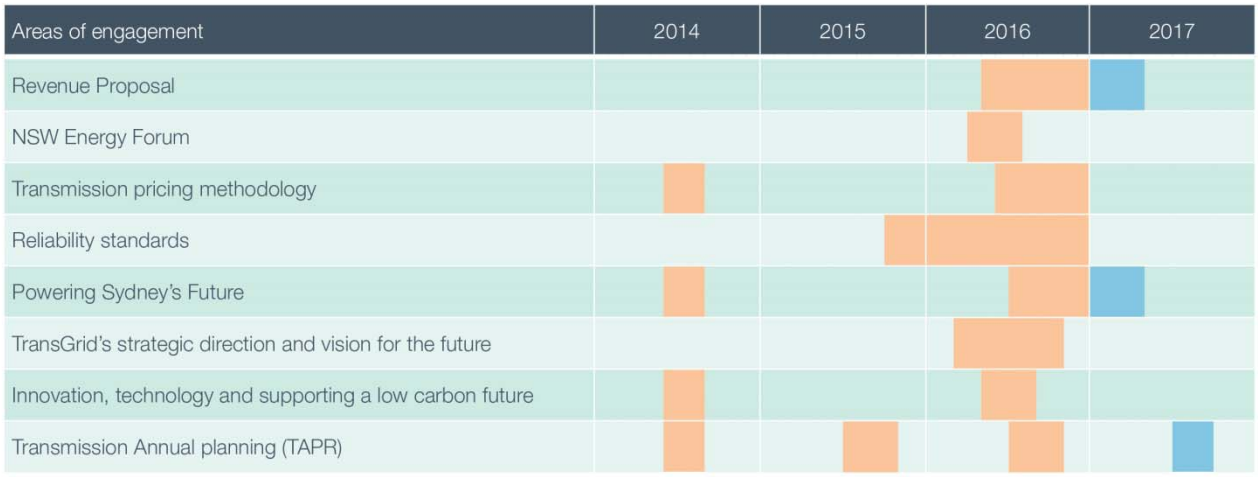
TransGrid is committed to measuring its engagement to further understand the ongoing value to stakeholders and seeks feedback on its performance in different ways. TransGrid's overall 'Net Advocacy Score' (NAS[20]) which measures the willingness of stakeholders to advocate for TransGrid has improved substantially over time.

TransGrid has also sought feedback through stakeholder surveys conducted independently by experienced researchers. The latest survey showed a significant improvement in 'trust in TransGrid to do the right thing' with an increase from 52% to 70% from 2015 to 2016. Such feedback is used to improve the quality and effectiveness of engagement activities but also informs the wider business more about what is most important to customers and stakeholders.

3.1.3 Recent and planned engagement activities

A range of recent and upcoming external engagements are summarised in Figure 3.2 with further detail provided in the following sections.

Figure 3.2: Recent and planned engagement activities



3.2 Stakeholder engagement around the revenue proposal

3.2.1 Engagement on the revenue proposal

TransGrid has listened to feedback from customers and consumers and adapted the revenue proposal in response to that input. A short summary of consumer engagement activities in relation to the revenue proposal and how feedback has been addressed is provided here with a more detailed account provided in Appendix C. The main forum for engagement was the RPWG, described above.

TransGrid designed the RPWG engagement process in line with IAP2's Core Values for Public Participation, to ensure that engagement was productive and valuable for its participants.

[20] NAS is an index ranging from -100 to 100. Any score above zero indicates that, amongst those surveyed, there are on average more advocates for TransGrid than detractors.

Key considerations for the engagement process included:

- Ensuring engagement is inclusive and focuses on understanding stakeholder needs, concerns and aspirations while recognising their time constraints by focusing on issues that they are most interested in and can influence
- Making engagement accessible and embedded as a business as usual activity and actively supported by senior and executive management
- Measuring stakeholders views or needs and using them to inform TransGrid's approach to the upcoming revenue proposal and is supported by the executive and senior management
- Facilitating timely two-way communication and building community and consumer capability and capacity when it comes to understanding how the business operates
- Balancing stakeholder views with business and shareholder priorities and requirements
- Fulfilling formal regulatory processes such as revenue resets.

RPWG meetings were held with participants in September, October and November 2016 through interactive roundtable discussions. RPWG meetings included members of the TAC plus the following additional organisations:

- Public Interest Advocacy Centre
- Sydney Water
- University of NSW
- Visy.

Meeting attendees provided insights into customer and consumer perspectives relating to areas of the revenue proposal.

As part of the RPWG meetings, TransGrid facilitated:

- Information sessions on the electricity market, regulation, incentive schemes and current developments in the energy sector
- Round table discussions on considerations for capital investment, demand response, operating expenditure, pricing and the Weighted Average Cost of Capital (WACC)
- A site tour of the Beaconsfield substation to help members visualise and understand key elements of the replacement expenditure program.

3.2.2 How customers and stakeholders have shaped the revenue proposal

Customers and stakeholders provided considerable insights in helping to shape the revenue proposal. Key feedback received during the RPWG meetings and TransGrid's subsequent actions are tabled below in table 3.3. A more detailed account of customer feedback and TransGrid's response is provided in Appendix C.

Table 3.3: RPWG Feedback

Feedback received	Actions taken by TransGrid
Customers commented on, and made recommendations to change TransGrid's proposed approach to output growth for forecasting operating expenditure	TransGrid changed its approach and adopted the recommendations. This has reduced the output growth trend and led to a $1 million lower operating expenditure forecast
Customers want TransGrid to invest in maintaining its assets to maximise their lives. In doing this, customers wanted to ensure that investments are made at the right time and are in their long term interest, minimising costs	TransGrid has improved the asset management strategy and risk framework. This proposal is centred on a capital program that is, efficient, innovative and in the long term interests of consumers
Customers wanted a reasonable explanation and justification for costs relating to the step change for off-easement vegetation risk management over the next period	TransGrid has reflected this feedback and provided further detail as Appendix D to the Revenue Proposal
Customers recommended that TransGrid focus more on the proposed WACC number rather than the approach itself	TransGrid has been transparent about the proposed WACC of 6.6%. The WACC value is included in the front of the Executive Summary and Overview Paper, in addition to the detail in later chapters
Customers were concerned that Productivity Commissions Productivity Update for 2016 data could have been distorted as it included the water sector	TransGrid looked again for an alternative forecast and subsequently identified that the AER's DNSP report, which includes a substantially larger data set to the AER's TNSP report, might be a suitable alternate
Customers suggested that TransGrid clarify its messaging on IT efficiencies as it created uncertainty around the potential for service impacts resulting from costs reductions	TransGrid improved and clarified the information in its proposal

Feedback received	Actions taken by TransGrid
Customers told TransGrid that there is a perception that transmission networks don't actively pursue non-network alternatives and that the process during a RIT-T can be seen as a 'tick box' exercise	TransGrid acknowledges this established concern and is working hard to satisfy customers that a non-network solution will be pursued wherever feasible and efficient. Non-network requirements for the Sydney CBD have recently been specified and TransGrid is actively seeking network support as part of the overall solution. A public forum was held in November 2016 to discuss the specific non-network requirements to this need. This was well attended and helped TransGrid and non-network proponents form a better mutual understanding. To actively develop the demand management market, TransGrid is proactively surveying the demand reduction available from commercial buildings in Sydney CBD. TransGrid is actively pursuing a non-network solution in the Broken Hill area. This is a result of the new NSW transmission reliability standards, published in December 2016. These create a new requirement to improve supply reliability at Broken Hill - a late change from the published draft. Options are still being developed but TransGrid considers that a non-network solution would be efficient in that location. TransGrid has committed to updating the AER as soon as an efficient solution is identified.

3.3 Insights and feedback from other stakeholder and consumer engagement

TransGrid regularly engages externally on a wide range of issues and with different groups. The feedback received and TransGrid's responses are summarised in the sections below.

3.3.1 Transmission pricing

In developing the Transmission Pricing Methodology for the next regulatory period 2018/19 to 2022/23, TransGrid engaged with the TAC, directly connected customers and industry stakeholders through a series of face-to-face meetings and an online discussion paper inviting interested parties to make a submission.

Overall, TransGrid found that customers were satisfied with the form and approach of the current Pricing Methodology, with no substantive changes in approach identified by consumers. This reflects the substantial changes introduced to the pricing methodology for the current regulatory period and the broad customer and consumer support for those changes received.

Topics raised and TransGrid's responses are summarised in Table 3.4.

Table 3.4: Topics raised during Transmission Pricing engagement

Topic raised	TransGrid's response
A lack of clarity of how transmission prices are passed through to distribution network service providers (DNSPs)	TransGrid has no direct say in how DNSPs and retailers pass through its charges. TransGrid arranged one-one-one consultations with customers and DNSPs to foster a mutual understanding of the issues.
The Pricing Methodology needs to be understood by diverse stakeholder group	The pricing methodology was rewritten with a stronger emphasis on plain English. Following consultation with the TAC, an issues paper was finalised and published to support a wider consultation on the pricing methodology for the next regulatory period. Modifications to the structure and presentation of the issues paper were made in response to TAC feedback.
Modelling of Long Run Marginal Costs (LRMC) outcomes for customers in dollar terms is required prior to further consideration of any Rule changes	Consultation with the TAC and the issues paper on pricing both contemplated possible longer term policy directions being signalled by government and institutional organisations. One of these possible future directions is the introduction of LRMC. TransGrid agrees with TAC members concerns that the full impact of such a methodological change would need to be modelled and understood before a preferred position could be determined.

3.3.2 NSW electricity transmission reliability standards

TransGrid recognises that the NSW electricity transmission reliability standards are a key driver to business investment requirements in the future and accordingly a material influencer of the revenue proposal. For this reason, TransGrid has worked alongside IPART in promoting IPART's review process and encouraging participation either directly with IPART or via TransGrid's own consultative processes.

TransGrid engaged with its stakeholders throughout the review process in 2015 to 2016. As part of its commitment to early and open engagement, TransGrid facilitated workshops with 12 stakeholders over two half day sessions in August 2015 to clarify reliability standards and canvas issues. The issues raised are in table 3.5l

Table 3.5: Topics raised during NSW electricity transmission reliability standards engagement

Topic raised	TransGrid's response
Lack of understanding about how reliability standards were set in NSW including how they could be expressed	TransGrid explained the current approach and how a standard can be 'an economically justified reliability standard (n-x)'. Most agreed with the approach.
Varying views about what frequency and duration of supply interruptions were acceptable for a CBD area in a major city	TransGrid explained the issues and conducted a survey to understand preferences. More than half identified an acceptable frequency of one interruption every ten years or less frequent.
Whether flexibility within transmission reliability standards was a good thing or not Some recognised the practical and commercial complexity with different levels of reliability for different customers	Flexibility could have efficiency benefits but there is some complexity. Flexibility provides an opportunity for trading off a small reduction in supply reliability to consumers with spending on network augmentation investments. However, at a more granular level, there are few avenues available at present for TransGrid to differentiate the value customers place on the supply reliability and to provide an appropriate level of service.
Opportunity for non-network options to be considered when reliability standards are set	TransGrid explained its approach to non-network options.

Engagement with customers, consumer representatives and other stakeholders continued over the course of the review and the insights gained were used to inform TransGrid's submissions to IPART on the review. TransGrid submitted a report including a series of recommended scenarios to IPART in 2015 along with feedback on the draft standards in July which included feedback received from stakeholders.

In November 2016, TransGrid also invited IPART to discuss the proposed approach to the CBD reliability standard at a dedicated Powering Sydney's Future consultation forum.

3.3.3 Industry changes and the Network Vision

In developing its Network Vision 2056, TransGrid collaborated with TAC to design a workshop to discuss changes in the industry and how TransGrid sees its role in the future. The resulting NSW Energy Forum was attended by thirty participants with sessions including panel discussions and breakout workshops, some chaired by external experts. Issues raised are shown in Table 3.5.

NSW energy forum attendees included PIAC, ECA, EUAA (as panellists). Other attendees included: BuildingIQ, NSW Mining, University of NSW, Vector Energy, Ausgrid, Bluescope Steel, Union Fenosa, AEMO, AER, City of Canterbury-Bankstown, IPART, NSW Department of Industry | Resources & Energy, Origin Energy, Sydney Airport, Sydney Water. Topics raised in the NSW energy forums are summarised in Table 3.6.

Table 3.6: Topics raised at the NSW Energy Forum

Topic raised	TransGrid's response
Participants found the session informative but stressed the need for TransGrid to clearly demonstrate how engagement with stakeholders influences decisions	TransGrid published its Stakeholder Engagement Feedback document that outlines feedback received and how engagement influences the way the business operates.
How innovative solutions can extend access for new generators	TransGrid prepared a feasibility study and report into the development of a Renewable Energy Hub to unlock renewable energy resources and optimise the network.
Strong support for innovation regarding non-network solutions, the demand-side and renewable connections.	TransGrid is actively investigating and held a technical workshop with non-network proponents to help further investigate a non-network solution for Powering Sydney's Future.
Electricity prices remain a concern for consumers. Stakeholders expressed the need for more transparency on how consumer bills are calculated and which services they are paying for	TransGrid recognises that its investment decisions have a direct impact on customers and consumers and has transformed its approach to both asset management and risk assessment. Additionally, the business recognises the need for a bigger conversation across the industry on price and tariff reforms. TransGrid has redrafted its pricing methodology to improve its accessibility and published an issues paper to strengthen engagement on the form of transmission pricing.
A key area of stakeholder interest was how the transmission and distribution reliability standards will be implemented together. There was a strong desire to see further clarity on how TransGrid will work with distribution companies once the transmission reliability standards are set.	TransGrid held a joint session with Ausgrid as a dedicated Powering Sydney's Future consultation forum. This included a discussion on the proposed approach to the CBD reliability standard. Noting that this is an area of interest to stakeholders, TransGrid will continue to engage on the impacts of the NSW electricity transmission standards once they are set. TransGrid also meets regularly with all distribution businesses to ensure joint planning of the network is effective and proactive.
Greater clarity on who TransGrid defines as a customer, given that transmission businesses have no direct touch points with everyday consumers. Stakeholders questioned how TransGrid knows what consumers are looking for and questioned how the business is going to know if it is	For TransGrid, customers are those directly connected to our network which includes some very large energy users plus distribution network service providers and generators. Consumers are those who use electricity and are connected to either the distribution or transmission network. Consumer representatives are organisations such as PIAC (the Public Interest

Topic raised	TransGrid's response
delivering a service that future consumers want. Stakeholders suggested that as the energy market evolves, TransGrid should further educate consumers on the energy supply chain.	Advocacy Centre) TransGrid makes sure that consumer representatives play a strong role in its engagement program as they advocate for the needs and views of consumers. Additionally, TransGrid has taken this feedback on board and will continue to position itself as a consumer centric, commercially astute business.

3.4 Changing consumer expectations and characteristics

In recent years, the expectation of electricity customers has and will continue to change. TransGrid has observed that there is increased awareness of price among consumers, and more desire to pursue alternative supply options, particularly where these provide some level of consumer control.

Below are two key recent changes in consumer characteristics that TransGrid has observations around price trends and the uptake of rooftop solar as an alternative supply option.

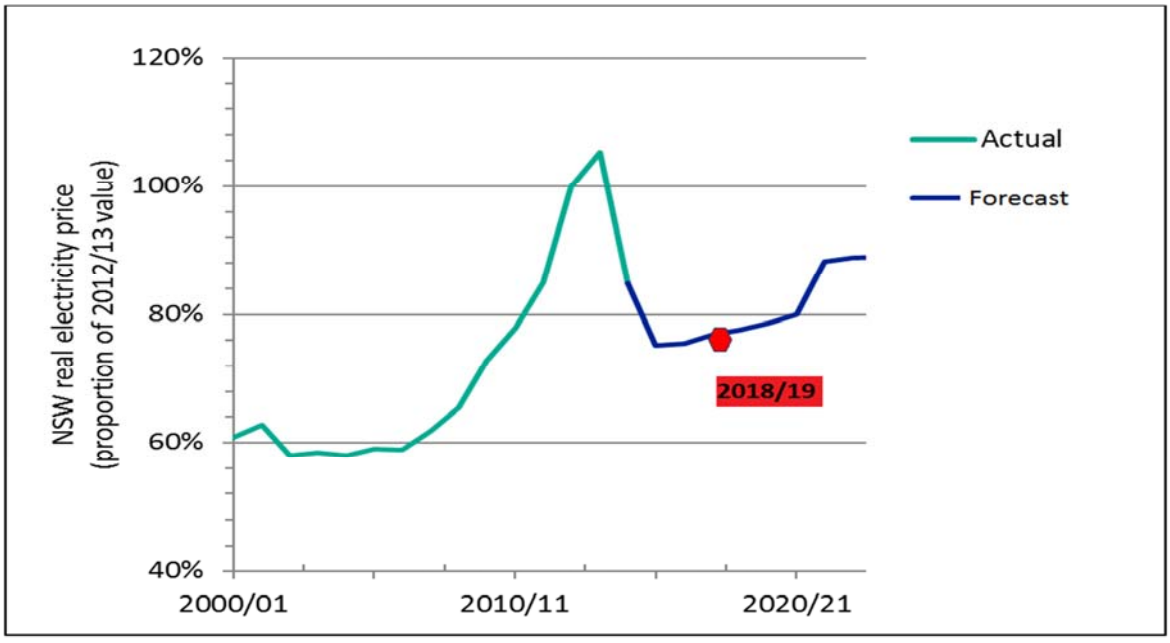
Ensuring affordability is important to TransGrid and is a key consideration to this revenue proposal.

3.4.1 Price trends

Consumers have demonstrated increasing awareness around the price of electricity, following the rapid and extreme price increase in the 2011/12 period. While prices have decreased significantly since 2011/12, consumers remain price sensitive.

Figure 3.3 shows that residential and commercial electricity prices in NSW have fallen from their highest levels in 2011/12. While they are expected to remain around twenty per cent lower than the highest levels for some years, there has been a lasting impact on electricity consumers' expectations.

Figure 3.3: NSW residential and commercial electricity price index (2012/13 base)



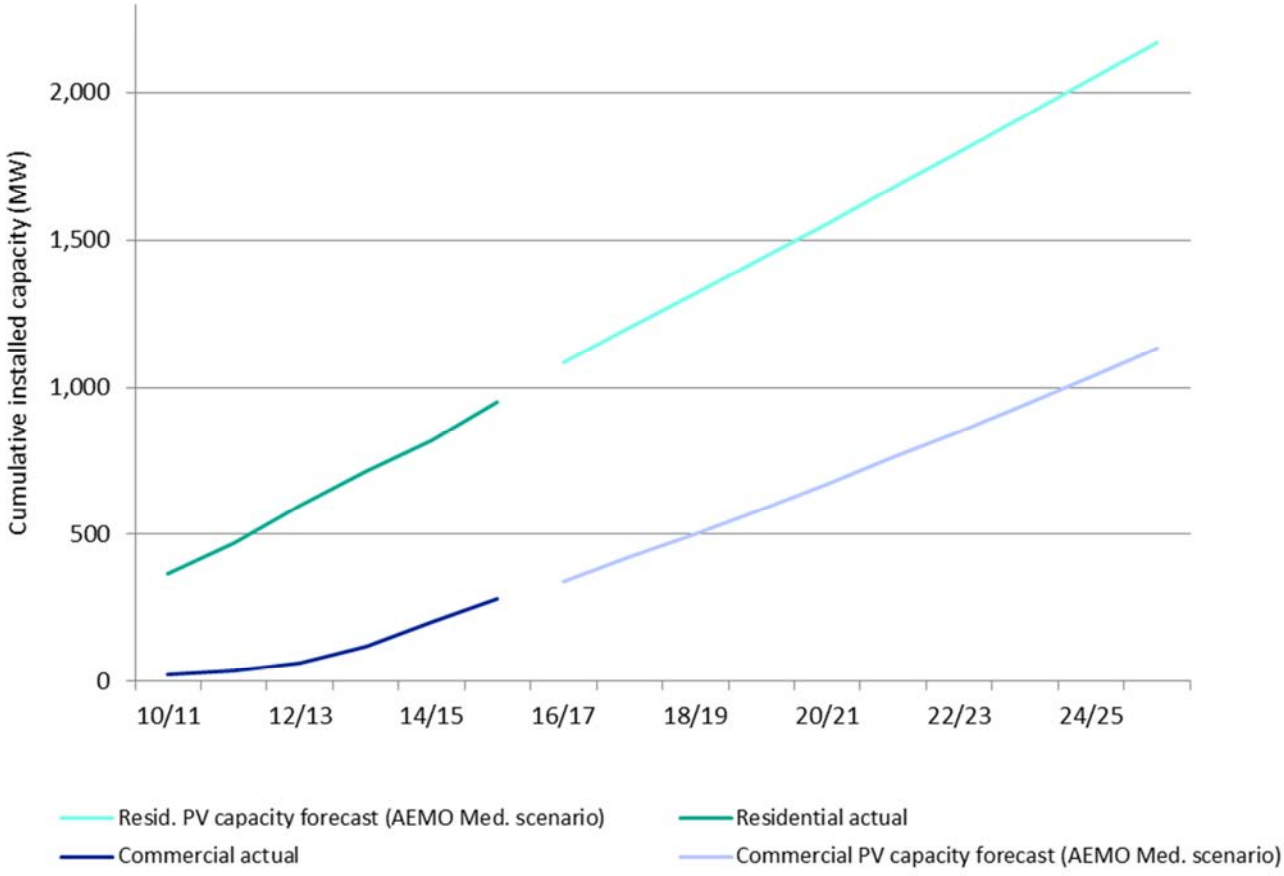
Source: TransGrid analysis (using AEMO data).

3.4.2 Rooftop solar

Over a similar period, the widespread uptake of solar panels has also brought alternative supply options into the mainstream. While some of the policy support for small-scale solar generation has reduced and residential installation prices have been stable in 2016[21], uptake has increased and more growth is forecast.

Figure 3.4 shows that residential rooftop solar capacity in NSW has doubled since 2010/11. Commercial solar capacity has increased by more than ten-fold over the same period, albeit from a lower base.

Figure 3.4: NSW residential and commercial actual and forecast rooftop solar capacity (MW)



Source: TransGrid figure, utilising data from AEMO National Electricity Forecasting Report (June 2015)

Figure 3.4 also shows that AEMO has forecast that small-scale solar capacity in NSW will continue to increase over the next ten years.

An increasing proportion of the new solar capacity is expected to be driven by commercial end-users, particularly as combined financing options become available. Commercial solar prices have reduced slightly over 2016.

[21] Throughout 2016, residential solar installation prices have been stable according to the 'solarchoice' index, accessed at 'http://www.solarchoice.net.au/blog/news/residential-solar-system-prices-november-2016-171116'

3.4.3 Future electricity consumer characteristics

There is a growing body of research into how consumer expectations will continue to evolve as they embrace technologies such as battery storage, for example.

The exact characteristics of future electricity consumers are not certain but it is clear they will have more scope to choose how their electricity is supplied and each consumer will have different needs. For example, a sophisticated electricity consumer could choose to procure their supply by:

- Purchase energy from a retailer during those parts of the day, that are cost effective to do so
- Supply the balance through their own on-site renewable generation
- Export any excess on-site generation back into the grid at times that maximise value of doing so
- Contract with a network for a smaller 'right-sized' connection with energy balancing services to ensure the capacity limit is not breached
- Contract an energy services company to either provide the analysis to optimise all the above and/or manage the contractual arrangements for the consumer.

Not every consumer will want this level of complexity, and the extent of the possibilities above suggest that some more sophisticated approaches will take time to reach scale. Nevertheless, TransGrid will ensure that its decisions take consumer needs into account and will continue to engage externally.

4. Approach to Managing the Network

4.1 Highlights

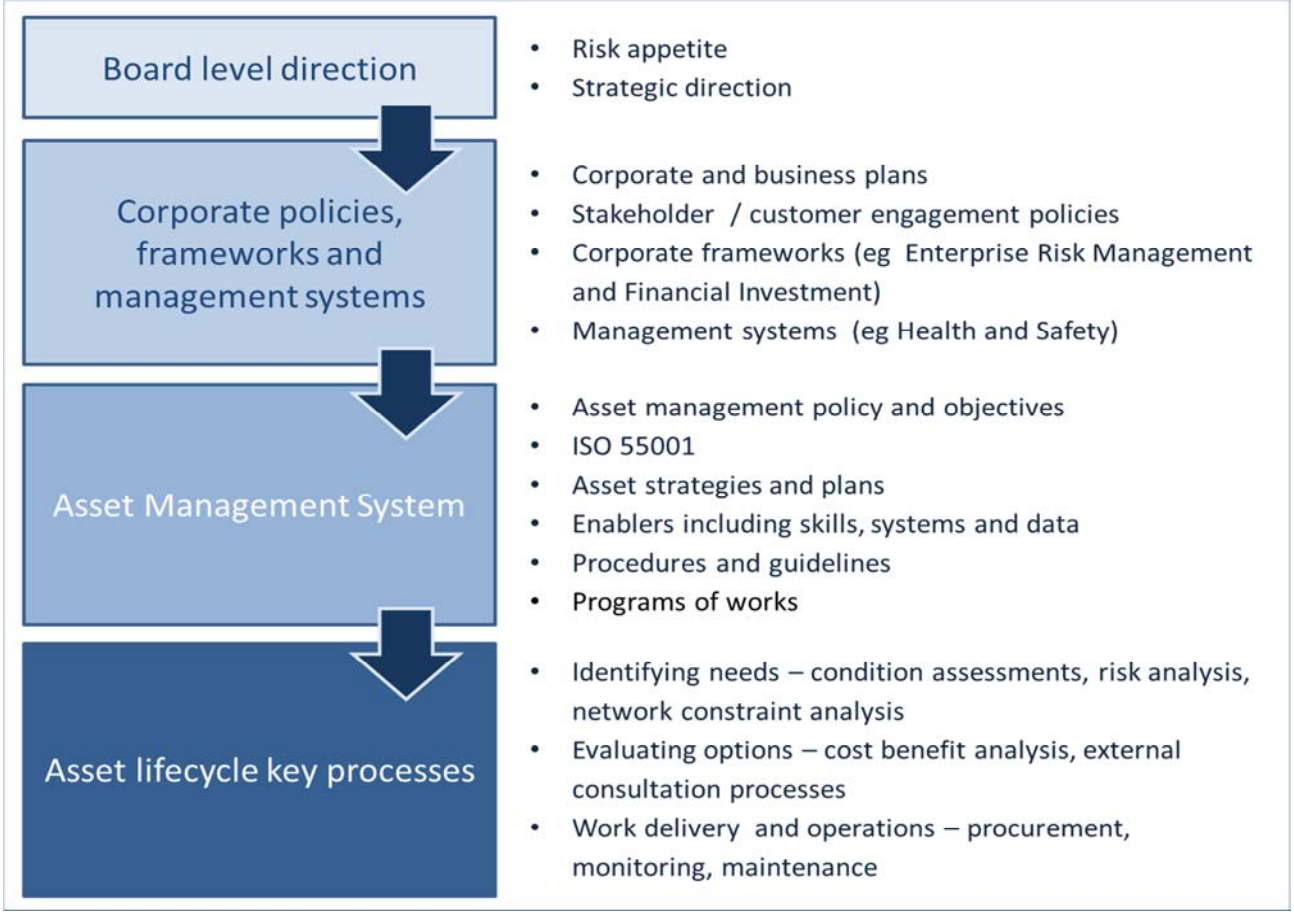
TransGrid has a robust and certified asset management framework and is committed to ongoing continuous refinements. Ensuring that it operates in the long term interests of consumers, TransGrid has transformed its approach to both asset management and risk assessment. A number of improvements made since the last revenue proposal relate to:

- the treatment and quantification of risk in asset condition assessment, investment option evaluation and capital program optimisation
- improved alignment to the Corporate Risk Framework and a more objective based replacement strategy
- the development of area plans, which present a transparent view of the range of factors impacting planning in a particular network area in the future, including those related to generators and customers
- developing a “top-down” asset replacement model to provide a useful cross-check to bottom up plans.

4.2 Introduction

In managing the network and its assets TransGrid’s objectives are to ensure efficient, reliable and safe operations in line with various legislative and regulatory obligations, such as the NSW electricity transmission reliability standards. This includes the use of non-network solutions to meet needs, where this is more efficient. Asset management is guided by the Board and the business, through a number of policies and strategies that are continuously improving. This ensures alignment with TransGrid’s overall risk appetite and strategic direction, and more importantly good asset management systems to manage risks and ultimately deliver value for the consumer. Figure 4.1 shows the asset management system and processes in the context of Board and corporate level guidance and policies.

Figure 4.1: Asset management within TransGrid's business



Independent engineering consultant Aurecon reviewed TransGrid's asset management framework and the resulting capital forecast for this proposal, concluding:

> It is Aurecon's view that TransGrid's framework for the preparation of its capital expenditure plan for the 18/19 to 22/23 regulatory period will result in a CAPEX forecast that is in accordance with good electricity utility practice and will meet the capital expenditure criteria as set out in 6A.6.7 of the National Electricity Rules.[22]

TransGrid is accredited to the global ISO55001 asset management standard and uses a comprehensive risk-based approach to asset refurbishment and replacement. The standard sets out requirements for the establishment, implementation, maintenance and continuous improvements of the asset management system. It also requires a clear recognition of risk and the alignment of asset management objectives with organisational objectives.

Processes set up within the asset management framework cover the whole of life management of TransGrid's assets considering capital and operational costs – from identification of a need, through to the development and acquisition of a solution, to decommissioning. Shown in Figure 4.2, these processes aim to achieve the maximum contribution of assets to service provision throughout their lives, while minimising their lifecycle costs.

[22] Aurecon, Independent Review of TransGrid's CAPEX Plan, Final Report, 25 January 2017, p. II [TransGrid-Aurecon-Appendix E Independent review of TransGrids Capex Plan-0117-PUBLIC]

Figure 4.2: Whole of life asset management processes

These processes are described in more detail in section 4.5.

To support the strong performance culture, TransGrid maintains appropriate frameworks, processes and training. Its engineers participate in international forums such as the International Council on Large Electric Systems (CIGRÉ[23]), International Transmission Operations and Maintenance Study (ITOMS) and the Energy Networks Association Asset Management Committee in Australia.

4.3 Recent improvements

TransGrid is an efficient, proactive business targeting top performance in all areas and actively seeks opportunities to improve its services.

TransGrid's increased focus on customer service ensures a proactive investment approach is applied to equip the business, and to leverage new opportunities as they arise. In response to this and previous concerns raised by the AER in the last revenue determination, TransGrid has made significant improvements to asset management strategies, policies, practices, and particularly its approach to risk. These new initiatives are driving further efficiencies and are reflected in expenditure forecasts. Improvements in the identification of needs and in the way investment options are evaluated include:

- A more rigorous and systematic approach to condition assessment, combining asset health (probability of failure) and criticality (the consequence of failure and the probability that the consequence eventuates) to quantify risk and provide information on which needs to prioritise.
- Development of the Investment Risk Tool which enables investment analysis to include a risk cost for assets before and after remediation by different options. This allows selection of an option which delivers the greatest benefit.
- Enhanced condition assessment which uses asset health indices plus takes account of criticality and risk. This is a more rigorous and systematic approach, providing clearer information on which to assess a network need, including its priority and timing.
- Enhanced definition and focussed development of Asset Management competencies for staff undertaking key asset management activities.

Response to corrosion of substation gantry steelwork

As part of its commitment to making investment decisions in the best interest of customers and consumers, TransGrid has undertaken detailed condition assessments at seven sites. This confirmed that corrosion of bolts, base plates and gantry steelwork present an unacceptable risk of failure. After analysis of various options, TransGrid identified that the most efficient method of rectification is to remove rust via abrasive blasting and painting of blasted steel with zinc paint. This significantly reduces capital expenditure in the next regulatory period compared to a full replacement of gantries.

[23] In French, named the Conseil International des Grands Réseaux Électriques, abbreviated as CIGRÉ

Recent improvements in investment optimisation and delivery include:

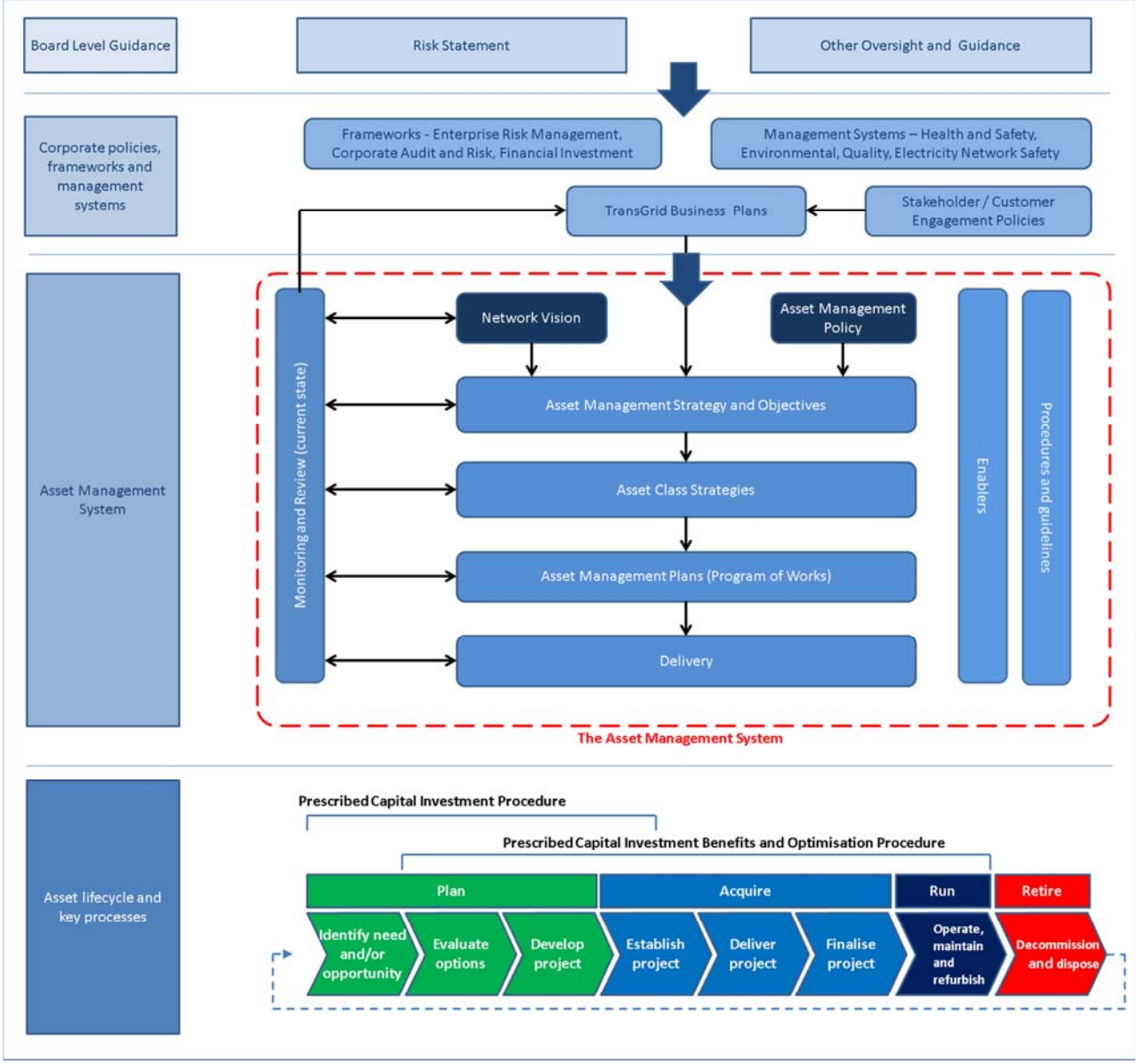
- A review of design and equipment standards. This has led to efficient changes in some equipment requirements and removal of some altogether, reducing scoping and design complexity in some areas. Examples are:
  - combining protection and control functions in substations
  - utilising multifunctional features of new numerical protection relays.
- Better prioritisation and optimisation of the capital portfolio, enabled by the new investment decision-making framework. Projects justified on the basis of a positive net present value (NPV) are normally prioritised based on that basis. Other projects are developed to ensure compliance (for example safety and reliability). More information on the investment process is presented in section 4.6.

4.4 Asset management within TransGrid's wider frameworks

Figure 4.3 illustrates TransGrid's Asset Management System and how it relates to higher level organisational policies and guidance. The tables that follow outline details of the system within this context and include references to documents included with this proposal.

The following sections provide summary information on the major elements of this framework and references to further explanations in this proposal and source documents.

Figure 4.3: Asset management with TransGrid's business



4.4.1 Board level guidance

Board level direction which informs the asset management framework includes the TransGrid Risk Appetite Statement which sets out overall corporate risk appetite. The board also sets the strategic direction, reviews and approves the business plans and budgets and ensures an effective system of corporate governance.

4.4.2 Corporate policies, frameworks and management systems

Table 4.1 provides summary information and references to corporate policies, frameworks and management systems. Copies of each of these documents have been provided to the AER as supporting information as part of this revenue submission.

Table 4.1: Corporate level policies, frameworks and management systems

Description	Reference
Stakeholder / Customer engagement policies	The stakeholder charter guides TransGrid's engagement. The stakeholder framework provides an overview on the approach, actions and responsibilities for customer and stakeholder engagement. The stakeholder engagement policy provides advice on stakeholder engagement principles and process specifically across four streams – business, network, project and community relations. See – TransGrid Charter - Stakeholder Engagement, Stakeholder Management Framework and, Stakeholder Engagement Policy
Risk Management Framework	A structure and tools to facilitate the use of a consistent risk management process used for all capital investment decisions. See Risk Management Framework
Financial Investment Framework	A framework that provides a consistent set of guiding principles for the management of all resources deployed in TransGrid on capital and operating activities. See Financial Investment Policy
Electricity Network Safety Management System	Specific requirements in relation to public, property and work safety in relation to electricity networks and the management of safety risks arising from loss of electricity supply. See Electricity Network Safety Management System Description
Management systems	Health and Safety Management System. See Health and Safety Management System Framework Environmental Management System – meets ISO 14001. See Environmental Management System Framework Quality System. See Quality Policy.

4.5 Asset management system

4.5.1 Overview

TransGrid's asset management system provides a framework for efficiently managing the transmission network assets over their life cycle. The asset management system governs the policy, strategies, objectives, plans, structures, processes and activities that apply to the management of network assets from inception to retirement.

The asset management system shown above in Figure 4.3 includes:

- High level elements which provide guidance, including the Network Vision and the Asset Management Policy
- The core asset management system, which is a set of documentation which drives the optimal combination of lifecycle activities across TransGrid's portfolio of physical assets and asset systems in accordance with their criticality, condition and performance
- Key processes which cover the complete lifecycle of the physical assets including investments in new assets and maintenance of existing ones.

These are described further below.

4.5.2 High level asset management guidance

4.5.2.1 Network vision

The Network Vision 2056 considers the development of the network over the next 40 years outlining the challenges, the guiding principles to be applied and the actions already being taken to prepare.

TransGrid's Network Vision 2056 is provided as Appendix A.

A new and more complex energy sector is developing. The grid is an important part of this future but its role will inevitably change. TransGrid developed the Network Vision 2056 to help deliver that future and ensure the network services continue to be customer focussed and meeting customers evolving needs.

It sets out a strategic approach to planning, operating and managing the NSW transmission network over the next 40 years. Taking a long term view of the development of the network is important, particularly as the ways that electricity is generated and used are undergoing rapid, significant change.

This Network Vision 2056 is not a detailed planning document. Rather, it outlines the challenges, the principles that guide how TransGrid will shape the NSW transmission network to respond to them and the actions we are already taking to prepare for that exciting future.

It also serves as a link between TransGrid's overarching business plan and our other planning and asset management documents, including the Transmission Annual Planning Report (TAPR, which has a ten year planning horizon) and the Network Development Strategy (which has a forty year planning horizon).

4.5.2.2 Asset management policy

The asset management policy is a charter which demonstrates senior management's commitment to adhere to all legal, regulatory, safety and environmental requirements placed upon TransGrid.

The Asset Management Policy states:

> TransGrid manages its assets across the complete asset lifecycle in a safe, efficient, co-ordinated, and environmentally sensitive way that serves the needs of its stakeholders, customers and electricity end-use consumers, and optimises the long term return on investment for its owners.

It also sets out how TransGrid will:

- Plan, design, and build assets to comply with obligations and to allow assets to be efficiently managed
- Operate, maintain, renew and dispose of assets safely and cost effectively, making corrective action when necessary based good quality, timely information
- Develop, maintain and continuously improve its asset management system, including ensuring that employees have the appropriate asset management skills.

4.5.3 Asset management system – core documentation

4.5.3.1 Asset management strategy and objectives

The Asset Management Strategy and Objectives sets out the objectives required to achieve the corporate plan and the long term objectives for the electricity transmission network. The business plans

and objectives are translated into specific asset and financial outcomes organised into seven sub-strategies[24].

4.5.4 Asset class strategies

Asset class strategies are customised for each asset class and may include specific asset class objectives. There are ten asset class strategies[25].

Each asset class strategy describes how the needs and objectives can be best delivered. For example, the strategy documents contain reviews of present and emerging risks and identify key initiatives to respond to these. Reviews of each major equipment category to identifying performance shortfalls and their impacts on a site by site basis are included. Emerging issues are screened on a risk basis to determine whether a replacement, refurbishment, routine or corrective maintenance strategy is most appropriate.

4.5.5 Asset management plans

Asset management plans are programs of work, which cover details of the actions required to achieve the relevant strategies with a seven to ten year outlook for capital investment and a rolling three year outlook for maintenance. They include long term forecasts of investment costs, project tracking, outage plans and maintenance and defect works schedules.

Asset management plans include:

- Renewal plan for replacement capital expenditure
- Area plans for network augmentation capital expenditure
- Non-network capital expenditure plan
- Maintenance plan
- Other operating expenditure.

Investment required to implement these plans is subject to the prescribed capital investment process, which is described in more detail in section 4.6 below.

4.5.6 Delivery

Once approved, asset management plans are prepared for delivery through a detailed scoping process which investigates opportunities to optimise delivery. All network investments are coordinated through a single group, which provides a single point of control and governance so that investment concepts and needs are consolidated plus risks are evaluated at a portfolio level. Investments are optimised across the portfolio balancing performance, cost and risks while ensuring compliance and delivery of the asset management strategy. This centralised coordination function also manages changes to scope and budget separately from project delivery.

Project delivery is managed either through TransGrid taking on the principal contractor role (with internal project delivery agreements) or through the tender and engagement of contractors. Following

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[24] Asset Management System Strategy, Design Lifecycle Strategy, Plan Lifecycle Strategy, Build Lifecycle Strategy, Operate Lifecycle Strategy, Maintain Lifecycle Strategy, Renew/Dispose Lifecycle Strategy

[25] Substation Renewal & Maintenance Strategy; Transmission Lines Renewal & Maintenance Strategy; Cables Renewal & Maintenance Strategy; Secondary Systems Site Installation Renewal & Maintenance Strategy; Digital Infrastructure Renewal and Maintenance Strategy; Automation Renewal and Maintenance Strategy; Metering Renewal and Maintenance Strategy; Network Property Renewal & Maintenance Strategy; Office and Depot Renewal and Maintenance Strategy; Security Assets Renewal and Maintenance Strategy.

the commissioning and handover of the asset, project close-out reports measure performance and capture lessons learned.

4.5.7 Monitoring, enablers and procedures

Asset management committees, asset management audit programs are key monitoring tools. The correct governance of asset management. Enablers include the Asset Management Competency framework, the Asset Information System and the Network Asset Risk Assessment Methodology (RAM) enable the correct governance of asset management.

There are also a range of procedures and guidelines that facilitate the asset management process including Standard Design, Operating, Procurement and Construction manuals.

Further information about monitoring, enablers and procedures can be found in the Asset Management System Description document[26].

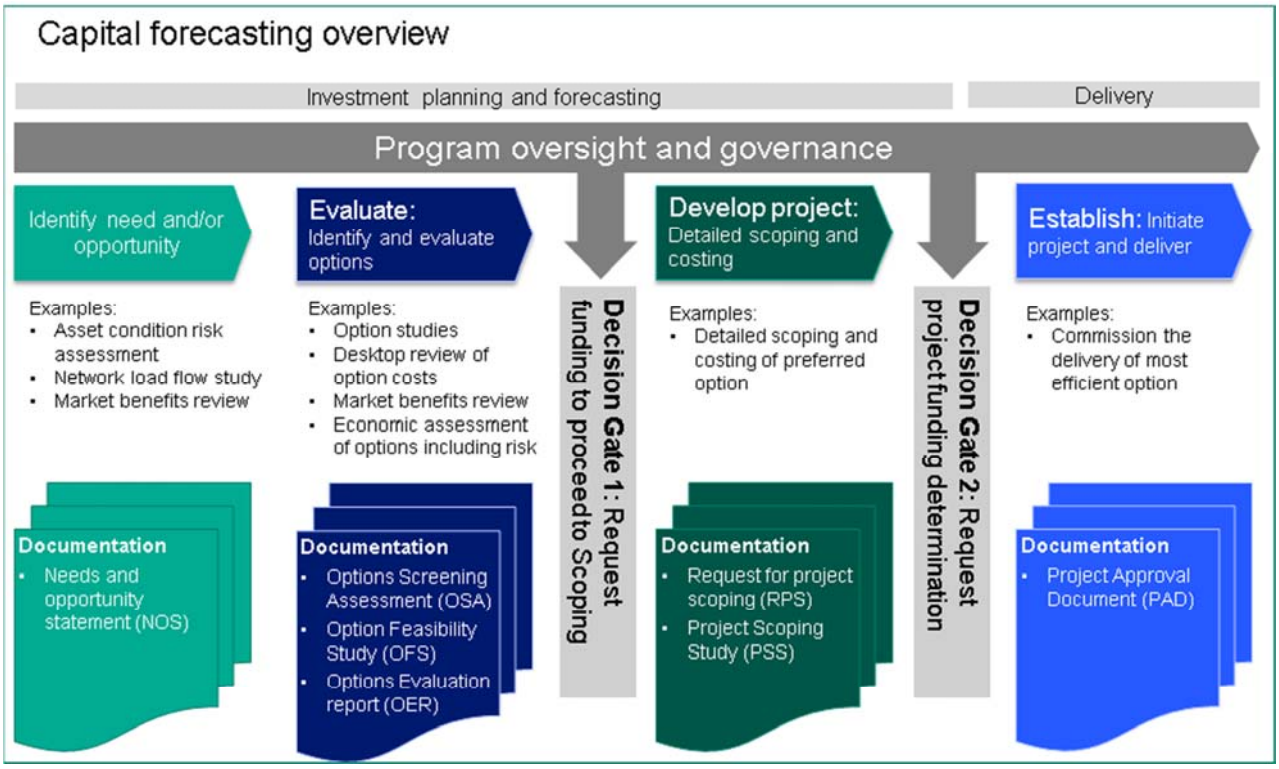
4.6 Capital investment process

The investment framework and asset management strategies have been transformed since TransGrid's previous revenue proposal. The capital investment process requires that investment decisions are made in the long term best interest of customers and consumers.

The prescribed capital investment framework generates a capital portfolio containing projects justified and prioritised on the basis of economic decision criteria. Compliance criteria (such as reliability planning standards and safety obligations) are also incorporated as relevant to the project. Figure 4.4 shows TransGrid's approach to developing and documenting the future capital investment requirements.

[26] Supporting Document [TransGrid – Asset Management System Description – 0107 – PUBLIC]

Figure 4.4: TransGrid's capital forecasting approach[27]



All capital projects included in the revenue proposal forecast have completed Option Evaluation Reports and are Decision Gate 1 ready at a minimum. Some projects will be more advanced in the planning horizon depending on the timing of their requirement.

TransGrid's capital expenditure is forecast as a bottom-up build of projects and programs of work. Projects are individually scoped to meet specific network needs, such as needs to augment the network or replace assets reaching the end of their serviceable lives. Programs of work are groups of minor projects of the same type, such as replacement of a particular model of equipment that exhibits consistent issues across the network.

Capital investments are categorised into 'network' (with sub-categories of augmentation, replacement, security and compliance, and strategic property acquisition) and 'non-network' (with sub-categories of information technology, mobile plant and motor vehicles).

All investment types follow the process above and generate the documentation at each point, although individual steps vary. The main steps are described below.

4.6.1 Identify needs and opportunities

Needs and opportunities are identified from potential changes to generation, demand growth, condition assessments, asset criticality, and risk. Needs are about reducing unacceptable risks to acceptable levels, for example the risk of plant failure and the risk of not supplying load. Opportunities include potential market benefits as well as other net present value (NPV) positive savings opportunities.

[27] The investment planning and forecasting process was streamlined during the time the forecast was prepared for this revenue proposal. The diagram shows the documentation of the process as it exists at the date of submission. Many projects within this submission followed a slightly different process that included Options Screening Report (OSR) and Option Feasibility Request (OFR) documents which have been replaced with a single Options Screening Assessment (OSA) document.

There are different processes for augmentation and replacement.

4.6.1.1 Augmentation

Augmentation projects increase the transmission capacity in the network, achieve the defined reliability standard and allow customers access to lower cost electricity. Key drivers for augmentation projects are local demand growth, reliability standards, voltage control issues and market opportunities which generate a net benefit for customers. These needs can sometimes be met by non-network solutions which are considered as part of the assessment of options.

Projects which relate to capacity augmentations are identified from area plans that consider current and forecast network flows, AEMO load forecasts and distributor connection point forecasts.

Other projects have been identified through a probabilistic assessment of potential economic growth paths for NSW developed by EY[28].

Probabilistic forecasts recognise that subject to economy level developments, there are a number of different investments with some uncertainty in regards to timing of the need to invest over the upcoming regulatory period. For investments in this category, a probabilistic forecast allows TransGrid to manage the risk for customers that some investments will be required and ensures a degree of funding to support the necessary investments without proposing that the full cost of every potential investment be covered. Further detail on the probabilistic planning approach is in 5.2.5.1 with individual projects covered in Appendix G.

4.6.1.2 Replacement

TransGrid has strengthened its approach to forecast network replacement by improving the approach to evaluating asset condition. Asset health indices have been developed for major asset classes to enable consistent and accurate assessment of condition.

Replacement investments are evaluated with the new risk assessment methodology which is applied through the investment risk tool. The investment risk tool includes a database that captures the evaluated asset condition, probabilities of failure taking into consideration different types of failure, consequences of failure and likelihood of the consequences eventuating. Asset condition evaluations take into account factors such as historical defect rate, age, life cycle analysis, planned maintenance, test reports, and condition assessment from physical inspection. Consequences are considered in each of the corporate risk areas of reliability, safety, environment, financial, reputation and operational. Reliability calculations consider the Value of Customer Reliability set by AEMO. A likelihood of occurrence is assigned to each consequence under the relevant risk areas and multiplied with the associated cost, to arrive at a consequence cost.

Calculated probability of failure is multiplied by the value of the consequence cost to arrive at a risk cost for each hazard. The sum of all such calculations for all consequences attributable to all hazards for the assets is the total risk cost of the asset.

4.6.2 Evaluate options

The network needs and opportunities are captured in a suite of documents that scope and estimate all credible options and ultimately compare options on a cost benefit basis. The Option Evaluation Report (OER) considers all of the feasible costed options and identifies the preferred option which may be a

[28] These are detailed in supporting documents, 'EY, Report to TransGrid on load developments, October 2016' [TransGrid-EY-Report to TransGrid on load developments-1016-PUBLIC] and 'EY, TransGrid load databook, October 2016' [TransGrid-EY-Transgrid load databook-1016-PUBLIC]

maintenance solution, a non-network solution or a capital solution. Where a capital solution is optimal it will then progress past Decision Gate 1 and progress to the detailed scoping and costing stage, with timing aligned to the required commissioning date.

4.6.3 Detailed scoping design

Detailed scoping and cost estimation is performed on the option that passes Decision Gate 1. A Request for Project Scoping (RPS) document is written with a greater detail of specification, requesting a Project Scoping Study report (PSS) which will include detailed scoping and a more accurate cost estimate with a plus or minus 10% level of accuracy.

4.6.4 Establish project and deliver

The TransGrid project delivery methodology has been enhanced and is now based on the PMBoK (Project Management Body of Knowledge) international standard which is recognised as good practice.

4.7 Network maintenance process

In conjunction with the network investment process described above, a core element of the asset management system is the network maintenance process established to manage the ongoing maintenance of its electricity transmission network assets to achieve high standards of reliability of supply in a safe, efficient and environmentally responsible manner.

This network maintenance process involves establishing a risk based maintenance strategy and maintenance plan for each asset class. The maintenance strategy and maintenance plan is reviewed on an annual basis based on feedback from the maintenance service provider and assessment of the ongoing asset health, performance and risks. The maintenance strategies and plans take into account key data and feedback from the Asset Monitoring Centre, which provides real time analytics and asset advice to the 24/7 control room on critical asset issues. The development of condition monitoring and improving controls on the prioritisation and schedule of defect maintenance are ongoing to support the maintenance process.

In performing the role of maintenance service provider, TransGrid has staff strategically based at locations throughout NSW in order to meet day to day operation and maintenance requirements, as well as being able to provide emergency response. Field operations are co-ordinated from major depots at Western Sydney, Newcastle, Tamworth, Orange, Wagga Wagga and Yass. TransGrid also outsources maintenance tasks where this is shown to be efficient.

5. Capital Expenditure

5.1 Introduction

Capital expenditure includes expenditure on new assets to increase network capacity and reliability, on replacement of existing assets at the end of their service lives and on assets which support the business.

5.1.1 TransGrid's capital expenditure aligns with its business commitments

TransGrid values innovation, responsiveness, efficiency and affordability. The capital expenditure forecast demonstrates this.

Innovation: TransGrid tests new ideas and practices to drive improvements

> TransGrid has transformed how it incorporates risk in capital investment analysis. This ensures a robust, rigorous and quantifiable approach is applied to every identified network risk and opportunity.

Responsiveness: TransGrid listens and responds to consumers

> Responding to feedback, TransGrid has made significant improvements to the asset management strategies and policies that underpin the capital investment process.

> In response to changing market conditions, the capital expenditure forecast includes five contingent projects. These will respond to market needs if triggered and will contribute to lower electricity prices and improved reliability in the long term interests of consumers.

Efficiency and affordability: TransGrid demonstrates a strong level of efficiency and performance, which will be maintained and will benefit consumers

> The new investment framework optimises the capital portfolio based on quantified risk assessments and cost benefit analysis. This benefits consumers by efficiently delivering service reliability, safety and environmental performance.

> A business-wide efficiency initiative led to the implementation of ongoing cost reductions which are built into the forecast. An example is a review of substation design and equipment standards which reduced costs.

5.1.2 Forecast highlights

Overview of major capital drivers:

> Condition assessments and risk analysis indicate that more of TransGrid's assets are reaching a point where action is required to manage their failure risk. While age does not determine replacement need, the analysis reflects the fact that 44% of operating assets were commissioned in the 1970s or earlier. Risk analysis has identified younger assets with a higher replacement priority and older assets that can safely continue operating.

> Key elements of the inner Sydney network are suffering from deteriorating condition, leading to capacity reductions and decreasing reliability. Oil-filled cables owned by Ausgrid are expected to be retired, and a TransGrid cable has had its capacity reduced. This has driven the need to consider how best to secure the inner Sydney network.

> Significant changes in generation location and type are in progress. Over the next five years, generation capacity in NSW will change by around one quarter of the currently installed capacity and new generation will be much more geographically dispersed. As the timing and location of

generation changes cannot be precisely forecast, TransGrid is managing the risks and cost impacts via contingent projects which will only proceed if specific events occur.

- Similarly, a number of possible new customer loads may drive capital expenditure in specific parts of the network. Given uncertainty in the timing and likelihood of these, TransGrid adopted a probabilistic forecasting approach using AEMO's economic scenarios and demand scenario analysis undertaken by EY. This manages the risk to customers that not all projects may eventuate but ensures that TransGrid can provide network services when required.
- Peak load growth in Western Sydney and Canberra are expected to drive investment in the period
- The ACT Transmission Licence requires the provision of two geographically separate points of supply to Canberra by 2020.

Overview of customer insights and responses

Over the past two years, TransGrid has learned much more about the range of customer views on capital expenditure through an improved engagement program:

- Customers are concerned about affordability and how TransGrid can manage assets most efficiently over their lifetimes to minimise price increases. TransGrid has shared information on its revised asset management framework and how the new asset monitoring centre will improve response times and the depth of insight into asset issues.
- Customers want to understand more about how capital expenditure was forecast. TransGrid was transparent in presenting and discussing the different approaches for different situations, such as dealing with generation uncertainty. Customers specifically recognised the progress TransGrid made in this area and TransGrid will continue to share such information.
- Customers and other stakeholders have a strong interest in the promotion of non-network solutions and want these to be encouraged and considered properly during investment decisions. TransGrid has identified a role for non-network solutions in the Powering Sydney's Future (PSF) project – feasible options can be combined with the network solutions currently under consideration. TransGrid also extended its consultation forum on PSF with a workshop dedicated to discussing non-network options.
- Consultation on the NSW Transmission Reliability Standard suggested that consumers on the inner Sydney network were concerned about the significant economic impact of supply interruptions.

The content of the capital forecast

- The total forecast capital expenditure for 2018/19 to 2022/23 is $1,612 million ($ June 18).
- In the current four year regulatory period, the annual average capital expenditure of $236 million is lower than it has been in recent history. In the period ending in 2013/14, the annual average was over $470 million. This lower expenditure trend continues into the next regulatory period, albeit with an increase over current levels.
- The majority of capital expenditure is for asset replacement, which is increasing compared to the current period and is the major portion of the forecast. A top down outlook of replacement investment suggests that this trend will continue for the foreseeable future. Given this, a priority for TransGrid is to develop innovative asset management methods to prudently minimise the future costs to consumers.
- Peak load is growing but as with the current period, there are only a few augmentation projects. However, the total augmentation forecast expenditure is substantially higher than the current period due to a major and complex project to service the Sydney CBD. Powering Sydney's Future is discussed in more detail in section 5.4.2.

- Business support (or non-network) expenditure is forecast to be slightly higher on average, than in the last four years. It includes the strategically important Enterprise Resource Planning investment which will enable further efficiency improvements when fully implemented.

Impact of the capital expenditure forecast on customer bills

- TransGrid has estimated the proposed capital expenditure forecast will add less than $5 per year ($June 18) to a representative residential bill[29]. Based on the proposed total revenue, TransGrid's contribution to the representative bill will be $69 a year on average ($ June 18).

5.1.3 Information in this chapter

The remainder of this chapter includes:

- An executive summary of TransGrid's capital expenditure forecast in total and by investment type
- A summary of capital investment drivers including National Electricity Rules obligations and those in specific jurisdictional instruments
- Information on how TransGrid has sought to facilitate the AER's capital expenditure forecast assessment, including where relevant information can be found in this proposal
- The forecasts for capital expenditure by category, ie, augmentation, replacement, security and compliance and non-network (business support), with project details and reference documents
- Contingent projects information, including proposed triggers
- Forecast inputs including cost assumptions, escalations and supporting expert reports
- Discussion of why the forecast is considered efficient and how it meets the capital expenditure criteria in light of the capital expenditure factors
- The current period capital expenditure
- Key assumptions.

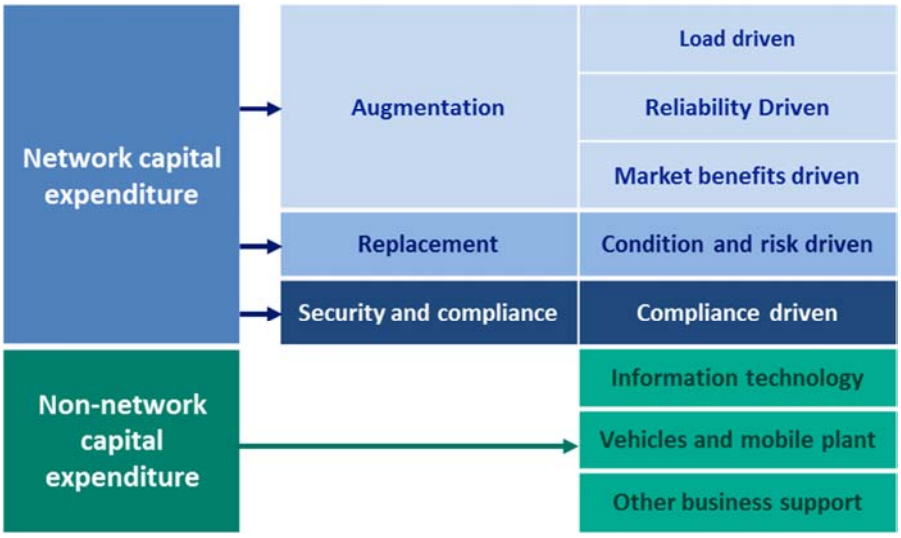
5.2 Forecast capital expenditure overview

5.2.1 Terminology

The forecast comprises different types of capital investment where the categories used align with the main investment driver. The categories of capital expenditure used in this forecast and throughout this chapter are shown in Figure 5.1.

[29] The impact on the representative residential bill is based on the price path analysis from the PTRM which provides a price in $/MWh using the annual energy demand of 5,953 kWh used by the AEMC in developing a 'representative bill' for a NSW residential customer.

Figure 5.1: Capital expenditure categories



5.2.2 Overview of investment approach

TransGrid's capital expenditure forecasts are developed under appropriate oversight and governance in line with the process set out in Chapter 4, Approach to Managing the Network.

The program is developed using a combination of bottom up forecasts based on TransGrid's analysis supported by economic justification, and on top down assessments and project prioritisation based on risk. This approach ensures that careful consideration of inter-relationships and synergies between investments are made. Recent improvements to the process include:

- Revising some design and equipment standards which resulted in a lower forecast
- Rationalising documentation requirements without reducing the integrity of process governance.

The capital expenditure forecast is based upon information from a range of sources. These include the latest demand forecasts from Australian Energy Market Operator (AEMO) and NSW distributors plus asset condition information, and cost estimates based on recent procurement and competitively tendered contracts.

5.2.2.1 Significant improvements to the approach

TransGrid has significantly developed its capital expenditure processes in the last two years. Improvements have been made in:

- **Identifying asset replacement needs**: The condition assessment process has been improved and focuses on determining the health of assets in respect to their useful lifespan. The improved risk assessment methodology is more asset focused and considers asset health (probability of failure) and criticality (the possible consequences of failure) to quantify risk.
- **Investment risk tool**: This new investment evaluation tool quantifies risk levels, generating a risk cost for the asset both before and after a proposed investment. Net present value analysis compares the difference between the two with the proposed investment cost to assess whether it has a positive NPV.
- **Forecast validation**: A top down, long term view of replacement capital expenditure has been established using a probabilistic model. This provides a sense check for the more rigorous bottom up forecast.
- **Portfolio optimisation**: This process further optimises the chosen portfolio by considering changes in cost, produced by bundling and modifying timing to level resource requirements.

More detail on the capital investment forecasting approach is included in Chapter 4 and in the overviews of forecasting for specific categories.

5.2.3 Overview of investment drivers

There are a range of regulatory, service and other legislative obligations which drive TransGrid's capital investment. These cover public and employee safety, network security and reliability and environmental protection and are covered in more detail in section 5.3. Potential investment needs are identified when such requirements are considered in light of the latest information about the assets, generation and demand, reliability, capacity, compliance and risk.

If it becomes apparent that action may be required to ensure that obligations can be met, responses can include:

- Managing the risk of asset failure and ensuring life cycle costs are efficient
- Providing infrastructure for new or larger connections to distribution networks
- Increasing capacity (via network or non-network means) to meet or manage forecast customer demand and/or to improve electricity market efficiency by eliminating material constraints
- Investing to improve the efficiency and effectiveness of the business.

The most influential capital investment drivers in the forecast period are:

- Deterioration in the condition of important cables that supply the Sydney metropolitan area and the expected retirements of these
- Asset risk assessments, which have identified the need to replace assets or otherwise manage risks. A large proportion of the risks relate to transmission lines and secondary systems
- The potential connection of a number of new large loads in different locations across NSW
- Demand growth in specific areas, which is driving a need to provide further connections to distribution networks.

Further detail on investment drivers and how these relate to investment categories is provided in this chapter.

5.2.4 Capital expenditure forecast overview

Table 5.1 shows the total forecast of capital expenditure of $1,612 million by category.

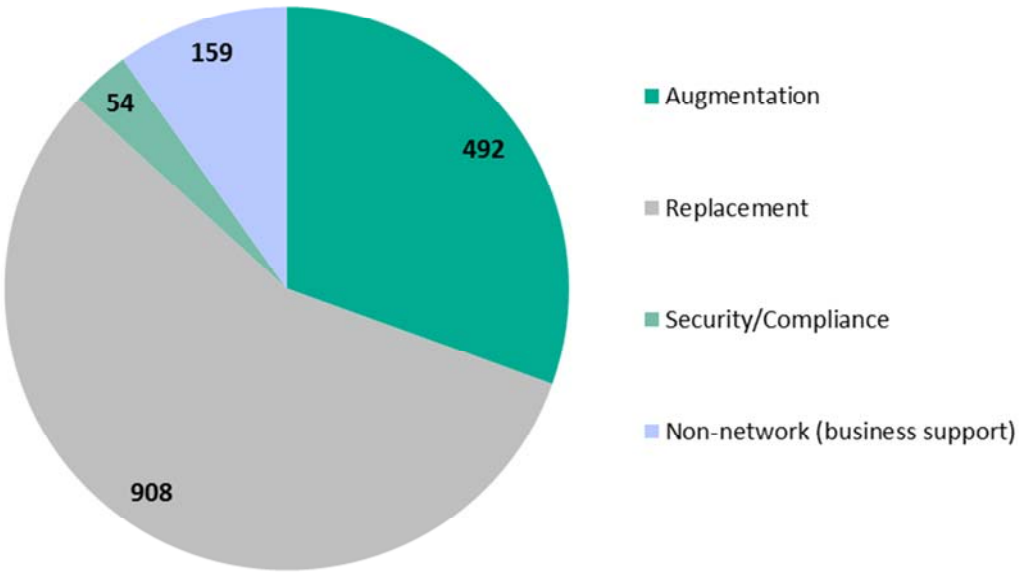
Table 5.1: Forecast ex-ante capital expenditure ($m June 18)

Category	2018/19 Forecast	2019/20 Forecast	2020/21 Forecast	2021/22 Forecast	2022/23 Forecast	Total ($)
Augmentation	27.6	75.6	73.2	148.2	167.1	**491.7**
Replacement	134.9	181.6	214.3	185.6	191.3	**907.8**
Security/Compliance	7.4	7.8	11.0	11.8	16.1	**54.0**
Non-network (business support)	25.5	41.8	39.4	24.4	27.7	**158.8**
Total	**195.3**	**306.8**	**337.9**	**370.1**	**402.2**	**1,612.3**

Source: TransGrid. Totals may not add due to rounding.

The breakdown of the ex-ante forecast by investment category shown in Figure 5.2 provides an indication of the investment priorities in the coming period, with replacement making up more than half of the total.

Figure 5.2: Total period capital expenditure forecast by category ($m June 18)

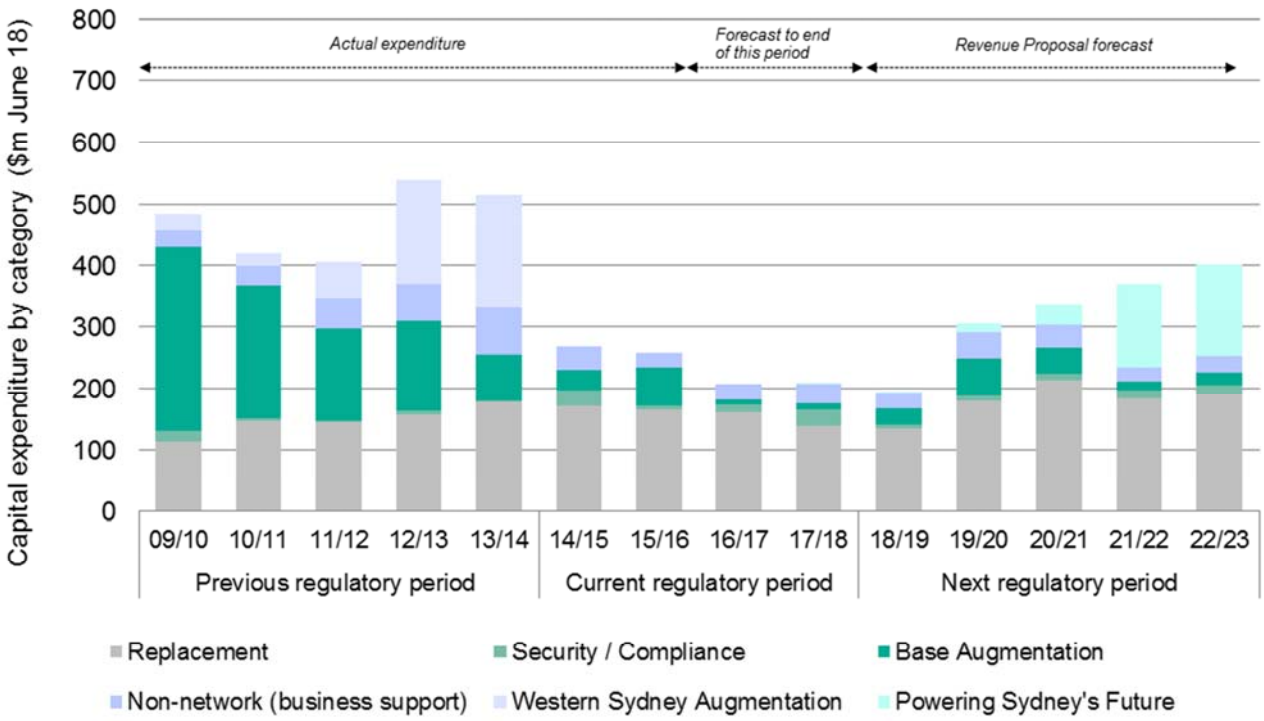


Source: TransGrid. Totals may not add due to rounding.

5.2.4.1 Capital expenditure forecast in context

This forecast is shown in the context of the current and previous regulatory periods in Figure 5.3. Two major augmentation projects are shown separately to demonstrate their impact on the trends.

Figure 5.3: Capital expenditure trend and forecast by category ($m June 18)



Source: TransGrid.

Expected capital expenditure at the end of the current four year period is $946 million, significantly lower than in the prior period ending in 2013/14 (which totalled $2,368 million). The major factor is lower augmentation expenditure generally and the absence of a single large project (in this case, the Western Sydney augmentation was completed in 2013/14). Replacement expenditure has also been lower in the current period compared to the period ending 2013/14.

The capital expenditure forecast of $1,612 million over the five year period from 2018/19 is higher than the current period. This is largely due to the Powering Sydney's Future project and higher asset replacement needs in the next period. The current period is also lower than originally forecast because TransGrid was able to de-scope and remove some replacement projects in this period following a review of the program against the new asset management process. This lower capital expenditure benefits consumers.

The capital expenditure profile is discussed further below.

5.2.4.2 Lower capital expenditure in the current period

Current period capital expenditure is lower than the regulatory allowance and customers will benefit from this through lower costs. Current period capital expenditure is also lower than in the previous period and lower than the forecast for the next period. There are two main reasons for this.

1. Augmentation expenditure is at historically low levels given the relatively stable level of customer demand and the absence of any new major augmentation project in the current period.
2. TransGrid developed and implemented a new investment and risk framework. This provided an opportunity to benefit consumers by prudently reducing capital expenditure in response to regulatory incentives.

TransGrid applied its new approach to risk, challenging existing investment proposals in light of updated asset condition information and other changes in circumstances. While there was a temporary

pause in initiating new projects during the process change, projects in delivery were not affected and there was no impact on service delivery or risk. The result of the analysis was the de-scoping or removal of planned capital investments with total savings of approximately $110 million ($June 18).

Savings related to changes in circumstances or the availability of new information included:

- Changes to the replacement project for Canberra substation to address only the most critical risks. As a result of the revised plan for Stockdill substation as the second ACT supply point, there was an opportunity to reconsider plans for Canberra substation. The decision was made to extend the lives of transformers at Canberra via minor works until Stockdill is commissioned. This avoided a full transformer replacement amongst other things, saving around $13 million.
- Planned replacements at Vales Point and Tamworth substations were also de-scoped to address only the most critical risks, saving around $14 million.
- Detailed steel tower inspections and updated risk assessments led to a decision not to repaint nine steel tower lines, saving around $20 million. This was largely enabled by the application of asset criticality and health indexes.

Revised assessments using the new risk model allowed some replacements to be deferred until the late 2020s, including:

- Secondary system component and full site replacement programs, with estimated savings of around $57 million. This includes the impact of revised design standards, which led to lower equipment and procurement costs. Analysis considered the future capabilities of secondary systems and the benefits of not doing replacements now to minimise integration costs later.
- Other small replacement programs, including the reduction in low span rectifications and re-scoping depot replacements to include the most critical items while maintaining site safety and other compliance. These led to savings of around $8 million.

5.2.4.3 Forecast capital expenditure

Forecast capital expenditure is based upon the latest information on asset condition and performance and network analysis with set via the new investment risk tool. Recent efficiency improvements are built into the forecast.

The forecast is higher than in the current period for a range of reasons:

- Augmentation expenditure is higher due to the Powering Sydney's Future project. This reflects two thirds of the total augmentation forecast. The project is detailed further in section Powering Sydney's Future 5.4.1.2 and in the public consultation report *RIT-T: Project Specification Consultation Report – Powering Sydney's Future (PSCR)*[30]. Other augmentation expenditure is driven by localised demand growth and new large spot loads.
- Replacement expenditure is also higher based upon the latest asset condition information and analysis using the new risk model. However, it is lower than the level suggested by top down modelling. Further detail is provided in section 5.2.6.

While the capital forecast is increasing, TransGrid considers that the new processes ensure that this will deliver transmission services more efficiently over the long term.

[30] This report is an appendix [TransGrid-Appendix B Project Specification Consultation Report PSF-1116-PUBLIC] and is available at: https://www.transgrid.com.au/powering-sydney, along with other consultation material.

5.2.4.4 Efficiency improvements built into the forecast

Efficiency improvements identified just prior to developing this Revenue Proposal are a result of TransGrid seeking innovative ways to reduce costs. These have been built into the forecast with a total estimated saving of around $30 million. Areas of improvement are summarised below.

Rationalised design standards (~$3.2 million p.a.): Design standards were reviewed to allow increased standardisation and reduced specifications where appropriate. Opportunities for changing to lower cost specifications while ensuring designs were still fit for purpose included:

- Alarm systems – with some back-ups were removed where appropriate
- Reduced requirements for concrete backfill where thermally stable bedding was a suitable alternative
- Changes to cable specifications.

New equipment standards (~$1.0 million p.a.): Equipment standards were reviewed against current needs and Australian Standards to identify areas where off the shelf products provided acceptable alternatives. Examples include changes to current transformer standards and substation batteries standards in some situations. Savings relate to lower equipment costs with related improvements in procurement lead times.

Innovative approach to protection and control design (~$1.8 million p.a.): Opportunities were identified to harness the capability of modern protection systems by integrating substation control functions within one of the two required protection systems.

This maintains compliance while reducing the protection and control footprint by one complete panel (or one third) per bay. This results in lower equipment, space and wiring costs.

Protection systems detect faults and activate circuit breakers to isolate them, maintaining safety and system security.

Substation control systems allow the network to be monitored and operating remotely from Sydney West Control Centre.

5.2.5 Capital expenditure overview - augmentation

Augmentation projects increase the transmission capacity in the network to meet defined reliability standards, and accessing low cost electricity by realising market benefits. The three categories of augmentation investment and the approach to forecasting needs, are briefly summarised below:

- **Load driven** augmentation projects are required to meet electricity demand.
- **Reliability driven** augmentation projects are required to meet a particular reliability standard and usually relate to either a change to an existing standard or a new one. This includes augmentation required by changing generation patterns.
- **Market benefits driven** augmentation projects are investments in transmission capacity that provide greater access to lower cost generation in the wholesale electricity market, as they eliminate network constraints. These projects result in economic benefits that exceed the project costs, resulting in lower electricity bills for consumers.

5.2.5.1 Augmentation forecasting approach

Needs are assessed via modelling which confirms the ability or otherwise of the network to meet forecast demand and generation changes, while complying with regulatory obligations. The assessment uses AEMO's state-wide forecasts, and connection point forecasts prepared by distribution network service providers, for subsystems and connection points.

For the coming period, TransGrid also applied a probabilistic planning method to some identified loads. This was to account for uncertainty surrounding the likelihood and location of large new spot loads and to support an efficient response. A probabilistic forecast is well suited to this type of driver as it allows for some investment to support the connection of new loads without proposing the full cost of every potential augmentation.

As supplying new loads could cause network constraints and drive augmentation (to meet reliability standards) TransGrid commissioned external research into what loads were possible in the period. This identified the size, timing, location and probability of 66 potential new demands based on robust criteria such as the existence of planning approval[31]. There was 350MW of possible demand which was not identified in other forecasts.

Probabilistic planning for uncertain new demands

The probability of each possible demand identified in the research was refined based on a synthesis of:

- each individual demand's likelihood (based on its drivers such as commodity prices) *and*
- the likelihood of it occurring in each of AEMO's low, medium and high scenarios.

Network analysis identified any network constraints which would be caused if the loads connected and augmentations to address these were identified and costed.

A probability weighted capital forecast for each augmentation project was calculated using the refined probability developed in the first step above. These weightings led to significant discounting of project costs.

The sum of these project forecasts is the probability weighted investment forecast included in Table 5.10. Further details are in Appendix G.

Market benefits driven augmentation projects are identified through market modelling which can be triggered by analysis of spot price outcomes and network congestion[32]. The impact of a network augmentation can be modelled to identify if it will have a net benefit.

In evaluating options for augmentation needs, TransGrid considers the opportunities for demand management and other non-network solutions. Large augmentation investments are also subject to consultation via regulatory investment test processes.

Cost estimates are based upon the annually updated Success Enterprise estimating system and an estimate of delivery costs.

5.2.5.2 Outlook for key augmentation drivers

The forecast is based on the following outlook for the three main drivers:

- **Deterioration in cables supplying inner Sydney**: Oil-filled cables owned by Ausgrid are at the end of their serviceable lives and their retirement will reduce supply capacity[33]. In conjunction, performance issues with a TransGrid cable has led to its capacity being reduced. Together, these issues have driven the need to consider enhancing the supply to inner Sydney. Early consultation suggests that consumers in the area were concerned about the significant economic impact of supply interruptions in Sydney[34].

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31 These are detailed in supporting documents, 'EY, Report to TransGrid on load developments, October 2016 - Public' and 'EY, TransGrid load databook, October 2016' [TransGrid-EY-TransGrid load databook-1016-PUBLIC]

32 These can include AEMO's National Transmission Network Development Plan and AER reports on high energy prices (eg 'Price above $5000/MWh'- 18 November 2016').

33 There is a range of evidence to support the cable condition findings. Through formal joint planning process, TransGrid has been party to detailed condition assessments.

34 For example, some considered that cost-benefit analysis would be required before any change was made to reliability standards. Responses varied as to the consumer preferences of reliability as expected. For example, some preferred as low as one outage in ten years and others were prepared to accept one every five years.

- **Demand growth in specific areas**: Peak load growth in specific locations is forecast to an extent where some action will be required. These are in Western Sydney and Canberra. The demand forecast is covered in more detail in Chapter 2.
- **Uncertainty around large spot loads**: there are a number of new potential loads, including mining and gas developments, which depend on future economic conditions and commodity prices. If they eventuate, these will drive investment in different parts of the network. As their likelihood and timing are uncertain (eg driven by commodity prices or environmental approvals) a probabilistic planning approach was applied to these investments to manage the risk with a lower cost to customers.
- **Reliability standard for the ACT:** The ACT Transmission Licence requires the provision of two geographically separate connection points of supply by 2020. The current network cannot comply and a separate, wholly independent substation and transmission line are being constructed, starting in the current period.

5.2.5.3 Augmentation forecast

The forecast for the augmentation category is shown in Table 5.2 below.

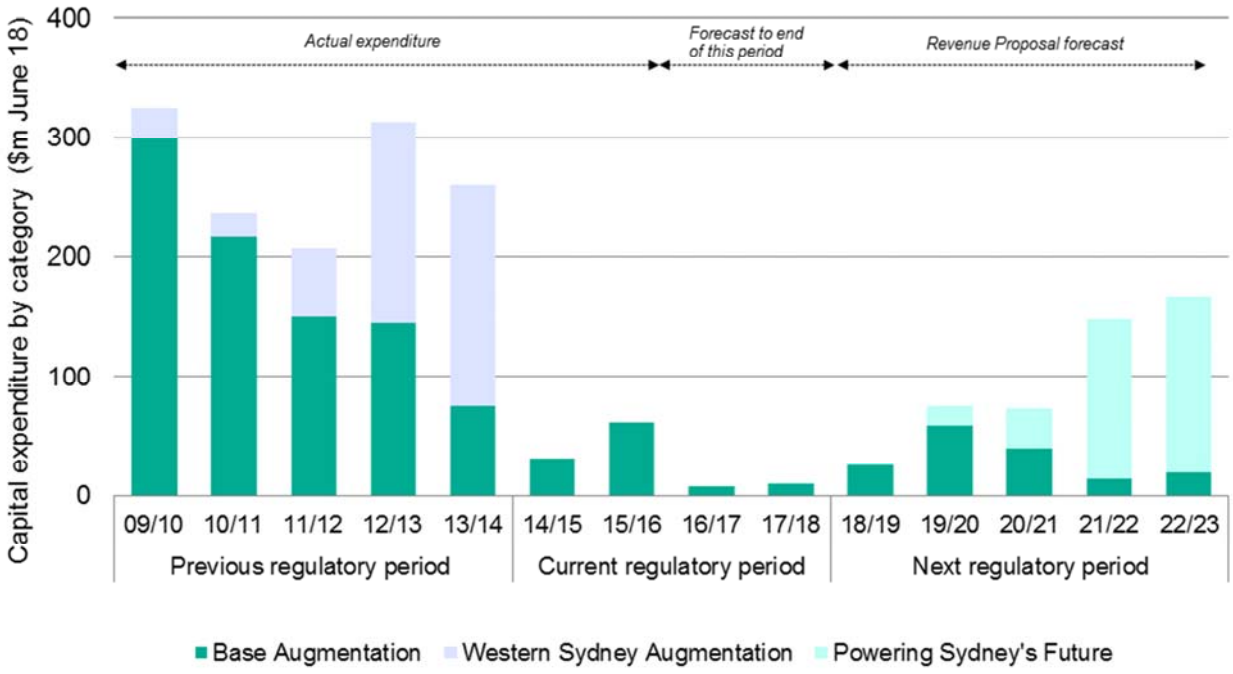
Table 5.2: Forecast augmentation capital expenditure ($m June 18)

Category	2018/19 Forecast	2019/20 Forecast	2020/21 Forecast	2021/22 Forecast	2022/23 Forecast	Total	% of total
Augmentation	27.6	75.6	73.2	148.2	167.1	**491.7**	**30%**

Source: TransGrid. Totals may not add due to rounding.

Augmentation expenditure is very low in the current period. Figure 5.4 shows that the increase in forecast augmentation expenditure is driven by the Powering Sydney's Future project. In the absence of this project, the trend would be very similar to the current period.

Figure 5.4: Augmentation capital expenditure showing infrequent major projects ($m June 18)



Source: TransGrid.

Further detail on the augmentation capital expenditure, including on individual projects, can be found in section 5.4.1.

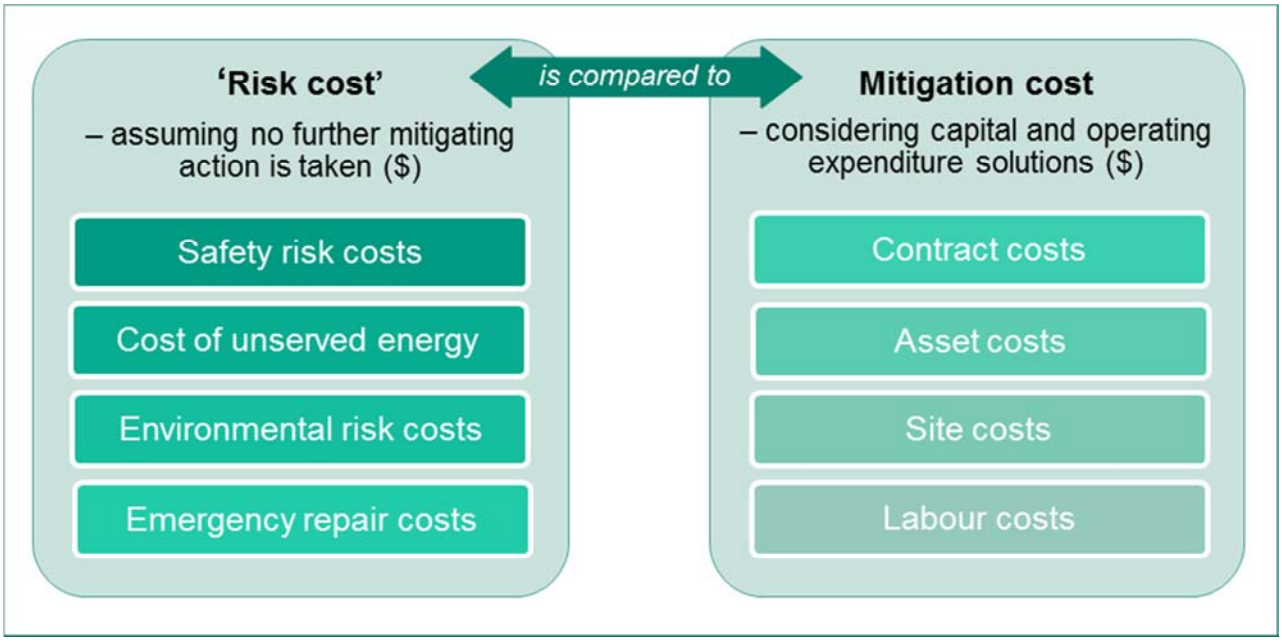
5.2.6 Capital expenditure overview - replacement

Replacement expenditure is driven by asset condition and related risk assessments and assets are only replaced if their condition and the related risk cost warrants it.

5.2.6.1 Replacement forecasting approach

The bottom-up replacement forecast was developed using a risk-based analysis method. Risks can be managed via maintenance, capital expenditure or a combination of these and the investment risk tool makes an informed decision on the most efficient approach. Figure 5.5 provides a simple representation of the model's comparison of the total risk cost of taking no action with the cost of remediation.

Figure 5.5: Investment risk tool - simplified representation

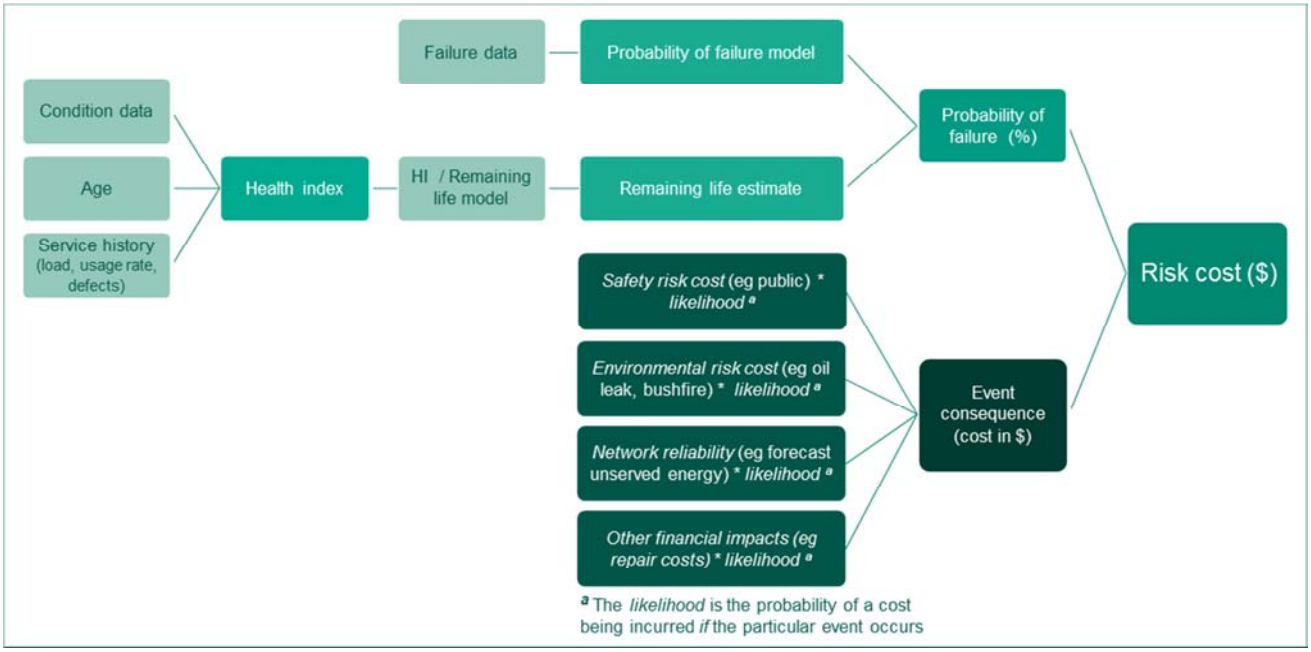


Risk cost is the sum of all the expected impacts of an asset failure, based upon:

- The **probability of asset failure** based on its condition and operation history and from analysis of the population's characteristics such as defect rates and technical lives
- The **consequential cost of a failure**. This includes the cost of relevant risks based on their likelihood of occurrence if an asset fails, with the existing mitigating controls in place. The consequence of an event is expressed in dollars.

This is represented in Figure 5.6.

Figure 5.6: Development of the risk cost



Assets selected for replacement based on asset health and criticality assessments therefore have a demonstrated replacement benefit that outweighs the program cost.

Cost estimates are based upon the Success cost estimating database which is updated annually based on recent data. Work is packaged in a way which optimises resourcing.

5.2.6.2 Outlook for key replacement drivers

Asset risk analysis has identified the following priority asset types:

- Transmission lines: Different condition risks have been identified in different geographical locations, including component corrosion in coastal areas and cracking in conductor joint fittings in the Snowy mountains area. Transmission line refurbishment and life extension works are discussed in section 5.4.4.
- Secondary systems and protection relays: Drivers of replacement next period include high levels of unreliability of one manufacturer's equipment
- Circuit breakers: the failure of which can have significant safety and system security implications.

5.2.6.3 Replacement forecast

The total forecast replacement expenditure for the period is $907.8 million, spread over five years as shown in Table 5.3. It is the largest component of the capital forecast.

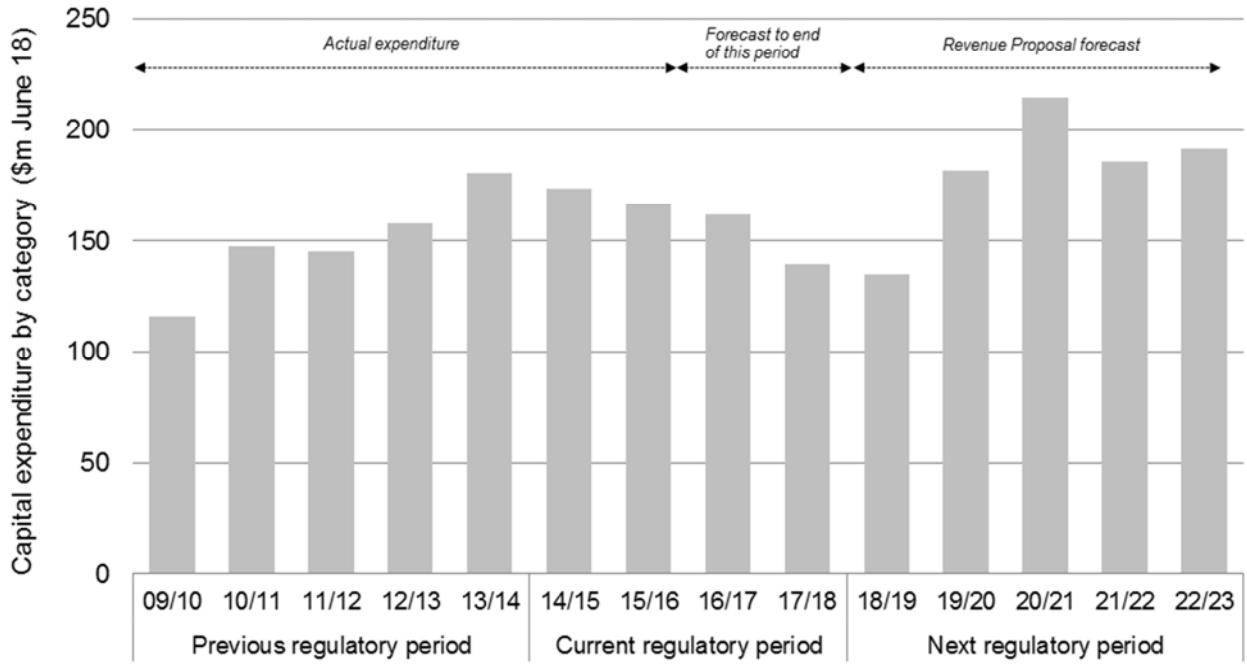
Table 5.3: Forecast replacement capital expenditure ($m June 18)

Category	2018/19 Forecast	2019/20 Forecast	2020/21 Forecast	2021/22 Forecast	2022/23 Forecast	Total	% of total
Replacement	134.9	181.6	214.3	185.6	191.3	**907.8**	**56%**

Source: TransGrid. Totals may not add due to rounding.

Figure 5.7 shows that the replacement expenditure is expected to be higher than in recent years. This trend is expected to continue for some time. See discussion in section 5.4.3.4.

Figure 5.7: Replacement capital expenditure trend ($m June 18)



Source: TransGrid.

TransGrid's top down replacement forecast is in line with its bottom up forecast. The top down model is similar to that used by the AER, with additional functionality. For example, it allows for greater granularity within asset categories where asset lives can vary significantly between components.

The top down modelling indicates that replacement expenditure will likely remain at a higher level for at least the next four regulatory periods, as assets installed in the 1970s and early 1980s reach the end of their service lives. Further detail and a comparison of top down and bottom up forecasts is provided in Section 5.4.3.3.

5.2.7 Security and compliance expenditure overview

This category includes investments required to comply with legislative obligations relating to the environment, staff and public safety and property. It includes items such as security fencing, lighting and site monitoring.

5.2.7.1 Security and compliance forecasting approach

TransGrid must comply with statutory obligations and appropriately manage the various risks. Needs are identified against the various obligations and options are costed like any other project and are then evaluated in the investment risk model. Further information on these obligations is provided in Section 5.3.2.3.

5.2.7.2 Outlook for key drivers

Risk assessments for the coming period have identified:

- Potential security risks: analysis has identified sites where deteriorating performance has hampered compliance and false alarms have increased response times and maintenance costs
- Inadequate lighting: Some sub-stations have been identified where lighting does not meet security and safety obligations
- Noise compliance risks: Six substation sites have been identified with a high risk of being non-compliant with noise obligations.

5.2.7.3 Security and compliance forecast

The forecast for the security and compliance category is shown in Table 5.4. This forecast is lower than expenditure in the current period.

Table 5.4: Forecast security and compliance capital expenditure ($m June 18)

Category	2018/19 Forecast	2019/20 Forecast	2020/21 Forecast	2021/22 Forecast	2022/23 Forecast	Total	% of total
Security and compliance	7.4	7.8	11.0	11.8	16.1	**54.0**	**3%**

Source: TransGrid. Totals may not add due to rounding.

More detail for security and compliance is provided in section 5.4.6.

5.2.8 Non-network (business support) expenditure overview

Non-network capital expenditure includes information technology, vehicles and mobile plant, accommodation and facilities.

5.2.8.1 Non-network forecasting approach

The forecasting approach differs for each category:

- Information Technology: The forecast is based on the information technology strategic plan, which considers business needs across the regulatory period
- Motor vehicles and mobile plant: the forecast is based on vehicle/plant-specific strategies which consider life cycle costs and business needs.

5.2.8.2 Outlook for key drivers

Major drivers for the next period include:

- Information technology: Investment drivers are to ensure service continuity and business enablement and to improve operational efficiency and reduce costs. In the coming period, there is a need to replace IT infrastructure and to upgrade the enterprise resource planning system. This will enable a new level of efficiency by improving maintenance resource planning, financial reporting and risk management.
- Motor vehicles and mobile plant: To minimise lifecycle costs, 70 per cent of the forecast is to replace motor vehicles and the rest is for mobile plant.

5.2.8.3 Non-network expenditure forecast

The forecast for the non-network category is shown in Table 5.5. The forecast is similar to expenditure in the current period. More detail for the next period forecast is provided in section 5.7.

Table 5.5: Forecast non-network capital expenditure ($m June 18)

Category	2018/19 Forecast	2019/20 Forecast	2020/21 Forecast	2021/22 Forecast	2022/23 Forecast	Total	% of total
Non-network	25.5	41.8	39.4	24.4	27.7	**158.8**	**10%**

Source: TransGrid. Totals may not add due to rounding.

5.2.9 Contingent projects overview

A significant factor which could impact TransGrid's capital expenditure requirements is the changing pattern of generation and the various impacts of this. The uncertainty around the exact nature of this has resulted in the development of four contingent projects. These are:

- NSI: an interconnection between New South Wales and South Australia
- Reinforcement of Southern Network
- Reinforcement of Northern Network (QNI upgrade)
- Support South Western NSW for Renewables.

A fifth contingent project relates to complying with the new transmission reliability standard at Broken Hill.

These projects and their proposed triggers are summarised in section 5.5.

5.3 Obligations relating to capital investment

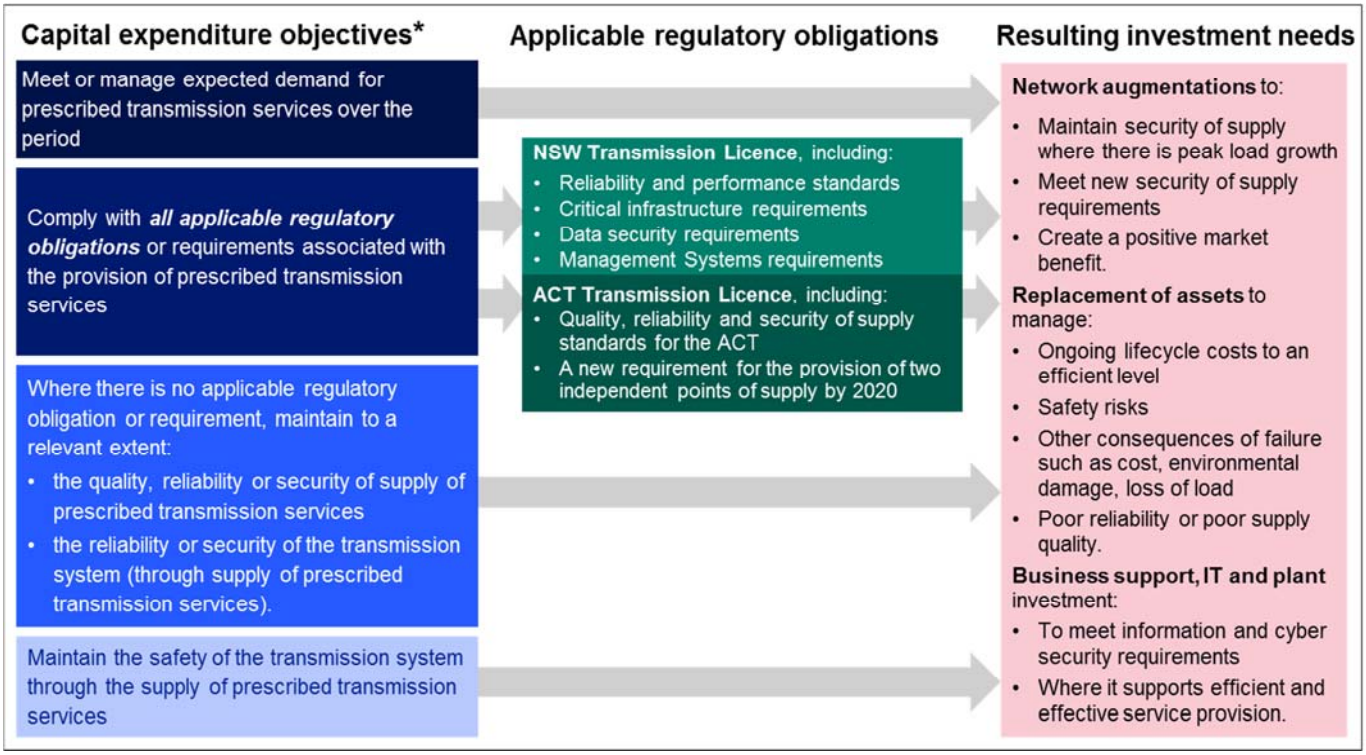
TransGrid's capital program is developed within the context of its regulatory obligations; these are summarised below.

5.3.1 National Electricity Rules - capital expenditure objectives

The capital expenditure objectives in the National Electricity Rules (NER) provide a basis for TransGrid's capital investment forecast. One of these is that TransGrid must comply with 'all applicable regulatory requirements'. This is a specific linkage between the NER and obligations defined elsewhere, such as those in Transmission Licences and safety and environmental legislation.

The relationship between the capital expenditure objectives and different types of investment is illustrated in Figure 5.8.

Figure 5.8: How NER obligations lead to investment needs



*__Note__: *the capital expenditure objectives are defined in Clause 6A.6.7 of the National Electricity Rules. They have been paraphrased for the purposes of this diagram.*

The capital forecast therefore depends upon the nature of the investment needs identified. The NER also describes what the AER considers when assessing the forecast. This provides an important guide on the things which the forecast needs to take into account. This is described further in Figure 5.9 in section Assessment of the capital expenditure forecast.

5.3.2 Applicable regulatory obligations

5.3.2.1 NSW Transmission Operators Licence

TransGrid was granted a Transmission Operator's licence under the Electricity Supply Act 1995 (NSW) on 7 December 2015. Put in place at the time of the change in TransGrid's ownership, this requires that various technical and prudential criteria are met. Further detail is provided in Table 5.6.

Table 5.6: NSW Transmission Licence requirements

NSW Transmission Licence	Summary requirements & comments
Reliability and performance standards	> Over the course of 2015 and 2016, the Independent Pricing and Regulatory Tribunal (IPART) reviewed the transmission reliability and performance standards applicable to TransGrid. > The NSW Government published the final standards in December 2016. > TransGrid's capital expenditure forecast was based on draft standards published in May 2016. Some changes were made as a result of differences published in the Supplementary Draft of September 2016. A review of the capital program is underway to assess any changes arising from the final standards. TransGrid will update the AER on the outcome and provide necessary revisions as soon as is practicable.
Critical infrastructure requirements	> Requirement to nominate specific personnel for critical defined roles > Specific reporting to the NSW Government related to TransGrid's ownership and restrictions on operations and control from outside of Australia.
Data security requirements	> Metering and personal information must be held in Australia and can only be accessed by authorised personnel from within Australia > This limits the way certain IT services can be structured and in some cases the choice of provider.
Management Systems requirements	> TransGrid must maintain certification to specific asset management and environmental management systems > Operations must be undertaken in accordance with these and compliance audits must be undertaken.
Reporting Manual Requirements	> TransGrid reports on the compliance of its Electricity Network Safety Management System against AS 5577 – Electricity Network Safety Management Systems.

5.3.2.2 ACT Transmission Licence

TransGrid is also subject to a reliability standard under the transmission licence it holds in the Australian Capital Territory. Applicable obligations for quality, reliability and security of supply to the ACT are set out in the Electricity Transmission Supply Code (July 2016) - Disallowable Instrument DI2016-189. This is set by the ACT Government under the Utilities Technical Regulation Act 2014. The standard requires the provision of two geographically separate points of supply by 2020.

5.3.2.3 Regulatory and legislative obligations in relation to safety

TransGrid also has specific obligations relating to health and safety, environmental and property damage and reliability, including:

> The Electricity Supply Act 1995 (NSW)
> The Electricity Supply (Safety and Network Management) Regulation 2014 (NSW)
> Work Health and Safety Act 2011 (NSW)
> The Utilities Act 2000 (ACT)
> The Utilities (Technical Regulation) (Electricity Transmission Supply Code) Approval 2016 (No 1) (ACT)

- Work Health and Safety Act 2011 (ACT)
- AS 5577:2013 - Electricity Network Safety Management Systems (an Australian Standard referenced in the regulations above).

The Work Health and Safety acts, and the Australian standard require TransGrid to manage So Far As Is Reasonably Practicable (SFAIRP) various risks. These include risks to the health and safety of workers and the public; to property (including from bushfires); and to safety, arising from loss of electricity supply. This requires that TransGrid must:

- Identify all reasonably foreseeable risks
- Identify all control measures which eliminate or minimise these risks
- Decide which controls are reasonably practicable to implement
- Implement management systems to ensure the controls are effectively maintained and monitored.

In seeking to comply with these obligations, high cost is not a necessarily a justifiable reason for inaction. TransGrid's investment risk tool accommodates such considerations when evaluating options.

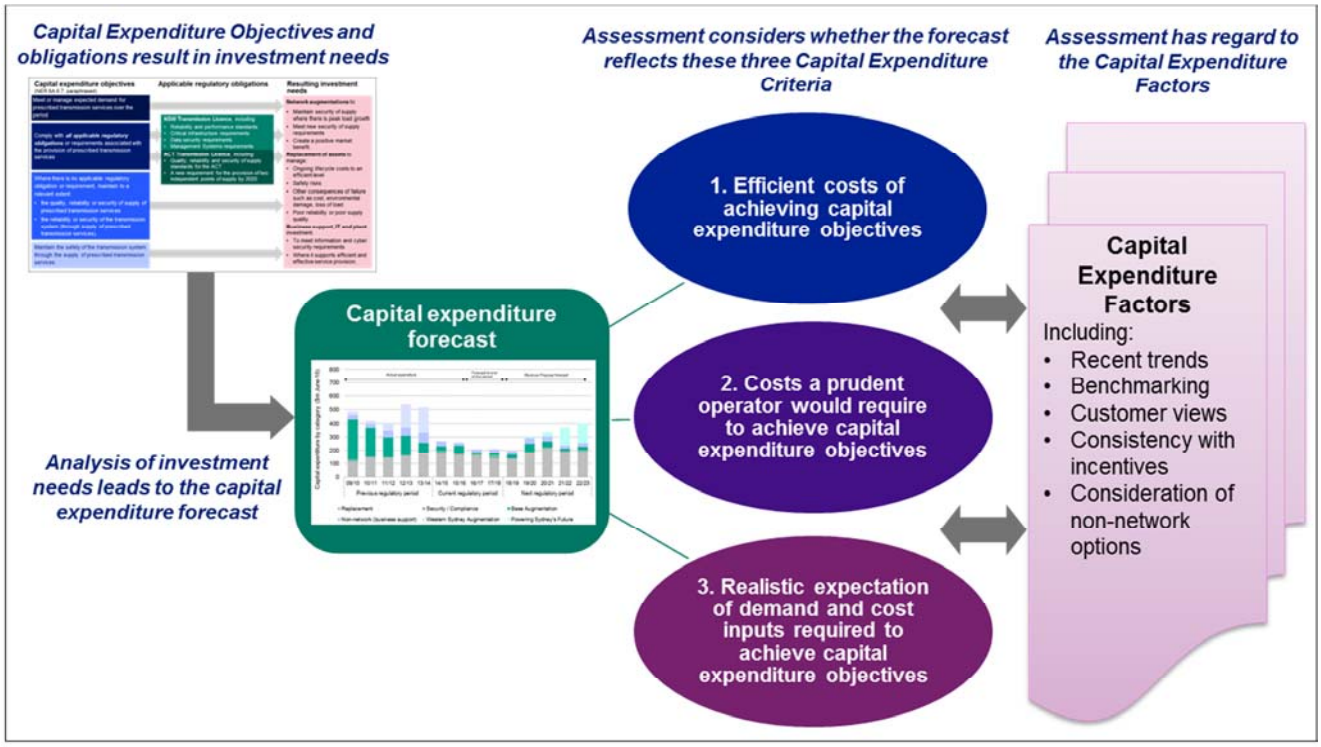
5.3.3 Assessment of the capital expenditure forecast

As noted above, obligations relating to capital expenditure originate from the *capital expenditure objectives* in the NER. The NER also sets out:

- the *capital expenditure criteria,* which need to be reasonably reflected for the AER to accept the forecast
- the *capital expenditure factors,* to which the AER must have regard when assessing a forecast.

Figure 5.9 illustrates the interaction between these.

Figure 5.9: Assessment of the forecast



5.3.3.1 Capital expenditure criteria

To support the AER's assessment of TransGrid's compliance with the Capital Expenditure Criteria assessment, this proposal includes information on:

- Proposed investments including needs, timing and costs. A high level summary is included in this Chapter, with detailed individual business cases in the supporting documentation.
- The prudence of TransGrid's operations and costs is supported by its governance processes and asset management system, covered in Chapter 4, Approach to Managing the Network. This is further supported by an independent expert review by consultant engineers Aurecon which examined the efficiency of the capital program. The report is provided in Appendix E.
- AEMO's demand forecast, used in forecasting the capital expenditure requirements, is detailed in Chapter 2.
- Input costs and relevant escalations are discussed in section 5.8.

5.3.3.2 Capital expenditure factors

Information on the capital expenditure factors which provide context to the AER's assessment is found throughout this chapter. TransGrid has also provided a range of expert reports which attest to the efficiency of asset management processes and the approach to capital forecasting.

Specific references are provided in Table 5.7.

Table 5.7: Location of relevant information for the capital expenditure factors

Factor	Where addressed
Most recent AER annual benchmarking report and benchmark capital expenditure that would be incurred by an efficient TNSP	> Addressed in Section 5.11.1 Benchmarking > Frontier Economics report Review of the MTFP and MPFP analysis in the AER's annual benchmarking report, January 2017 included as Appendix F.
Actual and expected capital expenditure during preceding regulatory control periods	> Addressed in Section 5.8.2 Historical and actual capital expenditure
Extent to which capital expenditure forecast includes expenditure to address concerns of electricity consumers	Findings from recent consumer engagement and TransGrid's response are addressed in: > Chapter 3 and Appendix C > In TransGrid document 'Stakeholder engagement Connecting with you: Summary report to inform TransGrid's 2018/19 to 2022/23 regulatory period > Section 5.4.1.2 on Powering Sydney's Future and section 5.11.8 on non-network alternatives
The relative prices of operating and capital inputs Substitution possibilities between operating and capital expenditure	> Every project has been assessed against alternatives, including solutions based on operating expenditure (where relevant) > Information can be found in supporting project documentation
Consistency of the capital expenditure forecast with incentive schemes	> Addressed in Section 5.11.5

Factor	Where addressed
Extent of capital expenditure to related parties	> Addressed in TransGrid-Reset RIN Related Party Transactions-0107-PUBLIC
Whether capital expenditure forecast includes amount relating to a project that should more appropriately be included as a contingent project	> This Chapter sets out at a high level both the ex-ante forecast and proposed contingent projects > Full supporting documentation establishing each project's business case and option analysis are available as supporting information
The most recent NTNDP and submissions made by AEMO	> Addressed in Section 5.11.7
The extent of consideration and provision for non-network alternatives	> Addressed in Sections 5.7 and 5.4.1.2
Relevant project assessment conclusions report	> The Powering Sydney's Future project is in the process of a RIT-T assessment but is not at this stage yet
Any other factor the AER considers relevant and has notified TransGrid of in writing prior to the submission of its revised Revenue Proposal	> The AER has not currently advised of any additional capex factors

5.4 Forecast capital expenditure in detail

TransGrid's forecast capital expenditure for the 2018/19 to 2022/23 period is shown in Table 5.8. The total forecast capital expenditure for the five year regulatory control period is $1,612.3 million.

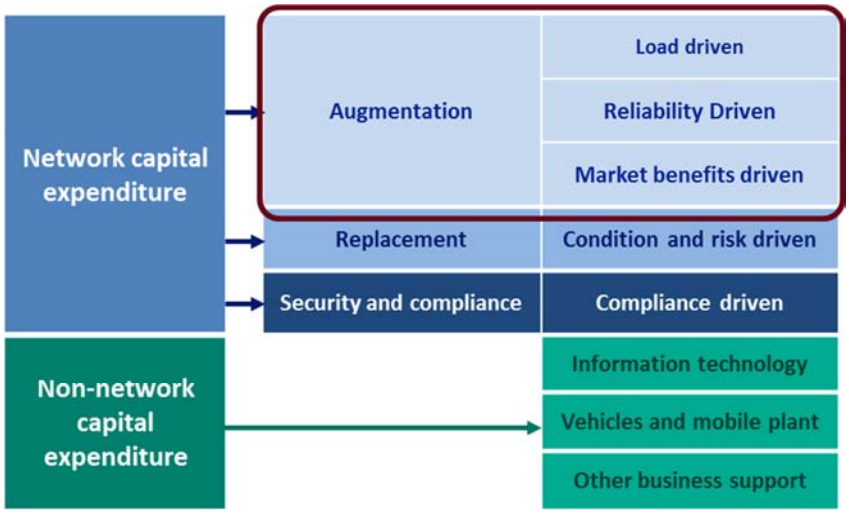
Table 5.8: Forecast capital expenditure ($m June 18)

Category	2018/19 Forecast	2019/20 Forecast	2020/21 Forecast	2021/22 Forecast	2022/23 Forecast	Total	% of total
Augmentation	27.6	75.6	73.2	148.2	167.1	**491.7**	**30%**
Replacement	134.9	181.6	214.3	185.6	191.3	**907.8**	**56%**
Security and compliance	7.4	7.8	11.0	11.8	16.1	**54.0**	**3%**
Support the business (non-network)	25.5	41.8	39.4	24.4	27.7	**158.8**	**10%**
Total	**195.3**	**306.8**	**337.9**	**370.1**	**402.2**	**1,612.3**	

Source: TransGrid. Totals may not add due to rounding.

The following sections summarise the forecast for each category of investment and detail the most material projects within each.

5.4.1 Augmentation forecast details



There are three categories of augmentation investment. Table 5.9 shows that load driven investment is the most significant augmentation category in this forecast.

Table 5.9: Augmentation expenditure by category ($m June 18)

Augmentation category	Total
Load driven	450.5
Reliability driven	41.2
Market benefits driven	0.0
Total	**491.7**

Source: TransGrid. Totals may not add due to rounding.

While there is no market benefit driven investment, the proposed contingent projects are related to market benefits.

5.4.1.1 Load driven investment details

Table 5.10 shows the projects in the load driven augmentation forecast, the largest of which is Powering Sydney's Future. An overview of Powering Sydney's Future is included below with more detail in the Project Specification Consultation Report included in Appendix B.

Summaries of other all other load-driven projects in Table 5.10 are included in Appendix G.

Table 5.10: Breakdown of load driven expenditure forecast ($m June 18)

Augmentation project	2018/19 Forecast	2019/20 Forecast	2020/21 Forecast	2021/22 Forecast	2022/23 Forecast	Total
Powering Sydney's Future	1.1	15.9	32.6	133.7	147.6	**330.9**
Projects driven by economic benefits and developments additional to demand forecasts	8.7	32.0	38.0	8.5	13.1	**100.3**
New Transformer and 66kV Switchbays at Macarthur 330/66kV Substation	0.7	1.0	1.2	3.8	1.1	**7.7**
New 132kV Switchbays to connect new loads	1.6	1.1	1.4	2.3	5.3	**11.7**
Total	**12.1**	**49.9**	**73.2**	**148.2**	**167.1**	**450.5**

Source: TransGrid. Totals may not add due to rounding.

5.4.1.2 Powering Sydney's Future

Background: The inner Sydney electricity network supports a highly and densely populated area which makes a significant contribution to Australia's economy. TransGrid studies show that the network is at imminent risk of failure from 2021/22.

It is supplied by an underground network including two 330 kV cables owned by TransGrid and a number of 132 kV cables owned by Ausgrid. The majority are an older oil-filled type, installed in the 1960s and 1970s and many are in poor condition.

Some cables exhibit increasing failure rates and there is a risk of fluid leakage and environmental damage. Faults take longer to repair and related costs are higher than for modern cable technologies due to oil management and the need for bespoke jointing.

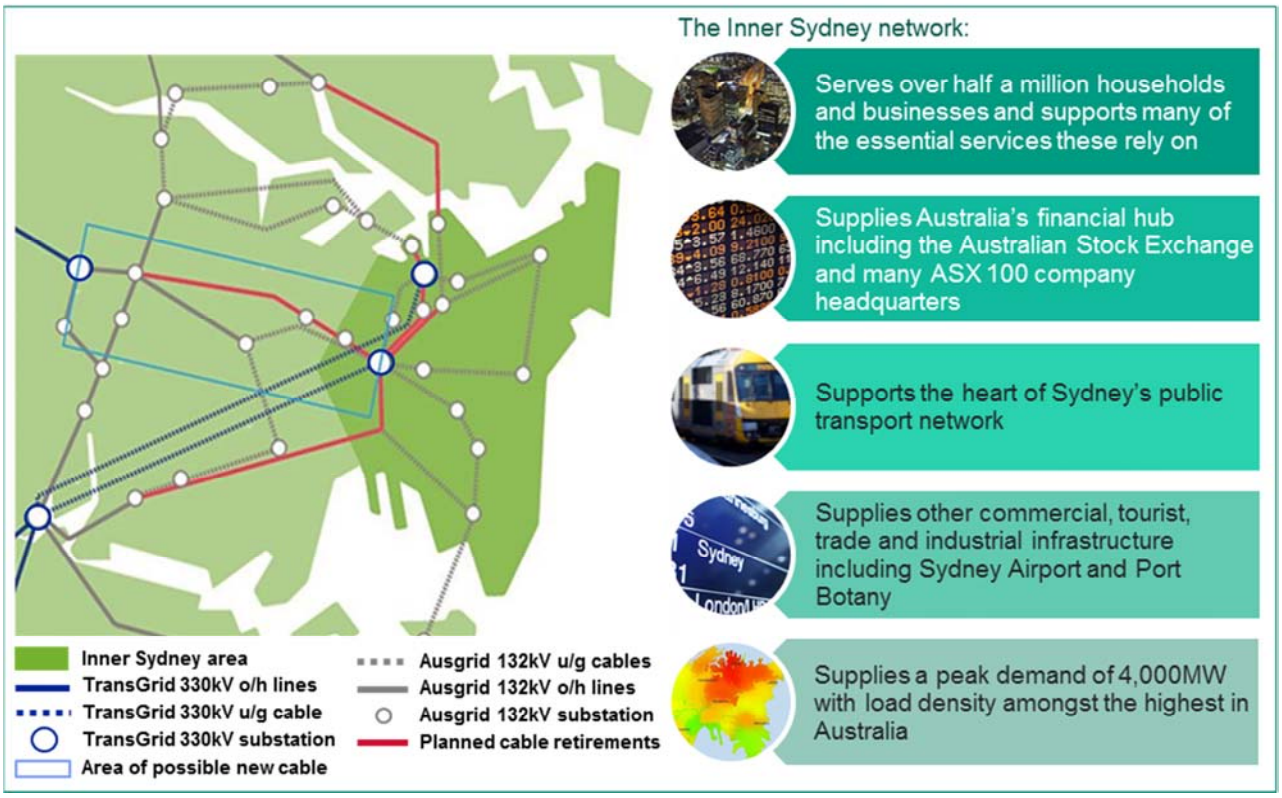
Some cables are due to be retired from service and planning needs to consider the future retirement of others as part of an efficient solution.

The area served and some of its important characteristics are shown in Figure 5.10.

Inner Sydney transmission reliability standards

- TransGrid consulted with customers to prepare for IPART's review of 'Electricity transmission reliability standards'
- This enabled a more informed consultation by explaining the issues and terminology
- It was also to understand customer views – that customers in this area value reliability of supply highly but also want non-network approaches to be included
- The published transmission reliability standard includes a higher standard for inner Sydney area compared to other network areas
- This is in line with international practice for important commercial centres.

Figure 5.10: Area served by the Inner Sydney network



Source: TransGrid.

Powering Sydney's Future is seeking to ensure a reliable and secure electricity supply to this important economic area in light of deteriorating assets and re-emerging demand growth. It is currently the subject of public consultation via the regulatory investment test for transmission (RIT-T) and the first round of submissions closed in January 2017. The project will evolve as a result of this and as more detailed assessment is completed.

Project Need: Due to a combination of factors which have emerged over time, analysis shows that the inner Sydney network is expected to experience increasing levels of unserved energy[35] in the coming years. The reasons are described in Table 5.11.

[35] 'Expected unserved energy' is defined TransGrid's 'Electricity Transmission Reliability Standards' as 'the expected amount of energy that cannot be supplied, taking into account the probability of supply outages attributable to credible contingency events, expected outage duration, and forecast load.'

Table 5.11: Factors driving higher forecast unserved energy in Sydney

Factor, reason and impacts
2008 to 2016 *- Reductions in the ratings of TransGrid and Ausgrid cables supplying inner Sydney* **Reason:** The original cable backfill was found to be unable to remove heat as designed. To maintain safe operating temperatures, capacities were reduced. **Impact:** Network capacity is more than 1200 MVA lower than in 2008[36].
2016 to 2018 *- Three Ausgrid oil-filled cables are to be retired in the next two years* **Reason:** Due to poor reliability, environmental risk and increasing operating costs. **Impact:** Network capacity is reduced further and the risk of unserved energy is increased.
2015 to 2023 *- Peak demand growth re-emerged in 2014/15 and is forecast to continue* **Reason:** Renewed economic activity and major infrastructure investment in Sydney. **Impact:** As peak demand grows, the network's ability to maintain supply under fault conditions reduces and the level of unserved energy increases.
2017 to 2023 *- Increasing unreliability of Ausgrid's eight remaining fluid-filled cables* **Reason:** Reliability analysis shows failure rates of these cables increases rapidly at around fifty years of age[37]. **Impact:** The risk of unserved energy increases with more cable failures. Due to long repair outages of two to three months or more, the chance of coincident outages and the related risk cost increases sharply over time[38]. The potential for environmental harm is also increased.

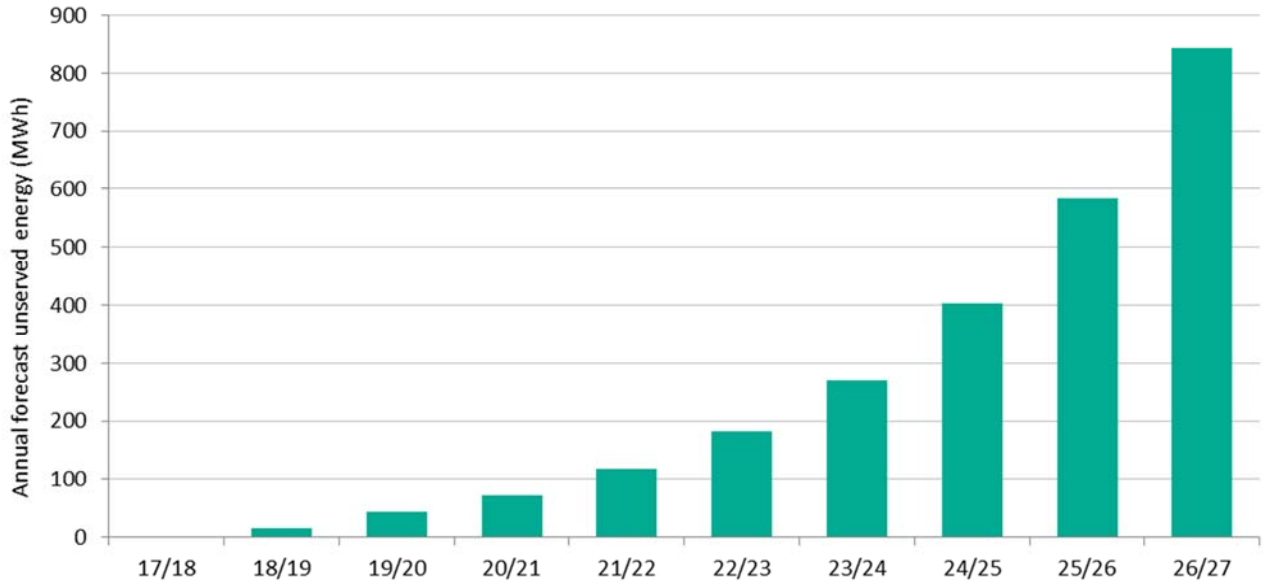
[36] Based on assuming that TransGrid's cable 41 rating has been reduced by 237MVA from 663MVA to 426MVA and Ausgrid's cable ratings have been reduced by 950MVA.

[37] This failure rate analysis for this actual population is shown in Appendix A4 of the Project Specification Consultation Report, published for the RIT-T process on 11 October 2016 [TransGrid-Appendix B Project Specification Consultation Report PSF-1116-PUBLIC]

[38] Fluid-filled cables are based on older technology. Repair times are much longer due to the requirement to drain all fluid before work starts, to manually wrap paper insulation layer-by-layer once a joint repair is completed and to re-fill the cable after. Cable joints are more complex and, as these cables are now less prevalent used less, joint repair kits must be specially ordered from manufacturers.

Figure 5.11 shows the forecast of unserved energy assuming that the above factors take effect and no action is taken.

Figure 5.11: Forecast of unserved energy in Inner Sydney, 2017/18 to 2026/27



Source: TransGrid.

By 2021/22, more than half of Ausgrid's remaining cables will have reached the point where failure rates begin to accelerate[39], increasing the likelihood of coincident outages. This is reflected in the forecast of unserved energy above, which begins to increases more rapidly. As the forecast of expected unserved energy increases, the related economic cost of this also increases. This is based on the value (in $/MWh) different types of customer place on their electricity supply[40]. Studies usually find this to be higher in CBD areas.

TransGrid forecast the total risk cost for the inner Sydney network. This includes the economic cost of unserved energy as well as other risk costs including the environmental costs of oil leakage and the cost of repairs. All of these are forecast to increase more rapidly after 2021/22, along with the prospect of environmental harm if the cables are not retired. The analysis of options compares this risk cost with the cost of potential mitigating actions.

Diverse options investigated

Initially, TransGrid considered a broad range of options such as generation, various network options and demand management to identify those which were technically feasible. The screening process took account of a range of factors including geography, cost, community and environmental impacts, planning considerations and technical feasibility. In summary, this screening process found:

- that a 132kV network solution was much more expensive than 330kV and would cause much more community disruption with multiple routes required

[39] The supporting analysis is described in the PSCR. [TransGrid-Appendix B Project Specification Consultation Report PSF-1116-PUBLIC]

[40] This is calculated by multiplying the Unserved Energy (MWh) with a Value of Customer Reliability (VCR) where VCR is an estimate of the value in $/MWh different types of customer place on electricity supply in different locations.

- for various 330kV network supply routes, the one from Rookwood Road was preferable. Other routes from Sydney North, Sydney East and Sydney South substations were limited by geography, route complexity, distance and cost. There was also increased environmental risk due to potential National Park and harbour crossings and routes from Sydney South would come through a densely populated area. . In some cases, other network constraints which would be exacerbated.
- A permanent non-network solution was not expected to be available, given the amount of capacity required and where it was required[41]. Nevertheless, there is good potential for non-network solutions to become part of a solution, as described further below,

The most feasible options are considered to include non-network options if available and 330kV cables from Rookwood Road to Beaconsfield West. These are now the subject of the RIT-T consultation.

A short list of options evaluated formally and consulted on

The published Project Specification Consultation Report (PSCR) includes six different credible network options which can be combined with non-network options. Network options differ based on whether:

- TransGrid's existing Cable 41 is remediated, operated without remediation (including at a lower voltage), or retired
- Ausgrid's eight oil-filled cables in the poorest condition are retired at once, or in stages
- Two new 330 kV cables are built together, or in stages.

All six options envisage the inclusion of non-network solutions of some type and combination and the extent of these depends upon the location, cost and capability of what is offered.

Seeking non-network options as part of Powering Sydney's Future

In recent engagement, TransGrid heard that customers and stakeholders value innovation and support a level playing field for non-network investment alternatives.

In response, TransGrid arranged an extended consultation session on Powering Sydney's Future to spend additional time discussing the requirements for non-network options. The workshop took place in November 2016 as part of the RIT-T consultation session.

It included information on the amount of demand reduction required by when. By 2022/23 the requirement is for 60MW and this rises to 190MW by 2024/25. Other important specifications for non-network options are:

- That the windows in which they need to operate are longer than those usually specified to manage peaks. Cable outages could last months and the network could be at risk for long periods of the day so the specification asks for options which can operate from November to March on weekdays.
- That the relative effectiveness of generation and/or demand management differs at different locations.

TransGrid looks forward to working with non-network proponents in progressing Powering Sydney's Future. As part of its commitment to this, there are plans to consult face-to-face with all parties submitting Expressions of Interest.

[41] It was not considered feasible that a large generator of hundreds of MW would locate in inner Sydney or that enough distributed sources would be found for a permanent solution.

Efficient solution & rationale

Currently, the most promising solution to maintain supply to Sydney's inner metro and CBD is option 3 in the PSCR - Install two 330kV cables (route as in 1.) at once and retire Cable 41 - with a forecast cost of $331 million. However, this could change following the RIT-T consultation, further evaluations and as the result of the expression of interest process seeking non-network solutions.

Planning and delivery complexity

TransGrid has already considered the need for a project like this. It previously consulted with the community and has carefully reviewed network security in order not to invest early. By securing electricity supply to the inner Sydney area now, this project will significantly contribute to the community and economy by avoiding uneconomic levels of unserved energy.

Undertaking such an infrastructure investment in Sydney is complex and detailed planning and careful procurement could take over a year, even after the RIT-T is completed. It will require careful consultation with communities when cable routes are considered and easements are procured. This process will benefit from certainty and the community will be keen to understand exactly what the project entails. TransGrid will also need to carefully coordinate activities with the other major infrastructure projects[42], to avoid disrupting these and to manage any compounding of community impacts during construction. TransGrid is engaging with all stakeholders around this important project.

5.4.1.3 Projects driven by economic benefits and developments additional to demand forecasts

Probabilistically planned projects due to new customer demand spot loads

AEMO's demand forecast for New South Wales is presented in terms of strong, neutral and weak economic and consumer outlooks, where neutral is most likely. TransGrid is aware that new large industrial and mine loads could connect in the period and understands that these are unlikely to be included in the AEMO or DNSP forecasts.

However, these are subject to uncertainty as they depend on future economic conditions and commodity prices.

As supplying large new spot loads could cause network constraints and require augmentations to meet reliability standards, TransGrid commissioned an external review to research what loads were possible in the period, and to consider the probability of these based on robust criteria such as the existence of planning approval. The result was that 66 new potential demands were identified with around 350MW of load which was not considered in other demand forecasts.

With the information on spot loads in combination with AEMO's forecast TransGrid undertook a probabilistic planning analysis as follows:

- Each new possible demand was given a probability weighting based on a synthesis of AEMO's strong, neutral and weak scenarios and the likelihood of individual new connections occurring by considering their individual drivers such as commodity prices.
- Network analysis was undertaken to identify constraints which would be caused if these loads connected. These identified transmission line overloading, low voltages and voltage instability under system normal as well as transmission contingencies.

[42] For example, the Westconnex motorway project which runs close to Rookwood Road.

- Augmentation projects to address these needs were identified and costed. They included transmission line connections, new capacitor banks and switchbay projects.
- A forecast for each augmentation project was created based on the likelihood of spot loads which drove the project occurring. This probability accounted for both the likelihood of the load and the likelihood of it occurring in AEMO's low, medium and high scenarios (meaning they were discounted significantly).
- The outcome of this analysis is a probability weighted investment amount for demand scenarios which may occur.

A summary of projects identified from probabilistic planning is in Appendix G.

Projects that deliver economic benefits

A number of opportunities (16 opportunities) have been identified that deliver economic benefits with relatively low cost investments. Projects have been identified in a number of areas:

- Improvement in power quality, eg voltage unbalance
- Reduction in load restoration time
- Improvement in network resilience during extreme weather events
- Improvements in operational efficiencies
- Improving ability to respond in grid emergencies.

A summary of identified projects that deliver economic benefits is in Appendix G.

Dynamic voltage support

The Federal Government has committed to increase the electricity generation from renewable sources up to 20% of the total generation by 2020. A significant proportion of this generation is likely to come from wind and solar farms connected to the outer edge of the grid.

Renewable sources connected to the outer, weak parts of the NSW transmission system will likely create voltage control and instability issues. Successfully achieving 20% of generation from renewable sources will require augmentation of the grid using dynamic reactive power support.

The following technology options were considered for meeting the reactive power support need:

- Static Var Compensators (SVCs)
- Synchronous Compensators
- Static Compensators (STATCOMs)
- A combination of two or more of the above.

A summary of projects included in the capital forecasts to provide dynamic voltage support is in Appendix G.

5.4.2 Reliability forecast

Reliability projects are augmentation projects which are primarily driven by reliability and security standards which are usually set by an external authority.

The only large project in this category is for the provision of a second supply to the Australian Capital Territory. This is required a result of the new ACT Transmission Licence Condition described in section 5.3.2.2. Some of the expenditure for this project will be in the current period with the remainder in the period covered by this Proposal.

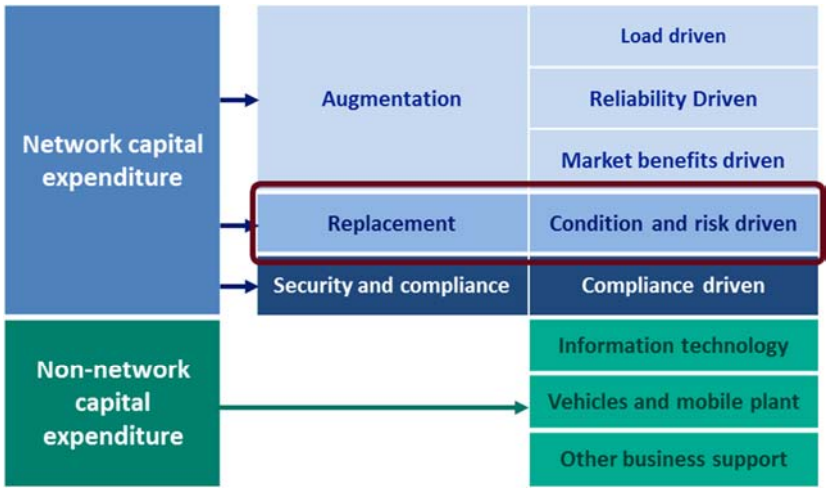
Table 5.12 shows the forecast expenditure for this and other minor reliability projects. A summary of all of these is included in Appendix G.

Table 5.12: Breakdown of forecast reliability driven expenditure ($m June 18)

Reliability project	2018/19 Forecast	2019/20 Forecast	2020/21 Forecast	2021/22 Forecast	2022/23 Forecast	Total
Second supply to ACT (Stockdill)	11.8	25.6	0.0	0.0	0.0	**37.4**
Mudgee reinforcement	0.2	0.0	0.0	0.0	0.0	**0.2**
Molong reinforcement	3.5	0.0	0.0	0.0	0.0	**3.5**
Total	**15.5**	**25.6**	**0.0**	**0.0**	**0.0**	**41.2**

Source: TransGrid. Totals may not add due to rounding.

5.4.3 Replacement investment



Replacement projects are driven by asset condition and related risk assessments.

This forecast is based upon the improved risk based economic methodology which calculates the risk cost of asset condition over time to determine the right time for replacement or refurbishment. Assets are not automatically replaced on a like-for-like basis, but are optimised for future requirements.

5.4.3.1 Replacement programs

Table 5.13 shows the forecast replacement expenditure of $907.6 million by asset category and years.

Table 5.13: Replacement capital expenditure by asset category ($m June 18)

Category	2018/19 Forecast	2019/20 Forecast	2020/21 Forecast	2021/22 Forecast	2022/23 Forecast	Total
Substation equipment	45.3	53.9	45.4	39.5	36.0	220.1
Substation civil infrastructure	9.2	9.3	9.3	9.4	9.5	46.6
Substation AC/DC systems	3.5	8.0	3.5	3.5	6.1	24.6
Secondary systems equipment	33.8	44.2	41.3	34.2	32.3	185.7
Transmission line assets	25.4	34.0	62.4	52.3	58.1	232.1
Other	17.7	32.3	52.5	46.8	49.3	198.6
Total	**134.8**	**181.7**	**214.3**	**185.7**	**191.3**	**907.8**

Source: TransGrid. Totals may not add due to rounding.

As noted in section 5.2.6.3, the replacement forecast is higher than in the current period. The drivers of specific increases in transmission line and secondary systems asset categories were also explained in that section.

As the forecast was derived from the bottom up using the investment risk model, it is the result of comparing risk costs with remediation costs. Given that risk costs are based on asset condition and the consequences of failure, this replacement program increase can be linked to the condition of assets and the risk of not taking action.

TransGrid was rigorous in developing its replacement program but was conscious of the need to test the forecast increase using a top down approach. Once known differences in model coverage were accounted for, the replacement forecast were similar. It was also notable that the top down model shows that a sustained increase in replacement expenditure is expected over the next twenty years.

The approach taken to this comparison and its results are covered in the section below. This is followed by a summary of the largest replacement program in this forecast (transmission line life extension and refurbishments) follows. Other replacement programs are described in Appendix G (Capital Expenditure Projects).

The top down model and the reasons for enhancements compared to the AER repex model are described below along with the results of the comparison of forecasts.

5.4.3.2 Choosing a top down method

The AER's calibrated repex model provides an outlook of future replacement investment, primarily based on the age profile of existing assets, recent costs and replacement volumes for similar projects. Consistent with the underlying philosophy of the AER model, TransGrid developed a modified version with enhancements to improve the top down forecast by:

- widening the coverage of asset classes
- increasing the granularity of asset information that can be used

> replacing the fixed calibration functionality to improve the accuracy of input costs and provide flexibility for changes in replacement approaches between periods.

This was populated with RIN and other relevant data to present a view of replacement capital expenditure over a 20 year period. Table 5.14 describes the main differences between the models.

Table 5.14: Comparison of AER and TransGrid top down repex models

Attribute	AER calibrated model	TransGrid top down model
Coverage	Excludes a number of critical asset classes (eg substation steel work)	Covers all major asset classes
Granularity	No ability to separate assets to allocate different lives to components	Allows a finer breakdown of asset types where better resolution is useful
Calibration – accuracy & flexibility	Less accurate for asset classes with small populations Can use inconsistent unit replacement costs, relying on historic costs and volumes only Does not accommodate period - period changes (eg failure rates, type issues or asset strategy)	Can use cost estimates from recent procurement or other up-to-date sources Allows for changes in strategy

For these reasons, TransGrid cross-checked its bottom up forecast using its own version of the top down repex model. The top down expenditure forecast is based on the asset renewal unit cost and a renewal time (year) that is normally distributed around its mean expected renewal age. It forecasts replacement capital expenditure, asset age, and residual lives 20-years into the future. Key inputs are:

> Asset age profile data from Category Analysis RIN data and other sources
> Renewal/replacement unit costs that are estimated from TransGrid's benchmarked estimating database
> Renewal/replacement time that is based on the mean expected renewal age from historic asset information and current observations
> A standard deviation for the renewal time that is the square root of the mean expected renewal age as per guidance from the AER.

The model forecast all fifteen major asset classes[43]. However, it does retain some limitations and is only considered to provide an indication of trend. For example, it does not provide accurate replacement timing as it spreads expenditure around replacement age in a wide normal distribution (sometimes over a 10 to 15 year period).

[43] Transformers, Circuit breakers, Disconnectors, Instrument transformers, Reactive plant (except SVCs due to small population), Substation steel work refurbishment, Substation buildings and civil infrastructure refurbishment, Substation AC/DC system replacement, Substation battery and charger replacement, Communications terminal equipment replacement, Control equipment replacement, Wood and concrete pole replacement (assuming that all wood poles are replaced by concrete poles), Steel transmission tower refurbishment (inland and coastal towers modelled separately as their mean expected renewal ages vary due to coastal corrosion), Overhead conductor replacement, Protection relay replacement by technology type (assuming two non-microprocessor relays replaced with one microprocessor relay)

5.4.3.3 Testing the replacement forecast

To allow for a like-for-like comparison, projects have been removed from the bottom up forecast to allow a representative comparison to be made. These projects relate to forecast expenditure which addresses emerging risks (which are not apparent from age or past trends) and where investments capture both benefits and risk. Such projects are 'un-modelled' in the top down analysis due to the limitations of the approach described above.

The top-down and equivalent bottom-up replacement forecasts are compared in Table 5.15. In the table, the bottom up forecast has un-modelled expenditure separated out.

Table 5.15: Top-down and bottom-up replacement forecasts ($m June 18)

Category	Top-down forecast	Bottom-up forecast	Difference
Substation equipment	317	220	97
Substation civil infrastructure	66	47	19
Substation AC/DC systems	46	25	21
Secondary systems equipment	198	186	12
Transmission line assets	308	232	76
Total for comparison	**935**	**710**	**225**
Un-modelled expenditure total[44]		198	
Total for reconciliation		**908**	

Source: TransGrid. Totals may not add due to rounding.

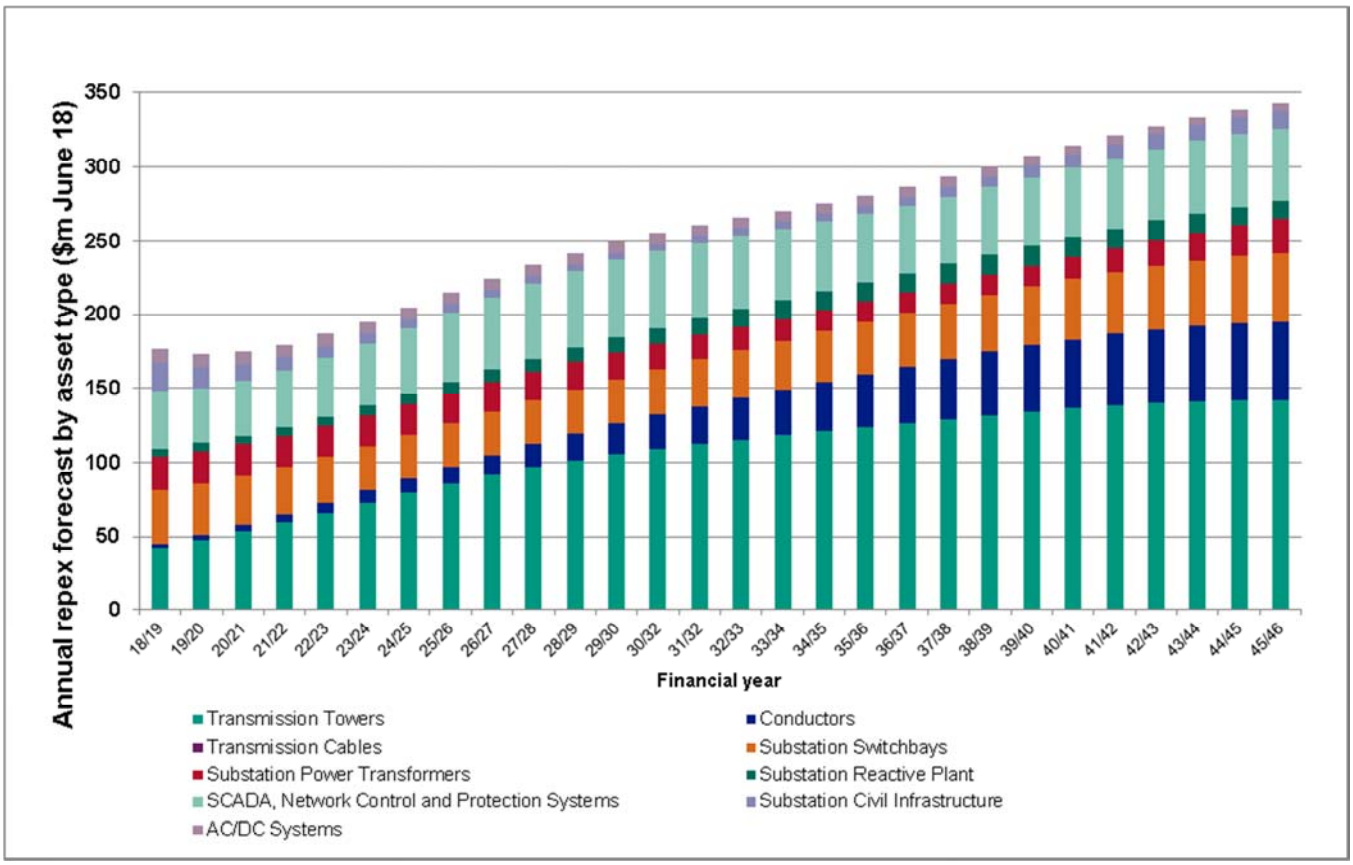
On a like-for-like basis, the top-down forecast is more than 30% higher than the bottom-up forecast. As both models use the same unit costs the differences relate to forecast volumes, which are higher in all categories. Overall the top-down modelling result provided an important cross-check that the bottom-up forecast appears reasonable.

[44] Projects in the un-modelled category in the bottom up forecast total $198 million. They include: upgrade communications infrastructure equipment; renewal of SVC control systems; remediation of a subset of transmission line, replacement of tools equipment and the small RIT-T impact.

5.4.3.4 Indication of future replacement expenditure

TransGrid's top down replacement forecast in Figure 5.12 indicates that replacement expenditure will steadily increase each regulatory period over the next 20 years.

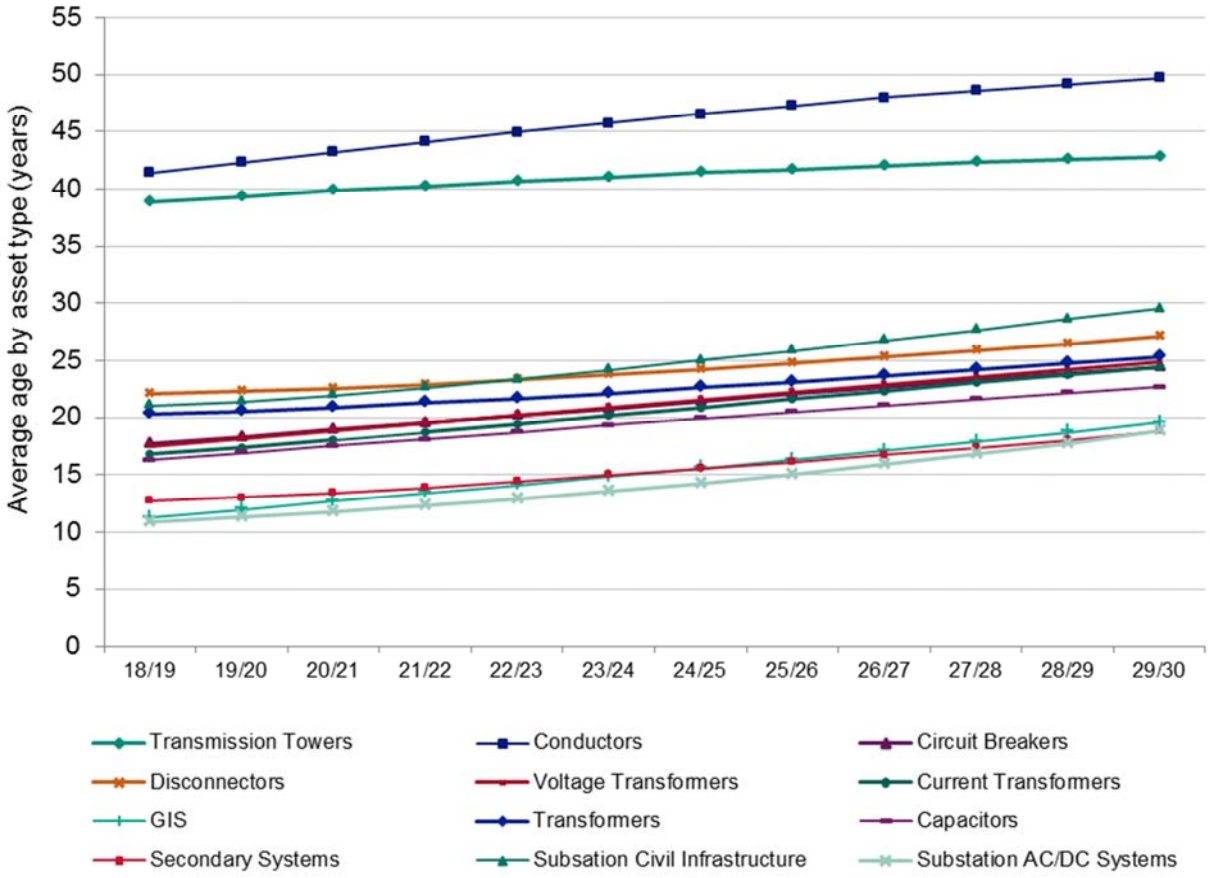
Figure 5.12: TransGrid's indicative top down replacement forecast to 2046 ($m June 18)



Source: TransGrid.

The top-down modelling is consistent with the increase expected in the coming period. Further, the top-down model suggests that even with this increasing replacement profile, average asset class ages would continue to rise. Average age increases from 2018/19 to 2029/30 are shown in figure 5.13.

Figure 5.13: Change in average asset ages using top down replacement profile



Source: TransGrid.

Figure 5.13 shows that TransGrid is not replacing based on age and that the improved risk assessment process is moderating the increase in replacement which may have otherwise occurred.

5.4.4 Replacement projects

Major projects contained in the replacement capital forecast are shown in Table 5.16. A summary of the largest, being transmission line refurbishment and life extensions, follows below. All other projects are summarised in Appendix G (capital expenditure projects).

Table 5.16: Forecast replacement expenditure by project ($m June 18)

Replacement project	Total
Various transmission line refurbishment and life extensions[45]	275
Circuit breaker replacement program	71
Rebuild transmission line 86	70
Installation of fibre networks	38
Protection relay replacement programs	60
Secondary system renewal/replacement	110
Steelwork renewal	47
Instrument transformers, bushing and disconnector replacement programs	57
SCADA replacement	16
Static VAR compensator (SVC) refurbishment	17
Various substation and ancillary	68
Various transformer replacements	78
Total	**908**

Source: TransGrid. Totals may not add due to rounding and some projects have been consolidated

5.4.4.1 Transmission line refurbishment and life extensions

The transmission line refurbishment and life extension program is a large program to address a range of issues different groups of assets within the transmission line population.

Background: The majority of TransGrid's transmission lines operate at above 132kV and are constructed with steel towers. 132kV transmission lines were constructed with wood poles.

Recent detailed inspections and analysis have identified a number of condition issues with steel and wood pole transmission lines. There are five issues relating to specific constructions and/or locations which differ in type and location from those being addressed in the current period. These five aspects of the program are summarised below.

Corrosion of transmission line components: Climbing inspections show that lines built before 1980, particularly in coastal or polluted areas exhibit advancing corrosion across all components. Inspection findings have been corroborated by measurements of galvanising and steel thickness.

The condition issues identified increase the probability of failure. Analysis has shown that risk costs can be offset by extending the lives of transmission lines through targeted refurbishment and replacement of specific components. This includes the refurbishment of corroded tower steel members and foundations, and the replacement of conductor fittings, earthwires and insulators.

[45] Note that the total for this is different from the transmission lines asset class replacement total shown in the table 'Replacement capital expenditure by asset category'. This is because the transmission line life extension projects include elements of work on other classes of asset.

This is at a lower cost than full line replacements.

Asbestos impregnated paint: Asbestos impregnated paint has been found on a significant number of steel tower transmission lines in the greater Sydney and Illawarra regions. Based on further analysis of sampling results, it is estimated that over 3,500 towers are affected.

Currently, the paint has been assessed as presenting a low health risk but it will deteriorate with time and the risk will increase. Some maintenance activities are not safe on towers with this paint.

TransGrid has considered different options. Effective encapsulation of the paint was not found to be feasible or efficient. Different methods for paint removal were evaluated and the use of solvents is considered to be the most feasible and efficient solution.

Corrosion of buried steel grillage foundations: A considerable number of TransGrid's earliest transmission line steel towers are constructed with grillage foundations, where footings are constructed in a steel grill and direct buried in soil.

These are subject to underground galvanic corrosion, dependent upon soil characteristics, increasing the risk that the structure will fail. Condition assessments and analysis were undertaken to understand the extent of the problem:

- A sample of grillage foundations were excavated and assessed by experts to determine condition and the likely contributing soil factors
- Sample data was used to calibrate a model of all grillage foundations, estimating the expected severity of corrosion using geospatial data.

The refurbishment program involves a combination of remediation of steelwork and/or the installation of sacrificial anodes. In particularly aggressive soil conditions additional reinforcement of the steelwork is required.

Snowy region conductor fitting failures: 330kV transmission lines in the Snowy Mountains region use a single large diameter conductor known as Silmalec. Joint fittings associated with this conductor have been found to be cracking resulting in fitting failures and conductor drops. The issue is widespread where this conductor is used and the nature of the risk and the risk cost require some action to be taken.

Options were assessed and the replacement of fittings is currently preferred as joint reinforcement has not yet been confirmed as being commercially feasible, given the non-standard size of this conductor. However, TransGrid plans to choose the most efficient option based on site specific assessments.

Poor condition of a number of wood pole transmission lines: Older 132kV transmission lines constructed with wood poles are deteriorating in condition due to wood rot, decay and termite attack. Where a high enough risk has been identified, remediation options have been considered. A trial of pole staking found that this was only applicable to a minority of defective poles as it only partially restores pole strength and restricts future maintenance. The main approach will be to replace poles with concrete or steel ones while retaining existing conductors.

The total cost is forecast at $275 million.

5.4.5 Replacement RIT-T rule change impact

The regulatory investment test – transmission (RIT-T) is a process to identify the single credible transmission investment option that maximises net economic benefit. Currently it applies to transmission augmentations where the most expensive option is above a threshold of $6 million.

Replacement projects are currently exempt from this. However, the AER has submitted a rule change proposal which would require network replacement expenditure to be subject to the RIT-T process.

If implemented, this Rule change will cause an increase in TransGrid's capital costs as there will be additional reporting and consultation requirements that are classified as capital costs by TransGrid's present accounting policies and procedures.

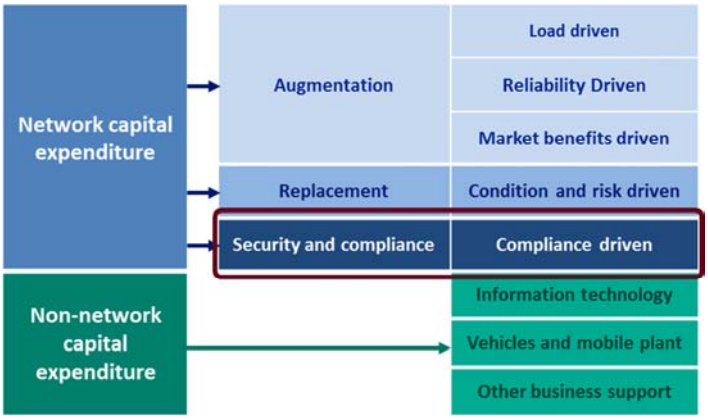
The forecast impact across the capital program has been calculated as an additional $0.57 million per annum, on the basis of the current rule change proposal and the number of projects expected to be affected.

This estimate has been built into TransGrid's capital expenditure forecast by entering these costs as a separate future replacement program in the capital accumulation model.

TransGrid has not included an operating expenditure step change. As the rule change is expected to be decided by mid-2017, TransGrid will review and update its assumptions and estimates in its revised proposal.

5.4.6 Security and compliance investment

5.4.6.1 Security/compliance investment – overview and approach



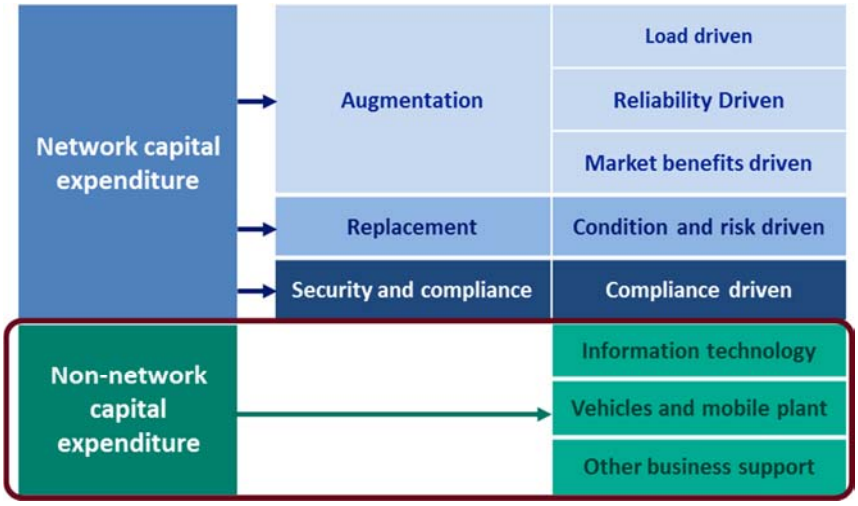
The program of security and compliance projects proposed is outlined in Table 5.17. Project summaries provided in Appendix G (capital expenditure projects).

Table 5.17: Forecast security and compliance expenditure by project ($m June 18)

Security and compliance project	Total
Motion detector and CCTV replacement	15
Access card and intrusion detection system replacement	11
Substation lighting replacement	8
Substation noise non-compliance	11
Other minor projects including physical security and electrical clearance remediation	9
Total	**54**

Source: TransGrid. Totals may not add due to rounding.

5.4.7 Non-network capital expenditure forecast



5.4.7.1 Non-network (business support) capital expenditure – overview and approach

Non-network capital expenditure includes information technology, vehicles and mobile plant, accommodation and facilities and other business support expenditure, such as office machinery. Expenditure in each of these areas is shown in Table 5.18.

Table 5.18: Non-network capital expenditure ($m June 18)

Non-network capital expenditure	Total
Information technology	103
Vehicles and mobile plant	53
Other business support	3
Total	**159**

Source: TransGrid. Totals may not add due to rounding.

In total, non-network capital expenditure is similar to that in the current regulatory period, although it makes up a smaller proportion, around ten percent of the total forecast.

5.4.7.2 Information technology

To support the high voltage network and corporate requirements, investments are required in information technology infrastructure, platforms, applications and devices. Investment drivers are typically to ensure service continuity and business enablement and to improve operational efficiency and reduce costs.

The forecast is based on the information technology strategic plan, which considers business needs across the regulatory period. This portfolio of information technology capital investment is informed by industry benchmarks. The IT strategic plan is categorised into core and enabling programs. Core programs directly support business functions while enabling programs replace and enhance the technology platforms which the core functions rely on.

TransGrid has forecast total Information and Communication Technology (IT) capital expenditure of $102.5 million over the period, grouped into eight work programs. The costs associated with each program are shown in Table 5.19.

Table 5.19: Proposed IT capital expenditure ($m June 18)

Program name and purpose	Total
IT security – to ensure technology, operational and information assets are protected from physical and cyber threats	7
Infrastructure enablement - to maintain and improve TransGrid's hardware, data centres, data storage and devices	15
Enterprise analytics platform – to enable compliance, operational insight and efficiency	8
Intelligent asset design – to improve the efficiency and quality of asset design	3
Intelligent operations centre – to enhance operational prediction capability and automation	10
Digital field force - to enhance safety, reliability and productivity in the field by expanding enterprise capabilities	9
Digital enterprise – to provide reliable and fit-for-purpose administrative and asset management capabilities via an Enterprise Resource Planning system	38
Corporate data and communications enablement – to facilitate collaboration and efficient access to corporate information systems	12
Total	**103**

Source: TransGrid. Totals may not add due to rounding.

5.4.7.3 Motor vehicles and mobile plant

TransGrid has forecast to spend $53 million on motor vehicles and mobile plant during the upcoming regulatory period. The business faces significant cost pressures in this area as it no longer has access to the preferential prices it benefitted from under NSW Government ownership. To ensure costs were controlled to the greatest extent possible, TransGrid reviewed both its disposal and maintenance strategy and has optimised the total cost of providing vehicles and plant. Periodic, major maintenance and repair of TransGrid's motor vehicles and mobile plant are efficiently managed by a competitively sourced external service provider.

Proposed capital expenditure grouped by motor vehicles and mobile plant is shown in Table 5.20.

Table 5.20 Motor vehicles and mobile plant ($m June 18)

Program	Total
Motor Vehicles	37
Mobile Plant	16
Total	**53**

Source: TransGrid. Totals may not add due to rounding.

The motor vehicle replacement strategy is based on business needs and whole of life cycle cost. A similar method is used for mobile plant replacement. Analysis on whole of life cycle costs is conducted on asset types rather than across the fleet, as different mobile plant have distinct capital costs and asset lives.

5.4.8 Treatment of shared assets

In line with the Rules, future projects which include assets expected to have a level of non-prescribed usage have been dealt with in the approved Cost Allocation Model.

5.5 Proposed contingent projects

A contingent project is a project that is reasonably necessary to meet any of the capital expenditure objectives, subject to the occurrence of a specific trigger event. However, the inclusion of the project in forecast capital expenditure would not be appropriate because either the occurrence of the trigger event is not sufficiently certain, or the cost of responding to the trigger event is not sufficiently certain.

These uncertainties have resulted in the development of five contingent projects. These are:

- NSI: an interconnection between New South Wales and South Australia
- Reinforcement of Southern Network
- Reinforcement of Northern Network (QNI upgrade)
- Support South Western NSW for Renewables
- Supply to Broken Hill.

The projects and proposed triggers are summarised below.

5.5.1 New South Wales to South Australia Interconnector (NSI)

Situation: In South Australia, conventional synchronous generation capacity reserves are reducing, with withdrawals of over 1,000 MW announced to occur over the next ten years[46]. At the same time, AEMO reports that there are 15 project proposals for wind generation in South Australia, and installation of rooftop PV continues.

AEMO's 2016 ESOO forecast low reserve conditions and potential power system security issues in South Australia, the latter the consequence of low levels of non-synchronous generation. Specific issues were:

- Reductions in dispatchable generation associated with high levels of PV and battery storage
- A shortage of local Frequency Control Ancillary Services (FCAS)
- Frequency stability issues as a result of low system inertia
- The increased likelihood of widespread or regional blackouts after non-credible events
- Low fault level impacts on protection schemes and voltage stability during disturbances.

An option to manage low reserve conditions and elements of system security is to increase interconnection to an adjacent state such as NSW. ElectraNet recently commenced regulatory consultation on the South Australian Energy Transformation, including consideration of options to increase the interconnection capacity between South Australia and NSW.

Trigger: TransGrid proposes this project as a contingent project with the following triggers:

- Successful completion of the RIT-T for the South Australian Energy Transformation, with a NSW to South Australia interconnector identified as the preferred option or part of the preferred option:

[46] AEMO 'Generator Information' webpage https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Generation-information

- demonstrating positive net market benefits; and/or
- addressing system security issues.

> Determination by the AER under clause 5.16.6 of the NER that the proposed investment satisfies the RIT-T.

> TransGrid Board commitment to proceed with the project subject to the AER amending the revenue determination pursuant to the Rules.

The trigger is specific and capable of objective verification, relates to a specific location or locations, and is probable but too uncertain to include the proposed contingent project in the forecast capital expenditure in this proposal.

The NSW component of the project has a cost estimate ranging between $279 million (low capacity) to $1,084 million (high capacity) depending on the option. The cost estimate exceeds the applicable contingent project threshold of $30 million or 5% of MAR.

5.5.2 Reinforcement of Southern Network

Situation: As noted in Chapter 2, there is significant uncertainty around the future generation locations, capacity and type in NSW. Chapter 2 also identifies potentially over 4,000 MW of possible new generation connections in NSW as well as potentially over 2,000 MW of existing generation retirements (from Smithfield and Liddell power station[47]) in NSW.

Among these potential new generation connections in NSW, 2,000 MW of new generation connections are proposed in the southern NSW area. Some of this new generation has recently been commissioned[48] or is at an advanced design stage, and further new generation is forecast to be commissioned towards the end of the present regulatory control period.

However, this new renewable generation (combined with generation from Snowy and imports from Victoria) could be constrained due to transmission system limitations.

There are a range of options for increasing the capacity of the network and enabling additional renewable generation. This could provide market benefits to NSW as well as the wider National Electricity Market. Benefits would likely include reduced energy costs (dispatch of lower cost generation) and increased generator competition. A preferred option will be determined through the RIT-T process.

Trigger: TransGrid proposes this project as a contingent project with the following triggers:

> New generation of more than 350 MW is committed in southern NSW at any current or future connection point(s) south of Bannaby and Marulan[49] or NSW import capacity from Southern Interconnectors is determined to be increased by more than 350 MW due to committed expansion of southern interconnections

> Successful completion of the RIT-T which will be initiated in the event of occurrence of any of the above triggers, including a comprehensive assessment of credible options demonstrating positive net market benefits

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[47] AEMO's generation information pages https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Generation-information

[48] For example. in the south Royalla Solar Farm and in the north Moree Solar Farm have progressively commissioned since 2014.

[49] AEMO classification of generation developments as being at the 'committed' stage of development on their 'Generator Information' webpage at https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Generation-information

- Determination by the AER under clause 5.16.6 of the NER that the proposed investment satisfies the RIT-T
- TransGrid Board commitment to proceed with the project subject to the AER amending the revenue determination pursuant to the Rules.

The trigger is specific and capable of objective verification, relates to a specific location or locations, and is probable but too uncertain to include the proposed contingent project in the forecast capital expenditure in this proposal.

The project has a cost estimate ranging between $60 million to $397 million, which exceeds the applicable contingent project threshold of $30 million or 5% of MAR.

5.5.3 Reinforcement of Northern Network (QNI upgrade)

Situation: There is significant uncertainty around the future generation locations, capacity and type in NSW. There are over 4,000 MW of possible new generation connections in NSW as well as potentially over 2,000 MW of existing generation retirements.

There are potential new generation connections of about 1,000 MW proposed for the New England area in northern NSW. Some new generation has recently been commissioned or is at an advanced stage. However, system adequacy studies indicate that new northern generation and the import from Queensland could be constrained due to transmission limitations. Particular issues are identified in the Liddell to Armidale corridor.

There are a range of options for increasing the capacity of this part of the network and enabling additional renewable generation. In addition, this new generation in Northern NSW and expected new generation in Southern NSW will lead to market benefits from reinforcing the Queensland to NSW Interconnector (QNI).

Increasing capacity in these circumstances could provide market benefits to NSW as well as the wider National Electricity Market. Benefits would likely include reduced energy costs (dispatch of lower cost generation) and increased generator competition. A preferred option will be determined through the RIT-T process.

Trigger: TransGrid proposes this project as a contingent project with the following triggers:

- Either:
  - Committed retirement of more than 1,100 MW of generation in the Hunter or Central Coast area; and/or
  - AEMO classification of generation developments as being at the committed stage of development on the Generator Information webpage, exceeding 1,100 MW at any current or future connection point(s) north of Armidale; and/or
  - AEMO classification of generation developments as being at the committed stage of development on the Generator Information webpage, exceeding 350 MW at any current or future connection point(s) south of Liddell and Bayswater.
- Successful completion of the RIT-T which will be initiated in the event of occurrence of any of the above triggers, including a comprehensive assessment of credible options demonstrating positive net market benefits
- Determination by the AER under clause 5.16.6 of the NER that the proposed investment satisfies the RIT-T

> TransGrid Board commitment to proceed with the project pursuant to the AER amending the revenue determination pursuant to the Rules.

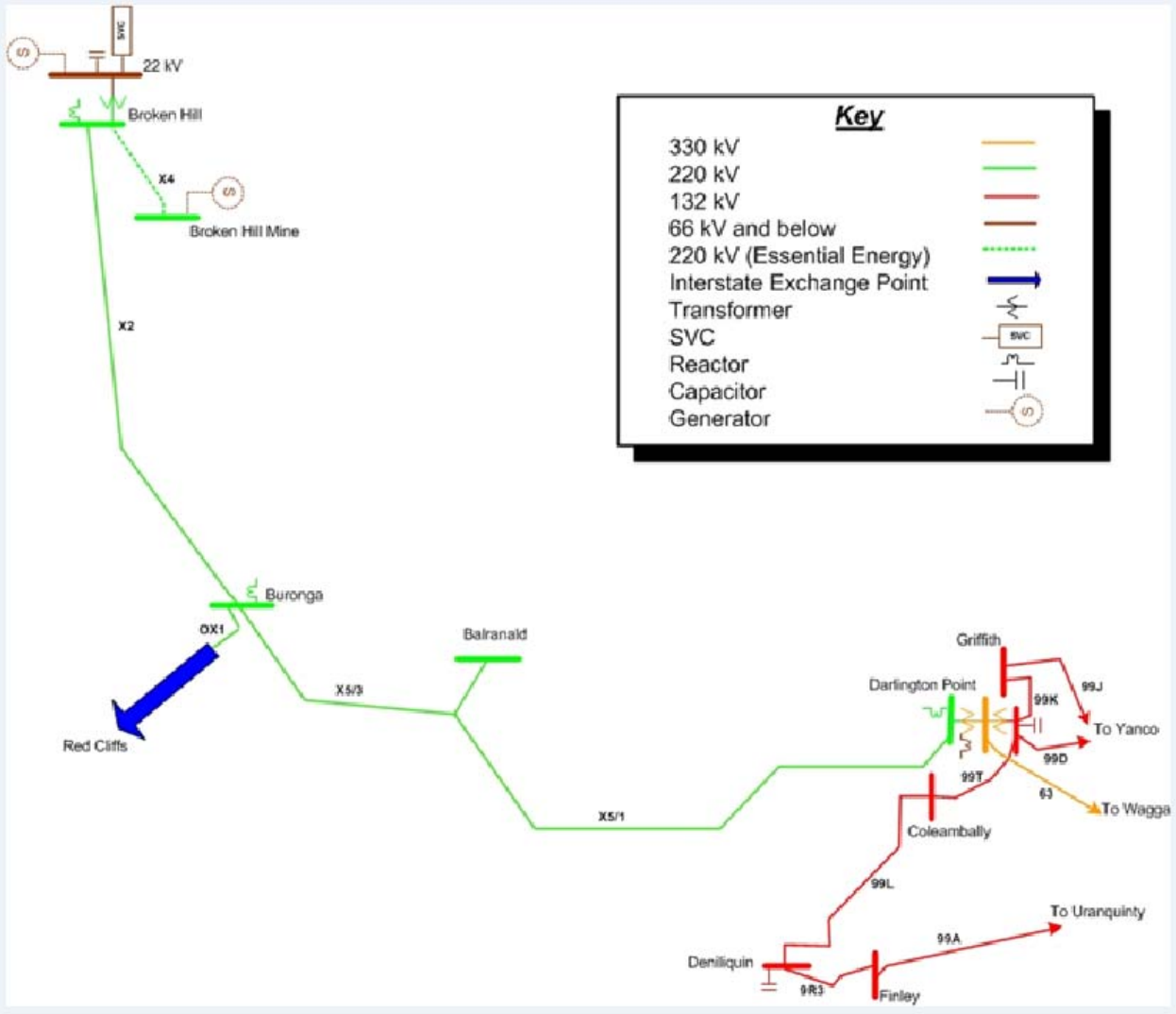
The trigger is specific and capable of objective verification, relates to a specific location or locations, and is probable but too uncertain to include the proposed contingent project in the forecast capital expenditure in this proposal.

The project has a cost estimate ranging between $63 million to $142 million, which exceeds the applicable contingent project threshold of $30 million or 5% of MAR.

5.5.4 Support South Western NSW for Renewables

Situation: The potential increase in the amount of renewable generation connecting in NSW over the next ten years was detailed in Chapter 2. The impacts on the capital expenditure forecast are various. This contingent project relates to potential high levels of renewable generation connecting in the South Western network shown in Figure 5.14.

Figure 5.14: Far West and Far South West Network



Source: TransGrid.

Review of information published by AEMO and accounting for TransGrid's own discussions with possible proponents, it is possible that up to 1,000MW of renewable generation could request a

connection in the South Western network. However, this new renewable generation (combined with an import from Victoria primarily as a result of renewables developments in North West Victoria[50]) could be constrained due to transmission system limitations. These include

- Transmission capacity (thermal) limitations between Buronga and Broken Hill
- Transmission capacity (thermal) limitations between Buronga and Darlington Point
- Transmission capacity (thermal) limitations between Darlington Point and Wagga
- Voltage control issues in the South Western transmission network.

Reinforcing the transmission network in this area (west of Wagga) to enable additional renewable generation could provide market benefits to NSW as well as the wider National Electricity Market. Benefits would likely include reduced energy costs (dispatch of lower cost generation) and increased generator competition.

Trigger: TransGrid proposes this project as a contingent project with the following triggers:

- New generation more than 400 MW is committed in South Western NSW (west of Wagga)[51]; and/or
- New generation in North West Victoria[52]
  - exceeding 800 MW for connection to the Ballarat – Waubra – Ararat – Horsham 220kV Lines or connection point(s); and/or
  - exceeding 200 MW for connection to the Redcliffs – Weman – Kerang 220kV Lines or connection point(s); and/or
  - exceeding 500 MW for connection to the Ballarat – Terang – Moorabool 220kV Lines or connection point(s); and/or
  - exceeding 1,500 MW in the North West Victoria zone.
- Successful completion of a RIT-T, either by TransGrid for South West NSW or AEMO for North West Victoria, demonstrating positive net market benefits with an augmentation of the transmission network south-west of Wagga identified as the preferred option or part of the preferred option.
- Determination by the AER under clause 5.16.6 of the NER that the proposed investment satisfies the RIT-T.
- TransGrid Board commitment to proceed with the project subject to the AER amending the revenue determination pursuant to the Rules.

The trigger is specific and capable of objective verification, relates to a specific location or locations, and is probable but too uncertain to include the proposed contingent project in the forecast capital expenditure in this proposal.

The project has a cost estimate ranging between $89 million to $473 million, which exceeds the applicable contingent project threshold of $30 million or 5% of MAR.

5.5.5 Supply to Broken Hill

Situation: As shown in Figure 5.14, Broken Hill is part of the Far West Network and is supplied by a single transmission line which stretches for around 200 km from Buronga.

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50 Victorian APR 2016 and AEMO's NTNDP 2016

51 AEMO classification of generation developments as being at the 'committed' stage of development on their 'Generator Information' webpage at https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Generation-information

52 AEMO classification of generation developments as being at the 'committed' stage of development on their 'Generator Information' webpage at https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Generation-information

The reliability standard for the upcoming regulatory period finalised by IPART on 22 December 2016 adds an unserved energy allowance requirement to the standard of redundancy currently in place. As a result, TransGrid may be required to provide additional capacity to supply Broken Hill in the event that the total 220kV and 22kV load at Broken Hill exceeds the capacity of the backup gas turbines owned by Essential Energy and expected unserved energy exceeds the unserved energy allowance for Broken Hill of 10 minutes in the reliability standard.

Should additional capacity be required, TransGrid will consider both network and non-network solutions. Should a network solution be the most economic option, TransGrid will need to trigger a contingent project to provide this capacity.

Trigger: TransGrid proposes this project as a contingent project with the following triggers:

- Notification from Essential Energy of available capacity of backup generation at Broken Hill that would result in expected unserved energy exceeding 10 minutes at average demand
- Successful completion of economic evaluation demonstrating that a network investment is the most efficient option to meet the applicable electricity transmission reliability standard
- TransGrid Board commitment to proceed with the project subject to the AER amending the revenue determination pursuant to the Rules.

The trigger is specific and capable of objective verification, relates to a specific location or locations, and is probable but too uncertain to include the proposed contingent project in the forecast capital expenditure in this proposal.

The project has a cost estimate ranging between $52 million to $178 million, depending on the type of network solution. This exceeds the applicable contingent project threshold of $30 million or 5% of MAR.

5.6 Most recent national transmission network development plan

The National Transmission Network Development Plan (NTNDP) is published annually by the Australian Energy Market Operator (AEMO) which considers the capability of the National Electricity Market (NEM) transmission grid and updates to its transmission flow paths[53]. The most recent NTNDP at the time of lodgement of this proposal is the 2016 NTNDP, published in December 2016.

The 2016 NTNDP lists committed main grid[54] transmission projects, transmission limitations and potential economic dispatch limitations. This revenue proposal aligns with the 2016 NTNDP for those projects which are within its scope in this time frame.

The 2016 NTNDP also considers other limitations identified in TransGrid's 2016 Transmission Annual Planning Report (TAPR) against the various NTNDP projected grid demand growth scenarios. This revenue proposal aligns with the NTNDP's assessment of the TAPR projects.

A comparison of the 2016 NTNDP projects relevant to New South Wales and this revenue proposal is shown in Table 5.21.

[53] AEMC 2016, *National Electricity Rules*, version 86, clause 5.20.2, 1 December 2016.

[54] In NSW, the main grid consists of the overlying the system with voltage level at 220 kV and above.

Table 5.21: Comparison of 2016 NTNDP and this revenue proposal

Category	Reference	Project or limitation	Revenue proposal
Committed main transmission projects	Reliability limitation in the Sydney CBD area	Powering Sydney's Future	Included
Potential economic dispatch limitations[55]	Transmission limitations on 330 kV cutset between Yass/Canberra and Sydney	Reinforcement of southern network	Proposed as contingent project
	New South Wales to Queensland Interconnector (QNI) – transmission limitations between 330 kV lines between Dumaresq and Liddell	Reinforcement of northern network	Proposed as contingent project
	220 kV between Broken Hill and Buronga	High wind generation at Broken Hill	Not included. Economic limitation expected to occur beyond regulatory control period Also a project to strengthen the far west network is proposed as a contingent project.
	132 kV Network around Wellington (e.g. Dubbo, Nyngan, Parkes etc.)	High solar penetration connected to 132kV network	Not included. Economic limitation expected to occur beyond regulatory control period
Inter-regional transmission outlook	New South Australia to New South Wales interconnector (RiverLink)	South Australia to New South Wales interconnector (Riverlink) including reinforcement of capacity between Buronga, Balranald and Darlington Point.	Proposed as contingent project

5.7 Non-network alternatives

TransGrid considers non-network, or network support, alternatives for all network needs under its Network Investment Process. TransGrid notifies interested parties of proposed network investments in its TAPR each year, and seeks network support as part of the regulatory consultation process and through requests for proposals.

To-date, TransGrid has identified three specific opportunities for non-network alternatives in the coming period.

5.7.1 Non-network options – Powering Sydney's Future

In the Powering Sydney's Future project, potential network support solutions are compatible with any of the network options which are being considered, as long they meet the performance criteria and reduce costs overall. An annual deferral value for the project has been calculated as $12.4 million. The estimated minimum level of network support required to defer the network investment is detailed in Table 5.22.

[55] Economic limitations are where more expensive generation is dispatched ahead of cheaper generation to avoid network overloads.

Table 5.22: Minimum level of required network support for deferral

Year	Minimum network support required
2022/23	60 MW
2023/24	90 MW
2024/25	150 MW

Source: TransGrid.

This is covered in Section 5.4.1.2 and also in Appendix B.

At the time of submission of this revenue proposal, an expression of interest for network support is currently open. TransGrid will evaluate responses to the expression of interest and provide an update to this proposal as soon as practicable.

5.7.2 Non-network options – Broken Hill

Situation: Broken Hill is part of the Far West Network and is supplied by a single transmission line which stretches for around 200km from Buronga. The substation at Broken Hill is therefore at risk of a single fault event on the transmission lines supplying it.

The reliability standard for the upcoming regulatory period finalised by IPART on 22 December 2016 adds an unserved energy allowance requirement to the standard of redundancy currently in place. As a result, TransGrid may be required to provide additional capacity to supply Broken Hill in the event that the total 220kV and 22kV load at Broken Hill exceeds the capacity of the backup gas turbines owned by Essential Energy and expected unserved energy exceeds the unserved energy allowance for Broken Hill of 10 minutes in the reliability standard.

Should additional capacity be required, TransGrid will consider both network and non-network solutions. Should a non-network solution be the most economic option, TransGrid will treat this as a network support pass through under Clause 6A.7.2 of the Rules.

TransGrid proposes a network support payment for Broken Hill in each year of the regulatory control period of $0m. While this appears superfluous with no dollar value, it allows TransGrid to access a network support pass-through payment if network support is required and demonstrated to be the most economic option. Should no requirement for network support eventuate during the regulatory control period, there will be no cost to consumers.

Non-network solution opportunity: This is a situation where a non-network solution could manage the amount of unserved energy as required with lower costs than a 200km transmission line. TransGrid is keen to work with proponents and stakeholders, including Essential Energy and existing mine sites to facilitate a solution in time to meet the standard.

TransGrid's preference is to implement a non-network solution. Given the need to comply with the reliability standard however, TransGrid has also proposed a contingent project in this Revenue Proposal. This is a back-up in the unlikely event that a non-network solution cannot be found.

5.7.3 Non-network options – Munyang

Situation: Munyang 132/33kV Substation supplies the ski fields in the Snowy Mountains of NSW. Munyang and the nearby Guthega 132kV Switching Station are connected to the rest of the transmission network via 97K Cooma to Munyang 132kV Line and 97G Guthega to Murray 132kV Line.

97G Line passes through mountainous terrain. It has an unavailability rate that is currently around five times greater than other 132kV lines and increasing over time due to:

- a large number of danger trees around the line on steep terrain
- the common occurrence of blizzard weather in winter in the area of the line, and
- difficulty accessing the line in winter due to the need to clear access tracks and weather conditions routinely creating unsafe conditions for aerial patrols and ground access for repairs.

Coincident unplanned outages of 97G and 97K Lines would restrict supply to the ski fields in winter, with potentially longer repair times than transmission lines in the rest of the transmission network. There is potential for network support in the area.

TransGrid proposes a network support payment for Munyang in each year of the regulatory control period of $0m. This will allow access to a network support pass through should the procurement of network support be economic in the event of coincident unplanned outages of 97G Line and 97K Line. Should no requirement for network support eventuate during the regulatory control period, there will be no cost to consumers.

5.8 Forecast inputs and cost escalation

5.8.1 Inputs to the forecast

The section details the inputs to the forecast including key assumptions, input cost assumptions and cost escalations.

5.9 Key assumptions

The key assumptions used to forecast capital expenditure are summarised as follows:

- All capital expenditure projects developed and forecast on the basis of current asset management procedures
- Transmission reliability standards as set out in the National Electricity Rules and the IPART Electricity Transmission Reliability standards
- Capital expenditure forecasts compliant with IPART Electricity Transmission Reliability standards
- Compliance with legislative obligations and Australian standards, including application of good electricity industry practice
- Individual project and program scopes developed to meet augmentation, replacement, security/compliance and other requirements
- Cost estimates developed in compliance with 6A.6.7 Forecast capital expenditure of the NER
- There are two main sources for the demand forecast:
  - New South Wales state demand forecasts as set out in the National Electricity Forecasting Report 2016 published by AEMO
  - Connection point demand forecasts as advised by NSW and ACT distribution network service providers and published in TransGrid's TAPR
- Inflation based on geometric average of Reserve Bank of Australia Statement on Monetary Policy for two years and the midpoint of its target range for eight years

- Labour cost escalation based on WPI forecasts for the Australia EGWWS sector by BIS Shrapnel
- Market-based commodities, property and construction are escalated by CPI
- Network growth estimated based on forecast augmentation expenditure (stripped of any real price escalation) resulting in a change to network size as a proportion of replacement value of the network
- Industry productivity trend assumed to be zero based on the majority of all measures indicating negative industry productivity.

5.9.1 Input costs

5.9.1.1 Cost estimation

TransGrid has maintained the approach to cost estimation that the AER did not raise concerns with at the previous revenue reset.

TransGrid's previous submission in 2013 followed a significant process to review and test its cost estimation approach. Both Evans and Peck and SKM were engaged to review different aspects of the cost estimating process, database and unit costs.

Evans and Peck found the cost estimating process in accordance with best practice estimating, delivering very close to a P50 outcome[56] and not requiring any portfolio level adjustment.[57]

SKM reviewed the Success database with specific focus on the reasonableness of the base unit cost and overall operation of the database. SKM concluded that unit cost data was reasonable, calculation algorithms were functioning correctly and resulted in accurate project estimates, and that there were no systematic errors. SKM therefore considered that the forecast capital cost estimates could be relied upon. TransGrid has maintained the same approach to calculating unit costs but has updated the cost database annually.

Annual database updates are applied following a detailed review of contract costs in the past year and comparing with other available information. Specific blind project costing is also conducted by independent engineering consultants to ensure ongoing accuracy.

At a portfolio level, the capital expenditure forecast is prepared to represent the most likely, or P50, cost of delivery. However, the P50 cost estimates reflect the expected average cost of delivery across the portfolio. That is, the actual costs of delivering projects are expected to fall equally higher and lower than the estimates, so the total capital expenditure forecast reflects the most likely cost of delivery of the portfolio.

5.9.1.2 Future projects

A future project is a project that has not reached Project Approval stage.

The Success Enterprise estimating system is used to estimate the full costs of future projects. This estimating methodology will generate the most likely (or P50) costs using the standard market costs derived from competitive tender costs, ensuring that the estimates reflect the efficient costs to deliver the project scope.

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[56] P50 refers to probability 50, which means the most likely cost estimate. That is, there is an equal chance that the costs will be higher or lower than the estimate.

[57] Refer to TransGrid Revenue Proposal, Appendix M, Evans & Peck, Estimating Risk Assessment, 2014/15 – 2018/19 Regulatory Submission, July 2013.

The cost estimates for future projects are based on a desktop engineering assessment of all the feasible options, project delivery method and timing and scope of work. Estimates comprise a base cost estimate for major scope components which is calculated from standard market costs for equipment, materials, factors for design and commissioning. It does not include allowances for risk, cost escalation or contingency.

The estimate also includes an allocation of allowances which is a costed value for project variables required to deliver the project scope. It is developed based on expected scope costs that are not able to be fully defined at this stage of the project. This is based on an assessment of occurrence in past projects.

5.9.1.3 Committed projects

A committed project is a project that has passed the Project Approval stage.

For committed projects, the expected cost for the project is used for the expenditure forecast. The expected cost is the most recent estimate of the completion cost. It is determined from committed contract costs, funding approval and detailed project scope depending on the stage in project delivery.

Cost escalation is not applied to committed projects.

5.9.1.4 Future and committed programs

A program of work is a group of similar projects that often relate to a particular asset type (eg a particular model of circuit breaker). Estimates for future and committed programs of work are based on standard costs for each activity. These are comprised of standard market costs for equipment and standard labour rates.

5.9.2 Cost escalation

All capital projects are costed in 2016 dollars, as the most recently available information and then escalated by the consumer price index (CPI) to reflect the actual planned timing of the expenditure. Some components of TransGrid's costs are forecast to increase above CPI. In particular, labour costs in the utilities sector have trended above CPI in recent years and this trend is expected to continue over the upcoming regulatory period. Clause 6A.6.7(c) of the Rules requires TransGrid to forecast capital expenditure that reflects realistic expectation of cost inputs required to achieve capital expenditure objectives.

5.9.2.1 Labour escalation

TransGrid's workforce includes a range of technical and commercial specialists. To escalate labour costs in the forecast TransGrid applied a labour cost escalator to project estimates. This is based on a forecast Wage Price Index (WPI) for the Electricity, Gas, Water & Waste Services (EGWWS) developed by BIS Shrapnel. BIS Shrapnel's report includes the assumptions driving the labour growth in NSW and Australia. It is included in Appendix H.

Table 5.23 provides the labour price growth forecast for the 2018/19 to 2022/23 regulatory period.

Table 5.23 Labour price growth forecast

Description	2018/19	2019/20	2020/21	2021/22	2022/23
BIS forecast	3.5%	3.7%	4.1%	4.3%	4.3%

Source: BIS Shrapnel, Report on Expected Wage Changes to 2022/23, November 2016

5.9.2.2 Commodity escalation

TransGrid has accepted the AER's recent position and the commodity elements of the capital forecast were adjusted for CPI.

Equipment used in capital projects is manufactured from commodities such as copper, aluminium, steel and oil (including oil products such as plastics). These commodities are traded on international markets, and TransGrid is a price taker of movements in commodity prices. While movements can vary significantly from CPI, TransGrid accepts that the AER has applied zero real change assumption for commodity escalations in recent determinations.

5.10 Efficiency of capital expenditure

TransGrid primarily assesses the efficiency of its capital expenditure through external assurance reviews and the comparison of cost estimates to comparable estimates prepared externally. It also procures and outsources capital work to external providers via competitive processes.

A major focus for TransGrid in the preparation for this revenue proposal was to develop and implement a new approach to asset management and network investment. The details of this approach are set out in Chapter 4. To test the reasonableness of the new approach and its ability to develop efficient capital expenditure forecasts TransGrid engaged expert consulting engineers Aurecon to scrutinise its capital forecasting methodology and test its implementation. As noted in Chapter 4, Aurecon concluded

> TransGrid's framework for the preparation of its capital expenditure plan for the 18/19 to 22/23 regulatory period will result in a CAPEX forecast that is in accordance with good electricity utility practice and will meet the capital expenditure criteria as set out in 6A.6.7 of the National Electricity Rules.[58]

TransGrid is certified to ISO55001, which is the benchmark for best practice in asset management. TransGrid has held this certification since November 2014. As this measure requires continuous improvement to remain certified, it is a strong indicator of good asset management practice. TransGrid is continuously increasing its capabilities and processes to better manage its assets through the development of its Asset Management System. This brings greater transparency and alignment to TransGrid's replacement expenditure and the safety, environmental, reliability and efficiency benefits that this expenditure will deliver to consumers.

TransGrid uses the most recent state load forecasts prepared by the Australian Energy Market Operator as the basis for main system network planning. Connection point forecasts from the relevant distributor are also used in assessing local investment needs. For Powering Sydney's Future, TransGrid engaged GHD to review and test Ausgrid's connection point forecasts. Findings are shown in Appendix I.

TransGrid is confident that its approach to cost estimating (detailed in Appendix M and Appendix N of TransGrid's 2014/15 to 2018/19 Revenue Proposal) was previously tested and found to be efficient. In the last revenue determination, the AER found the unit costs developed under this approach were reasonable.[59] The same approach has been applied for this proposal but with updated unit costs.

TransGrid believes that this approach, leveraging off both internal and external experts as appropriate, has developed an efficient and prudent capital expenditure program for the 2018/19 to 2022/23 period.

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[58] Aurecon: *Independent Review of TransGrid's CAPEX Plan*, Final Report, 25 January 2017, pp. II,51 [TransGrid-Aurecon-Appendix E Independent review of TransGrids Capex Plan-0117-PUBLIC]

[59] AER: *Draft Decision for TransGrid 2014/15 to 2018/19*, p34 and Final Decision, p39.

It has also examined the AER's benchmark reports, which comment on the relative efficiency of TransGrid in comparison with its peers. These are discussed further in section 5.11.1.

5.11 Assessment against capital expenditure factors

5.11.1 Benchmarking

TransGrid supports the use of benchmarking as a tool to provide insights into a business' cost base and has participated in various benchmarking studies over the last decade to help drive efficiency in its operations.

However, TransGrid notes that the AER's report states that its benchmarking results should be treated with caution when measuring relative performance between businesses. Reasons stated include the small sample size and the impact of model specification on relative rankings.

TransGrid engaged expert economic advisors, Frontier Economics to investigate the AER's approach and provide an independent view. Frontier Economics raised a number of material concerns with the AER's benchmarking approach and the results in its 2016 benchmarking report. These material concerns are explained in Frontier Economics' report *Review of the MTFP and MPFP analysis in the AER's annual benchmarking report*, provided in Appendix F. Given these conclusions, TransGrid is unsure about how to interpret the published benchmarking results.

5.11.2 Historical actual capital expenditure

Capital expenditure for each year of this period and the previous regulatory control period is shown in Table 5.24.

Table 5.24: Past and forecast capital expenditure ($m June 18)

Category	9/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
Augmentation	324.7	237.0	207.5	313.4	260.3	31.9	61.9	7.4	9.6
Replacement	115.6	147.7	145.4	158.1	180.2	173.6	166.8	161.8	139.8
Security / Compliance	15.8	3.8	2.8	6.8	0.4	24.9	6.3	14.1	27.3
Support the business	28.6	32.9	50.0	60.5	76.8	38.5	23.8	26.1	32.0
Total	**484.6**	**421.4**	**405.8**	**538.8**	**517.7**	**268.8**	**209.4**	**209.4**	**208.7**

Source: TransGrid. Totals may not add due to rounding.

5.11.3 Consumer engagement

TransGrid sought feedback on its capital expenditure forecasts during consultation with residential, small business and large energy users and consumer group representatives. Further details on this engagement are provided in Appendix C.

5.11.4 Relative prices of operating and capital inputs and substitution possibilities between operating and capital expenditure

TransGrid considers the relative prices of operating and capital inputs and possibilities for substitution between operating and capital expenditure in the option identification and economic evaluation for each capital project.

When planning an investment, low cost operating and capital options to defer large capital expenditure are considered and implemented where feasible. These include load transfers, de-rating of equipment, network support, and the use of low cost equipment such as reactive plant.

TransGrid has completed the evaluation of options for all projects included in the expenditure forecasts, and has considered substitution possibilities between operating and capital expenditure as part of the option evaluation.

5.11.5 Consistency with incentive schemes

TransGrid responds to the incentives offered under the regulatory framework and has achieved material improvements in the efficiency of both its capital and operating expenditure as a result. TransGrid recognises that the operating and capital input substitution is further supported by the AER's complementary incentive schemes which encourage efficiency improvements in both operating and capital expenditure.

The capital expenditure forecast in this proposal is consistent with the related incentive schemes, being the capital expenditure sharing scheme and service target performance incentive scheme. There is no capital expenditure in this proposal specifically to improve performance under the service target performance incentive scheme.

5.11.6 Contingent projects

TransGrid proposes five contingent projects in this revenue proposal: Reinforcement of Southern Network; Reinforcement of Northern Network (QNI upgrade); NSI, an interconnection between New South Wales and South Australia; Support South Western NSW for Renewables and Supply to Broken Hill. The projects are set out in more detail in Section 5.5.

5.11.7 Most recent National Transmission Network Development Plan

The 2016 NTNDP lists committed main grid transmission projects, transmission limitations and potential economic dispatch limitations[60]. This revenue proposal aligns with the 2016 NTNDP for those projects which are within its scope in this time frame. Alignment with the NTNDP is discussed in Section 5.6.

5.11.8 Non-network alternatives

TransGrid considers non-network, or network support, alternatives for all network needs under its Network Investment Process. TransGrid notifies interested parties of proposed network investments in its TAPR each year, and seeks network support as part of the regulatory consultation process and through requests for proposals. This is discussed in more detail in Section 5.7.

5.11.9 Regulatory investment test for Transmission

TransGrid is conducting a RIT-T for the Powering Sydney's Future project. The Project Specification Consultation Report was published for consultation on 11 October 2016 and a stakeholder forum and workshop was held on 28 November 2016. The consultation period was extended to account for the holiday period and closed on 13 January 2017.

In order to proceed, the proposed contingent projects will also be required to pass the regulatory investment test for transmission (RIT-T).

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[60] In NSW, the main grid consists of the overlying the system with voltage level at 220 kV and above.

5.11.10 Other capital expenditure factors

At the time of submission of this proposal, the AER has not advised TransGrid of additional capital expenditure factors.

5.12 NSW Licence compliance

On 7 December 2015 TransGrid became subject to new obligations under the Transmission Operators Licence under the Electricity Supply Act 1995 (NSW). An audit of TransGrid's compliance with the new licence conditions has identified new interpretations of and requirements for compliance. Whilst the Independent Pricing and Regulatory Tribunal (IPART) is yet to reach a decision in regards to the audit outcome, it is clear that adjustments to current practices are required to ensure compliance.

Given the timing of this Audit and the unexpected nature of its findings, it has not been possible for TransGrid to develop a cost-effective, sustainable solution in time for the revenue proposal. TransGrid raised this issue with the AER as soon as it became known and TransGrid has committed to keep the AER informed as it develops a compliant solution at an efficient cost. TransGrid notes that there is most likely to be both capital and operating cost adjustments to the revenue proposal arising from this event.

TransGrid will provide a fully justified cost estimate to address this new understanding of the licence conditions that will ensure compliance at the lowest possible cost for the business and for consumers.

6. Operating Expenditure

6.1 Introduction

Operating expenditure is the ongoing cost of providing transmission services. It includes planning the network, managing assets, 24 hour monitoring and operation of the network, maintenance and business activities.

6.1.1 TransGrid's operating expenditure aligns with its commitments

Customers and consumers sit at the heart of TransGrid's strategy. To meet their needs, the operating expenditure forecast in this proposal supports the following key areas: :

Innovation: TransGrid tests new ideas and practices to drive improvements

> TransGrid has established an Asset Monitoring Centre that allows remote monitoring of assets and the co-ordination of responses to network incidents in real time. This has reduced ongoing operational costs for the call out of field staff and scheduling as well as reducing staffing costs for data analytics. These reductions as a result of innovation have been built into TransGrid's forecast.

Responsiveness: TransGrid listens and responds to consumers

> TransGrid has created a dedicated forum so that customers, consumers and interested parties can discuss and tangibly influence TransGrid's revenue proposal

> The ideas and views expressed by stakeholders in this forum have been shared with TransGrid's Board and Executive team, and are reflected in TransGrid's forecasts.

Efficiency and Affordability: TransGrid demonstrates a strong level of efficiency and performance, which will be maintained and will benefit consumers

> TransGrid's performance in recent years reflects a high level of efficiency that has been verified by independent benchmarking and the AER's operating expenditure benchmarks

> After the AER's last revenue determination, TransGrid implemented a multi-year program to drive further savings that will reach completion in 2016/17, with final benefits to be delivered in 2017/18

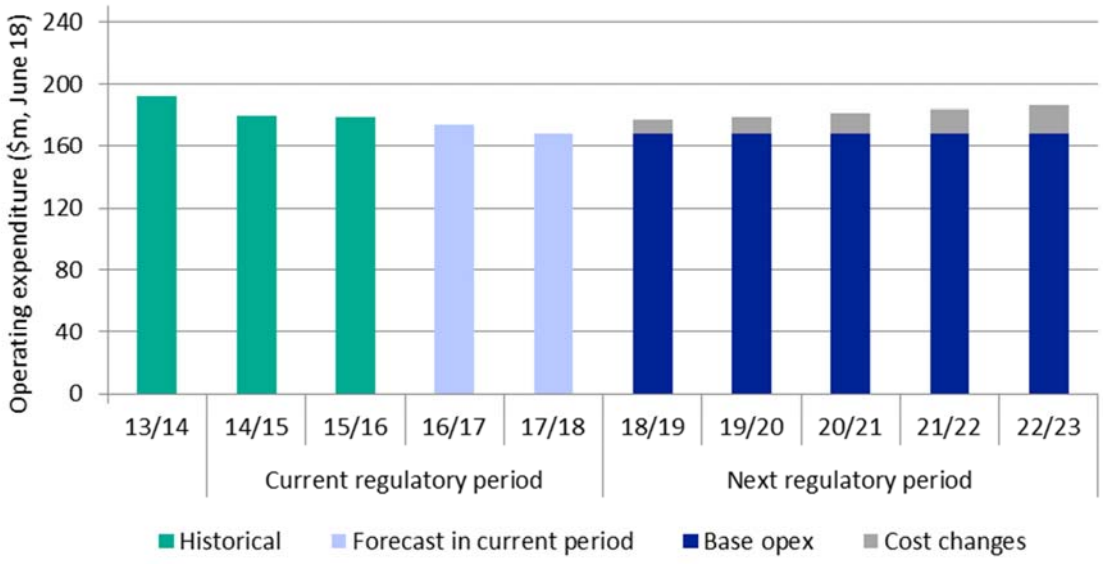
> The efficiency achievements from this process will be maintained throughout the next regulatory control period, and consumers will benefit from these savings in future years.

6.1.2 Forecast highlights

Over the next regulatory control period TransGrid expects $908 million ($June 2018) of operating expenditure will be required to provide the prescribed transmission services needed by its customers. This is an efficient, prudent and realistic level of expenditure, developed using up to date forecasts and in line with the guidelines.

In real terms, prescribed operating expenditure is expected to remain below 2013/14 levels until 2023. At the same time the scale of TransGrid's network and its services will have grown in an external environment of upward cost pressures. TransGrid's historical and forecast prescribed operating expenditure is as follows:

Figure 6.1: TransGrid's historical and forecast operating expenditure



Source: TransGrid.

The efficiency of TransGrid's operating expenditure was assessed and accepted by the AER[61,62] in its last revenue determination, and TransGrid performed well in various independent benchmarking studies at the time.[63,64] Since then, TransGrid has gone on to achieve improved levels of efficiency despite absorbing almost $4 million per annum in increased costs, including those needed to comply with new regulatory and statutory obligations following privatisation. The net impact of this will be a cost saving of 3% in 2016/17 compared to 2015/16 costs, enabled by an estimated $9m (or 5%) of gross savings. Additional cost savings expected in 2017/18 will deliver a further 3% net reduction compared to 2016/17 expenditure.

TransGrid has factored in cost saving opportunities into its forecasts and does not expect material further savings will be realised in the near term. TransGrid must now stabilise its cost path, and manage its operations in an environment of increasing regulatory pressures (eg the emerging requirements of IPART's new compliance regime) and the continued need to maintain safe operations and levels of reliability and service expected by its customers.

6.1.3 Information in this chapter

The remainder of this chapter includes:

- A summary of TransGrid's prescribed operating expenditure forecast, in total and by category
- How TransGrid's forecast supports efficiency, responsiveness and innovation
- TransGrid's approach to forecasting its prescribed operating expenditure
- How the forecast is efficient and meets the operating expenditure criteria

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61 AER: *FINAL DECISION TransGrid Transmission Determination 2015-16 to 2017-18 Attachment 7 – Operating Expenditure*, April 2015, pp.7-20.

62 AER: *Annual benchmarking Report Electricity transmission network service providers*, November 2015.

63 TransGrid: *Revenue Proposal 2014/15 to 2018/19*, May 2014, pp.144-145.

64 ITOMS: *2015 Report*, January 2016 (uses 2014 data for TransGrid) [TransGrid-UMS Group-Appendix M ITOMS blind benchmarking report-0116-PUBLIC]

> Key assumptions.

6.2 Forecast operating expenditure overview

2016/17 is the first full year of operations under TransGrid's new ownership structure, and includes the full extent of the efficiency initiatives implemented since the AER's previous revenue determination as well as a range of new statutory and regulatory costs following privatisation. Operating expenditure needed in the next regulatory control period is as follows:

Table 6.1: Total operating expenditure forecast, $m June18

	2018/19	2019/20	2020/21	2021/22	2022/23
Forecast operating expenditure[65]	177.2	178.8	181.3	184.0	186.4

Source: TransGrid. Totals may not add due to rounding.

TransGrid has achieved new levels of efficiency, and has forecast future operating expenditure to reflect these lower costs.

> TransGrid has listened to its customers, and made adjustments to its forecast based on their feedback

> TransGrid's forecast methodology is aligned with the AER, with minor modifications to reflect TransGrid's cost drivers

> 2016/17 is the most relevant efficient base year as it fully reflects TransGrid's new ownership, and has been used to forecast operating expenditure for the next regulatory control period

> Further savings expected in 2017/18 have also been built into the forecast for the next regulatory control period

> There will be an increase in operating expenditure in the next regulatory control period, mainly driven by the step change to address off-easement risk management bush-fire risk

> Operating expenditure after 2018/19 reflects expected changes in labour costs and growth of the network, which are above the consumer price index.

TransGrid must forecast the operating expenditure it needs to provide prescribed transmission services, in accordance with the National Electricity Rules (Rules), and to do this, TransGrid has aligned its methodology closely with the AER's *Expenditure Forecast Assessment Guideline.* TransGrid's obligations and forecasting principles are summarised within *TransGrid's Approach to Forecast Expenditure*[66].

To ensure its forecast represents the best value to its customers, TransGrid has tested its operating efficiency using a range of independent measures, including:

> The AER's latest benchmarking report (2016)

[65] Excludes debt raising costs.

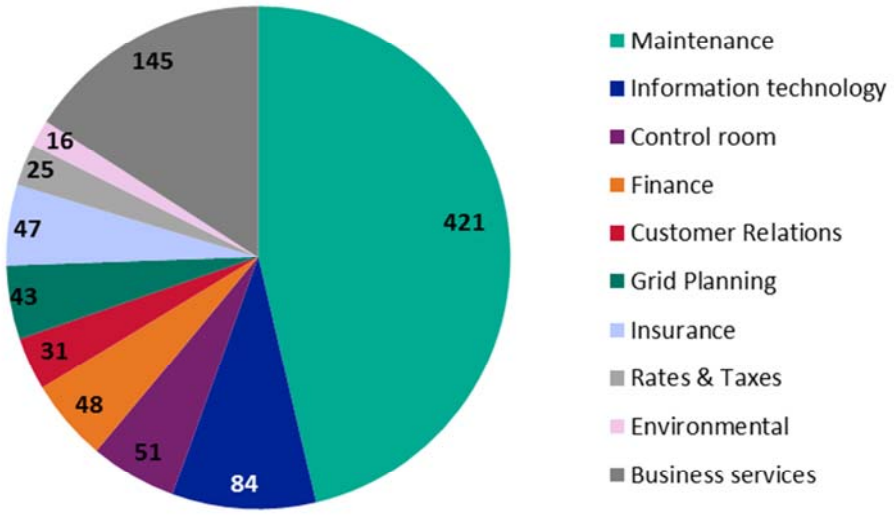
[66] TransGrid: *Approach to Forecast Expenditure for 2018-23*, June 2016

- CEB benchmarking report [67]
- KPMG benchmarking report[68]
- The UMS Group's latest ITOMS report[69]
- An Aurecon report that reviewed TransGrid's maintenance approach and 2016/17 budget (2016).[70]

TransGrid has also responded to the efficiency incentives of the Efficiency Benefit Sharing Scheme (EBSS). Over the current period TransGrid expects to achieve a saving of $16.7 million, relative to the operating expenditure allowance set by the AER. By all measures, TransGrid's forecast operating expenditure efficiency is high. TransGrid has also listened to its customers, and their feedback has influenced this proposal and its supporting forecasts.

A summary of TransGrid's forecast operating expenditure in the next regulatory control period is shown in Figure 6.2, as requested by members of the TransGrid Advisory Council:

Figure 6.2: TransGrid's forecast operating expenditure by category ($m June 18)



Source: TransGrid. Totals may not add due to rounding.

An overview of TransGrid's forecasting model is shown in Figure 6.3:

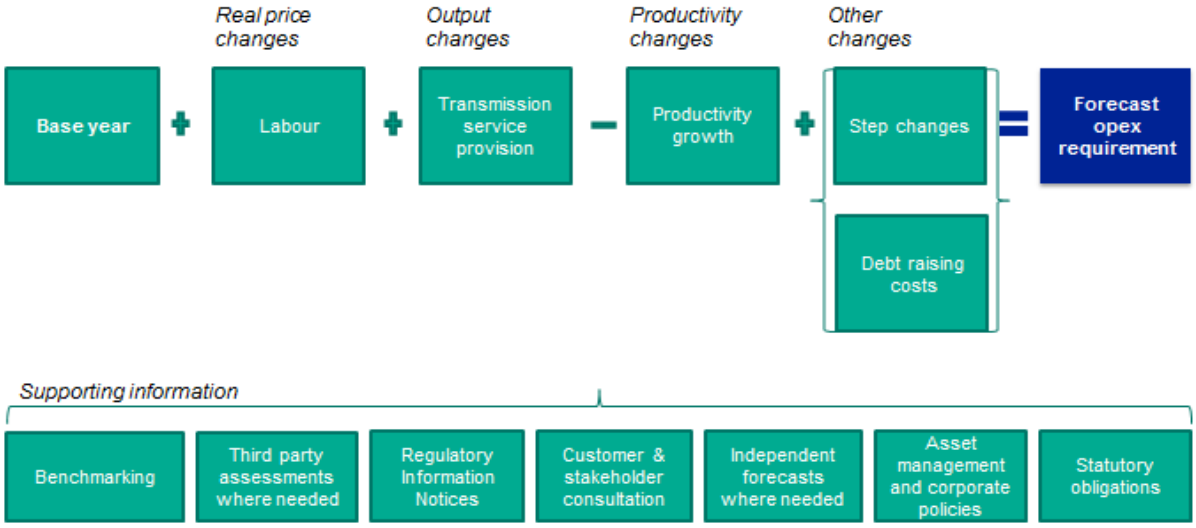
[67] CEB: *IT Budget Benchmark Report Prepared for TransGrid*, October 2016. [TransGrid-CEB-Appendix P IT benchmark report-0916-PUBLIC]

[68] KPMG: *2016 Utilities IT Benchmarking – Final Results*, January 2017 [TransGrid-KPMG-Appendix N 2016 Utilities Benchmarking-0117-CONFIDENTIAL]

[69] UMS Group: Overview – *ITOMS 2015 Report*, 28 January 2016 [TransGrid-UMS Group-Appendix M ITOMS blind benchmarking report-0116-PUBLIC]

[70] Aurecon: *2016/17 Asset Maintenance Assurance*, December 2016 [TransGrid-Aurecon-Appendix O 1617 Asset maintenance assurance-1216-PUBLIC]

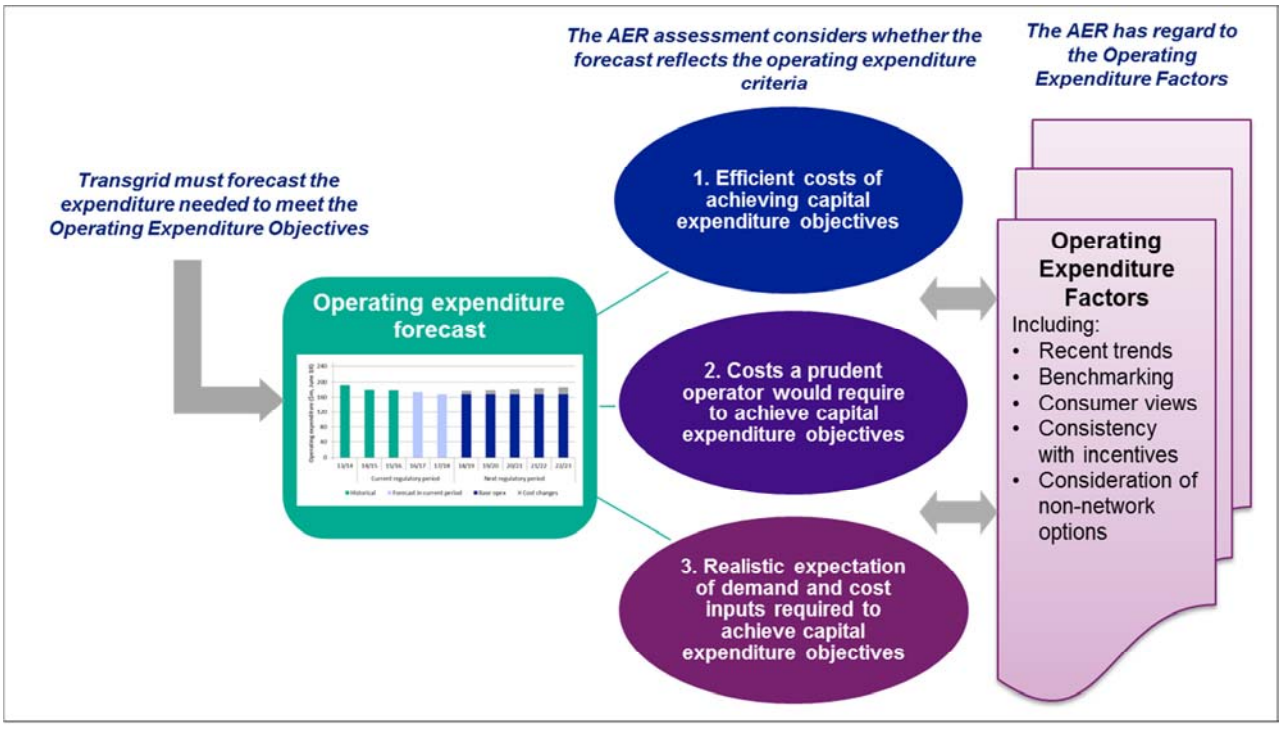
Figure 6.3: TransGrid's operating expenditure forecast model



6.3 AER forecast assessment criteria

The Rules require that TransGrid's total forecast operating expenditure must reasonably reflect the *operating expenditure criteria* before the AER can accept it. The Rules also set out the *operating expenditure factors* the AER use to assess TransGrid's forecast. Figure 6.4 illustrates the interaction between these.

Figure 6.4: AER Assessment of the operating expenditure forecast



6.3.1 Operating expenditure criteria

To support the AER's assessment of TransGrid's compliance with the *operating expenditure criteria*, this proposal covers:

- Independent expert assessments and benchmarking reports examining the efficiency of TransGrid's operating performance and costs in recent years, provided in Appendices N, O, P and Q. These support the view that TransGrid has demonstrated a high level of operating efficiency in recent years. Operating efficiency is expected to be further improved in 2016/17, making it the most appropriate base year from which to forecast operating expenditure.
- An explanation of how TransGrid's forecast methodology is aligned with the AER's, with minor modifications to reflect TransGrid's cost drivers that are supported by independent expert advice, in section 6.4.
- The prudence of TransGrid's operations and costs, which are established by its governance processes and asset management system covered in Chapter 4, 'Approach to Managing the Network'.
- AEMO's demand forecast, which is detailed in Chapter 2.
- Input costs and relevant escalations, with the way they apply to the prescribed operating expenditure forecast explained in section 6.4, and an independent expert forecast provided in Appendix H.

6.3.2 Operating expenditure factors

Information on the operating expenditure factors which the AER use to assess TransGrid's forecast is provided throughout this chapter. A summary has been included in Table 6.2 for ease of reference.

Table 6.2: Location of relevant information for the operating expenditure factors

Factor	Where addressed
Most recent AER annual benchmarking report and benchmark operating expenditure that would be incurred by an efficient TNSP.	Sections 5.11.1 Benchmarking and 6.4.1.1. The analysis underpinning the AER's benchmarking is addressed in Frontier Economics' paper in Appendix F.
Actual and expected operating expenditure during preceding regulatory control periods.	TransGrid economic benchmarking regulatory information notice responses for the period 2005/6 to 2015/16.
Extent to which the operating expenditure forecast includes expenditure to address concerns of electricity consumers as identified by the TNSP.	Consumer feedback from TransGrid's customer and stakeholder engagement and TransGrid's response is summarised in chapter 3 and Appendix C.
The relative prices of operating and capital inputs; substitution possibilities between operating and capital expenditure.	Every capital project has been assessed against alternatives, including solutions based on operating expenditure (where relevant). Information can be found in supporting project documentation.
Consistency of the operating expenditure forecast with incentive schemes.	Sections 6.4.1 and 13.4

Factor	Where addressed
Extent of operating expenditure to related parties.	TransGrid - Reset RIN Related Party Transactions – 0107 - PUBLIC.
Whether the operating expenditure forecast includes amount relating to a project that should more appropriately be included as a contingent project.	Section 6.4.7
The most recent NTNDP and submissions made by AEMO	Section 5.6.
The extent of consideration and provision for non-network alternatives	Section 5.7
Relevant project assessment conclusions report	The Powering Sydney's Future project is in the process of a RIT-T assessment but this report has not yet been prepared.
Any other factor the AER considers relevant and which the AER has notified the Transmission Network Service Provider in writing prior to the submission of its revised Revenue Proposal	The AER has not currently advised of any additional factors

6.4 Forecast operating expenditure methodology

TransGrid has closely aligned its forecast methodology with the AER's expenditure forecast assessment guideline. However, a small number of variations have been made. These variations are supported by independent expert advice, and are explained in more detail within this chapter. Table 6.3 summarises the variations.

Table 6.3: Summary of variations TransGrid has made to the AER's methodology

Variation	Approach	Reason
Forecast starting point	Start forecast directly from revealed cost base year.	Provides a more accurate operating expenditure forecast than a modelled future base year would.
Weighting of wage forecast	Weight wage forecasts in accordance with TransGrid's actual internal labour composition.	Using actual information provides a more accurate operating expenditure forecast, based on an efficient level of expenditure.

Variation	Approach	Reason
Industry productivity	Set to zero instead of 0.2%.	TransGrid has considered a wide range of independent productivity measures that indicate declining productivity for Australian utilities. TransGrid has built business specific future efficiency improvements into its base year forecast, as well as productivity improvements via its approach to output growth, which includes economy of scale factors.
Output growth	Replaced with network growth calculated by commissioned augmentation relative to the replacement cost of the network, modified by economies of scale.	More accurate method and the AER accepted a similar network growth approach proposed by AusNet in their draft decision.

6.4.1 Selection of the base year

TransGrid has followed the AER's forecasting approach and selected a base-year that is recent, reflects a relatively recurrent level of expenditure, and meets the operating expenditure criteria[71]. TransGrid considers 2016/17 to be the most relevant year for this purpose as it will be the first full year of operations under TransGrid's new ownership and as such reflects the efficient forward looking costs of the business under its new regulatory regime.

Although 2016/17 has not fully elapsed, TransGrid has estimated 2016/17 prescribed operating expenditure using expenditure-to-date and an operating expenditure target. The full year audited financials for 2016/17 are expected by the end of August 2017 and will be available in time for the AER's draft decision. TransGrid will provide an early statement of 2016/17 financials to the AER to use in arriving at its draft decision, if required.

TransGrid has operated in accordance with the intent of the efficiency benefit sharing scheme throughout the current regulatory control period. This provides continuous incentives to achieve efficiency savings and avoid efficiency losses. Prescribed operating expenditure for 2016/17 is forecast to be the lowest so far this regulatory control period, with further efficiency savings forecast for 2017/18, these have been taken up in the forecasts for the next regulatory control period.

TransGrid's operating cost base has increased materially since 2015/16, as a result of new obligations imposed on the privatised business following the lease transaction and other cost increases. Some of these factors are discussed in more detail in Section 6.4.4 Step Changes. However, the estimated $4m increase per annum in permanent ongoing costs has been outweighed by decreases in operating expenditure due to efficiency improvements.

[71] AER: *Final decision TransGrid transmission determination 2015-16 to 2017-18 Attachment 7 – Operating expenditure*, April 2015, p.13

TransGrid expects to incur $174 million[72] ($June 18) of prescribed operating expenditure in 2016/17, representing a net real reduction of 3% compared to the prior year. The savings TransGrid has achieved since 2015/16 are closer to 5% (ie, $9m), once the estimated $4m of permanent ongoing cost increases absorbed by TransGrid are taken into account.

6.4.1.1 TransGrid's benchmarked performance

According to the AER's methodology, whether a given year meets the operating expenditure criteria is determined using a number of techniques, including benchmarking. The AER's transmission network service provider benchmarking report ranked TransGrid as second in its 2015 report and improved its performance in the 2016 report for opex partial factor productivity[73,74]. TransGrid estimates that the AER's 2017 report (based on 2015/16 data) will show that TransGrid's operating expenditure efficiency has improved further (see dotted lines in figure 6.6).

As mentioned previously, further improvements in productivity are forecast in 2016/17, through a combination of reduced costs and increased outputs.

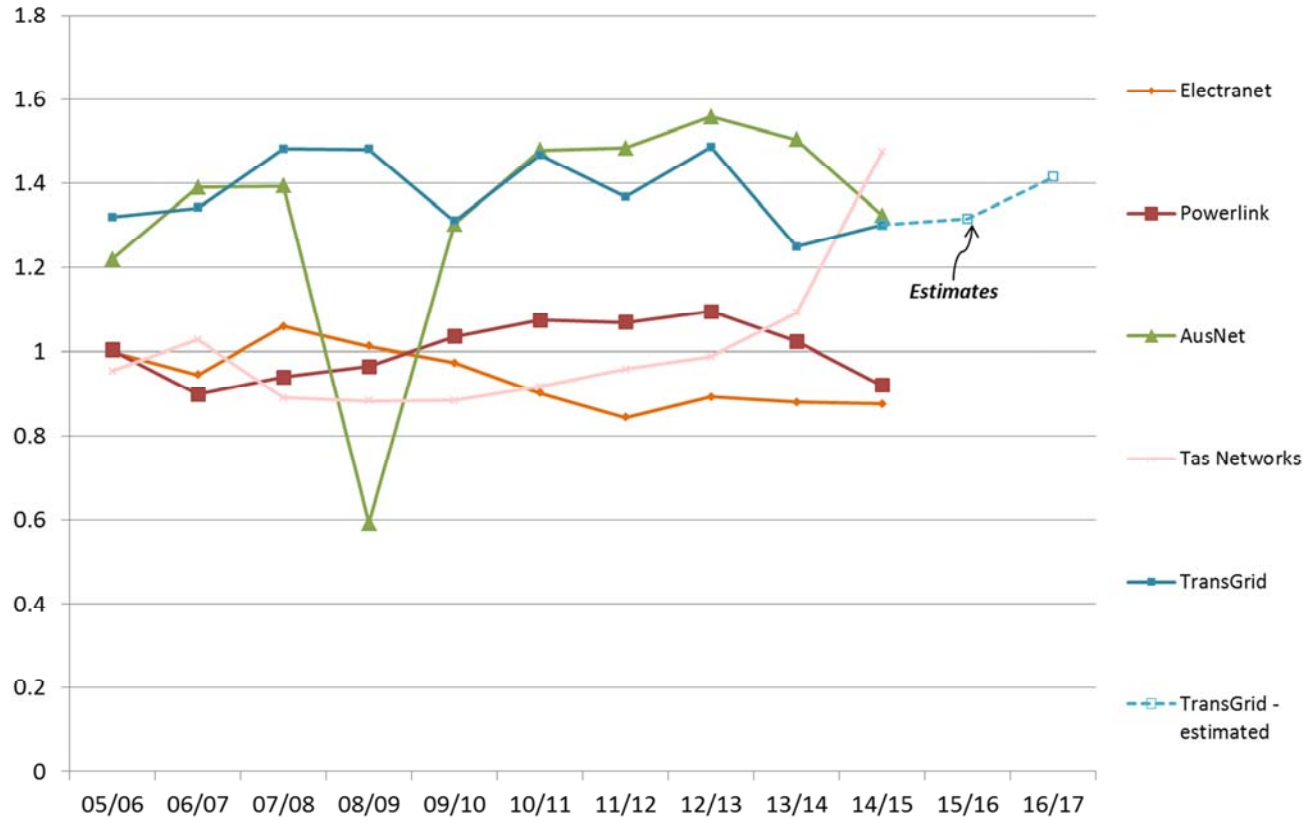
Figure 6.5 shows opex partial factor productivity from the AER's 2016 report, augmented with estimates for TransGrid's performance for the 2015/16 and 2016/17 years (shown as dotted lines).

[72] Debt raising costs are not included in this target.

[73] AER: *Annual Benchmarking Report, Electricity transmission network service providers*, November 2015, p.17

[74] AER: *Annual Benchmarking Report, Electricity transmission network service providers*, November 2016, p.18

Figure 6.5: AER's operating expenditure productivity measure



Source: Solid lines from AER[75]. Dashed lines are TransGrid forecasts.

The AER's benchmarking report also contains other measures, including partial performance indicators such as total cost per km of transmission circuit length. In the two most recent reports TransGrid was ranked as a middle or high performer on all these measure. TransGrid expects the 2016/17 data will also demonstrate improved performance on these measures.

The AER uses total cost to produce partial performance indicators, "made up of opex and the user cost of assets";[76] the partial performance indicators do not therefore provide the same focussed view of TransGrid's prescribed operating expenditure as the AER's opex partial factor productivity measure. The user cost of assets the AER refers to relates to a synthetic capital measure of TransGrid's cost comprised of its network capacity plus a notional return on and of capital. In TransGrid's view, this renders the benchmark report's partial performance measures less appropriate for considering TransGrid's operating expenditure efficiency. This is because even if TransGrid's operating expenditure goes down whilst an output measure, eg, peak demand remains constant, the effect of the operating expenditure efficiency may well be lost if other factors within TransGrid's network have changed, such as increased transformer or line capacity, or an increase in TransGrid's regulatory asset base.

The AER's itself states that its benchmarking should be treated with caution when measuring relative performance between businesses due to a range of limitations in the model, including that the relative

[75] AER: *Annual Benchmarking Report, Electricity transmission network service providers*, November 2016.

[76] AER: *Annual Benchmarking Report, Electricity transmission network service providers*, November 2016, p.19

rankings observed are currently sensitive to model specification and the data set is very small[77]. Accordingly, TransGrid has noted its favourable performance in the AER's 2016 benchmarking report but acknowledges that limited weight should be applied to the results when comparing itself to other networks. Expert advice provided by Frontier Economics raises material concerns about the AER's methodology, and is explained in Frontier Economics' report (Appendix F). In summary Frontier Economics said

> …the results contained in the AER's 2016 annual benchmarking report are entirely unsuitable to be used to support regulatory decisions on the relative efficiencies of the TNSPs[78]

Consequently, although the AER's benchmarking for TransGrid's operating expenditure appears positive, TransGrid has also considered independent benchmarking and assurance reports about its prescribed operating expenditure efficiency taken from a range of experts.[79] These reports confirm the view that TransGrid's performance was at a high level of efficiency leading up to and including 2016/17. Their findings are discussed in more detail in section 6.5: Efficiency of operating expenditure.

6.4.2 Forecast starting point

Operating expenditure in the next regulatory control period is not directly forecast from base year expenditure using the AER methodology. Instead, a starting point is calculated and used to forecast operating expenditure in the next regulatory control period. This starting point is calculated by:

- Determining the underspend from the base year (ie, the difference between the operating expenditure allowance and the operating expenditure incurred in the base year)
- Subtracting this base year underspend from the operating expenditure allowance in the final year of the current regulatory control period (2017/18)
- Adding back any non-recurrent efficiency gains realised in the base year. [80]

The AER identify this calculated starting point as "the best estimate of actual opex for the final year of the preceding regulatory control period".[81]

TransGrid has used a slightly different approach to improve accuracy. The 2016/17 base year has been escalated in accordance with the latest available supporting forecasts for the entire forecast period; 2017/18 to 2022/23, which includes the last year of the current regulatory control period. TransGrid has taken this approach following advice from Frontier Economics (Appendix J) and Herbert Smith Freehills (Appendix K).

The implication of using separate estimation methodologies for final year expenditure for the efficiency benefit scheme and operating expenditure forecast is discussed in Chapter 13.

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77 AER: *Annual Benchmarking Report, Electricity transmission network service providers*, November 2016, p.13

78 Frontier Economics: *Review of the MTFP and MPFP analysis in the AER's annual benchmarking report*, December 2016, p6. [TransGrid-Frontier Economics-Review of the MTFP and MPFP analysis in the AERs 2016 Anuual Benchmarking Report-0117-PUBLIC]

79 UMS Group: Overview – *ITOMS 2015 Report*, 28 January 2016.[TransGrid-UMS Group-Appendix M ITOMS blind benchmarking report-0116-PUBLIC]

AURECON: *Asset Management Budget Review, 2016/17 Asset Maintenance Opex*, November 2016. [TransGrid-Aurecon-Appendix O 1617 Asset maintenance assurance-1216-PUBLIC]

CEB: *IT Budget Benchmark Report Prepared for TransGrid*, October 2016.[TransGrid-CEB-Appendix P IT benchmark report-0916-PUBLIC]

80 AER: *Expenditure Forecast Assessment Guideline for Electricity Transmission*, November 2013, p.23

81 AER: *Expenditure Forecast Assessment Guideline for Electricity Transmission*, November 2013, p.23

6.4.3 Rate of change

TransGrid's forecast uses the AER's methodology to apply a rate of change to prescribed operating expenditure for each year of the forecast.[82] The AER's *Expenditure Forecast Assessment Guideline* (Nov 2013) states that operating expenditure rate of change comprises output growth, real price growth and productivity growth. TransGrid has applied the real price growth and output growth to its forecast.

As explained in Section 6.4.2, TransGrid's operating expenditure forecast starts directly from the 2016/17 base year. To develop the forecast from this point, a rate of change has been applied to the final year of the current regulatory period. This approach allows a more accurate forecast to be developed[83]. It is in accordance with advice provided by Frontier Economics (Appendix J) and Herbert Smith Freehills (Appendix K).

6.4.3.1 Real price growth

Real price increases in goods, services and commodities have a direct impact on TransGrid's operating costs. TransGrid has followed the AER's approach to forecast the impact of these, simplifying operating expenditure into two price sensitive categories:

- Internal labour expenditure.
- All other expenditure.

TransGrid manages external cost pressures where possible using competitive procurement and by negotiating strategic purchases. However, there are limits to this as prices are often determined by global markets and are out of TransGrid's control.

Internal labour expenditure

There are two considerations in accurately applying real price growth to internal labour forecasts:

- The proportion of operating expenditure which is internal labour
- The forecast change in labour prices over the relevant period, noting that a high proportion of TransGrid's workforce is highly skilled.

TransGrid has applied an internal labour proportion of 70% of operating expenditure in the 2016/17 base year. Consistent with the AER's wage forecasting approach TransGrid has applied an independent forecast of wage changes to internal labour over the period.

Proportion of labour

In recent decisions relating to both transmission and distribution network service providers, the AER has applied a 62% weighting to its wage growth forecast to calculate its impact on operating expenditure. This implies that the proportion of operating costs attributable to labour is the same for the different types of business.

TransGrid has incorporated the impact of wage changes on operating expenditure by applying actual workforce costs as:

- TransGrid reports actual prescribed operating expenditure relating to internal labour through independently audited accounts, submitted in accordance with Australian accounting standards

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[82] AER: *Expenditure Forecast Assessment Guideline for Electricity Transmission*, November 2013, p.23

[83] This is because the base year is more represent current rate of change forecasts are applied and any distortions created by older forecasts from the prior regulatory decision are avoided

- TransGrid's actual labour composition from 2009/10 to 2013/14 was between 69% and 77%. It is forecast at 70% for the proposed base-year, at the low end of the actual range
- TransGrid's actual operating expenditure is efficient according to various sources, including the AER's final revenue decision in 2015, the AER's 2016 Benchmarking Report and the 2015 ITOMS report
- The 62% estimate for labour composition was initially developed in 2004 by Pacific Economics Group and later reviewed by Economic Insights[84]. By the end of the forecast regulatory period, it will be almost twenty years out of date. Different real changes in wages and other costs since 2004 could mean that it is now inaccurate. Also, the estimate was based on five electricity and one gas distribution business with assets, service requirements and operations which are quite different from TransGrid's.

For the reasons above, TransGrid has used a labour composition of 70% in its forecast operating expenditure. It has received legal advice from Herbert Smith Freehills that supports this:

> … the operating expenditure objectives require an accurate forecast to be determined. We do not consider that the 62% weighting recently used by the AER would result in an accurate forecast that would reflect the realistic input costs of TransGrid.[85]

Wage price growth forecast

TransGrid's main ability to control internal labour prices is via the Enterprise Agreement (EA). This sets out collective employment arrangements with the majority of its employees with three year durations. The previous EA was scheduled for renewal in December 2016 but this process is yet to conclude.

In line with the AER's approach to forecasting wage changes in recent determinations, TransGrid has used an independent forecast of wage changes. This was prepared by expert forecasters BIS Shrapnel[86] using the Wage Price Index (WPI) within the EGWWS (Electricity, Gas, Water and Waste Services) sector. This is consistent with the AER's wage forecasting approach and is representative of TransGrid's specialist workforce.

The effect of TransGrid's approach of applying the wage forecast provided by BIS Shrapnel to the labour proportion of operating expenditure is shown below.

Table 6.4: Expected real increases in TransGrid's labour costs, $m June18

Regulatory Year	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
Increase from previous year	1.3	1.3	1.5	2.1	2.4	2.4

Source: TransGrid. Totals may not add due to rounding.

[84] Economic Insights: Memorandum to the AER – Opex input price index weights, 19th February 2016, pp.2-3

[85] Herbert Smith FreeHills: *TransGrid – Operating expenditure*, 23rd January 2017. [TransGrid-Herbert Smith Freehills-Appendix K Operating expenditure advice-0117-PUBLIC]

[86] BIS Shrapnel: *Report on Expected Wage Changes to 2022/23*, November 2016, p.ii [TransGrid-BIS Shrapnel-Appendix H Expected wage changes-1116-PUBLIC]

All other expenditure

Consistent with the AER's recent approach to non-labour operating expenditure, TransGrid has assumed all other prescribed operating expenditure will change in accordance with the consumer price index (CPI).

6.4.3.2 Output growth

In the *Better Regulation Expenditure Forecast Assessment Guideline* (Nov 2013), the AER explains that output measures should:

- Align with the National Electricity Law and Rules objectives
- Reflect services provided to customers
- Be significant.

TransGrid's approach is consistent with these principles. However, it has not adopted the methodology the AER has used in the majority of its recent decisions for transmission network service providers. Frontier Economics have found material concerns with the analysis (refer to Appendix F), TransGrid is reluctant to adopt this methodology until the AER and Economic Insights have had an opportunity to consider and comment on the Frontier Economics report.

TransGrid has noted the AER accepted an alternative methodology used by AusNet in their November 2015 proposal, which used network growth moderated by economies of scale. The AER accepted this as a substitute to their output growth methodology, albeit with the following qualifiers. TransGrid has developed a similar network growth moderated by economies of scale methodology, taking care to address the concerns raised by the AER.

Table 6.5: Concerns raised by the AER about AusNet's network growth methodology

Concern raised by the AER July 2016	TransGrid's response
"AusNet Services' calculation may overstate the output growth associated with the rolled in group 3 assets because the group 3 assets have not been depreciated as much as the assets already in the asset base."	TransGrid has used the replacement cost of its network instead of the Regulated Asset Base, which avoids the depreciation concerns the AER has raised. TransGrid has one asset similar to an AusNet group 3 asset, but this asset has been depreciated from commissioning date and is not included in the augmentation capital expenditure.
"AusNet Services' calculation is influenced by replacement capex, which does not relate to an increase in output."	TransGrid's approach is not affected by replacement capital expenditure, only capital expenditure that is expected to result in a change to network size. This is because it only uses augmentation capital expenditure.
"AusNet Services' calculation is influenced by the value of unregulated assets that are not group 3 assets, which will not impact the opex associated with operating and maintaining its regulated assets."[87]	TransGrid's approach is not influenced by the value of non-prescribed assets, and links only to prescribed augmentation expenditure and the replacement cost of the prescribed network. This is evident by the inputs used to formulate its network growth calculation.

Prescribed network assets enter TransGrid's regulated asset base (RAB) in a different way to AusNet, and consequently TransGrid used the following approach to reflect this:

$$Network\ growth_t = \frac{Forecast\ prescribed\ augmentation\ expenditure_t}{Forecast\ RAB_t}$$

To calculate the effect of network growth on operating expenditure, TransGrid used similar economies of scale factors to AusNet, and applied these on a lagging one year basis:

$$Growth\ in\ opex\ requirement_{t+1} = Network\ growth_t\ x\ Economy\ of\ Scale\ Factor_t$$

The lag effect reflects how new assets may not fully impact TransGrid's operating expenditure until the following financial year, depending on when they are commissioned. When TransGrid presented this approach to the TransGrid Advisory Council, they suggested it was not appropriate to use the Regulated Asset Base for this as it represents the depreciated value of TransGrid's assets whereas augmentation expenditure is not depreciated. In response, TransGrid adjusted its network growth methodology using the replacement cost of the network instead of the Regulated Asset Base. Accordingly, TransGrid's proposed approach to forecasting operating expenditure, based on the advice from its customers and stakeholders, is as follows:

[87] AER: *Draft Decision, AusNet Services transmission determination 2017-18 to 2021-22, Attachment 7 operating expenditure*, July 2016, p. 22

$$Network\ growth_t = \frac{Forecast\ prescribed\ augmentation\ expenditure_t}{Forecast\ replacement\ cost\ of\ prescribed\ network_t}$$

To calculate the effect of network growth on operating expenditure TransGrid has used similar economies of scale factors to AusNet, applied on a lagging one year basis:

$$Growth\ in\ opex\ requirement_{t+1} = Network\ growth_t\ x\ Economy\ of\ Scale\ Factor_t$$

TransGrid has calculated the replacement cost of its network in accordance with its prescribed pricing methodology, which uses a component build-up of the prescribed transmission network using component replacement costs that are priced on an annual basis from TransGrid's SUCCESS database. The future replacement cost of the network has been calculated based on projected as-commissioned augmentation expenditure in accordance with TransGrid's planned capital program (net of any planned asset disposals that reduce the size of the network). Price increases above the consumer price index that are expected to affect TransGrid's augmentation expenditure have been removed.

This approach has improved the accuracy of its forecast and reduced TransGrid's total operating expenditure forecast by approximately $1 million over the next regulatory control period, compared to using the RAB..

TransGrid has taken into consideration the three concerns raised by the AER about AusNet's methodology, as follows:

TransGrid forecasts that it will incur the following increases in prescribed operating expenditure as a result of changes to its network:

Table 6.6: Expected increases in TransGrid's costs due to network growth, $m June18

	2018/19	2019/20	2020/21	2021/22	2022/23
Increase from previous year	0.0	0.1	0.4	0.3	0.1

Source: TransGrid. Totals may not add due to rounding.

6.4.4 Step changes

TransGrid has included a single step change in its forecast. This is for 'off-easement risk management' to mitigate fire risks from trees which are outside TransGrid easements but could contact conductors if they fell. This requirement is related to the new compliance framework put in place when TransGrid's safety regulator changed. The cost has been added to the escalated base operating expenditure for in accordance with the AER's forecast methodology[88].

Step changes reflect the impact of changes to prescribed operating expenditure which are not included in the base year. They are usually the result of new statutory or regulatory changes or future capex/opex trade-offs. As part of the transition to private ownership, compliance changes had a material effect on TransGrid's operating expenditure, these are included in the 2016/17 operating expenditure and are included in the forecast as a result. If an earlier base-year was used it would need to be adjusted for a number of items which increased the cost base substantially:

- Australian Capital Territory utility Licence fee and related obligations

[88] AER: *Expenditure Forecast Assessment Guideline*, November 2013, p.22

- New South Wales Transmission Operator's Licence fee
- Annual rent payable to New South Wales government
- New debt financing requirements:
  - Number of external bank financiers increased from one to 25
  - Dealings with bank syndicate now involves security trustee and inter-creditor agent
- Placement of an external insurance program in the market, to replace the significantly cheaper and more comprehensive New South Wales government insurance.

Even after these, the efficiency program will deliver an overall reduction in expenditure in 2016/17.

The single proposed step change is discussed below. Note that a second step change has been considered and may be required if RIT-T rule changes are implemented.

6.4.4.1 Off-easement risk management

Following various legal proceedings and the enquiry into the 2009 Victorian bush fires there has been a material change in the expectations of how network businesses manage vegetation risks. Specific changes in TransGrid's compliance requirements have driven a re-interpretation of safety compliance obligations. There is a need to manage the additional risks posed by 51,500 trees which are *outside* TransGrid's easements but could touch conductors if they fell. The total forecast cost of this over the next period is $37 million.

TransGrid is committed to the health, welfare and safety of employees, contractors and the public and its operations must comply with applicable regulations and guidelines. The Electricity Supply (Safety and Network Management) Regulation 2014 (the regulation) requires the following to be managed in accordance with AS 5577 electricity network safety management systems:

- the safety of members of the public and of those working on networks
- risks to property (whether or not it belongs to a network business)
- safety risks relating to the environment (eg bush fires ignited by network assets)
- safety risks arising from loss of electricity supply.

The regulation is not new and TransGrid has always managed vegetation within easement corridors to maximise network reliability and public safety and to minimise bush fire risk.

New interpretation of requirements and recent events

Requirements were reviewed when the safety regulator changed (from NSW Department of Trade and Investment to IPART) and clearer, more stringent compliance requirements were published. As a result there is now an additional need to manage the risk presented by off-easement trees.[89]

In 2016, TransGrid recorded four events where off-easement trees fell onto transmission lines, much higher than the historical average of 0.6 events per year recorded

Recent example of off-easement fire risk

Residents and business owners recently sued Endeavour Energy for damages in the NSW Supreme Court regarding a bushfire in October 2013. They claim the electricity distributor failed to prune or remove a tree which was a fire hazard next to a power pole in Springwood.

On a hot, windy and dry day, the fire destroyed 194 homes and razed 3,600 hectares of bush, although fortunately there was no loss of human life.

[89] Full details of the Winmalee/Springwood Bush Fire Class Action, described in the box, are available on the Supreme Court of NSW website at: http://www.supremecourt.justice.nsw.gov.au/Pages/sco2_classaction/winmalee.aspx

over the previous decade.

Table 6.7: Off-easement tree events in 2016

Date	Transmission line	Consequence
24/6/2016	Coffs Harbour – Raleigh	Auto-reclose of breaker and subsequent line patrol.
22/7/2016	Murray – Guthega tee Geehi	Line out of service for four days.
04/08/2016	Armidale – Coffs Harbour tee Dorrigo	Line out of service for seven days. Significant loss of supply for 16 hours.
13/11/2016	Tumut – Burrinjuck	Line out of service for two days.

A step change is appropriate

An operating expenditure step change is needed to manage off-easement tree risks as:

- It is the result from a change in regulator and its new compliance regime and audit guidelines
- There has been a significant increase in the number of off-easement tree events in 2016
- TransGrid's reassessment of the regulations is supported by independent legal advice
- TransGrid needs time to correctly develop and efficiently implement appropriate risk management controls so cost cannot be forecast using the 2016/17 base year.

Proposed approach

Under the new compliance framework, TransGrid must manage the risk So Far As Is Reasonably Practicable (SFAIRP) via the following steps:

- Identify all credible, reasonably foreseeable risks
- Identify all control measures which could eliminate or minimise these risks
- Decide which controls are reasonably practicable to implement and identify further possible controls even if the risk is reduced to a tolerable level.

Using aerial laser surveys and modelling TransGrid has calculated that some 51,500 trees *outside* TransGrid's easements could touch conductors if they fell. It is not reasonably practical to remove all of these trees. TransGrid needs to address the trees which present the greatest risk and has identified that more controls are needed to manage the risk appropriately. Compliance requires a regular and thorough monitoring program including:

- Identification of trees at risk through LIDAR
- Assessment of the condition of each relevant tree by a qualified person
- Where an off-easement tree is deemed a risk it will be lopped, pruned or regularly reassessed.

A more detailed strategy will be developed during 2016/17, followed by scoping works as part of existing easements inspections during 2017/18 and implementation of controls from 2018/19 onwards.

The total forecast risk management cost over the period is $37 million, or $7.5 million per year ($June 2018).

Table 6.8: Forecast step changes, $m June 18

Step change cost forecast	2018/19	2019/20	2020/21	2021/22	2022/23
Off-easement risk management	7.5	7.5	7.5	7.5	7.5

Source: TransGrid. Totals may not add due to rounding.

The 'risk cost' of off-easement trees has been assessed against this control cost as follows. The risk management cost is less than the risk cost.

Table 6.9: Cost benefit analysis for off-easement risk management, $m June 18

Annualised network safety risk cost reduction	Annualised spend	Reasonably practicable?
7.7	7.5	Yes

Source: TransGrid. Totals may not add due to rounding.

TransGrid raised this off-easement risk management issue with the TransGrid Advisory Council (TAC). TAC advised that the full risk analysis and risk mitigation strategy should be made available, in order to support the proposal. This was to avoid a potential perception that the risks were overstated. TransGrid has provided its detailed analysis in Appendix D of this proposal.

6.4.4.2 Changes to regulatory investment test – transmission

The regulatory investment test – transmission (RIT-T) is a cost-benefit analysis used to identify the single credible transmission investment option that maximises net economic benefit. It aims to ensure robust and efficient transmission investment decisions, and requires transmission network service providers to prepare reports assessing potential options and publically consult on these. Currently the RIT-T must be conducted for any transmission network augmentation investment where the estimated capital cost of the most expensive credible option is above a threshold of $6 million.

Replacement projects are currently exempt from this process. However the AER has made a rule change proposal relating to network replacement expenditure, given the increasing proportion of capital expenditure relating to replacement for many network businesses and the emergence of new technologies.

TransGrid has considered the potential expenditure impact of implementing the proposed rule, while noting that the rule change process is subject to a consultation process that is still ongoing. On the basis of the information currently available TransGrid believes that the new RIT-T requirement, should it proceed, will be predominantly capitalised consistent with the existing RIT-T process for augmentation projects. Should the form of the final Rule change be different from current guidance it is possible that the RIT-T costs would become operating costs, in which case a step change may be required. As the Rule change is expected to be finalised by mid-2017 this should be clear by the time of the revised proposal. TransGrid will review and update its assumptions and estimates in its revised proposal in line with the final Rule requirements. Accordingly there is no step change proposed for the proposed RIT-T rule change but TransGrid will reassess this following finalisation of the Rule change.

6.4.5 Debt raising costs

Debt raising costs are benchmark unavoidable costs which include arrangement fees, legal fees, company credit rating fees and other transaction costs that are incurred in the course of debt raising activity. At its inception, based on the practices of the Australian Competition Consumer Commission

(ACCC), the AER adopted a method for estimating debt raising transaction costs that were incurred by businesses at that time.[90] Since this time the Global Financial Crisis has occurred and debt management practices have changed.

Standard & Poor's has published its expectations for modern debt management practices to ensure businesses can maintain appropriate credit ratings. TransGrid has used this transparent method to estimate the benchmark efficient costs of raising debt. Incenta Economic Consulting's (Incenta) view is that these, or similar requirements, represent the minimum standards expected of all large businesses participating in debt markets.

The three main drivers of debt raising costs are:

- the transaction related costs of issuing the bonds
- refinancing maturing debt at least three months ahead of the debt maturing; this has applied since 2008[91]
- meeting formal requirements with respect to liquidity (which refers to the buffer the business has to meet for short term cash requirements); this has applied since 2010[92].

The AER has previously recognised transaction costs, but not the other two sources of debt raising costs.[93] TransGrid engaged Incenta to consider the reasons given by the AER, and provide an estimate of the benchmark debt raising cost for a benchmark business with TransGrid's characteristics.[94] Incenta's findings are summarised in this section, and a detailed paper is included in Appendix L.

Based upon the advice of Incenta, in addition to the transaction related costs, TransGrid considers that refinancing three months ahead and liquidity costs are costs that a prudent and efficient operator will incur when participating in debt markets over the next regulatory control period.

The AER has previously decided that there are elements of the calculation of the building block revenue requirement that provide an offsetting bias and accordingly the full debt raising costs are not required to be compensated.

TransGrid's view, supported by legal advice, is that the AER is not permitted under the Rules to apply perceived conservatism in one of the building block items to offset an otherwise appropriate allowance for another (unconnected) item.

Incenta has demonstrated that a prudent and efficient operator incurs these costs to meet the requirement in relation to liquidity and the timing of refinancing of debt in order to maintain an investment grade credit rating. Incenta further notes that a prudent and efficient TNSP would always seek to maintain an investment grade credit rating,[95] and that the AER's assessment of the debt risk premium assumes that regulated networks have an investment grade credit rating.

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90 ACG (2004), Debt and Equity Raising Transaction Costs – Final Report, Report to The Australian Competition and Consumer Commission, December 2014. [TransGrid-ACG-Debt and Equity Raising Transaction Costs-1214-PUBLIC]

91 Standard & Poor's (22 April, 2008), Refinancing And Liquidity Risks Remain, But Australia's Rated Corporates Are Set To Clear The Debt Logjam, Global Credit Portal. [TransGrid-S&P-Refinancing & Liquidity Risk Remain-0408-PUBLIC]

92 Standard & Poor's (2011), Methodology And Assumptions: Liquidity Descriptors For Global Corporate Issuers, 26 September; [TransGrid-S&P-Methodology And Assumptions_Liquidity Descriptors For Global Corporate Issuers-0911-PUBLIC] and Standard & Poor's (2 January, 2014), Methodology and Assumptions: Liquidity Descriptors For Global Corporate Issuers.[TransGrid-S&P-Methodology And Assumptions_Liquidity Descriptors For Global Corporate Issuers-0114-PUBLIC]

93 AER (April, 2015), FINAL DECISION, TransGrid Transmission determination 2015-16 to 20117-18, Attachment 3 – Rate of return, pp. 3-547 to 3-550.

94 Incenta (December, 2016), Debt Raising Cost – TransGrid's 2018/19 to 2022/23 Revenue Determination, Report for TransGrid. [TransGrid-Incenta-Appendix L Debt Raising Cost TransGrid 2018_19 to 2022_23 Revenue Determination-0117-PUBLIC]

95 Ibid. p.1

TransGrid proposes a benchmark total debt raising cost of 20.7 basis points, comprised as follows.[96] For full details on the methodology for calculating the debt raising costs, refer to Appendix L.

- 8.8 basis points per annum for the transaction-related costs of issuing the bonds for an assumed debt portfolio of $3,843 million (ie, RAB debt)
- 7.7 basis points per annum to establish and maintain bank facilities required to meet Standard & Poor's liquidity requirements condition for maintaining an investment grade credit rating
- 4.2 basis points per annum to compensate for the requirement (again as a condition of maintaining an investment grade credit rating) that Standard & Poor's requires businesses to re-finance their debt 3 months ahead of the re-financing date.

TransGrid's debt raising costs, calculated using this approach, are as follows:

Table 6.10: TransGrid's calculated debt raising costs, $m June 18

	2018/19	2019/20	2020/21	2021/22	2022/23
Non-capitalised debt raising costs	8.0	7.9	8.0	8.1	8.2

Source: TransGrid. Totals may not add due to rounding.

6.4.5.1 Operating expenditure productivity

In developing its forecast of operating expenditure, TransGrid has considered the effect of changes in productivity for businesses operating in the same sector as TransGrid. This is to ensure its productivity matches that of its peers, and is in alignment with the principles used by the AER in their forecast methodology.

The AER approach measures industry productivity according to metrics calculated by Economic Insights. The metrics are formulated specifically for transmission network service providers that operate in the NEM and include an operating expenditure specific measure of productivity called *industry-level partial factor productivity- opex*. The AER use this measure to calculate the change in aggregate transmission network service provider productivity since 2005/6 and apply this to their forecast of each transmission network service provider's operating expenditure as an expenditure deflator.

TransGrid notes that using historical trends of industry productivity may not be a suitable way of forecasting efficiency changes as TransGrid's new licencing obligations pose additional constraints on how the business can operate and will reduce opportunities that could drive productivity in the future.. For example, NSW Transmission Licence restrictions in how data must be held and accessed from within Australia have meant TransGrid's SCADA[97] system cannot be serviced remotely, in real time, by the service provider any more. Instead staff will make periodic trips from Europe to provide this specialist function.

TransGrid expects these constraints will continue to reduce its opportunities to achieve productivity gains in the future.

TransGrid also has some concerns about the productivity metric the AER uses for its forecasts:

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[96] Incenta calculated this using a discount rate of 6.6 per cent. The NPV of transaction costs over the regulatory period was divided by the NPV of the RAB values over the same period to obtain a levelised cost in basis points per annum.

[97] Supervisory Control and Data Acquisition

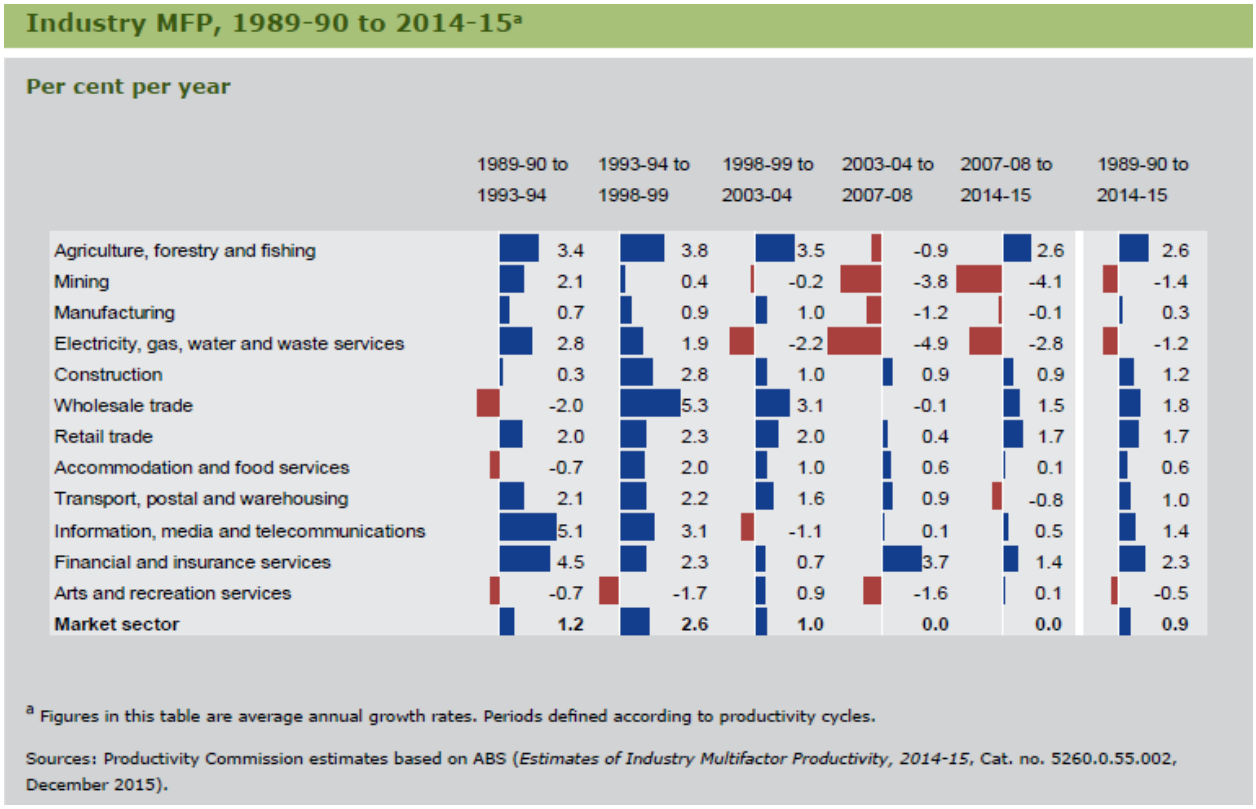
- The productivity measure for operating expenditure used by the AER, *industry-level partial factor productivity- opex,* is compiled from only five transmission network service providers, using aggregate changes in their operating expenditure productivity between 2005/06 and the most recent year the AER has data for - the full extent of the AER's dataset. This is a very small sample set over a relatively short period of time, and has the potential to be skewed by one-off circumstances
- TransGrid notes the AER updated their methodology this year to help minimise the effect of "outlier observations lying at either the start or the end of the time period".[98] This reverses what TransGrid estimates would have been a slightly negative industry productivity growth using the AER's previous methodology. Instead, the AER's new calculation methodology, using the same data, has indicated a slightly positive annual increase in industry productivity since 2005/06. This suggests there may be a number of reasonable calculation methodologies that can be used, which can give materially different results
- The weightings the AER apply to energy throughput, weighted number of connections, ratcheted peak demand and circuit length to calculate *industry-level partial factor productivity- opex* are the result of the same regression analysis performed by Economic Insights for the 2006 to 2013 period, which according to Frontier Economics has various problems. Refer to Appendix F.

TransGrid has considered three potential alternatives for measuring industry productivity. The first two are:

- The Productivity Commission's *Productivity Update for 2016*: This report measures the multi-factor productivity of various industries for the period 1989/90 to 2014/15, including EGWWS, the industry sector the AER uses when forecasting changes in transmission network service provider wages. The report indicates that EGWWS productivity has declined by 1.2% p.a. over the 1989/90 to 2014/15 period.

[98] Economic Insights: *Memo on transmission multilateral total factor productivity results*, 29 April 2016, p5. [TransGrid-Economic Insights-Memo on transmission multilateral total factor productivity results-0416-PUBLIC]

Figure 6.6: Extract from Productivity Commission's July 2016 update[99]



Industry MFP, 1989-90 to 2014-15[a]

Per cent per year

	1989-90 to 1993-94	1993-94 to 1998-99	1998-99 to 2003-04	2003-04 to 2007-08	2007-08 to 2014-15	1989-90 to 2014-15
Agriculture, forestry and fishing	3.4	3.8	3.5	-0.9	2.6	2.6
Mining	2.1	0.4	-0.2	-3.8	-4.1	-1.4
Manufacturing	0.7	0.9	1.0	-1.2	-0.1	0.3
Electricity, gas, water and waste services	2.8	1.9	-2.2	-4.9	-2.8	-1.2
Construction	0.3	2.8	1.0	0.9	0.9	1.2
Wholesale trade	-2.0	5.3	3.1	-0.1	1.5	1.8
Retail trade	2.0	2.3	2.0	0.4	1.7	1.7
Accommodation and food services	-0.7	2.0	1.0	0.6	0.1	0.6
Transport, postal and warehousing	2.1	2.2	1.6	0.9	-0.8	1.0
Information, media and telecommunications	5.1	3.1	-1.1	0.1	0.5	1.4
Financial and insurance services	4.5	2.3	0.7	3.7	1.4	2.3
Arts and recreation services	-0.7	-1.7	0.9	-1.6	0.1	-0.5
Market sector	**1.2**	**2.6**	**1.0**	**0.0**	**0.0**	**0.9**

[a] Figures in this table are average annual growth rates. Periods defined according to productivity cycles.

Sources: Productivity Commission estimates based on ABS (*Estimates of Industry Multifactor Productivity, 2014-15*, Cat. no. 5260.0.55.002, December 2015).

Source: Productivity Commission.

> *Productivity in NSW* by David Buckland & Harley Smith, NSW Trade & Investment, published 18 September 2014: This report measures productivity for various industries within NSW, including a utility specific measure. It indicates a decline in NSW utility productivity of approximately -1.86% p.a. between 1995 and 2013 using a multi factor productivity measure. It also indicates a similar result for all of Australia.

Both the Productivity Commission and NSW Trade and Investment studies use a broad dataset covering a long time period to measure utility productivity, and both indicate a negative productivity trend for Australian utility service providers. In contrast, TransGrid notes the AER's productivity metric of transmission networks, indicates a slight increase in aggregate productivity[100].

TransGrid discussed the negative productivity with the TransGrid Advisory Council, and its members advised that the alternative studies considered by TransGrid were not specific enough to TransGrid's industry, as they contained water utilities whose outputs may not have been properly captured by the reports[101]. TransGrid has also considered the AER's latest assessment of distribution networks productivity, from their 2016 benchmarking report. Whilst distribution networks are substantially different in composition to transmission networks TransGrid considered this report because it benchmarks only

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[99] Productivity Commission: *Productivity Update*, 2016, p. 10 [TransGrid-PC-Productivity Update-0416-PUBLIC]

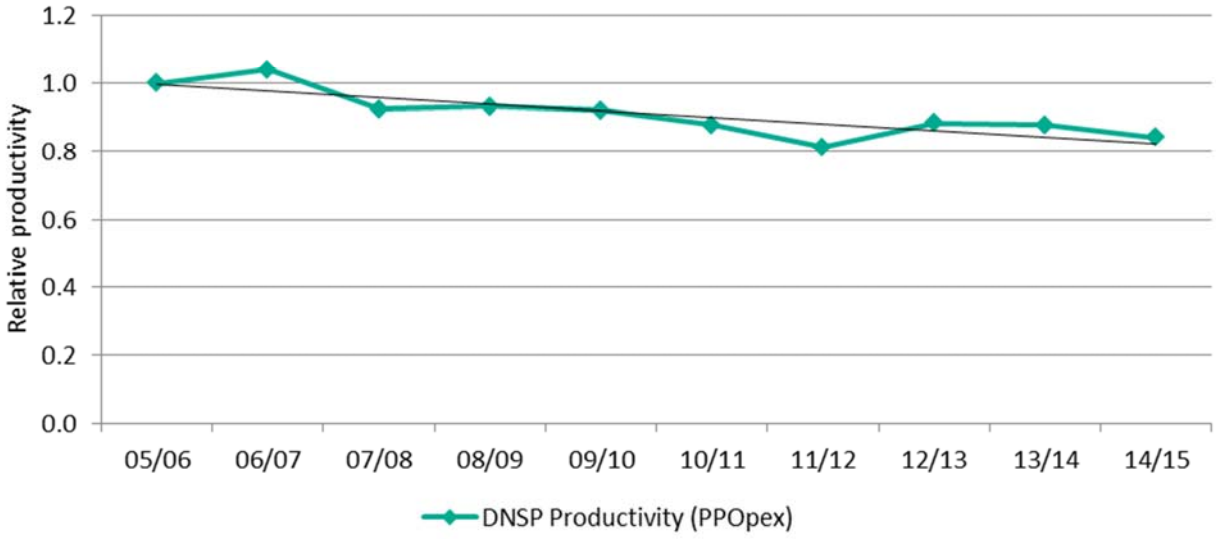
[100] Economic Insights: *Memo on transmission multilateral total factor productivity results*, 29 April 2016. [TransGrid-Economic Insights-Memo on transmission multilateral total factor productivity results-0416-PUBLIC]

[101] The Productivity Commission has previously acknowledged that this may well be due to drought related events such as water restrictions and investments in "water security" (that is, desalination plants) and increases in water quality and treatment standards that are not captured in standard measures of output. See Productivity Commission: *Australia's Urban Water Sector*, Inquiry Report Volume 1, 31 August 2011, pp. 39-40 [TransGrid-PC-Australias Urban Water Sector Inquiry Report Volume 1-0811-PUBLIC]

electricity network businesses, whilst still using a much larger dataset (thirteen businesses), than the five businesses used by the AER for their transmission network analysis.

Aggregate Australian distribution network service provider productivity in operating expenditure terms has declined at a rate of approximately 1.8% per annum since 2005/06, using the data in the AER's 2016 distribution network report as shown in the graph below:

Figure 6.7: AER's 2016 assessment of distribution network service provider productivity



Source: AER.[102]

The productivity reports mentioned above all indicate a negative industry productivity trend. In contrast, the AER's latest method for calculating transmission network service provider productivity would result in a slightly positive trend. As concerns were raised by Frontier Economics relating to the AER's methodology, and adopting a negative trend is inconsistent with TransGrid's expected performance, TransGrid has decided to assume no change in industry productivity for the forecast period.

Distinct from industry productivity expectations and real cost drivers, TransGrid has expectations for further efficiency savings of 4% in 2017/18 when wage growth and output growth are taken into account, which are incorporated in future operating expenditure.

[102] AER: *Economic Insights DNSP benchmarking data file,* 7 November 2016, Series PPOpex, https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/annual-benchmarking-report-2016 [Retrieved 1 December 2016]

6.4.6 Forecast operating expenditure requirements

The operating expenditure that TransGrid forecasts it will need in the next regulatory control period is comprised as follows:

Table 6.11: Total forecast operating expenditure, $m June 18

	2018/19	2019/20	2020/21	2021/22	2022/23
Previous year's opex	168.4	169.7	171.3	173.8	176.5
Change in cost of labour	1.3	1.5	2.1	2.4	2.4
Network growth	0.0	0.1	0.4	0.3	0.1
Total step changes	7.5	7.5	7.5	7.5	7.5
Total prescribed opex[103, 104]	**177.2**	**178.8**	**181.3**	**184.0**	**186.4**

Source: TransGrid. Totals may not add due to rounding.

6.4.7 Operating expenditure for contingent projects

TransGrid has tried to ensure its planning accommodates a range of scenarios, and that its revenue is matched to user requirements despite some uncertainty about the needs of the customers and consumers during the forecast period.

Five contingent projects are included in the capital program to meet the potential needs of customers and consumers under different scenarios. The decision of whether to proceed with these projects will be in accordance with user requirements and grid investment rules, through a process that will commence subject to an external trigger approved by the AER.

If the contingent projects go ahead in the next regulatory control period there will be operating expenditure requirements to efficiently support them. TransGrid will propose incremental operating expenditure to support these projects using the same methodology should these projects be triggered. These expenditure increments will be subject to the AER's approval separate to this transmission determination, and will be subject to 6A.8 Contingent Projects in the Rules.

6.5 Efficiency of operating expenditure

Operating efficiency has been a continued top priority since the last revenue decision. TransGrid has driven changes that have positively impacted the business and benefited consumers. This has been a challenging process that has balanced the need to maintain compliance, quality of service and safety. Final benefits of the program will be delivered in 2017/18 with the planned savings reflected in the forecasts for the next period.

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[103] The NER, S6A.1.2, requires that TransGrid identifies the extent to which this forecast expenditure is on costs that are fixed and to what extent it is on costs that are variable: In the short term, operating expenditure can be regarded as variable. However, in the medium to long term, the cost of sustainably managing high value, long life assets is more appropriately regarded as fixed, relative to a particular asset base.

[104] Excludes debt raising costs

Efficiency is a priority:

- Various independent reports and assessments have ranked TransGrid's operations:
  - ITOM's latest report (2015) identified TransGrid as a top performer internationally. This report used 2014 data and TransGrid anticipates that future ITOMs reports will indicate improved assessments given that TransGrid has implemented various efficiency initiatives since 2014.[105]
  - The AER's latest benchmarking report ranked TransGrid in second place for operating expenditure efficiency in 2013/14, and indicated that TransGrid increased its efficiency in 2014/15.[106]
- Since the AER's previous revenue determination TransGrid has conducted a detailed review of all aspects of the business. The benefits from this have led to reduced operating expenditure, with benefits expected to be fully realised by the 2017/18 year. These planned savings have been built into forecast operating expenditure for the next period.
- Reductions in operating expenditure have more than offset increases in ongoing operating costs, including those from regulatory and statutory changes, estimated to be in the region of $4 million per annum.
- TransGrid's projections, using the same benchmarking methodology as the AER, indicate cost reductions will drive improvements in TransGrid's benchmarked performance when more recent data is taken up in the AER reports.
- Aurecon, KPMG and CEB have assessed TransGrid's expected operations and expenditure within core parts of the business in 2016/17, and their findings have been highly favourable. The relevant reports have been included as Appendices to this proposal.

6.5.1 Independent benchmarked performance

The ongoing focus on efficiency has helped TransGrid find opportunities for improvement in service performance and cost reductions since the previous revenue determination. According to independent assessments, at the time of the AER's previous revenue determination TransGrid was already a high performer both internationally and within its Australian peer group. For example, the most recent, International Transmission Operations and Maintenance Study (ITOMS) 2015 (refer to Appendix M), which uses 2014 data, identified TransGrid as an "overall top performing company" for transmission line operations out of 31 other international transmission businesses.[107]

ITOMS also scored TransGrid highly in its overall composite benchmark, with a strong service level and relatively low cost. This result is shown in Figure 6.8 which plots the performance of various transmission network operators around the world according to composite service level and cost. Top right is the best performing quadrant, and is where TransGrid is placed. The improvements and cost reductions that TransGrid has achieved since 2014 (the year from which this report is taken) are expected to significantly improve TransGrid's position in the ITOMs benchmark.

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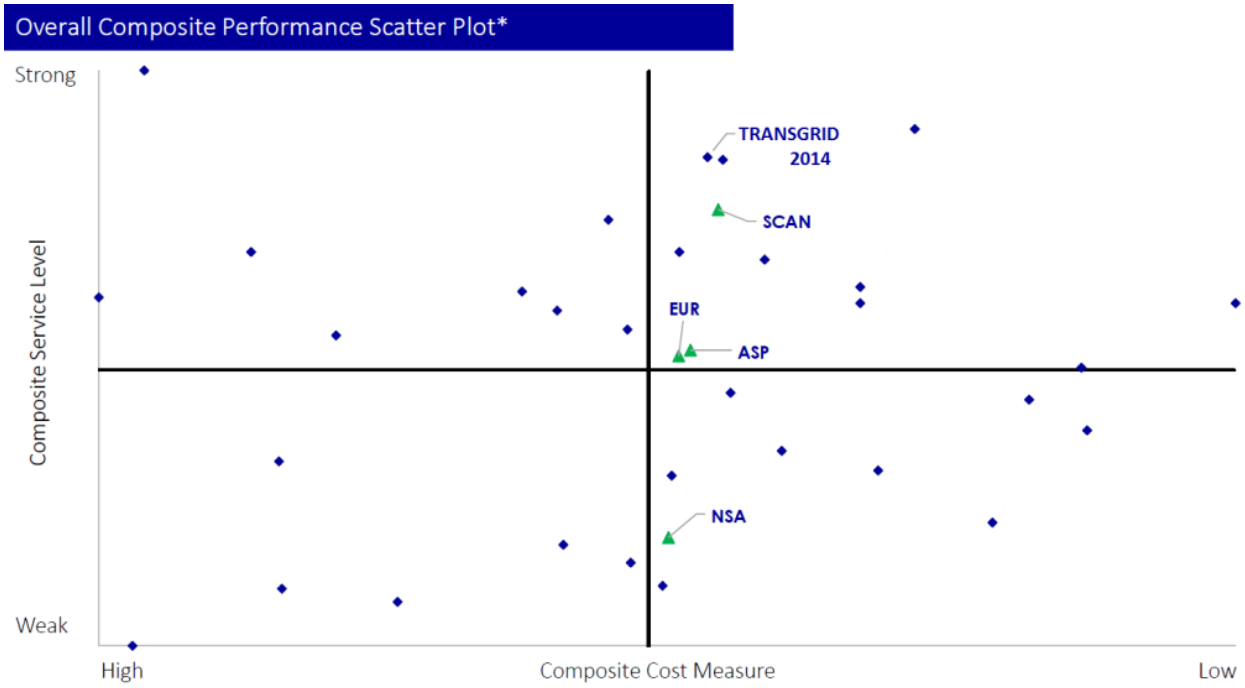
[105] UMS Group: Overview – *ITOMS 2015 Report*, 28 January 2016, p.26 [TransGrid-UMS Group-Appendix M ITOMS blind benchmarking report-0116-PUBLIC]

[106] AER: *Annual benchmarking report, electricity transmission network service providers*, November 2016

[107] UMS Group: Overview – *ITOMS 2015 Report*, 28 January 2016, p.26 [TransGrid-UMS Group-Appendix M ITOMS blind benchmarking report-0116-PUBLIC]

Figure 6.8: ITOMs benchmarking report



Source: ITOMS

The KPMG benchmarking report (2016), included in Appendix N, also provides information about the relative performance of TransGrid to other network service providers, using publically available regulatory information notice data. The report indicates that TransGrid has the lowest operating expenditure per customer of all six transmission network service providers. On the per circuit kilometre measure TransGrid was the lowest in most years of the study.

6.5.2 Maintenance and asset management

TransGrid operates and manages one of the largest[108] transmission networks in the national electricity market, and maintaining it accounts for about 44% of prescribed operating expenditure. TransGrid's asset management system is certified to ISO5001; an international asset management standard published by The International Organisation for Standardisation (ISO). In accordance with this standard TransGrid has implemented the following improvements to maintenance in 2016/17:

- **Maintenance planning:** Shifted from routine time based maintenance of assets, where maintenance occurs at regular set time intervals, to a condition based maintenance regime for suitable asset classes. Condition based maintenance relies on accurate monitoring of critical asset components such that a maintenance task can be triggered if set limits are exceeded, prior to excessive wear or failure of the asset. The maintenance frequency is thus tailored to the needs of each asset, allowing maintenance to occur less regularly in most cases. This shift has been enabled by:
  - The definition of asset condition data to be collected during asset inspections, improving the availability, accuracy, consistency and dependability of condition data

[108] TransGrid operates the largest transmission network in the NEM according to the following network metrics published by the AER: energy throughput, ratcheted peak demand, transformer capacity and underground cable capacity (measured as MVA.Km).

  - The introduction of the Asset Inspection Manager, which is an online system where condition data is collected and reported. Issues are automatically raised when out of specification / tolerance conditions are reported
  - The increased use of online condition monitoring systems, which monitor asset condition in real time and trigger alarms when thresholds are exceeded.

- **Remote monitoring:** A re-optimisation of the frequency of routine inspection and routine maintenance tasks. Inspection and maintenance activities have had their frequency decreased and in some cases the activity has been eliminated while continuing to maintain asset risk and performance to acceptable levels. This has been enabled in many cases by the use of remote monitoring equipment, such as online condition monitoring systems and remote visual monitoring of assets via CCTV systems
- **Resource management:** Improvements in the delivery of maintenance, achieved through:
  - Aligning multiple inspection and maintenance tasks into consolidated work packages
  - Better management of external contractors
  - Efficient utilisation of internal resources

  These improvements have been enabled through initiatives such as resource management system and an application driven mobility solution.

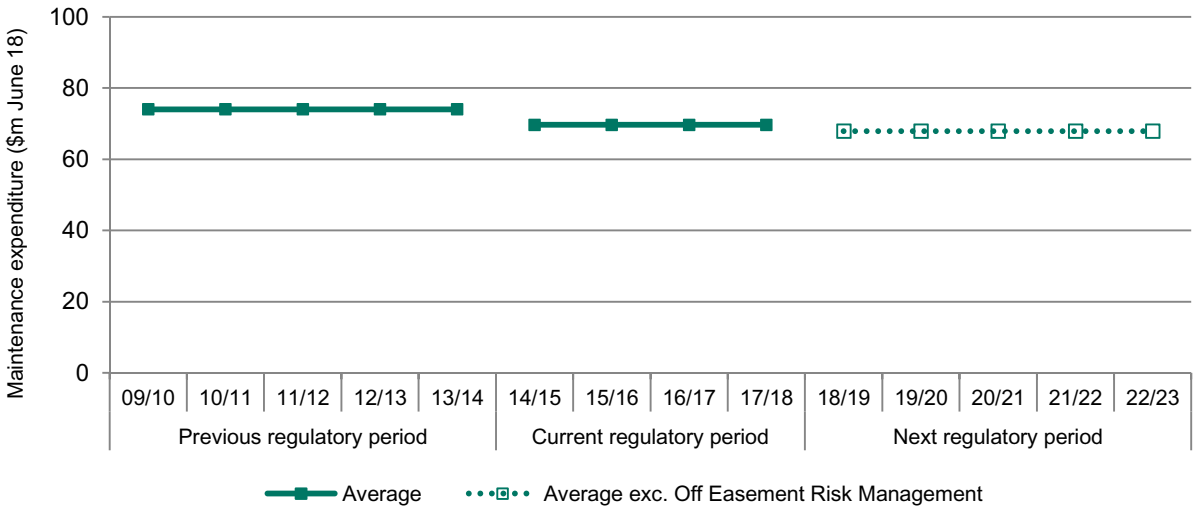
TransGrid engaged Aurecon to perform an independent review of good industry practice[109]. Aurecon's full report is included in Appendix O. Their primary findings were that:

- TransGrid's maintenance expenditure has been driven by rational improvements that meet internal and external stakeholder requirements.
- TransGrid is moving towards more data driven asset management, and this is consistent with modern asset management approaches and aligns well with ISO55001.
- TransGrid has demonstrated a commitment to ensuring that its processes are robust and consistent.

TransGrid will continue to monitor the effectiveness and safety of its asset management strategies and plans to ensure they deliver in accordance with expectations. TransGrid's historical and expected maintenance expenditure is shown in the graph, below:

[109] Aurecon is an engineering consultancy with considerable experience and expertise in asset management and infrastructure projects across 28 countries

Figure 6.9: TransGrid's historical and forecast maintenance expenditure



Source: TransGrid.

6.5.3 Information technology

Information technology is an essential enabler of TransGrid's ability to provide high quality prescribed transmission services. TransGrid efficiently and prudently invests in information technology to:

- Manage and optimise the value of assets across their lifecycle by providing information to inform acquire, operate, maintain and replace decisions
- Monitor asset condition and performance to reduce unplanned outages and failures
- Plan, schedule and coordinate mobile plant, equipment and field crews to minimise downtime and maximise effective utilisation
- Implement efficient, common processes across the business
- Provide data and reports to market participants and other stakeholders.

In the next regulatory control period, it is expected that both the scope and business-criticality of information technology services will increase. To meet these needs, TransGrid will continue to carefully evaluate information technology investments by considering their whole of life cost, benefits, risks, and alignment to strategy.

TransGrid recognises that while information technology can help realise benefits, the operational costs associated with supporting information technology systems must be controlled, and efficiencies pursued wherever they present. Accordingly, TransGrid's information technology operations in 2016/17 are already set to achieve the following cost improvements:

- Controlled software expenditure, including rationalisation and consolidation of applications
- The cost of service providers managed down
- Reduced reliance on external consulting support.

TransGrid's information technology operations have been benchmarked by CEB against other international businesses operating in various sectors and regions (refer to appendix P for full report). CEB's main findings were that:

- Information technology expenditure as a percentage of business revenue at 3.5% lower than the median of 4%, and at the median point amongst TransGrid's peer group in the energy, metals and mining sector
- Information technology outsourcing levels of 13.3% were slightly higher than the median of 12.4% in the energy, metals and mining sector
- Operating expenditure growth for 2016/17 was in the lowest quartile, with no increase to operating expenditure from 2015/16 versus a median growth of 5%
- Information technology investment growth for 2016/17 was in the lowest quartile, with a reduction in investment expenditure of -1.7% vs a median investment growth of +5%.[110]

TransGrid has considered these results from CEB together with the KPMG benchmarking report in Appendix N which both indicate lower than average expenditure levels. TransGrid has also listened to feedback from its customers and consumers concerned that the low growth in Information Technology operating expenditure could be interpreted as a sign of under-investment unless service levels are maintained. TransGrid's view is that its 2016/17 cost levels reflect a new, optimised and sustainable cost-base, realised through the careful delivery of efficiencies and existing service levels will be maintained. However, TransGrid will monitor its performance to ensure this remains the case throughout the forecast period, as any further reductions in spending will entail increased risk.

It should also be emphasised that although overall Information Technology costs have been carefully managed down, TransGrid has progressively increased its investment in cyber security in light of an increased global threat level[111]. Cyber security is a very real concern shared by most networks in Australia, and KPMG has ranked IT security as a top challenge facing Australian network service providers[112].

6.5.4 Innovation

Innovation has played an essential role in allowing TransGrid to achieve efficiencies. A range of new initiatives have been implemented or tested in 2016/17, including:

The Asset Monitoring Centre

The new Asset Monitoring Centre allows TransGrid to remotely monitor its assets and co-ordinate responses to network incidents in real time. It combines previously disparate data sources to more completely understand the condition of equipment. This monitoring system is underpinned by advances in high speed communication networks that allow large quantities of data to be transmitted and processed in real time.

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[110] CEB: *IT Budget Benchmark Report Prepared for TransGrid*, October 2016. [TransGrid-CEB-Appendix P IT benchmark report-0916-PUBLIC]

[111] Australian Cyber Security Centre: *Threat Report 2016*, October 2016, pp.17-18.

[112] KPMG: *2016 Utilities IT Benchmarking*, p. 74, January 2017 [TransGrid-KPMG-Appendix N 2016 Utilities Benchmarking-0117-CONFIDENTIAL]

The use of the new Asset Monitoring Centre has reduced operating costs in the following ways:

- Reduced the call out of field staff out of hours
- Improved work scheduling
- Consolidated analysis functions
- Improved trend-to-fail diagnostics and allowed just-in-time repair.

The use of drones

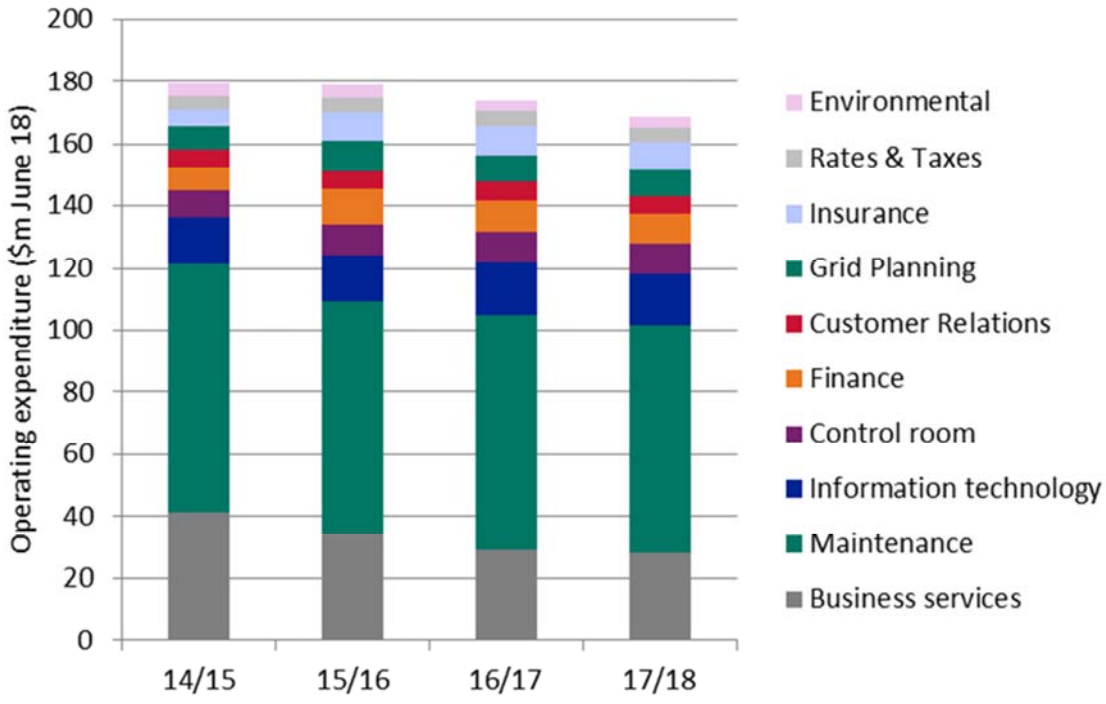
During the current regulatory control period TransGrid investigated how it could use Unmanned Aerial Vehicles (UAVs) or drones to improve inspection methods. Drones are a developing technology, and TransGrid has observed that technology improvements such as new GPS guidance systems in combination with high resolution photography and infrared or FLIR cameras make it possible to inspect transmission equipment, especially towers, without having to access the equipment though traditional means.

Drones have the potential to provide faster inspection techniques whilst providing similar or in some cases better inspection results than with traditional climbing methods. Over the next regulatory period TransGrid will continue to invest in and refine the use of this technology.

6.6 Operating expenditure this period

TransGrid's prescribed operating expenditure in the first two years of the current regulatory control period is shown in Figure 6.11, in conjunction with estimates for 2016/17 and 2017/18. Operating expenditure has consistently been in line with the allowance set by the AER in its previous revenue decision, with an under-spend expected in 2016/17 (the proposed base year) and in 2017/18. TransGrid has achieved this by pursuing a multi-year efficiency program that is now in its final stage.

Figure 6.10: Expenditure by category in the current regulatory control period



Source: TransGrid.

6.7 Key assumptions

The key assumptions used to forecast operating expenditure are as follows:

- Base year is 2016/17, which is an efficient and representative year from which to project operating expenditure for future years
- Forecast efficiency savings in 2017/18 will be sustainable and have been built into all future year forecasts
- Debt raising costs based on the costs facing a benchmark efficient firm, consistent with the approach to determining the allowed rate of return
- Inflation based on geometric average of Reserve Bank of Australia Statement on Monetary Policy for two years and the midpoint of its target range for eight years
- Labour cost escalation based on WPI forecasts for the Australia EGWWS sector by BIS Shrapnel
- Network growth estimated based on forecast augmentation expenditure (stripped of any real price escalation) resulting in a change to network size as a proportion of replacement value of the network
- Industry productivity trend assumed to be zero based on the majority of measures indicating negative industry productivity.

6.8 NSW Licence compliance

With effect from 7th December 2015 TransGrid became subject to the Transmission Operators Licence under the Electricity Supply Act 1995 (NSW) (the Licence) and various conditions from the Foreign Investment Review Board arising from the change in ownership. An audit of TransGrid's compliance with the new licence conditions has identified new interpretations of and requirements for compliance. Whilst the Independent Pricing and Regulatory Tribunal (IPART) is yet to reach a decision in regards to the audit outcome, it is clear that some adjustments to current practices will be required to ensure ongoing compliance.

Given the timing of this Audit and the unexpected nature of its findings, it has not been possible for TransGrid to develop a cost-effective, sustainable solution in time for the revenue proposal. TransGrid raised this issue with the AER as soon as it became known and TransGrid has committed to keep the AER informed as it develops a solution that meets the final requirements of the NSW Government's licence conditions at the lowest possible cost. TransGrid notes that there is most likely to be both capital and operating cost adjustments to the revenue proposal arising from this event.

TransGrid will provide a fully justified cost estimate to address this new understanding of the licence conditions that will ensure compliance at the lowest possible cost for the business and for consumers.

7. Regulatory Asset Base

The regulatory asset base is the value, as calculated in the AER's roll forward model (RFM), of the assets used by TransGrid to provide regulated network services.

This chapter sets out the calculation of the opening regulatory asset base as at 1 July 2018 and the forecast annual regulatory asset base for the upcoming regulatory control period. TransGrid has calculated its opening regulatory asset base (RAB) in accordance with Clause 6A.6.1, Schedule 6A.2 and Schedule 6A.1.3(5) of the Rules.

7.1 Roll forward methodology

The AER's roll forward model has been used to establish the opening RAB as at 1 July 2018.

The opening RAB has been calculated based on forecast depreciation, ie, depreciation is derived from the forecast capital expenditure at the time of the 2014/15 regulatory decision. The RAB is rolled forward based on actual capital expenditure less the depreciation on the forecast capital expenditure approved for the regulatory control period.

The opening RAB for 2014/15, actual and forecast of the net capital expenditure, inflation, WACC and other inputs for 2014/15 to 2017/18 regulatory period are included in the roll forward model submitted together with this proposal.

The AER has proposed to use the forecast depreciation approach to establish TransGrid's RAB at the commencement of the 2023/24 to 2027/28 regulatory control period in its final framework and approach for the 2018/19 to 2022/23 regulatory period revenue reset.

7.2 Roll forward value of the regulatory asset base

Applying the roll forward methodology within the AER's roll forward model (RFM), TransGrid's opening RAB at 1 July 2018 is calculated as $6,405.6 million. This is shown in Table 7.1.

Table 7.1: Roll forward regulatory asset base ($m nominal)

RAB	2014/15 Actual	2015/16 Actual	2016/17 Expected	2017/18 Expected
Opening RAB	6,075.8	6,190.6	6,284.9	6,335.4
Net capital expenditure as incurred	254.6	251.7	204.4	210.0
Straight line depreciation	-244.2	-261.9	-279.7	-266.4
Inflation adjustment	104.4	104.5	125.7	126.7
Closing RAB	6,190.6	6,284.9	6,335.4	6,405.6
Opening RAB 1 July 2018				6,405.6

Source: TransGrid. Totals may not add due to rounding.

7.3 Asset disposals

To establish the opening RAB for a regulatory control period, Schedule 6A.2.1(f)(6) of the National Electricity Rules requires that the previous value of the RAB be reduced by the disposal value of any asset that has been disposed of during the previous regulatory control period.

TransGrid has used the net proceeds approach from the sale of regulatory assets for disposals within the roll forward model for the current regulatory control period, consistent with the 2014/15 to 2017/18 revenue determination. The same approach will be adopted within the post-tax revenue model to forecast asset disposals in the upcoming regulatory control period.

7.4 Regulatory asset base forecast methodology

TransGrid has used the AER's post-tax revenue model (PTRM) to calculate the annual RAB for the upcoming regulatory control period. Commencing from the opening RAB as at 1 July 2018 discussed in Section 3, TransGrid calculates the annual RAB by:

- adding the forecast capital expenditure during financial years from 2018/19 to 2022/23, set out in Chapter 5
- removing forecast asset disposals during financial years from 2018/19 to 2022/23
- removing the depreciation expense based on the rates and methodologies discussed in Chapter 10
- adding forecast inflation.

7.5 Adjustments to Regulatory Asset Base

7.5.1 Network support and control ancillary services

Network Support and Control Ancillary Services (NSCAS) are used to maintain a secure transmission network and maintain or increase its power transfer capability. As the result of a competitive tender process in 2013, AEMO contracted TransGrid to provide up to 800 MVAr of NSCAS from 1 January 2015 to 30 June 2019. The NSCAS service is provided by six shunt reactors and certain line capacity.

The need for the service will continue beyond the end of the contract and accordingly the assets will continue to provide the same network support functions but from 2019/20 they will be provided as a prescribed service under the Rules and included in the RAB on that basis. This change in funding arrangements aligns with TransGrid's responsibilities under the Rules and is supported by AEMO.

The approach taken to bring these non-prescribed assets into the RAB has been discussed with the AER and is similar to the process used in Victoria for "Group 3" assets, where augmentations requested by AEMO are rolled into the RAB. The NSCAS asset value is determined based on the remaining asset value of the installed plant.

The remaining asset value is calculated using the AER's roll forward model.

7.6 Forecast Regulatory Asset Base

TransGrid has applied the methodology used in the post-tax revenue model to calculate the RAB for 2018/19 to 2022/23. The forecast RAB is shown in Table 7.2.

Table 7.2: Forecast regulatory asset base ($m nominal)

RAB	2018/19	2019/20	2020/21	2021/22	2022/23
Opening RAB	6,405.6	6,525.2	6,725.0	6,952.8	7,212.3
Net capital expenditure	228.0	325.3	367.1	405.5	458.7
Straight line depreciation	-261.6	-281.5	-300.0	-312.3	-331.3
Inflation adjustment	153.2	156.0	160.8	166.2	172.4
Closing RAB	6,525.2	6,725.0	6,952.8	7,212.3	7,512.1

Source: TransGrid. Totals may not add due to rounding.

8. Rate of Return

8.1 Introduction

The allowed return on capital is the building block component of the allowed revenue that covers the costs to the business of both debt and equity capital funding. In estimating the allowed return in this proposal, TransGrid has sought to follow the AER's 2013 Rate of Return Guideline. Where the Guideline sets out fixed parameter estimates, TransGrid has adopted them. Where the Guideline sets out estimation methods to be applied at the time of each determination, TransGrid has applied those methods using current data. In summary, TransGrid's approach is as follows:

- The allowed return is estimated as the vanilla weighted-average cost of capital (WACC) – a weighted average of the estimates of the return on equity and the return on debt
- The allowed return on equity is estimated using the Sharpe-Lintner Capital Asset Pricing Model (SL-CAPM). The three parameters of this model are estimated in accordance with the Guideline
- The allowed return on debt is estimated as the yield on Australian 10-year broad BBB-rated corporate bonds in accordance with the estimation methods and transition approach set out in the Guideline and the AER's subsequent decisions
- Gearing (the relative proportion of debt financing) is estimated in accordance with the Guideline.

TransGrid proposes an allowed return (vanilla WACC) of 6.6%, as summarised in the table below. TransGrid notes that the estimates of some parameters will need to be updated closer to the beginning of the next regulatory control period and that the allowed return on debt will be updated at the beginning of each year of the next control period.

Parameter	AER Rate of Return Guideline	TransGrid's approach	Value
Risk-free rate	Estimated at the commencement of each regulatory period as the yield on 10-year CGS averaged over 20-days.	Follows Guideline estimation approach. To be updated at beginning of regulatory period.	2.24%
Equity beta	0.7	Adopts Guideline fixed estimate.	0.7
Market risk premium	Estimated at the commencement of each regulatory period commensurate with the prevailing market conditions. > Greatest[113] consideration to the long-run mean of historical excess returns; > Significant[114] consideration to the AER's DGM estimates. Two-step approach: > Set a range based on the aggregated ranges of its historical excess returns and DGM estimates; and > Use other relevant evidence to select a point estimate from within that range.	Follows Guideline estimation approach.	7.5%
Return on equity			7.49%
Return on debt	Spot return on debt estimated at the commencement of each regulatory year as the mid-point of RBA and Bloomberg estimates of the yield on Australian 10-year broad BBB-rated bonds. AER 10-year transition method applied. Updated at the beginning of each year of the regulatory period.	Follows Guideline estimation approach. Quoted rate is for first year of regulatory period and reflects TransGrid's current transition path. To be updated at beginning of regulatory period.	6.01%
Gearing	60%	Adopts Guideline fixed estimate.	60%
WACC			6.6%

In relation to the return on debt, TransGrid has adopted, in full, the approach set out in the AER's Rate of Return Guideline. TransGrid has taken the mid-point of estimates provided by the Reserve Bank of

[113] AER Rate of Return Guideline, Explanatory Statement, p. 95.
[114] AER Rate of Return Guideline, Explanatory Statement, p. 97.

Australia and Bloomberg for 10-year Australian BBB-rated corporate bonds and has applied the AER's transition from a "rate on the day" approach to the "trailing average" approach.

TransGrid believes that there is a sound economic rationale for the allowed return on debt to be immediately set using the trailing average approach. This is because a trailing average approach is efficient for a Benchmark Efficient Entity (BEE). An immediate adoption of the trailing average allowance would create a match between the allowed return on debt and the efficient cost of debt. An immediate adoption of the trailing average allowance would result in materially higher allowed revenues. Consequently, TransGrid's adoption of the AER's transition approach reduces allowed revenues.

In relation to the return on equity, TransGrid has followed the Rate of Return Guideline in using the Sharpe-Lintner Capital Asset Pricing Model (SL-CAPM) as a foundation model. The estimates of the three SL-CAPM parameters are informed by the same relevant evidence that the AER applied in its Guideline.

TransGrid has adopted a risk-free rate of 2.24%, estimated as the yield on 10-year Commonwealth Government Securities in accordance with the AER's Guideline approach.[115]

TransGrid has adopted an equity beta of 0.7, consistent with the fixed estimate adopted in the AER's Guideline. TransGrid considers that figure to be conservatively low. More recent evidence indicates an increase in statistical beta estimates, the AER's estimate does not fully correct for the low-beta bias that has been documented for the SL-CAPM, nor does it consider unregulated infrastructure firms that operate in competitive markets.

TransGrid has adopted a market risk premium (MRP) of 7.5% by applying the AER's Guideline approach to the current market evidence. The AER's Guideline approach is to construct a range of the MRP from a combination of estimates from two methods, historical excess returns and the dividend growth model (DGM), and then to use a range of relevant evidence to select a point estimate from within that combined range. TransGrid has followed the same approach using the AER's own excess returns and DGM estimates. TransGrid notes that since the 2013 Guideline, the excess returns estimate has remained largely the same whereas the AER's DGM estimates have increased materially. This leads to an MRP of 7.5% for the prevailing market conditions. This is higher than the 6.5% estimate that the AER adopted for the financial market conditions in 2013. This higher MRP is commensurate with the change in market evidence over the ensuing period, and the application of the AER's Guideline approach to the more recent evidence.

In summary, TransGrid's proposed return on equity is based on:

- A risk-free rate of 2.24%
- An equity beta of 0.7
- A market risk premium of 7.5%.

This produces a return on equity estimate of 7.5%[116].

The table below shows that the current proposal is materially lower than the AER's transitional decision, which was made immediately after its Rate of Return Guideline was published. Immediate application of the Guideline by the AER produced a return on equity allowance of 8.9%, whereas TransGrid is

[115] This will be updated to reflect an averaging period close to the commencement of the next regulatory control period, in accordance with the Rate of Return Guideline.

[116] 2.24%+0.7×7.5%=7.5%. This estimate will be revised to reflect data over the specified averaging period prior to the commencement of the next regulatory control period

currently proposing an allowance of 7.5%. That is, the proposed increase in the MRP estimate only partially offsets the decline in the risk-free rate that has occurred since the Guideline.

AER decision 2009-14	AER transitional decision 2014-15	TransGrid's revised proposal for 2014/15 to 2017/18	AER final decision 2014/15 to 2017/18	TransGrid's proposal for 2018/19 to 2022/23
11.86%	8.90%	9.75%	7.1%	7.5%

Source: TransGrid and AER

8.2 Regulatory framework

8.2.1 Legislative basis

One of the building block components of the annual revenue requirement is the allowed return on capital. Electricity transmission businesses are capital intensive businesses that require significant capital investment. In order to:

- attract and keep the necessary amounts of capital investment
- ensure that consumers pay prices that are fair and reasonable.

it is essential that investors receive a return that is appropriately commensurate with the risk involved. Setting the allowed return too low will create a disincentive for investment and encourage inefficient over-consumption, whereas setting the allowed return too high will create an incentive for inefficient (unnecessary) investment and will act as a disincentive to efficient levels of consumption.

In this regard, the National Electricity Law (NEL) defines the National Electricity Objective (NEO) as follows:

- The objective of this Law is to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to:
  - price, quality, safety, reliability and security of supply of electricity
  - the reliability, safety and security of the national electricity system.[117]

The NEL also sets out a number of Revenue and Pricing Principles (RPP) including:

- A regulated network service provider should be provided with a reasonable opportunity to recover at least the efficient costs the operator incurs in providing direct control network services.
- A regulated network service provider should be provided with effective incentives in order to promote economic efficiency with respect to direct control network services the operator provides.
- A price or charge for the provision of a direct control network service should allow for a return commensurate with the regulatory and commercial risks involved in providing the direct control network service to which that price or charge relates.[118]

The RPP also specifically refer to the need to set an appropriate allowed return so as not to create incentives for under- or over-investment or under- or over-consumption:

[117] NEL, s 7.
[118] NEL, s 7A(2), (3), (5).

> Regard should be had to the economic costs and risks of the potential for under and over investment by a regulated network service provider in, as the case requires, a distribution system or transmission system with which the operator provides direct control network services.

> Regard should be had to the economic costs and risks of the potential for under and over utilisation of a distribution system or transmission system with which a regulated network service provider provides direct control network services.[119]

Sitting below the NEL are the National Electricity Rules (Rules), which state that the allowed rate of return must be set to be commensurate with the efficient financing costs of a benchmark efficient entity. The Rules define this requirement to be the "allowed rate of return objective" (ARORO):

> The allowed rate of return objective is that the rate of return for a *Transmission Network Service Provider* is to be commensurate with the efficient financing costs of a benchmark efficient entity with a similar degree of risk as that which applies to the *Transmission Network Service Provider* in respect of the provision of prescribed transmission services.[120]

The Rules also requires that regard must be had to a broad range of evidence:

> In determining the allowed rate of return, regard must be had to relevant estimation methods, financial models, market data and other evidence.[121]

In summary, the NEL and Rules provide three main principles to guide the determination of the allowed rate of return:

> The allowed rate of return must be set to provide investors with a fair return. Setting the allowed return materially above or below the return that would be required by investors in the market is likely to create incentives for inefficient levels of investment and consumption. Setting a fair return for investors, and consequently providing a fair price for consumers, is consistent with the RPP and the ARORO, and is ultimately in the long-run interest of consumers.

> The allowed rate of return must be determined with reference to a benchmark efficient entity. That is, the allowed return must be sufficient to provide what investors would require from a comparable firm that is being financed, managed and operated efficiently. For example, the fact that a particular firm might be financed or managed or operated differently from the efficient benchmark is irrelevant to the determination of the allowed return for that firm.

> When determining the allowed rate of return, proper regard must be given to all relevant evidence.

TransGrid considers that an allowed rate of return that is consistent with these principles satisfies the legislative requirements, provides investors with a reasonable return on capital and customers with reasonable prices, creates the appropriate incentives for investment and consumption, and is therefore consistent with the long-term interests of consumers. Consequently, TransGrid considers that the proposed rate of return, guided by these three main principles, is materially preferable to any alternative estimate.

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[119] NEL, s 7A(6), (7).

[120] NER 6A.6.2(c). Rules 6A.6.2(b) requires that the allowed rate of return is to be determined so that it achieves the allowed rate of return objective.

[121] NER 6A.6.2(e)(1).

8.2.2 WACC definition

The Rules recognise that there are two forms of investment capital – debt capital whereby investors lend funds with the expectation of future repayment, and equity capital whereby investors take an ownership interest in the firm. The Rules contemplate that the different sources of capital are likely to have different levels of risk and therefore require different levels of return. The Rules specify that:

> …the allowed rate of return for a regulatory year must be:
>
> (i) a weighted average of the return on equity for the regulatory control period in which that regulatory year occurs…and the return on debt for that regulatory year…; and
>
> (ii) determined on a nominal vanilla basis…[122]

In summary, the Rules require that the allowed rate of return must be estimated as a weighted average of the return that would be required by the providers of equity capital and the return that would be required by the providers of debt capital. This average required return is known as the weighted-average cost of capital (WACC).

Whereas there are different ways to define the WACC, the Rules require that a nominal vanilla WACC must be determined, the formula for which is:

$$WACC = r_e \frac{E}{V} + r_d \frac{D}{V}$$

where:

- r_e represents the required return on equity capital;
- r_d represents the required return on debt capital; and
- $\frac{E}{V}$ and $\frac{D}{V}$ represent the relative proportions of the firm's assets that are financed by equity and debt, respectively, where $\frac{E}{V} + \frac{D}{V} = 1.$ The proportion of debt financing is also known as "gearing" or "leverage".

In summary, estimating the WACC, and consequently the allowed rate of return on capital, requires estimates of gearing, the required return on equity capital and the required return on debt capital.[123]

8.3 Return on equity

8.3.1 Estimation approach

The return that investors would require to commit equity capital to a particular firm is not something that cannot be observed or looked up; it must be estimated. A number of economic models have been developed for the purpose of estimating the required return on equity. This section reviews the relevant financial models and provides the relevant background and context.

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[122] Rules 6A.6.2(d).

[123] In practice, some stakeholders may use a different specification of WACC that reflects the tax deductibility of interest payments by applying a factor of (1-*T*) to the return on debt, where *T* represents the corporate tax rate. This makes no difference to the calculation of allowed revenues, it is simply a case of reporting the WACC in different units. The vanilla WACC of 6.60% corresponds to a 'classical' WACC of 5.52%.

Prior to the 2012 revisions, the Rules required regulators to estimate the return on equity using the Capital Asset Pricing Model (CAPM). The CAPM is a function of three parameters:

$$r_e = r_f + \beta \times MRP$$

where:

- r_e represents the required return on equity
- r_f represents the risk-free rate of return. This is the return that is available to investors on an investment that is completely free of risk. Commonwealth government bonds are usually assumed to be such a risk-free investment
- MRP represents the market risk premium, which is the amount of extra return (over and above the return on a risk-free asset) that investors would require for investing in an asset with an average amount of risk
- β represents the equity beta, which indicates the extent to which the particular investment has more or less risk than the average investment. For example, an equity beta of 1.2 indicates that the investment is 20% more risky than average, in which case it would require a risk premium that is 20% more than would be required for an investment of average risk.

Thus, under the previous Rules, the regulatory task was to estimate each of the three parameters and insert them into the CAPM formula.

In November 2012, the Australian Energy Markets Commission (AEMC) revised the Rules to require that regard must be given to "relevant estimation methods, financial models, market data and other evidence."[124]

In its Final Determination Guidance, the AEMC sought to address concerns that, despite its best efforts in making material changes to the Rules, the regulator would seek to continue to estimate the required return on equity via a mechanistic implementation of the CAPM, as was the approach under the previous Rules. The AEMC sought to assuage these concerns, but indicated that it would not set out a list of what other information and models the regulator should consider, or the manner in which such information should be considered, due to the risk that any such list or instructions itself would themselves be applied in a mechanistic fashion:

> A major concern expressed in numerous submissions is that under the proposed changes the regulator would still be able to, in effect, make exclusive use of the CAPM when estimating a rate of return on equity. The Commission understands this concern is potentially of considerable importance given its intention is to ensure that the regulator takes relevant estimation methods, models, market data and other evidence into account when estimating the required rate of return on equity. As discussed above, the Commission takes the view that the balance between flexibility and prescription has been adequately achieved in the final rules. It would be counterproductive to attempt to prescribe a list of models and evidence, which would almost certainly be non-exhaustive and could lead to rigid adherence to them in a mechanistic fashion.[125]

[124] NER6A.6.2(e)(1).

[125] AEMC, 2012, Rule Change Final Determination, p. 57.

Electricity transmission and distribution businesses coordinated their response through the Energy Networks Association (ENA) and submitted that regard should be given not only to the CAPM but also to three other financial models – an approach that became known as the "multi-model approach."

The ENA noted that, in the conditions in the equity market at the time, the Sharpe-Lintner CAPM produced a materially lower estimate of the required return on equity than any of the other relevant financial models.[126]

In its 2013 Rate of Return Guideline, the AER stated that its approach to estimating the required return on equity would be to use the SL-CAPM as a "foundation model" and then to use other relevant financial models to inform the parameters of that single foundation model.[127]

In every one of its decisions since the Rate of Return Guideline, the AER has estimated only the SL-CAPM. The AER's approach has been to estimate the three parameters of the SL-CAPM, insert them into the SL-CAPM formula, and then to adopt the output from that formula without further modification.

TransGrid considers that the other financial models that were analysed throughout the AER's Guideline process fall into the class of "relevant estimation methods, financial models, market data and other evidence" and consequently regard must be given to them. TransGrid's view is that it is difficult to have proper regard to these models without estimating them, and note that the estimates of these other models have been shown to produce materially higher estimates than those produced by the SL-CAPM. However, TransGrid also notes that:

- The Australian Competition Tribunal (Tribunal) did not find error in the AER's foundation model approach to the estimation of the required return on equity[128]
- A number of consumer groups have expressed a preference for using the SL-CAPM as a single foundation model.[129]

Consequently, TransGrid has followed the AER's SL-CAPM foundation model approach to estimate the required return on equity. TransGrid notes that, because this approach produces estimates that are, in the current financial market conditions, lower than the estimates from the other relevant financial models, it produces lower estimates of required revenues.

8.3.2 Risk-free rate

In its 2013 Rate of Return Guideline, the AER stated that its approach to the risk-free rate would be to take a 20-day average of the yield on 10-year nominal Commonwealth Government Securities, observed as close as practically possible to the commencement of the regulatory control period.[130]

In all of its decisions since the Guideline, the AER has adopted a consistent approach to interpolating between different CGS series and of annualising the resulting estimates.

TransGrid considers that the AER's approach to estimating the risk-free rate is appropriate and has adopted that approach without modification.

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[126] Energy Networks Association, 2013, "Response to AER Rate of Return Guideline Consultation Paper," 28 June, Table 2, p. 76. [TransGrid-ENA-Response to AER Rate of Return Guideline Consultation Paper-0613-PUBLIC]

[127] AER, 2013, Rate of Return Guideline, Table 5.1, p. 13.

[128] Applications by Public Interest Advocacy Centre Ltd and Ausgrid [2016] Australian Competition Tribunal 1, Paragraph 772. [TransGrid-ACompT-Applications by Public Interest Advocacy Centre Ltd and Ausgrid-0216-PUBLIC]

[129] AER, 2013, Rate of Return Guideline, Explanatory Statement, p. 68.

[130] AER 2013 Rate of Return Guideline, p. 15.

The application of that approach to a sample averaging period ending on 31 October 2016 produces an estimate of 2.24%, which is adopted throughout this submission. This estimate will be updated at a time close to the commencement of the next regulatory control period in accordance with the Rate of Return Guideline.

8.3.3 Equity beta

The equity beta represents the systematic risk of the benchmark efficient entity relative to the average firm. A firm with average risk has an equity beta of 1.0 and requires an average return premium to compensate investors for that risk. A firm with an equity beta less than 1.0 has below average risk and therefore would require a lower return premium to compensate investors.

TransGrid considers that the equity beta should be estimated on the basis that the BEE is a hypothetical efficient competitor in a competitive market, in accordance with the Tribunal's *PIAC-Ausgrid* decision.[131] The evidence summarised below suggests that the AER's Guideline estimate, which is based on an analysis of regulated firms, is a downwardly biased estimate of the beta for a BEE as defined by the Tribunal. Consequently, TransGrid's adoption of the AER's Guideline estimate reduces allowed revenues.

8.3.3.1 The AER Guideline approach to estimating beta

In its 2013 Rate of Return Guideline, the AER adopted a two-stage approach to the estimation of equity beta. In the first stage, the AER set a "primary range" of 0.4 to 0.7 for the equity beta of the BEE.[132] This primary range is based on a set of domestic comparators for a regulated energy network business.

In the second stage, the AER used all other evidence that it considered relevant to select a point estimate from within the primary range. This led the AER to adopt a point estimate of 0.7, which it has maintained in every subsequent decision.

In Appendix Q: An equity beta estimate for the benchmark efficient entity, Frontier Economics[133] notes that, in its decisions since the Guideline, the AER has explained that:

a. It considers the "best empirical estimate" of beta to be 0.5[134]
b. The allowed beta is to be set to 0.7 due to three "additional considerations":
    i. "International estimates"[135] – the weight of evidence from international comparators supports a beta estimate materially above the AER's domestic starting point estimate of 0.5
    ii. "Considerations of the Black CAPM"[136] – there is consistent empirical evidence to support the proposition that the SL-CAPM systematically understates the required return on low-beta stocks
    iii. "Investor certainty"[137] – instability in equity beta allowances may cause investors to increase their assessment of regulatory risk.

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131 Applications by Public Interest Advocacy Centre Ltd and Ausgrid [2016] Australian Competition Tribunal 1, Paragraph 914.

132 AER Rate of Return Guideline, p. 15.

133 Frontier Economics, 2017, "An equity beta estimate for the benchmark efficient entity." [TransGrid-Frontier Economics-Appendix Q An equity beta estimate for the benchmark efficient entity-0117-PUBLIC]

134 Ausgrid Final Decision, Attachment 3, p. 3-129.

135 JEN Final Decision, Attachment 3, p. 64.

136 JEN Final Decision, Attachment 3, p. 64.

137 JEN Final Decision, Attachment 3, p. 64.

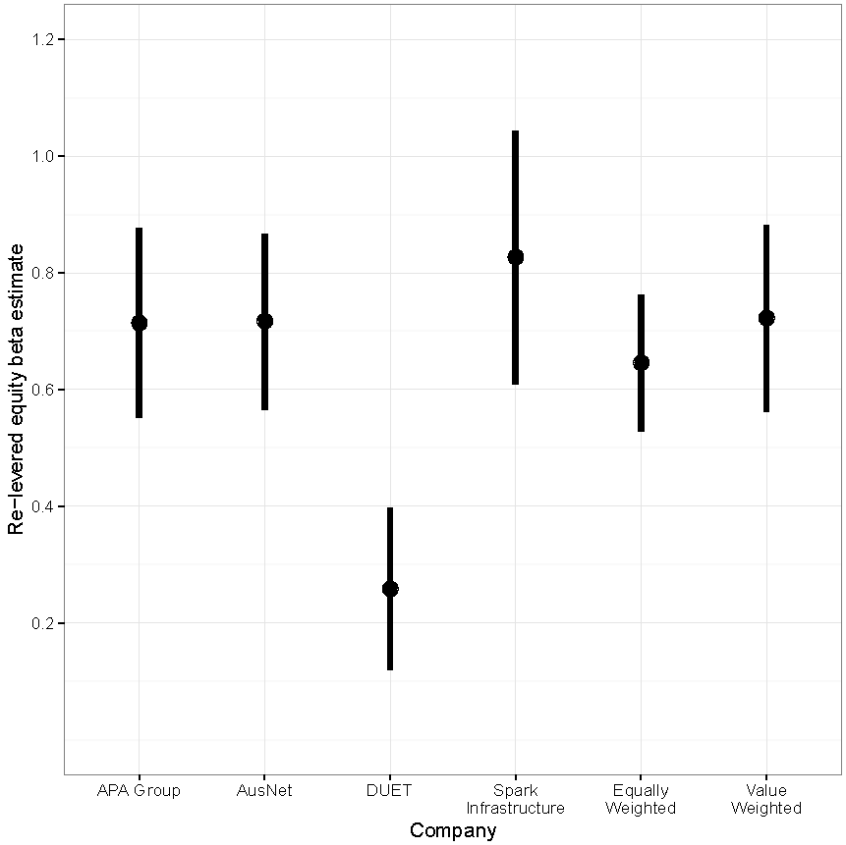
Thus, the AER's approach is to begin with its "best empirical estimate" of 0.5 from domestic comparators, and then apply an uplift to 0.7 on the basis of a number of other considerations.

8.3.3.2 Updated estimates

The Frontier Economics report notes that approximately three years have elapsed since the analysis that was performed at the time of the AER's Guideline, providing approximately 150 more recent weekly returns observations, and that the updated evidence supports an increase in the statistical beta estimates.

The Frontier Economics report applies the same empirical estimation methodology that the AER employed at the time of its Guideline, updated to include the most recent data. Four domestic comparators remain for the first stage estimation of a starting point beta: APA Group, AusNet Services, DUET and Spark Infrastructure. Frontier Economics follows the AER's approach by estimating betas for each individual firm and for equally-weighted and value-weighted portfolios. The point estimates and statistical confidence intervals for the most recent 5-year period are set out in **Figure 8.1**. The re-levered equity beta estimates for three of the four firms are in the order of 0.7 to 0.8, with the DUET estimate appearing to be an outlier in the sense that it is materially below the other three estimates. The mean estimate over the four firms is 0.63, and if DUET is excluded the mean rises to 0.75. The portfolio estimates (which include DUET) are 0.65 and 0.72, respectively. These figures are all materially higher than the 0.5 starting point estimate that was used when setting the current beta allowance of 0.7.

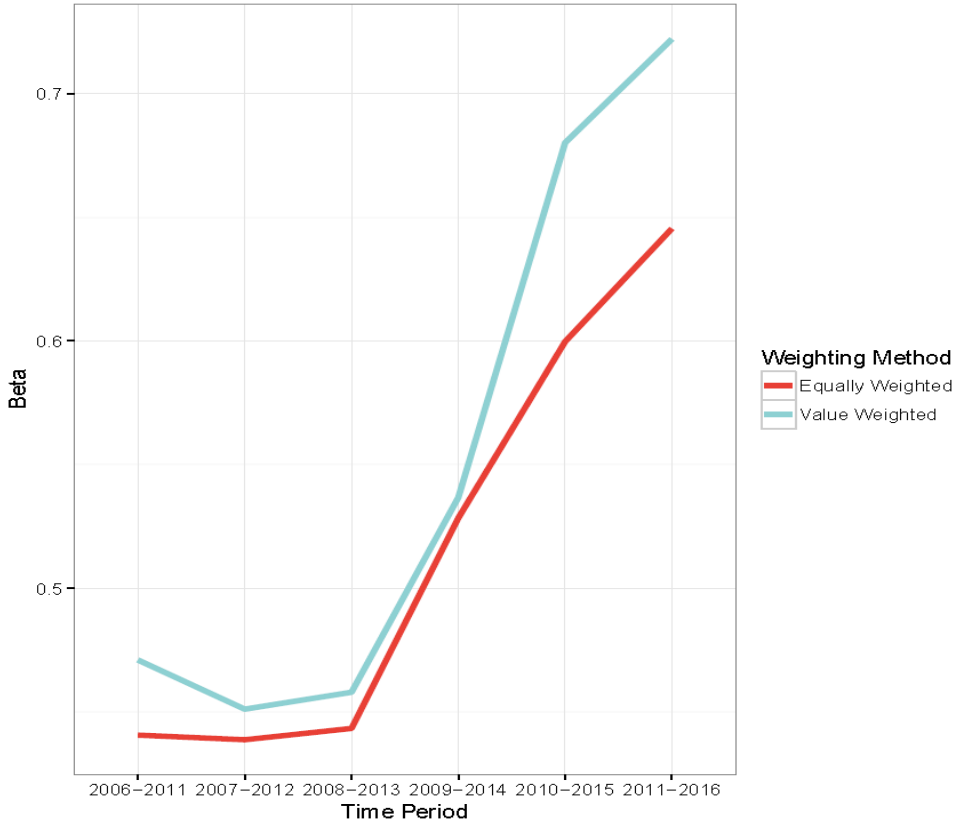
Figure 8.1: 95% confidence intervals for weekly beta estimates over the last 5 years



Source: Frontier Economics, 2016, "An equity beta estimate for the benchmark efficient entity."

The Frontier Economics report also shows rolling 5-year equity beta estimates for the two portfolios of domestic network businesses, as set out in Figure 8.2 below. Clearly, the estimates have increased materially since the AER's 2013 Guideline analysis.

Figure 8.2: Rolling 5-year portfolio estimates of beta



Source: Frontier Economics, 2016, "An equity beta estimate for the benchmark efficient entity."

8.3.3.3 Recent analysis by the ERA

The Frontier Economics report also notes that the Economic Regulation Authority of Western Australia (ERA) has recently updated its equity beta estimates for the BEE and concluded that the latest available data supports a best statistical beta estimate of 0.7 – a material increase on the AER's 2013 best statistical estimate of 0.5.

That is, the ERA has concluded that equity beta estimates based on current data for domestic regulated network comparators are materially higher than the estimates at the time of the 2013 Guidelines.

For a recent decision, the ERA updated its beta estimates for domestic comparators and concluded that:

> …the Authority considers that a 95 per cent confidence interval range of equity beta using the most recent data is from 0.479 and 0.870 based on the portfolio results (see Appendix 4A, Table 21 and Table 22). The central estimate given by the average of the portfolios is 0.699. The Authority notes that portfolio estimates have a narrower range than the individual assets.
>
> Based on its own analysis and the other evidence before it, together with the recognition that estimates of equity beta from empirical studies exhibit a high level of imprecision, the Authority is of

> the view that the point estimate of equity beta of 0.7 (rounded) provides a conservative and appropriate central best estimate for beta for use in the SL-CAPM.[138]

8.3.3.4 Estimates from other infrastructure firms

In Appendix Q: An equity beta estimate for the benchmark efficient entity, Frontier Economics also note that in its February 2016 *PIAC-Ausgrid* decision, the Tribunal considered the definition of the BEE and concluded that the BEE should be considered to be a hypothetical unregulated competitor:

> The BEE, in the view of the Tribunal, is likely to refer to the hypothetical efficient competitor in a competitive market for those services. Such a BEE is not a regulated competitor, because the regulation is imposed as a proxy for the hypothetical unregulated competitor. Otherwise, the starting point would be a regulated competitor in a hypothetically regulated market. That would not be consistent with the policy underlying the purpose of the NEL and the NGL in relation to the fixing of terms on which monopoly providers may operate.[139]

In reaching this conclusion, the Tribunal cited a determination of the Australian Energy Markets Commission (AEMC) which set out the objective of regulation as being:

> …to reproduce, to the extent possible, the production and pricing outcomes that would occur in a workably competitive market in circumstances where the development of a competitive market is not economically feasible.[140]

Frontier Economics computes beta estimates for a set of firms that are comparable to an energy network business, but which operate in workably competitive markets. They selected a set of firms that demonstrate the characteristics of:

a. Ownership of very long-lived, tangible, infrastructure assets
b. Capital intensive businesses
c. Provision of an access service to customers that provides a relatively stable series of cash flows
d. Listed on the ASX.

In relation to beta estimates for these unregulated infrastructure firms, Frontier Economics conclude as follows:

> The conclusion from this analysis of unregulated infrastructure firms is that the re-levered equity beta estimates are all materially above the AER's current starting-point "best statistical" equity beta estimate. This, evidence suggests that an equity beta of 0.7 is conservatively low.[141]

8.3.3.5 Uplift for low-beta bias

One of the factors that the AER considers in selecting a final point estimate for the equity beta is the "Black CAPM" evidence of low-beta bias.[142] This is a reference to the consistent empirical evidence which indicates that the SL-CAPM systematically understates the returns on stocks with a beta less

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[138] ERA, 2016, DBP Final Decision, Attachment 4, Paragraphs 473-474.
[139] Applications by Public Interest Advocacy Centre Ltd and Ausgrid [2016] Australian Competition Tribunal 1, Paragraph 914.
[140] Applications by Public Interest Advocacy Centre Ltd and Ausgrid [2016] Australian Competition Tribunal 1, Paragraph 80.
[141] Frontier Economics, 2016, "An equity beta estimate for the benchmark efficient entity," p. 25.
[142] JEN Final Decision, Attachment 3, p. 64.

than 1.0, and the evolution of the CAPM to correct for that bias. However, rather than estimate later generation CAPMs, the AER's Guideline approach is to modify the SL-CAPM by adjusting the equity beta estimate.

In Appendix R: Low-beta bias, Frontier Economics summarises the implications of the empirical evidence on low-beta bias as follows:

> The evidence set out above suggests that the actual relationship between beta and stock returns has a flatter slope than the SL-CAPM predicts. The result of this is that the SL-CAPM systematically underestimates the required return on low-beta stocks (ie, those with a beta estimate less than 1).[143]

Frontier Economics note that a financial model known as "the Black CAPM" was specifically developed to correct for low-beta bias and produces estimates of the required return on equity that are more consistent with the observed empirical relationship between beta and returns. However, the AER's approach is to make no estimate of the Black CAPM, but rather to account for the empirical evidence of low-beta bias by making an adjustment to the equity beta that is used in the SL-CAPM. Frontier Economics concludes that:

> In summary, there are two ways to correct for the low beta bias in this case:
>
> – Estimate the parameters of the Black CAPM and insert those parameters into the Black CAPM formula; or
>
> – Continue to use the SL-CAPM formula, but use an increased beta estimate that is calibrated to offset the bias that arises from applying the SL-CAPM to low-beta stocks.
>
> If the adjustment to the beta estimate under the second approach is consistent with the estimate of the zero-beta premium that is required for the first approach, the estimates of the required return on equity will be the same under both approaches.[144]

The issue of low-beta bias, and the AER's approach to correcting for it, were considered by the Tribunal in the recent *PIAC-Ausgrid* case. The Tribunal determined that there was no error in either recognising the existence of low-beta bias or in correcting for it by making an adjustment to beta in the SL-CAPM, as the AER has done.

In Appendix R: Low-beta bias, Frontier Economics also considered the magnitude of low-beta bias, concluding that:

> The majority of the estimates set out above imply a zero-beta premium [the additional return, over and above the SL-CAPM forecast, for an asset with a beta of zero] between 2% and 4% and we consider that range to be a reasonable characterisation of the available data.[145]

This range is slightly above the 1.5% to 3% range that the AER considered in its Rate of Return Guideline.[146]

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[143] Frontier Economics, 2016, "Low beta bias," section 2.4. [TransGrid-Frontier Economics-Appendix R Low_beta Bias-0117-PUBLIC]

[144] Frontier Economics, 2016, "Low beta bias," section 4.

[145] Frontier Economics, 2016, "Low beta bias," section 6.

[146] The AER did not conduct an empirical estimation exercise, but concluded that its proposed range was "reasonable" and "open to us." AER Rate of Return Guideline, Explanatory Statement, Appendix C, p. 71.

Frontier Economics concludes that the AER's uplift of 0.2 (from a best statistical estimate of 0.5 to an allowance of 0.7) is insufficient to fully correct for the empirically observed low-beta bias.

8.3.3.6 Conclusions and submission on equity beta

TransGrid has considered the AER's approach to equity beta in the context of the updated empirical evidence set out in Appendix Q: An equity beta estimate for the benchmark efficient entity. TransGrid notes that there is a range of evidence to support an increase in the equity beta from the current allowance of 0.7:

- Equity beta estimates using updated data support an increase in the starting point beta estimate. The ERA(WA) has performed the same analysis and reached the same conclusion
- Equity beta estimates for other infrastructure firms support a higher starting point estimate,[147]
- An uplift of more than 0.2 would be required to fully correct for low-beta bias.

The current evidence suggests that the starting point equity beta estimate should be at least as high as the 0.5 estimate adopted in the AER's Guideline and the uplift to correct for low-beta bias (and other relevant considerations) should be at least 0.2. This evidence supports an equity beta estimate above 0.7. However, TransGrid has adopted the AER's Guideline equity beta of 0.7. For the reasons set out above TransGrid considers this estimate to be conservatively low, and notes that the adoption of a lower beta estimate reduces allowed revenues.

8.3.4 Market Risk premium

8.3.4.1 Background

The market risk premium represents the additional return, over and above the risk-free rate, that is required to compensate investors for the risk of an average investment.

The MRP varies over time as investors re-assess the amount of risk involved in holding risky assets and as they adjust the amount of return that they require for bearing risk. Both of these components vary over different market conditions. The regulatory task is to adopt a forward-looking estimate of the MRP that is commensurate with the prevailing conditions in the market for equity funds.

Two primary methods are used for estimating the MRP:

- The historical excess returns approach. The excess return in each year is the return on a broad stock market index for that year less the return that could have been earned on risk-free government bonds in that year. Excess returns can be compiled for a long historical period (dating back as far as 1883). The mean excess return over a long historical period can be used as an estimate of the average MRP over that period.
- The dividend growth model approach. This approach involves forecasting the future dividends on the broad stock market index and solving for the discount rate that equates the present value of those dividends with the current value of the stock index. This procedure produces an estimate of the total required return on the market. Subtracting the risk-free rate produces a contemporaneous forward-looking estimate of the MRP.[148]

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[147] Indeed, if the BEE is defined as an unregulated entity operating in a competitive market, estimates from these unregulated infrastructure firms would receive more weight than the estimates from regulated firms.

[148] The AER publishes estimates for two-stage and three-stage versions of its DGM. In both cases, the estimates of the dividend growth rate are taken from analyst forecasts for the first two years. The two-stage DGM applies a long-run growth rate from year 3 whereas the three-stage DGM applies a long-run growth rate from year 10, with linear interpolation between years 2 and 10. For both variants of the model, the AER reports results for three different long-run growth rates, thus producing a range of estimates.

8.3.4.2 The AER Guideline approach to estimating the MRP

The AER's Rate of Return Guideline establishes an approach that will be used to estimate the MRP at the time of each determination – it does not set out any particular fixed estimate of the MRP.[149] That is, in relation to the MRP, the Guideline's approach is more akin to the risk-free rate (for which an estimation process is set out) than the equity beta (for which a specific estimate was set out).

In response to a request from stakeholders, the AER provided a worked example of the application of its MRP estimation approach to the evidence as at December 2013. In this regard, the AER stated that:

> …many stakeholders requested that we provide additional guidance and examples on the approach we are intending to apply. Therefore, in this explanatory statement to our final guideline we have included a worked example to show how we would apply the material available to inform the MRP in December 2013…This example is provided as a guide only. We intend to consider and review a range of material on the MRP, as it becomes available. We will draw on this material and will consider more up to date information when determining the MRP at each determination.[150]

The approach to estimating the MRP that is set out in the AER's Rate of Return Guideline is to give:

- Greatest[151] consideration to the long-run mean of historical excess returns
- Significant[152] consideration to the AER's DGM estimates
- Some[153] or limited[154] consideration to other evidence including surveys, independent expert reports, conditioning variables, and other regulators' allowances.

The Guideline approach to setting the MRP allowance involves two steps:

1. Set a range based on the aggregated ranges of the historical excess returns and DGM estimates
2. Use other relevant evidence to select a point estimate from within that range.

In its application of the Guideline to the evidence as at December 2013, the AER set the allowed MRP to 6.5% on the basis that:

> This point estimate lies between the historical average range and the range of estimates produced by the DGM. This reflects our consideration of the strengths and limitations of each source of evidence.[155]

8.3.4.3 The relevance of the prevailing conditions in the market for equity funds and the importance of forward-looking DGM estimates

The Rules require that, when estimating the return on equity, regard must be had to the prevailing conditions in the market for equity funds.[156]

The historical excess returns approach estimates the MRP by taking the mean excess return over a long historical period. Self-evidently, this estimate must reflect the average market conditions over the

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[149] AER Rate of Return Guideline, p. 16.
[150] AER (2013), Rate of Return Guideline: Explanatory Statement, p. 89.
[151] AER Rate of Return Guideline, Explanatory Statement, p. 95.
[152] AER Rate of Return Guideline, Explanatory Statement, p. 97.
[153] AER Rate of Return Guideline, Explanatory Statement, p. 97.
[154] AER Rate of Return Guideline, Explanatory Statement, p. 97.
[155] AER Rate of Return Guideline, Explanatory Statement, p. 97.
[156] NER 6.5.2(g).

historical period that was used. Logically, this approach can only produce a forward-looking estimate that is commensurate with the prevailing conditions in the market in two circumstances:

- Investors always require the same MRP in all market conditions; or
- The current market conditions are the same as the average market conditions over the historical period.[157]

However, neither of these conditions is likely to hold. The AER has stated that it does not consider that the MRP is the same in all market conditions, and the current conditions are quite unlike the average historical conditions in that the current government bond yield (to which the MRP is added to produce the allowed return on equity) is at historical lows.

By contrast, there is broad agreement that the DGM method does produce a forward-looking MRP that is commensurate with the prevailing conditions in the market for equity funds. The AER has stated that:

> …we consider DGM estimates have strong theoretical grounding and are more likely to reflect prevailing market conditions than other approaches.[158]

Indeed, the AER itself distinguishes between its historical MRP estimates on the one hand and its forward-looking DGM estimates on the other:

> …we used results from both forward looking methods and historical averaging of excess returns for estimating the MRP and the results from forward looking methods unambiguously constitute estimates of the prevailing rather than the long-term average value for the MRP.[159]

The AER has concluded that the only reason that there is any need to rely on mean historical excess return estimates is due to concerns about relying exclusively on the forward-looking DGM estimate:

> If a perfectly reliable estimate of the MRP could be generated from market prices it would be reasonable to use this estimate. However, no such estimate exists.[160]

8.3.4.4 The evolution of the AER's evidence

In Appendix S: The market risk premium, Frontier Economics summarise the evolution of the AER's primary MRP estimates and the AER's MRP allowance as in Figure 8.3.

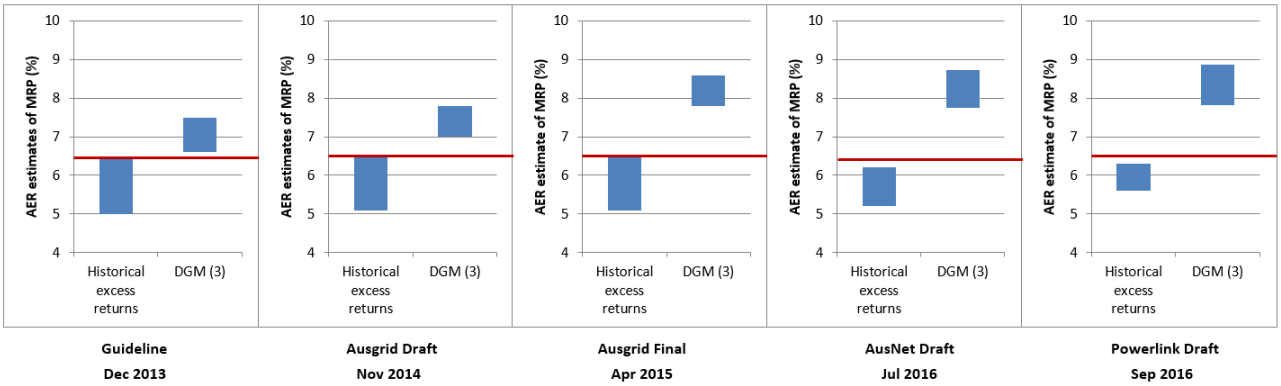
[157] The point we are making here is that one of these two conditions must hold for the historical mean estimate to also be a forward-looking estimate that is commensurate with the prevailing conditions. A different argument is that the historical mean estimate might still be given some weight, even though it is not a forward-looking estimate, because the forward-looking estimates that are available are not sufficiently reliable to be relied on exclusively.

[158] AER (2013), Rate of Return Guideline: Explanatory Statement, Appendices, p. 85.

[159] AER (2013), Rate of Return Guideline: Explanatory Statement, Appendices, p. 103.

[160] AER (2013), Rate of Return Guideline: Explanatory Statement, Appendices, p. 110.

Figure 8.3: The AER's primary MRP estimates



Source: Rate of Return Guideline December 2013; Ausgrid Draft Decision November 2014; Ausgrid Final Decision April 2015; AusNet Draft Decision July 2016; Powerlink Draft Decision September 2016.

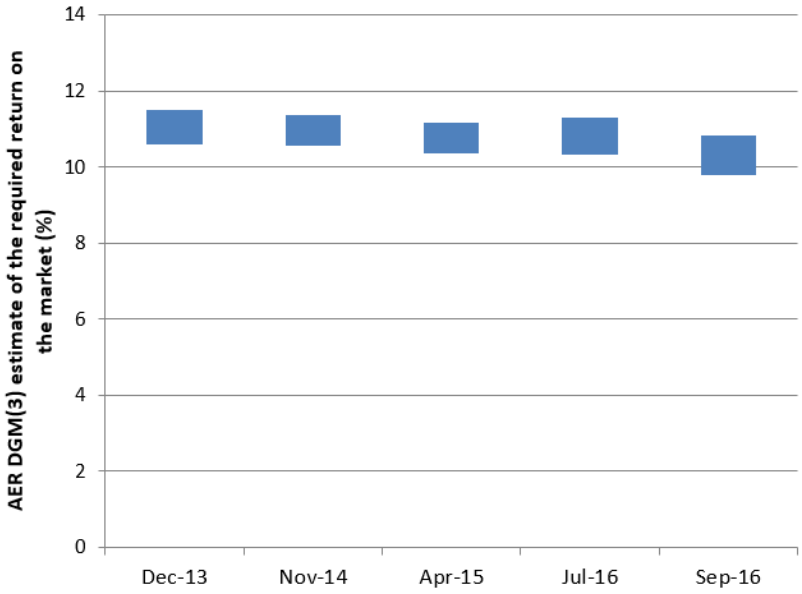
By construction, the historical excess returns estimate is effectively constant over time and is independent of the prevailing conditions in the market. Note that the 2016 changes in the AER's historical excess returns estimates are due to a change in the way the AER summarises the data into a range rather than a change in the data itself.

However, the AER's DGM estimates of the MRP have increased materially since the Guideline and are currently higher than at any time since the Guideline. Although the AER has recently stated that there is no reason to decrease the weight applied to its DGM evidence,[161] the allowed MRP has remained fixed at 6.5%, even as the DGM evidence has become more and more inconsistent with that figure.

Frontier Economics notes that the reason for the increase in the AER's DGM estimate of the MRP is that the evidence suggests that the overall required return on equity has remained remarkably stable since the Guideline, even as government bond yields have fallen sharply. This is illustrated in Figure 8.4.

[161] AusNet Draft Decision, Attachment 3, p. 207.

Figure 8.4: AER three-stage DGM estimates of the required return on the market



Source: Rate of Return Guideline December 2013; Ausgrid Draft Decision November 2014; Ausgrid Final Decision April 2015; AusNet Draft Decision July 2016; Powerlink Draft Decision September 2016.

8.3.4.5 The reduction in weight applied to the DGM evidence

The AER's DGM estimates of the MRP have increased substantially because:

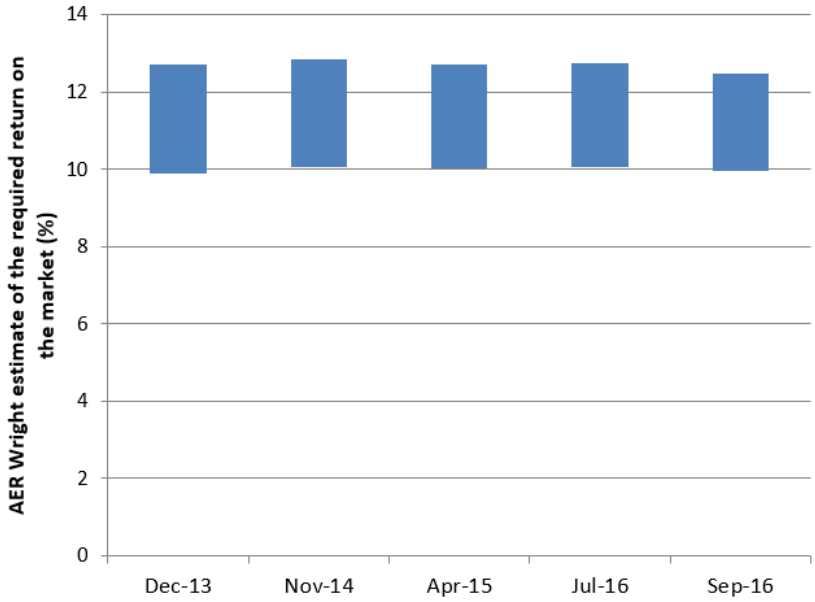
- As shown in Figure 8.4, the DGM approach estimates that the forward-looking required return on the market has remained stable since the Guideline
- Government bond yields have fallen materially since the Guideline
- The MRP is estimated by subtracting the government bond yield from the forward-looking estimate of the required return on equity.

The AER has maintained the same MRP allowance even as its DGM estimates have increased materially. It appears that the AER has reduced the relative weight that it applies to its own DGM estimates as they have become increasingly inconsistent with its 6.5% allowance. TransGrid believes this approach is inconsistent with the intent of the guidelines.

8.3.4.6 Other evidence considered by the AER

The AER also reports that its Wright estimates of the required return on the market have remained stable since the Guideline, as summarised in Figure 8.5.

Figure 8.5: AER Wright estimates of the required return on the market



Source: Rate of Return Guideline December 2013; Ausgrid Draft Decision November 2014; Ausgrid Final Decision April 2015; AusNet Draft Decision July 2016; Powerlink Draft Decision September 2016.

In Appendix S: The market risk premium, Frontier Economics notes that the other evidence that receives some or limited consideration by the AER is also generally consistent with the notion that the required return on equity has remained quite stable since the Guideline even as government bond yields have fallen, thus implying a higher MRP. For example:

- Other regulators are currently adopting higher MRP estimates
- Independent experts are currently adopting higher MRP estimates
- Conditioning variables are generally consistent with a stable required return on equity and a higher MRP.

8.3.4.7 Views from the market

In Appendix S: The market risk premium, Frontier Economics also conclude that the evidence from a range of market participants is consistent with the weight of evidence set out above – that the required return on equity has remained relatively stable even as government bond yields have fallen. In this regard, Frontier Economics cites evidence from:

- Central banks such as the Reserve Bank of Australia and the Federal Reserve Bank of New York
- Other regulators such as Ofgem, FERC, the ERA, and IPART
- Corporate advisory firms such as McKinsey and NERA-US
- Independent expert firms such as EY, KPMG, Deloitte, and Lonergan Edwards.

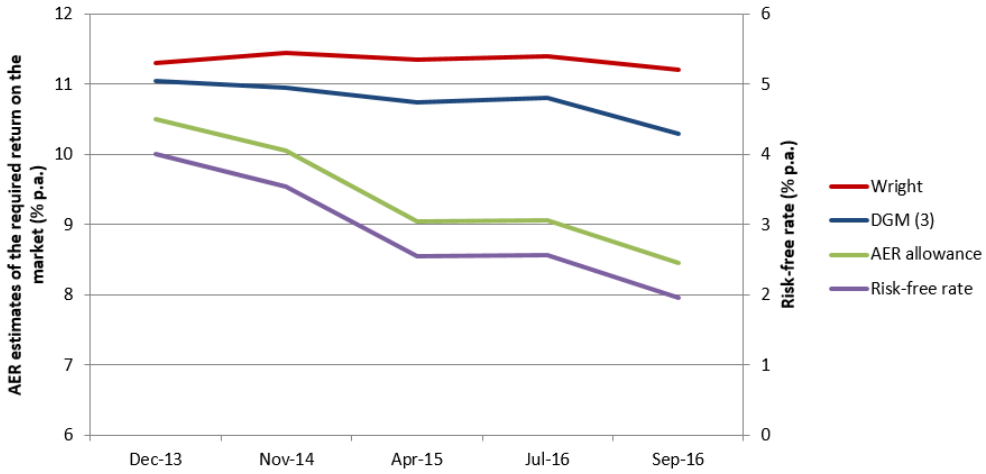
8.3.4.8 Implications of the constant MRP approach

Since its 2013 Guideline, the AER has allowed an MRP of 6.5% in every one of its draft and final decisions. That is, the AER's application of the Guideline approach to the changing evidence since 2013 (including a halving of government bond yields to unprecedented lows) has resulted in an allowed MRP of exactly 6.5% in every decision. The AER's advisors note that this approach results in the allowed return on equity moving one-for-one with changes in risk-free rates:

> The AER decisions hold the risk premium nearly constant (although upward adjustments of 0.5% have been made). As (sic) result the regulated return tends to fall 1 for 1 with falls in the risk free rate.[162]

The inevitable consequence of setting a nearly constant MRP is that the allowed return on equity falls one-for-one with falls in government bond yields. Since government bond yields have fallen sharply since the Guideline, the AER's allowed return on equity has also fallen correspondingly. This occurs in spite of the evidence set out above – including the AER's own DGM estimates – that the required return on equity has remained remarkably stable since the Guideline. The distinction between the AER's estimates and its regulatory allowance is summarised in Figure 8.6, drawn from Appendix S: The market risk premium.

Figure 8.6: The required return on the market – AER estimates and allowances



Source: Rate of Return Guideline December 2013; Ausgrid Draft Decision November 2014; Ausgrid Final Decision April 2015; AusNet Draft Decision July 2016; Powerlink Draft Decision September 2016.

In Appendix S: The market risk premium, Frontier Economics conclude that:

> Since its Guideline in December 2013, the yield on 10-year government bonds has fallen from 4.1% to 1.9%.[163] The AER has maintained the same 6.5% MRP in every one of its decisions since December 2013. Thus, the AER considers that the required return on equity for the average firm[164] has fallen from 10.6%[165] in December 2013 to 8.4%[166] now. This represents a decline of more than 25% over the last two and a half years.
>
> By contrast…there is a substantial body of evidence to support the proposition that the required return on equity has **not** fallen by over 25% in the last two and a half years.

The broader effect of the AER's approach to distilling the MRP evidence into a single regulatory allowance is illustrated in Figure 8.7, also drawn from Appendix S. That figure contrasts the AER's

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[162] Partington and Satchell (2016), p. 17. [TransGrid-Partington and Satchell-For AER Cost of Equity issues 2016 Electricity and Gas Determinations-0416-PUBLIC]

[163] http://www.rba.gov.au/statistics/tables/xls/f02hist.xls.

[164] Which, under the CAPM, is equal to the sum of the risk-free rate and the MRP.

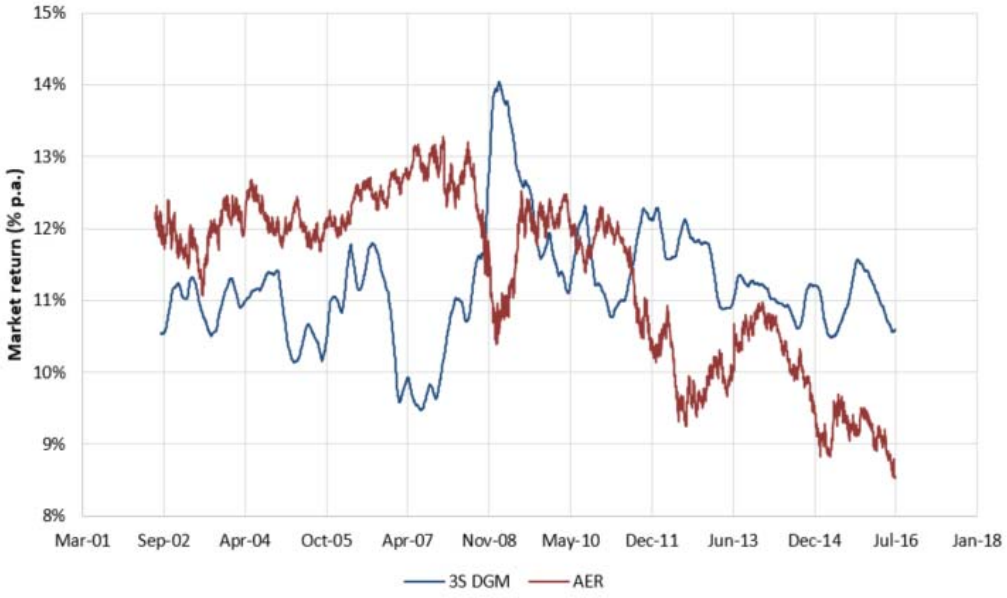
[165] 4.1% + 6.5%.

[166] 1.9% + 6.5%.

allowance for the required return on the market with mid-point estimates from the AER's three-stage DGM.[167]

The most obvious point of departure is during the global financial crisis (GFC) in late 2008. The constant MRP approach implies that the required return on equity fell dramatically during the peak of the GFC – as investors moved funds into government bonds, lowering yields. Such an outcome is unlikely – the required return on equity capital does *not* fall materially during financial crises. But that is precisely what an effectively constant MRP suggests. By contrast, the AER's own forward-looking DGM method suggests that the required return on equity increased during the GFC.

Figure 8.7: The required return on the market – AER mid-point DGM estimates and regulatory allowances



Source: Appendix S, Frontier Economics, The Market Risk Premium, section 1.1 figure 5,

Figure 8.7 also shows that the divergence between the two methods is not confined to the peak of the GFC. For example, throughout 2007 when equity prices were very high and it is widely accepted that equity capital was relatively cheaper, the constant MRP approach suggests that the cost of equity capital was very high.

Importantly, the two approaches currently suggest very different required returns. Whereas the DGM method suggests that the required return on equity has remained quite stable since 2013 (hovering around 11%), the constant MRP approach suggests a material decline in the cost of equity to the lowest level ever on record.

8.3.4.9 The problem with a constant MRP allowance

The problem with the application of an effectively constant MRP is that it implies that the required return on equity **always** falls one-for one with **every** decline in government bond yields. This fixed relationship between allowed returns and government bond yields leads to implausible estimates in some market conditions, including the current market conditions.

In this regard, Partington and Satchell (2016) have recently advised the AER that:

[167] That is, estimates based on the AER's specification and implementation of the DGM with a long-run growth rate of 4.6%.

> We begin by stating our position that it seems likely that the risk premium changes over time. It is also entirely possible that the risk premium sometimes changes at the same time as interest rates change, but that change may either be in the same direction as the interest rates, or in the opposite direction. At any point in time, there are three possibilities for the market risk premium, it may remain unchanged, it may go down, or it may increase. There is no compelling reason for an interest rate decrease to automatically be associated with an increase in the market risk premium.[168]

In Appendix S: The market risk premium, Frontier Economics state that:

> We agree with everything that Partington and Satchell have said in the above paragraph. However, just as there is "no compelling reason for an interest rate decrease to automatically be associated with an increase in the market risk premium," there is equally no compelling reason for an interest rate decrease to never be associated with an increase in the market risk premium.
>
> This is the crux of the problem with the AER's nearly constant MRP. Even though government bond yields have halved since the Guideline, and even though there is strong evidence that the real-world required return from equity holders has not fallen one-for-one with those yields, the AER has maintained the same MRP allowance.
>
> We do not suggest that the AER should always increase the MRP allowance whenever the government bond yield falls or that any increase should completely offset the fall in yields. We simply suggest that the AER should sometimes increase the MRP allowance to partially offset the fall in yields – when objective evidence supports that course of action.

8.3.4.10 A current estimate of the MRP

TransGrid commissioned Frontier Economics to construct an estimate of the MRP that applies the approach set out in the AER's Guideline and which uses the updated currently available data.

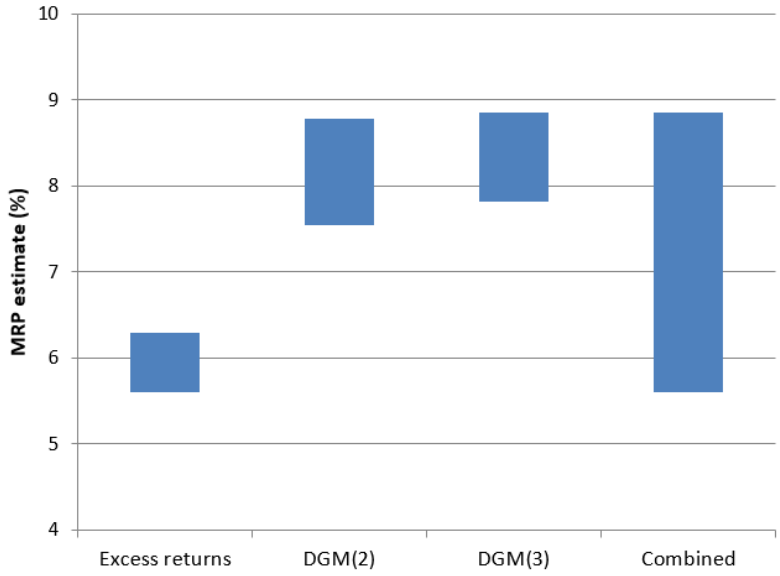
Consistent with the AER's Guideline approach, Frontier Economics began by constructing a combined range from the historical excess returns and DGM ranges. This is set out in Figure 8.8 below, where:

- The historical excess returns range is set to 5.5% to 6.5% with a mid-point estimate of 6.0%, as per Figure 8.8
- The DGM estimate is that reported in the AER's most recent draft decision.[169]

[168] Partington and Satchell (2016), p. 17

[169] Powerlink Draft Decision, Attachment 3, September 2016.

Figure 8.8: Current MRP range – AER Guideline approach



Source: Frontier Economics calculations based on estimates set out in the Powerlink Draft Decision, Attachment 3, September 2016.

The second step of the AER's Guideline approach is to select a point estimate from within the combined range and the AER's Guideline approach is to select a point estimate where:

> This point estimate lies between the historical average range and the range of estimates produced by the DGM. This reflects our consideration of the strengths and limitations of each source of evidence.[170]

In selecting a point estimate, Frontier Economics reports that:

- The AER stated that its preferred historical excess returns estimate is 6.0%[171] and its most recent mid-point three-stage DGM estimate 8.5%.[172] The mid-point of these two estimates is 7.3%.
- The upper bound of the AER's historical excess returns approach is 6.5% and the lower bound from the AER's three-stage DGM approach is 7.8%. The mid-point of this gap between the two ranges is 7.2%.
- At the time of the Guideline, the AER's historical excess returns range and its two-stage DGM range overlapped. In the current market conditions, the upper bound of the historical excess returns range is 6.5% and the lower bound of the two-stage DGM range is 7.5%. The mid-point of the gap between these two ranges is 7.0%.
- The combined range is from 5.5% (the lower bound of the excess returns range) and 8.9% (the upper bound of the DGM range[173]). The mid-point of the combined range is 7.2%.

Frontier Economics notes that the ranges set out above are downwardly biased relative to the AER's Guideline approach in the sense that the lower bound DGM estimates are based on a long-run dividend

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170 AER Rate of Return Guideline, Explanatory Statement, p. 97.

171 AER Rate of Return Guideline, Explanatory Statement, p. 97.

172 The AER has subsequently stated its preference for the three-stage specification of the DGM. See, for example, JGN Draft Decision, Attachment 3, Appendix C, p. 222.

173 Note that the upper bound is currently the same for the AER's two-stage and three-stage DGM approaches.

growth rate of 3.8% compared with the Guideline figure of 4.0%. That is, the lower figure is a departure from the Guideline approach and results in lower MRP estimates.

Frontier Economics also notes that those regulators who seek to obtain an estimate of the MRP that is commensurate with the prevailing conditions in the market are currently adopting higher estimates:

- The ERA adopted MRP estimates of 7.6% and 7.4% in its recent ATCO Gas and DBP decisions.
- IPART has adopted an MRP estimate of 7.3%, which it applies to a risk-free rate set 120 basis points above the contemporaneous yield in its most recent update – an effective MRP above 8.0%.

Frontier Economics concludes that:

> In summary, we have identified the considerations that the AER applied when selecting its Guideline MRP of 6.5%. If we apply those same sorts of considerations to the current evidence that the AER has compiled, the result is an estimate of approximately 7.5%.
>
> An allowed MRP of 7.5% is an outcome that lies between:
>
> – The view that the MRP is constant over all market conditions such that the required return on equity rises and falls one-for-one with changes in the risk-free rate; and
>
> – The view that the required return on equity has remained stable over the period since the Guideline.
>
> In our view, 7.5% is a reasonable estimate of the MRP in light of the weight of evidence set out above – which supports the notion that the required return on equity has not declined materially since the Guideline.

8.3.4.11 Conclusions and submission on the MRP

For the reasons set out above, TransGrid considers that the approach set out in the AER's Rate of Return Guideline, when properly applied to the current data, supports an MRP of 7.5%. TransGrid has adopted an MRP of 7.5% and considers that this represents a reasonable estimate in the current market conditions.

8.4 Return on debt

8.4.1 Rule requirements

In its Rate of Return Guideline, the AER notes that:

> The allowed return on debt must be estimated such that it contributes to the achievement of the allowed rate of return objective. It should therefore provide compensation to a service provider for the debt financing cost which is commensurate with the efficient financing costs of a benchmark efficient entity with a similar degree of risk.[174]

The Rules also require that, when estimating the allowed return on debt, regard must be given (among other things) to the desirability of minimising any difference between the allowed return on debt and the return on debt of a BEE.[175]

Thus, the regulatory task is to determine the cost of debt that would be incurred by a BEE and to set the allowed return on debt accordingly.

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[174] AER, 2013, Rate of Return Guideline, p. 18.

[175] NER 6A.6.2(k).

8.4.2 The efficient debt management approach of the benchmark efficient entity

In its Rate of Return Guideline, the AER considered a range of debt management approaches and concluded that the BEE would:

- Issue debt with a maturity of 10 years[176]
- Issue debt with a credit rating of BBB+[177]
- Issue fixed-rate debt on a staggered maturity basis. Specifically, each year, the BEE would refinance 10% of its debt requirements by issuing new 10-year fixed-rate debt.[178]

The Rules permit the AER to set the allowed return on debt based on an historical average of the required return on debt,[179] and to set a different allowed return on debt for each year of a regulatory control period.[180] Thus, the AER Guideline approach is to set the allowed return on debt based on a 10-year trailing average of the cost of 10-year, fixed rate BBB+ rated debt. Each year the allowed return on debt is updated to reflect the most recent 10-year average. This has become known as the "trailing average approach" to the allowed return on debt.

In its Guideline, the AER identified several advantages of the trailing average approach over the "on the day approach" that was adopted under the previous version of the Rules.[181] Specifically, the AER noted that the trailing average approach would:

- more closely align the allowed return on debt with the efficient debt financing practices of regulated businesses
- reduce cash flow volatility to network service providers over the long-term (which would promote efficient network investment)
- reduce price volatility to consumers.

In respect of the last of these benefits (ie, dampening of price volatility faced by consumers) two important points are worth noting:

- Changes in the return on debt allowance under a trailing average approach tend to be quite small from one year to the next. This is because, under a 10-year trailing average, nine out of the 10 years that make up the return on debt allowance would be the same as in the previous year. This would tend to smooth out both the allowed rate of return and the revenue path, when compared with the on the day approach. This, in turn, will mean that the change in allowed revenues and prices faced by consumers, from one regulatory control period to the next, will be less volatile than would be the case under the on the day approach. Under the on the day approach, the variation in prices faced by consumers can be quite pronounced during periods of high debt market volatility.

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[176] The AER's analysis indicated that the set of comparator firms had issued bonds in the domestic and international markets with an average term to maturity of 9.7 years. See AER, 2013, Rate of Return Guideline, Explanatory Statement, p. 136.

[177] The AER reported that the median credit rating for its set of comparator firms was BBB as at November 2013 and was BBB+ but on negative watch over the period of 2002-2013. The ENA submitted that a more reasonable interpretation of the relevant evidence was a rating of BBB or BBB- (see Energy Networks Association, 2013, "Response to AER Rate of Return Guideline Consultation Paper," pp. 92-93.) However, the debate about the precise credit rating is effectively moot as third party data providers do not distinguish between different ratings modifiers, publishing a single combined estimate for all ratings with a BBB base.

[178] AER, 2013, Rate of Return Guideline, Section 6.3.1, p. 19.

[179] NER 6A.6.2(j)(2).

[180] NER 6A.6.2(i)(2).

[181] Under the rate on the day approach, the allowed return on debt was set to the spot rate observed in the market at the beginning of each regulatory control period and held fixed for the duration of that period.

- Unlike some network service providers (who may be able to use hedging instruments, such as interest rate swaps, to manage mismatches between their efficient cost of capital and the on the day allowed return on debt—at least in respect of the base risk-free rate), consumers have no access to hedging instruments and, therefore, no ability to manage exposure to debt market volatility. The trailing average approach minimises this exposure.

It was these advantages that prompted energy consumers to propose to the AEMC in 2011 that the AER's on the day approach should be replaced by the trailing average approach.[182]

TransGrid agrees that the allowed return on debt should be based on the 10-year trailing average approach and have adopted that approach when calculating the required return on debt.

8.4.3 Data sources and estimation

Implementation of the full trailing average approach will require an estimate of the yield on 10-year BBB+ debt for the relevant period[183] over each of the previous 10 years. Under the AER's transition approach, the full 10-year history will not be required until the completion of the transition. The AER's approach is to estimate this yield to use independent third party data sources.[184]

The AER did not specify particular data sources in its Guideline, but in decisions since the Guideline it has given equal weight to estimates provided by Bloomberg and the Reserve Bank of Australia.

TransGrid agrees that this is a reasonable approach to estimating the yield on 10-year Australian corporate bonds, and have adopted that approach when calculating the required return on debt.

8.4.4 Transition

In its 2013 Rate of Return Guideline the AER proposed a gradual transition, over a 10-year period, from its previous rate on the day approach to its new trailing average. The transition would be implemented as follows:

- in Year 1, the return on debt allowance will be 100% the prevailing, on the day rate
- in Year 2 the return on debt allowance debt will be 90% of the Year 1 on the day rate and 10% of the Year 2 on the day rate
- in Year 3 the return on debt allowance will be 80% of the Year 1 on the day rate, 10% of the Year 2 on the day rate and 10% of the Year 3 on the day rate
- and so on until by Year 10 the return on debt allowance would be an equal-weighted average of the past 10 on the day rates.[185]

In all decisions since 2013, the AER has decided to implement the 10-year transition from the on the day rate to the full trailing average rate. The AER's main reasoning is that:

- Under the Rules, it is required to have regard to any impacts (including in relation to the costs of servicing debt across regulatory control periods) on a BEE that could arise as a result of changing the methodology that is used to estimate the return on debt from one regulatory control period to the next.[186]

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[182] AEMC, National Electricity Amendment (Economic Regulation of Network Service Providers) Rule 2012, National Gas Amendment (Price and Revenue Regulation of Gas Services) Rule 2012—Final Rule Determination, p.iv.

[183] An averaging period, usually 20 days in length, is required for each year.

[184] AER, 2013, Rate of Return Guideline, p. 21.

[185] AER, 2013, Rate of Return Guideline, pp. 19-20.

[186] NER 6A.6.2(k)(4).

- Under the previous rate on the day approach, the only efficient debt management strategy for the BEE would have been to issue floating rate debt at the start of the regulatory period, and then to fix the base risk-free rate of borrowing to the AER's risk-free rate allowance using interest rate swaps. However, under the trailing average approach, a different debt management strategy (ie, the staggered issuance of fixed rate debt, without the use of interest rate swaps) would be efficient. The AER contends that the efficient debt management strategy for the BEE is contingent on the regulatory arrangements because it defines the BEE to be a regulated energy network.
- Unless a 10-year transition of the kind proposed by the AER is used, an immediate switch from the on the day approach to the trailing average approach would result in windfall gain to regulated network service providers.

The AER's rationale for this transition was challenged in the *PIAC-Ausgrid* case[187] where the Tribunal concluded that the AER had erred in its reasoning. Two key aspects of the Tribunal's decision on this matter are worth highlighting.

First, the Tribunal held that AER was incorrect to treat the BEE entity as a regulated business rather than "an efficient competitor in a competitive market."[188] Thus, the relevant consideration is not what a regulated entity might have done in response to the way the AER determined its regulatory allowance, but rather the debt management strategy that an efficient business in a competitive market might be expected to employ.

Second, the Tribunal set out how the AER should have approached the question of whether a transition was appropriate.[189] The Tribunal makes clear in its reasons that, when deciding on whether a transition was appropriate, the AER should have begun by considering whether the network service provider, given the degree of risk, had adopted an efficient financing costs structure. Several businesses, including the NSW distributors, had argued that their financing costs structure were efficient in their circumstances (because the hedging strategy that the AER considered to be the efficient strategy under the on the day approach was not feasible for companies with debt portfolios as large as theirs).

TransGrid asked Frontier Economics for advice on the economic basis for the AER's proposed transition and they set out the following framework for addressing the issue:

> In our view, the framework for considering the question of the return on debt transition is straightforward, and the approach that should be adopted is as follows:
>
> - Determine the efficient debt management approach that the BEE would have adopted under the previous National Electricity Rules (Rules). This determines the debt portfolio that the BEE has at the end of the last regulatory control period (RCP) under the previous Rules. Call this the "starting debt portfolio";
> - Determine the efficient debt management approach that the BEE would adopt under the current Rules. This determines the debt portfolio that the BEE would construct under the current Rules. Call this the "target debt portfolio";
> - Determine how, and over what period, the BEE would most efficiently convert the starting debt portfolio into the target debt portfolio. This involves determining the efficient debt portfolio that the BEE would have in place in each year over the transition period;
> - The regulatory allowance in each year should match the efficient cost of the efficient debt portfolio that the BEE would have in place in each year.

[187] Applications by Public Interest Advocacy Centre Ltd and Ausgrid [2016] ACompT 1.
[188] Applications by Public Interest Advocacy Centre Ltd and Ausgrid [2016] ACompT 1, para 914.
[189] Applications by Public Interest Advocacy Centre Ltd and Ausgrid [2016] ACompT 1, para 934.

> This framework really suggests nothing more than that the regulatory allowance for each year of a RCP should equate to the efficient cost that would be borne by the BEE in that year. We note that equating the regulatory allowance with the efficient cost is consistent with the Rules in that:
>
> - Rule 6A.6.2(h) requires that the allowed return on debt for each regulatory year must be estimated such that it contributes to the achievement of the allowed rate of return objective; and
> - Rule 6A.6.2(c) defines the allowed rate of return objective, requiring that the allowed return must be commensurate with the efficient financing costs of the BEE.
>
> Thus, the combination of these two provisions in the Rules requires the allowed return on debt to be set so that it is commensurate with the efficient financing costs of the BEE every year. This is precisely the approach that we have set out above – determine what debt portfolio the BEE would have in place each year, and then determine the efficient cost of that debt portfolio for that year.[190]

The *PIAC-Ausgrid* Tribunal noted that the longstanding debt management approach of the NSW distributors was already consistent with the trailing average approach that the AER had determined would be the efficient approach going forward. This approach is also consistent with the practice of comparable businesses that operate in competitive markets. The Tribunal stated that it was "ironic" for the AER to argue that the strategy adopted by the NSW distributors was inefficient when, according to the AER, that very strategy would be the only efficient strategy going forward.

In this case, there should be no transition. The BEE would simply maintain its use of the trailing average debt management approach throughout and should be compensated in accordance with the cost of that strategy.

However, TransGrid is already a number of years through the transition that was applied by the AER in the last regulatory review. For this reason, the continuation of that transition over the forthcoming regulatory control period is accepted. TransGrid notes that this approach results in materially lower allowed revenues and commensurately lower prices for consumers over the transition period.

8.4.5 Return on debt estimate

Continuation of the AER's transition approach, using the mid-point of the RBA and BVAL estimates in accordance with the AER's methodology produces a return on debt allowance of 6.01%. This estimate will be revised to reflect data over the specified averaging period prior to the commencement of the next regulatory control period.

8.5 Gearing

The gearing ratio represents the proportion of total capital that that is provided in the form of debt – it is the ratio of debt finance to total finance. The gearing ratio is used for three purposes:

> It defines the weights in the WACC calculation

> It is used in the re-levering step of the beta estimation process

> It is used when determining the appropriate credit rating for the estimation of the required return on debt.

[190] Appendix T: The AER's application of a transition to the trailing average approach [TransGrid-Frontier Economics-Appendix T Return on debt transition letter-0117-PUBLIC]

As part of its 2013 Rate of Return Guideline process, the AER performed an empirical analysis of gearing estimates for a number of comparator firms and concluded that "the empirical evidence supports a gearing of 60 per cent".[191]

TransGrid also notes that the AER has consistently maintained a 60% gearing allowance since its inception.

TransGrid considers that a gearing estimate of 60% is appropriate and have adopted that figure when estimating the required return on capital.

[191] AER, 2013, Rate of Return Guideline, Explanatory Statement, Appendix F, p. 126. See also Table F.1, p. 127.

9. Value of imputation credits

9.1 The role of gamma in the regulatory process

Under the Australian regulatory framework and the AER's Post-tax Revenue Model (PTRM) there is a two-step approach to estimating the revenue requirement in relation to the return on equity capital:

- In the first step, the regulator estimates the total required return on equity, including any benefit from dividend imputation tax credits
- In the second step, the regulator subtracts the estimated value of imputation credits, leaving an estimate of the ex-imputation required return on equity.

The allowed revenue is then set to enable the firm to provide that ex-imputation required return on equity to shareholders. The total required return on equity is then composed of the ex-imputation return that is generated from the firm's allowed revenues plus the value of imputation credits that shareholders receive via the tax system.

Thus, an estimate of the value of imputation credits is required and the Rules define this parameter to be gamma.

9.2 Interpretations of gamma

Prior to the AER's Rate of Return Guideline in 2013, all stakeholders interpreted gamma to be the value of imputation credits, where value takes its ordinary meaning of "worth to investors". That is, gamma was interpreted in terms of what investors would be willing to pay for a credit – the market value. Accordingly, gamma was always estimated with reference to the observed prices of traded securities – the same way other WACC parameters are estimated.

In its Guideline, and in all subsequent decisions, the AER has proposed a very different interpretation of gamma. The AER now interprets and estimates gamma in terms of the proportion of credits that are available for redemption by shareholders, rather than as the value of those credits to investors.

There is broad agreement among stakeholders that:

- If the market value interpretation is adopted, we should use estimation methods that are designed to estimate the market value from the market prices of traded securities
- If the redemption proportion or utilisation interpretation is adopted, we should use estimation methods that are designed to estimate the proportion of credits that are (or are likely to be) redeemed.[192]

TransGrid submits that, for the reasons set out below, the market value interpretation should be adopted and market value estimation methods should be used. By contrast, the utilisation approach is adopted in the AER's Guideline and subsequent decisions. Consequently, TransGrid seeks to depart from the Guideline in relation to gamma for the reasons set out below.

9.3 Key point of contention

Gamma has been a point of contention in the regulatory process because the market value estimate (0.25) is materially lower than the AER's redemption proportion estimate (0.40). That is, the AER

[192] See, for example, Citipower Final Decision, May 2016, Attachment 4, pp. 32-39.

estimates that 40% of created credits end up being redeemed by shareholders, and the market value estimate indicates that each created credit has a market value equal to 25% of the face amount.

A number of reasons have been identified to explain why investors would not value a redeemed credit at the full face amount, including:

- There is a time delay between receiving a credit and being able to convert it into a reduction in personal tax payments
- There are administrative costs, in the form of maintaining records and filing tax forms, that do not apply to the receipt of cash dividends
- There are portfolio rebalancing costs. Domestic shareholders who are able to redeem credits are likely to tilt their investment portfolios towards stocks that distribute imputation credits. They would rationally do this until the benefit of the last credit received just offset the cost of tilting the portfolio away from what would otherwise be optimal for the investor. Thus, the last credit received (and redeemed) would have a negligible net benefit to the investor.

The AER has not disputed the evidence that the market value of credits (0.25) is materially lower than its estimate of the redemption proportion (0.40). Rather, the AER's position has been that the market value is not relevant. Whereas the Rules state that "gamma is the value of imputation credits,"[193] the AER has maintained that "value" should be interpreted as something other than "worth to investors" or "market value." The AER has variously interpreted the reference to "value" in the Rules to mean:

- The number that is used for this parameter[194]
- The proportion of company tax paid that investors redeem[195]
- The representative investor's expected utilisation of franking credits as a proportion of the total company tax paid[196]
- The before-personal-tax reduction in company tax per one dollar of imputation credits that the representative investor receives[197]
- The proportion of tax collected from the company which gives rise to the tax credit associated with a franked dividend[198]
- "Utilisation value" which is further defined to be the incremental reduction in personal tax, if any, which arises from the receipt of a franked dividend compared to the receipt of an otherwise equivalent unfranked dividend[199]
- The before-personal-tax and before-personal-costs utilisation value to investors in the market per dollar of imputation credits distributed.[200]

The last definition somewhat clarifies the AER's interpretation of the "value" of imputation credits. The AER does not dispute that there are reasons why investors would value credits at less than the full face amount (ie, why investors would not be willing to pay the full face amount to buy a credit). Rather, the AER's position is that gamma should be estimated on a gross basis rather than net of all of the factors

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193 NER 6A.6.4.

194 AER Rate of Return Guideline, Appendix H, p. 138.

195 AER Draft Rate of Return Guideline, Explanatory Statement, p. 234

196 AER Draft Rate of Return Guideline, Explanatory Statement, p. 122

197 AER Rate of Return Guideline, Explanatory Statement, p. 165

198 AER Rate of Return Guideline, Explanatory Statement, p. 158.

199 Handley, J.C. and K. Maheswaran, 2008, A Measure of the Efficacy of the Australian Imputation Tax System, The Economic Record 84(264), 82-94, p. 84. [TransGrid-Handley Maheswaran-A Measure of the Efficacy of the Australian Imputation Tax System-0308-PUBLIC]

200 TransGrid Final Decision, Attachment 4, p. 30.

(or personal costs as the AER now calls them) that lead to investors valuing credits at less than the full face amount. For example, consider an investor who redeems a credit with a $1 face amount, but who bears 30 cents in personal costs including time delay, administration costs, portfolio rebalancing costs, and any other relevant considerations that go to the net value of the credit to the investor. The AER's approach is to assume that the value of this credit is $1 because it was redeemed. However, an investor would only be prepared to pay the net value of 70 cents for such a credit and it is this 70 cent value that would be reflected in the market price of the shares.

In summary, the AER's approach is to estimate the proportion of credits that are redeemed and to assume that every redeemed credit has a value under the Rules of its full face amount. The AER estimates this redemption proportion in two steps. First, the AER estimates that approximately 70% of created credits are distributed to shareholders. The remainder are not distributed so cannot be redeemed. Second, the AER estimates that approximately 60% of distributed credits are redeemed. The product of these two quantities is approximately 0.4.[201]

Whereas regulated businesses agree that approximately 70% of created credits are distributed to shareholders, there is disagreement with the remainder of the calculation in two respects.

- First, regulated businesses have submitted that the evidence suggests that only 45% of distributed credits are redeemed. Whereas the AER's 60% estimate is an indirect one that comes from trying to estimate the proportion of shares that are owned by resident investors, the 45% estimate is a direct estimate of the redemption rate from data provided by the Australian Taxation Office.
- Second, regulated businesses have submitted that it is not correct to assume that every redeemed credit was valued at the full face amount – that the net value should be used. The analysis of share prices in the market indicates that investors value each redeemed credit at approximately 78% of the face amount.

Thus, approximately 70% of credits are distributed, approximately 45% of them are redeemed, and the value of each redeemed credit is approximately 78% of the face amount. The product of these quantities produces the market value estimate of gamma of 0.25.

The market value estimate of gamma can be estimated using a technique known as dividend drop-off analysis. This is a well-accepted empirical technique that has been applied to many markets around the world in papers that have been published in leading journals. It estimates the market value of credits by comparing the price of shares immediately before an ex-dividend date (which reflects the market value of the dividend and credit) with the ex-dividend share price. The 0.25 estimate was first based on a dividend drop-off analysis prepared for the ENERGEX merits review[202] in 2011.[203] The estimate has remained unchanged over two subsequent updates. The most recent update is included as Appendix U: An updated dividend drop-off estimate of theta.

9.4 Why the market value interpretation must be used

The Rules define gamma as the value of imputation credits.[204] TransGrid interprets "value" as taking its ordinary meaning of worth to investors – the amount that investors would be prepared to pay to buy a credit. That is, TransGrid considers that gamma is clearly a market value concept and must be estimated as such.

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[201] The AER uses a range of estimates for the distribution rate and the redemption rate, but these are representative point estimates.

[202] Merits reviews are appeals heard by the Australian Competition Tribunal under the National Electricity Law.

[203] Australian Competition Tribunal, 2011, Application by Energex Limited (Gamma) (No 5) [2011] ACompT 9, 12 May.

[204] NER 6A.6.4.

There are two primary reasons for interpreting gamma as the market value of imputation credits:

- If gamma is set to anything other than the market value of credits, shareholders will not receive an appropriate return on equity. A simple example illustrates this point. Suppose a regulated firm creates $100 of imputation credits, and investors value those credits at $25 (consistent with the market value estimate of gamma of 0.25). Also suppose that 40% of these credits are redeemed (consistent with the AER's estimate of utilisation). If the allowed return to equity is reduced by $40 in relation to credits that are worth only $25, shareholders will be under-compensated. The reduction in the allowed revenue in relation to imputation credits must be set in accordance with the value (in the ordinary sense of that word) of those credits to shareholders.
- Other WACC parameters are estimated on a market value basis with reference to the observed prices of traded securities – they are not estimated on a pre-personal cost and pre-personal tax basis. For example, the risk-free rate is estimated from the market prices of government bonds. Those market prices reflect all of the considerations that all investors make when determining what that asset is worth to them – including the effects of any personal costs and personal taxes. No adjustment is made to determine what the bond price would have been prior to the investors' consideration of personal costs and personal taxes. The same applies to the market risk premium and beta. Those parameters are estimated with reference to observed market stock prices that also reflect all of the considerations that investors make when determining the value of that asset to them. Again, no adjustment is made and no alternative estimation approach is used to try to determine what the pre-personal cost and pre-personal tax value of the shares would be. TransGrid considers that it would be inconsistent and wrong to estimate gamma on a different basis than other WACC parameters.[205]

9.5 Value of gamma

For the reasons set out above, TransGrid considers that gamma must be interpreted as the value of imputation credits, where "value" takes its ordinary meaning of worth to investors – the amount that investors would be prepared to pay to buy a credit. TransGrid considers that gamma is clearly a market value concept and must be estimated using market prices – in the same way as other WACC parameters are estimated. This leads TransGrid to adopt the market value estimate of 0.25 and to reject the AER's utilisation estimate of 0.40. Under a market value construction of gamma, the utilisation estimate can only be used as an upper bound and not a point estimate of gamma. This is because credits that are redeemed may have a value to investors less than the face amount of those credits.

TransGrid notes that some aspects of the theoretical basis for gamma, and some issues relating to the empirical estimation of gamma, are rather technical. Also, there have been a number of merits reviews and Full Federal Court appeals in relation to gamma that have caused even more complexity. These issues are addressed in full in the attached report from Frontier Economics, Appendix V Estimating Gamma for Regulatory Purposes. TransGrid's proposal to estimate gamma as the market value of imputation credits is consistent with the approach taken in the *ENERGEX* and *PIAC-Ausgrid* Tribunal decisions. Whereas the *SAPN* Tribunal held that it was also open to the AER to use its discretion to adopt the utilisation approach, TransGrid submits that the market value approach must be used.

However, the key issue is the interpretation of "value" and our view is that it is clear that the interpretation must be in terms of "worth to investors" and therefore that the market value estimate of 0.25 should be adopted. This involves a departure from the AER's Rate of Return Guideline in relation

[205] In addition, NER 6A.6.2(d)(2) and NER 6A.6.2(e)(2) require parameters to be estimated on a consistent basis.

to gamma. As explained above, our reason for departing is that TransGrid considers that the Guideline estimate of 0.4 is an estimate of the wrong thing. It is an estimate of the proportion of credits that are available for redemption by domestic investors, whereas the Rules require an estimate of the value of those credits to investors.

10. Depreciation

This chapter presents TransGrid's forecast of the depreciation on prescribed assets during the 2018/19 to 2022/23 period.

Depreciation is defined in Australian Accounting Standard AASB 116 (Property, Plant and Equipment) as the systematic allocation of the depreciable amount of an asset over its useful life.

Depreciation is part of the annual building block revenue requirement calculated in accordance with Clause 6A.5.4 of the Rules. The annual regulatory depreciation allowance is a depreciated value of the RAB that reflects the nature of the assets over their economic life.

Regulatory depreciation is also referred to as "return of capital", and is straight line depreciation of the RAB less an adjustment for inflation.

10.1 Forecast depreciation

In the final decision on TransGrid's revenue determination for the 2014/15 to 2017/18 regulatory period, the AER determined that forecast depreciation will be used to establish the opening RAB for the 2018/19 to 2022/23 regulatory control period[206]. Accordingly, TransGrid has adopted the forecast depreciation approach in the Roll Forward Model.

10.2 Depreciation methodology

Clause 6A.6.3(c) of the Rules states that an asset (or group of assets) must be depreciated on a straight line basis over the life at which that asset (or group of assets) was first included in the RAB for that transmission system.

TransGrid has applied the straight line depreciation method to each asset category in the RAB over the economic life of the asset across the regulatory control period, based on the value of the assets included in the RAB at the beginning of each regulatory year.

The annual depreciation expense for the 2018/19 to 2022/23 period is calculated within the AER's post-tax revenue model based on:

- the opening RAB value as at 1 July 2018, derived from the roll forward model;
- the annual capital expenditure forecast set out in Chapter 5;
- the standard asset lives described in section 10.3; and
- the remaining asset lives discussed in section 10.4.

The post-tax revenue model commences the annual depreciation calculation for a new asset over its standard asset life in the year after the capital expenditure is commissioned. The existing assets as at 1 July 2018 are depreciated over their remaining asset lives. The remaining asset lives are calculated within the post-tax revenue model.

Assets that are forecast to be disposed of, or decommissioned, are removed from the asset base of the relevant asset class in the year of disposal.

Depreciation is not applied to the land and easement asset category.

[206] Draft decision, TransGrid transmission determination, 2015–16 to 2017–18, Attachment 2: Regulatory asset base, p2-12.

TransGrid's depreciation calculation details are contained in the completed post-tax revenue model submitted with this revenue proposal.

10.3 Asset classes and standard asset lives

Clause 6A.6.3(b) of the Rules states that the depreciation schedules must depreciate using a profile that reflects the nature of the assets or category of assets over the economic life of that asset or category of assets.

TransGrid has assigned regulatory lives to well recognised classes of assets that reflect the assets' expected technical lives. TransGrid has applied consistent asset lives to those proposed and accepted by the AER in the current regulatory period.

TransGrid creates a separate asset class for each regulatory control period to ensure accurate treatment of depreciation and asset disposals. In this proposal, the following existing asset classes have been removed as they are fully depreciated:

- SCADA and communications (pre 2004-05)
- Non-network assets (pre 2004-05)
- Snowy Mountain Hydro Electricity Authority Assets (pre 2004-05)
- Non-network assets (2004-09)
- Business IT (2009-14)

The new asset classes and standard lives for the upcoming regulatory control period are shown in Table 10.1.

These asset categories and lives have been used in the post-tax revenue model to forecast TransGrid's revenue requirements.

The standard asset life of 36 years for the Network Support and Control Ancillary Services (NSCAS) asset class, described in section 7.5.1 of this proposal, represents the weighted average remaining life of the Substations and Secondary Systems components of the assets currently providing NSCAS. The assets will continue to provide the same network support functions but from 2019/20 they will be provided as a prescribed service under the Rules and included in the RAB on that basis.

Table 10.1: Asset categories and standard lives

No	Asset class	Asset life (years)
1	Transmission lines (2018-23)	50
2	Underground cables (2018-23)	45
3	Substations (2018-23)	40
4	Secondary systems (2018-23)	15
5	Communications (2018-23)	10
6	Business IT (2018-23)	4
7	Minor plant, motor vehicles and mobile plant (2018-23)	8
8	Transmission line life extension (2018-23)	25
9	NSCAS assets	36
10	Land and easements	N/A

Source: TransGrid.

10.4 Remaining asset lives

Clause 6A.6.3 of the Rules states that the economic life of the relevant assets and the depreciation methodologies and rates underpinning the calculation of depreciation for a given regulatory control period must be consistent with those determined for the same assets on a prospective basis in the transmission determination for that period.

For existing assets, TransGrid has used the same asset lives in accordance with the Rules. The calculation of weighted average remaining asset lives in the roll forward model and post-tax revenue model has been adopted by TransGrid to calculate remaining asset lives.

10.5 Depreciation forecast

Regulatory depreciation is made up of straight line depreciation and an adjustment for the annual inflation of the opening RAB.

Schedule 6A.1.3 (7) of the Rules requires TransGrid to provide the depreciation schedules which categorise the relevant assets for these purposes by reference to well accepted categories such as:

- asset class (e.g. transmission lines and substations)
- category driver (e.g. regulatory obligations or requirements, replacement, reliability, net market benefit, and business support)

and also by location, together with:

- details of all amounts, values and other inputs used by the transmission network service provider to compile those depreciation schedules

- a demonstration that those depreciation schedules conform with the requirements set out in Clause 6A.6.3(b) of the Rules
- an explanation of the calculation of the amounts, values and inputs referred to in subparagraph (iii).

The depreciation schedules are provided in Appendix W of the revenue proposal.

The forecast regulatory depreciation allowance is shown in Table 10.2.

Table 10.2: Forecast regulatory depreciation ($m nominal)

	2018/19	2019/20	2020/21	2021/22	2022/23
Straight line depreciation	261.6	281.5	300.0	312.3	331.3
Less: inflation adjustment on RAB	-153.2	-156.0	-160.8	-166.2	-172.4
Regulatory depreciation	108.4	125.5	139.2	146.1	158.9

Source: TransGrid. Totals may not add due to rounding.

11. Corporate Income Tax

The estimated cost of corporate income tax is a building block in the revenue calculation under the Rules. TransGrid has calculated the cost of corporate income tax in accordance with clause 6A.6.4. of the Rules.

11.1 Tax depreciation

For the purpose of estimating the cost of income tax, TransGrid has calculated tax depreciation on a straight line basis, using the AER's roll forward model and post-tax revenue model. The asset lives applied for tax purposes are the same as standard asset lives which are set out in Table 10.1 in Chapter 10.

Forecast tax depreciation for the upcoming regulatory control period, calculated using the AER's post-tax revenue model, is set out in Table 11.1. This has been used to calculate TransGrid's corporate income tax allowance.

Table 11.1: Forecast tax depreciation schedule ($m nominal)

	2018/19	2019/20	2020/21	2021/22	2022/23
Tax depreciation	145.7	156.9	168.9	172.5	185.5

Source: TransGrid.

11.2 Tax allowance

Clause 6A.6.4 of the Rules sets out the methodology for calculating the allowance for corporate income tax. The estimated cost of corporate income tax of a Transmission Network Service Provider, for each regulatory year (ETC_t), must be estimated in accordance with the following formula:

$$ETC_t = (ETI_t \times r_t)\ (1 - \gamma)$$

where:

- ETI_t - is an estimate of the taxable income for that regulatory year, that would be earned by a benchmark efficient entity, as a result of the provision of prescribed transmission services, if such an entity, rather than the Transmission Network Service Provider, operated the business of the Transmission Network Service Provider, such estimate being determined in accordance with the post-tax revenue model
- r_t - is the expected statutory income tax rate for that regulatory year as determined by the AER
- γ - is the value of imputation credits

The estimate of taxable income is calculated using the AER's post-tax revenue model. TransGrid has applied γ of 0.25 and a 30% statutory income tax rate, as discussed in Chapter 9.

TransGrid has calculated the forecast cost of corporate income tax in accordance with the methodology set out in Clause 6A.6.4 of the Rules, using the AER's post-tax revenue model. The forecast corporate income tax is shown in Table 11.2.

Table 11.2: Forecast cost of corporate income tax ($m nominal)

	2018/19	20119/20	2020/21	2021/22	2022/23
Corporate income tax	59.4	62.9	65.8	69.6	73.0
Less: value of imputation credits	-14.8	-15.7	-16.4	-17.4	-18.3
Total allowance	**44.5**	**47.1**	**49.3**	**52.2**	**54.8**

Source: TransGrid. Totals may not add due to rounding.

12. Shared Assets

Shared assets are assets that are used to provide both prescribed transmission services and non-regulated services.

TransGrid's prescribed assets are funded by consumers through their use of prescribed services. TransGrid may also provide non-regulated services on a commercial basis which utilise prescribed assets where it is efficient to do so.

If it is known at the time of investing in an asset that it will be used for both prescribed and non-regulated services, only a proportion of the asset's cost is added to the regulatory asset base. This ensures that electricity customers only pay for the share of the asset they use.

Occasionally, an asset will be fully included in the regulatory asset base, but at some point later in the asset's life it may also be used for non-regulated services. At this time the asset becomes a "shared asset".

Consumers who fund shared assets through their electricity bills can share in the benefits of the unregulated activities by an amount that reflects the alternate use of the asset.

12.1 National Electricity Rules requirements

Clause 6A.5.5 of the Rules sets out the requirements for shared assets, where an asset is used to provide both prescribed transmission services and either non-regulated transmission services or services that are not transmission services.

The definition of prescribed transmission services in Chapter 10 of the Rules excludes negotiated transmission services and market network services. Similarly, non-regulated transmission services are defined in Chapter 10 of the Rules as a transmission service that is neither a prescribed transmission service nor a negotiated transmission service.

12.2 Shared asset guideline requirements

The AER's shared asset guideline details the AER's preferred approach to adjusting the maximum allowed revenue to reflect a TNSP's use of shared assets. The guideline does not apply to assets where the approved Cost Allocation Methodology (CAM) has been applied. TransGrid has applied the AER's methodology as detailed in the guideline.

The guideline has a materiality principle, where adjustments are only to be made if the average of the non-regulated revenue from shared assets is expected to be greater than 1% of total smoothed revenue over the regulatory period. A control step ensures the reduction in revenue is limited to the estimate of the sum of return on and return of capital for the shared assets.

12.3 Shared assets proposal

TransGrid has identified two categories of non-regulated services provided using shared assets, as follows.

- **Telecommunications services**. TransGrid provides telecommunications services using shared assets in the following two areas:
  - **Leasing of radio repeater site facilities**: TransGrid provides third party access to its radio communication sites including leasing of tower space for attaching radio transmitters, equipment building space and ground space to locate third party telecommunication assets.

TransGrid provides these services to approximately 50 customers including other utilities, government organisations, emergency services and licensed telecommunications carriers.

- **Leasing of the optical fibre network capacity**: TransGrid provides both dark fibre and bandwidth backhaul services to a number of customers, including electricity supply industry members and licensed telecommunications customers.

> **Property rental**. In some circumstances, land owners may be unwilling or unable to subdivide or land is purchased for future development requirements, if this occurs then TransGrid may rent these properties to ensure an efficient and effective use of assets. The nature of lettings includes land for agricultural and grazing or other purposes.

TransGrid has applied the materiality test based on the methodology set out in the final Shared Asset Guideline. The total smoothed annual revenue requirement is derived from the PTRM. Non-regulated revenue from shared assets is based on TransGrid's forecast of expected revenue during 2018/19 to 2022/23. TransGrid estimates that the materiality threshold will not be exceeded in the next regulatory period on the basis of TransGrid's proposed MAR. Table 12.1 sets out TransGrid's calculations for this.

Table 12.1: Shared asset revenue adjustment

$m nominal	2018/19	2019/20	2020/21	2021/22	2022/23
Revenue					
Optical fibre network capacity	2.06	2.37	2.71	3.09	3.52
Radio repeater site facilities	3.74	3.85	3.97	4.09	4.21
Property rental	0.06	0.06	0.06	0.06	0.06
Total revenue from shared assets	**5.86**	**6.28**	**6.74**	**7.24**	**7.79**
Average annual revenue from shared assets	**6.78**	**6.78**	**6.78**	**6.78**	**6.78**
Smoothed MAR	796.53	824.26	852.96	882.66	913.39
1% of the Smoothed MAR	7.96	8.24	8.53	8.83	9.13
1% Materiality Test	Not exceeded	Not exceeded	Not exceeded	Not exceeded	Not exceeded
Revenue to be deducted from MAR	-	-	-	-	-

Source: TransGrid. Totals may not add due to rounding.

13. Efficiency Benefit Sharing Scheme

The efficiency benefit sharing scheme (EBSS) aims to provide a continuous incentive for TransGrid to pursue efficiency improvements in operating expenditure, and to fairly share efficiency gains with customers. The EBSS applies to TransGrid in the current period and is expected to continue in the next regulatory control period.

As discussed in Section 6.5, there has been a sustained focus on efficiency since the AER's last revenue determination. As a result TransGrid has delivered a large number of efficiency initiatives throughout its operations, and achieved material savings against the operating expenditure allowance. TransGrid is proud of this achievement, and pleased that customers will benefit from these savings over the coming regulatory period.

This chapter sets out the EBSS carryover amounts that will take effect from 2018/19 to 2022/23, calculated in accordance with the AER's EBSS Guidelines. These carryover amounts are the result of the efficiency savings achieved in the current regulatory control period. This chapter also sets out how the EBSS is expected to be applied in the next regulatory control period.

TransGrid has achieved material savings:

- TransGrid has responded to the incentives that would be provided by a correctly functioning EBSS, and achieved material cost savings in the current regulatory period. Examples of these savings initiatives are discussed in Chapter 6.
- There are potentially inappropriate rewards and penalties when a four year carryover period is combined with a five year regulatory control period. Consequently, TransGrid proposes that the EBSS carryover from the 2014/15 to 2017/18 years is calculated using a five year carryover period.

13.1 How the EBSS shares benefits with consumers

The efficiency benefit sharing scheme has been designed to share the benefits of increased operating efficiencies with consumers over time. In the AER's own words:

> The EBSS also leads to a fair sharing of efficiency gains and losses between TNSPs and consumers. For instance the combined effect of our forecasting approach and the EBSS is that opex efficiency gains or losses are shared approximately 30:70 between TNSPs and consumers. This means for a one dollar efficiency saving in opex the TNSP keeps 30 cents of the benefit while consumers keep 70 cents of the benefit.[207]

TransGrid estimates it will have achieved a combined $151 million of operating efficiencies by 2017/18, since operating efficiency incentive schemes were introduced in 2004/5. According to the approximate 30:70 sharing ratio in favour of consumers, with a correctly functioning sharing scheme this will lock in more than $100 million in benefits to consumers by the end of this regulatory period.

[207] AER: *TransGrid final framework and approach 2018-23*, July 2016, p. 13

13.2 Length of carryover period

In TransGrid's final revenue determination in May 2015, the AER determined that a four year carryover period would apply for the 2014/15 to 2017/18 regulatory control period. This was because at the time of the determination, TransGrid's next regulatory control period commencing 2018/19 was anticipated to be four years in duration.

TransGrid's forthcoming regulatory control period is now set to be five years, and consequently TransGrid has raised concerns with the AER that the four year carryover period may no longer be in the long term interests of consumers. This is because a four year carryover period combined with a forthcoming regulatory control period:

- Does not fairly share efficiency gains between TransGrid and its network users
- Creates an incentive for TransGrid to increase operating expenditure in the expected base-year
- Can reward TransGrid for efficiency losses and penalise it for efficiency gains
- Does not provide a continuous incentive for TransGrid to pursue efficiency improvements in operating expenditure.

These issues are inconsistent with the Rules which require[208]:

- Fair sharing between transmission network service providers and transmission network users of operating expenditure efficiency gains and losses
- A continuous incentive for transmission network service providers to reduce operating expenditure.

Further, the AER have stated:

> …there are two potential incentive problems with our revealed cost forecasting approach when an EBSS is not in place:
>
> - A Network Service Provider (NSP) has an incentive to increase opex in the expected base year to increase its forecast opex allowance for the following regulatory control period.
> - An NSP's incentive to make sustainable change to its practices, and reduce its recurrent opex, declines as the regulatory control period progresses. It then increases again after the base year used to forecast opex for the next regulatory control period. By delaying these ongoing efficiency gains until after the base year the NSP can retain the benefits of doing so for longer because they won't be reflected in the opex forecast for the following period.[209]

However, the problems the AER have identified remain when a four year EBSS carryover period is combined with a forthcoming five year regulatory control period. This is illustrated in the worked examples, below. They show the total operating expenditure related revenue (ie, the combined operating expenditure allowance and EBSS carryover penalties and rewards) that would be received by TransGrid with a four year EBSS carryover under three different scenarios: low base year; medium base year, and high base year.

In each scenario, the same total operating expenditure is incurred within the first regulatory control period, and the same level of operating expenditure is achieved in the next regulatory control period. However, there are material differences in the operating expenditure related revenue received by

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[208] AEMC: *National Electricity Rules*, Chapter 6A, v81

[209] AER: *Better Regulation, Explanatory Statement EBSS for Electricity Network Service Providers,* November 2013

TransGrid, depending on base year expenditure. This indicates the four year EBSS carryover is not functioning correctly.

The worked examples are for illustrative purposes only, and consequently use hypothetical expenditure and allowances.

Table 13.1: Summary of three revenue scenarios using a four year EBSS carryover, $

Scenario:	Low base year	Medium base year	High base year
Expenditure, $ (hypothetical)			
Total opex spend in 1st period	100	100	100
Base year opex spend in 1st period (allowance $25)	15	25	35
Total opex spend in 2nd period	125	125	125
Revenue, $ (hypothetical)			
Total opex allowance in 2nd period	75	125	175
Total EBSS allowance in 2nd period	45	15	-15
Total combined opex related revenue (EBSS + opex allowance)	**120**	**140**	**160**
Scenario:	Low base year	Medium base year	High base year

Source: TransGrid. Example data only

The AER's scheme is designed to be indifferent to the actual spend in the base year, that is irrespective of a higher or lower spend in the base year, the combined operating expenditure related revenue (from the opex allowance and the EBSS allowance) in the next period should be insensitive to the timing of spend.

These scenarios set out in Table 13.1, which assume a total period spend of $100 in all scenarios but differing base year spend, are indeed highly sensitive to the base year spend when a four year carryover is applied. The scenarios show that the more TransGrid spends in the expected base year, the more revenue it can expect to receive in the forthcoming regulatory control period.

The low base year scenario also shows there is a risk TransGrid may not receive sufficient revenue to match its operating expenditure requirement if it achieves too large a saving in the base year. This is because the total operating expenditure allowance and EBSS carryover TransGrid would receive in the 2nd regulatory period is $120, whereas its operating expenditure requirement during the same period would be $125. The incentives and risks illustrated by these scenarios are removed if a five year EBSS carryover is applied.

TransGrid submitted to the AER through the Framework and Approach process that the current four year carryover period should be replaced with a five year carryover period for the EBSS incentives to work correctly[210]. The AER responded in the Framework and Approach final decision:

[210] TransGrid, *Proposal to change EBSS carryover resulting from the current regulatory control period from 4 to 5 years,* Letter to the AER, 11th April 2016 [TransGrid-Letter to AER Regarding TransGrid 4 Year Carryover-0416-PUBLIC]

> …we understand TransGrid's concern that applying a four year carryover period may create inappropriate incentives.
>
> We consider the NER provides the flexibility for us to implement an EBSS in a way which will address any inappropriate incentives arising from a change in the duration of regulatory control periods. Noting this, if TransGrid considers that a four year carryover period creates inappropriate incentives, TransGrid should continue to pursue efficiency gains in line with the objectives of the EBSS. If, at the time of submitting its regulatory proposal, TransGrid maintains that a five year carryover period is preferable, then we will consider whether that better meets the requirements of the NER. [211]

TransGrid maintains that a five year carryover period is preferable and consistent with the objectives of the EBSS. TransGrid has respected the intended operation of the scheme and responded consistently with a correctly functioning scheme, rather than in line with the operation of the scheme as it is currently specified. That is, TransGrid has continued to seek out and implement efficiency opportunities and reduce operating expenditure wherever possible.

13.3 Proposed carryover amounts from the current period

TransGrid proposes that a five year carryover period should be applied in calculating the EBSS component of the next revenue decision. This is because the current four year carryover period produces inappropriate rewards and penalties that are at odds with the objectives of the EBSS and therefore may not be in the long term interests of consumers. TransGrid has honoured the spirit of the scheme and acted in accordance with the intended incentive properties of the scheme, rather than the incentives created by the four year carryover.

TransGrid has calculated the following carryover amounts in accordance with the AER's May 2015 final revenue determination[212], but using a five year carryover period:

Table 13.2: Proposed EBSS carryover from the current period ($m June 18)

Regulatory year	2018/19	2019/20	2020/21	2021/22	2022/23
EBSS Carryover	25.4	25.4	3.4	8.3	0

Source: TransGrid.

13.4 Application of EBSS 2018/19 to 2022/23

EBSS version two[213] is expected to be applied to TransGrid for the next regulatory control period, with a carryover period of five years. In accordance with the EBSS guidelines, all operating expenditure excluding debt raising costs, should be subject to the EBSS.

Consequently, TransGrid has proposed the following operating expenditure forecast for EBSS purposes, which excludes debt raising costs:

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[211] AER: *Framework and approach for TransGrid for regulatory control period commencing 1 July 2018*, July 2016, pp. 16-17

[212] AER: *Final Decision, TransGrid transmission determination 2015-16 to 2017-18, Attachment 9 – Efficiency benefit sharing scheme (EBSS)*, April 2015, p.9

[213] AER: *Better Regulation, Explanatory Statement, Efficiency Benefit Sharing Scheme for Electricity Network Service Providers*, November 2013.

Table 13.3: Forecast operating expenditure for EBSS 2018/19 to 2022/23 ($m June 18)

Regulatory year	2018/19	2019/20	2020/21	2021/22	2022/23
Forecast operating expenditure for EBSS	177.2	178.8	181.3	184.0	186.4

Source: TransGrid.

13.5 Inter-relationship with TransGrid's forecasting methodology

TransGrid has considered the inter-relationship between its operating expenditure forecast and the EBSS. This is in light of TransGrid's modification to the AER methodology for forecasting the final year of the current regulatory control period, 2017/18, for the purpose of forecasting operating expenditure in the next regulatory control period.

According to advice provided by Frontier Economics, there are no perverse or unintended outcomes in TransGrid using an alternative forecast for 2017/18 for its operating expenditure forecast in conjunction with version two of the EBSS:

> … it would be appropriate to continue applying the EBSS by using the existing methodology for final year estimation of actual opex alongside the use of the alternative methodology for forecasting opex for the next RCP [regulatory control period]. This combination would expose the TNSP to approximately 30% of the one-off gain or loss arising from differences between RoCn and RoCn+1.[214]

RoCn and RoCn+1 means the rate of change of operating expenditure in the current period and the rate of change of operating expenditure in the next period.

[214] Frontier Economics: *Prescribed operating expenditure forecast starting point*, January 2017, p.16 [TransGrid-Frontier Economics-Appendix J Opex forecast starting point-0117-PUBLIC]

14. Capital Expenditure Sharing Scheme

14.1 Introduction

The capital expenditure sharing scheme (CESS) allows savings to be shared between consumers and a transmission business when capital expenditure in a period is lower than the capital expenditure allowance. Consumers benefit through lower future network charges and the transmission business receives a financial benefit for becoming more efficient. The business could also be subject to a financial penalty if actual capital expenditure is higher than the allowance and is not later found to be efficient.

14.2 Capital Expenditure Sharing Scheme in the current period

In this regulatory period the scheme operates only over 2015/16 to 2017/18, as the 2014/15 transitional year of the last determination was excluded[215] and CESS Version 1 was applied. Consistent with the AER's Guideline[216], capital expenditure for a priority project approved under the network capability component of the Service Target Performance Incentive Scheme (STPIS) was excluded from the scheme.

The Final Framework & Approach paper for 2018/19 to 2022/23 concluded that CESS Version 1 would also apply in the coming period.

14.2.1 Historical performance 2015/16 to 2017/18

TransGrid's CESS target (the net capital expenditure allowance) for this period was set by the 2014/15 to 2017/18 revenue determination. Early in the period, TransGrid responded to the incentive and sought ways to reduce the capital program through efficiency identification, risk adjustment and project de-scoping. Later in the period, it sought to further optimise the program by applying a much improved approach to risk management. The result was the actual for 2015/16 and expected underspend is shown in Table 14.1.

Table 14.1: Current period CESS performance ($m nominal)

	2015/16	2016/17	2017/18
CESS capital expenditure target	308.8	242.6	231.7
Actual/expected CESS capital expenditure	237.3	190.7	200.2
Difference (actual/expected underspend against CESS target)	71.5	51.9	32.6

Source: TransGrid. Totals may not add due to rounding.

[215] AER, FINAL DECISION - TransGrid transmission determination - 2015−16 to 2017−18 Attachment 10 – Capital expenditure sharing scheme (CESS) April 2015, p7

[216] AER, Capex incentive guideline, November 2013, p.6

14.2.2 Capital Expenditure Sharing Scheme allowance for 2018/19 to 2022/23

On the basis of the AER Guideline, 70% of the efficiency savings benefit consumers and 30% is allocated to TransGrid. TransGrid has calculated the CESS building block allowance for 2018/19 to 2022/23 (which arises from performance in 2015/16 to 2017/18) to be $22.47 million ($m June 18).

TransGrid's calculation uses WACC as the discount rate. Nominal vanilla discount rates used were 6.75% for 2015/16, 6.67% for the remainder of this period and 6.6% for the upcoming period.

14.2.3 Inter-period deferral

The CESS calculation has also adjusted for the deferral of capital expenditure between periods and TransGrid's Stockdill project fits the criteria[217]. Stockdill substation is the intended second supply point for the ACT, as required by the ACT transmission licence. This project was delayed due to challenges obtaining land and an easement corridor relating to the original site. A new site has been found but it is unlikely that the investment will be completed within the current period. Consistent with the AER Guideline, an adjustment has been made to the CESS calculation for this project's forecast capital expenditure in the next regulatory control period. This has reduced the calculated CESS building block allowance.

14.3 Proposed scheme for 2018/19 to 2022/23

TransGrid proposes to apply the CESS mechanism as set out in the existing AER Guideline for the upcoming regulatory control period. Any CESS penalty/allowance arising from expenditure overspend/savings through 2018/19 to 2022/23 will therefore be determined in the 2023/24 regulatory decision.

[217] Inter-period deferrals are projects which were intended to be built in the period when the regulatory allowance was set but which are ultimately deferred into the next period

15. Maximum Allowed Revenue

The maximum allowed revenue defines the maximum amount of revenue TransGrid proposes it be allowed to recover in each year of the upcoming regulatory control period.

TransGrid's proposed maximum allowed revenue (MAR) is calculated based on the building block approach outlined in the National Electricity Rules and the AER's post-tax revenue model.

The pricing methodology approved by the AER is applied to the MAR to calculate prices for TransGrid's transmission customers.

The detailed information substantiating the building block components has been described in the preceding chapters. This chapter summarises the building block approach and presents the resultant maximum allowed revenue and x-factor, along with an indication of the average price path.

15.1 Building block approach

The building block components outlined in Clause 6A.5.4 of the Rules, and to be applied in each year of the regulatory control period, are:

MAR = return on capital + return of capital + opex + tax allowance + revenue adjustments

ie, MAR = WACC*RAB + regulatory depreciation + opex + tax allowance + revenue adjustments

where:

- MAR = maximum allowed revenue
- Return of capital = straight line depreciation less indexation of RAB
- opex = operating expenditure
- tax allowance = cost of corporate income tax for the regulated business
- Revenue adjustments:
  - EBSS = Efficiency benefit sharing scheme
  - CESS = Capital expenditure sharing scheme
  - Shared Assets = revenue decrements (if any) arising from the use of assets that provide prescribed transmission services to provide non-regulated transmission services or services that are not transmission services.

TransGrid has applied the AER's building block approach to forecast the revenue requirement. The proposed revenue requirement is then smoothed with an x-factor in accordance with Clause 6A.6.8 of the Rules.

A brief summary for each building block component is set out in the rest of this chapter along with unsmoothed and smoothed revenue requirements.

15.1.1 Regulatory Asset Base

The forecast regulatory asset base over the 2018/19 to 2022/23 period is discussed in detail in Chapter 7 and set out in Table 15.1.

Table 15.1: Forecast regulatory asset base ($m nominal)

RAB	2018/19	2019/20	2020/21	2021/22	2022/23
Opening RAB	6,405.6	6,525.2	6,725.0	6,952.8	7,212.3
Net capital expenditure	228.0	325.3	367.1	405.5	458.7
Straight line depreciation	-261.6	-281.5	-300.0	-312.3	-331.3
Inflation adjustment	153.2	156.0	160.8	166.2	172.4
Closing RAB	6,525.2	6,725.0	6,952.8	7,212.3	7,512.1

Source: TransGrid. Totals may not add due to rounding.

15.1.2 Equity raising costs

TransGrid has applied the AER's approach to forecast equity raising costs in the PTRM.

15.1.3 Inflation assumption

TransGrid's forecast inflation is 2.39% for 2018/19 to 2022/23 regulatory period based on the AER preferred approach.

TransGrid notes that the AER will consult on the approach to forecasting expected inflation during 2017. Currently, TransGrid bears the risk of any difference between forecast and actual inflation under the rules. In the 2014/15 to 2017/18 regulatory period, there has been a mis-match between forecast and actual inflation that is resulting in TransGrid receiving significantly reduced revenue than what would have been allowed if there had not been a mis-match. The level of under-recovery in this period to date is unprecedented. TransGrid calculates this reduced revenue to be $110 million in the first two years of this regulatory period, and estimates it to be $170 million by the end of the period. TransGrid submits that the current approach to forecasting inflation, and its treatment in the PTRM calculate the MAR, should not be amended without TransGrid first having an opportunity to recover this lost revenue under the current arrangements. TransGrid's current expectation is that over the passage of time mis-matches between forecast and actual inflation giving rise to gains and losses in specific regulatory periods for TransGrid will equalise. TransGrid considers that it would be inconsistent with sound regulatory principles to amend a methodology with the effect of removing a potentially offsetting favourable outcome while not compensating shareholders for past losses arising from the previous application of the methodology.

15.1.4 Return on capital

The return on capital is calculated based on applying the post-tax vanilla nominal WACC to the opening RAB in the respective year using the AER's PTRM. The calculation of the WACC of 6.6% is discussed in Chapter 8.

The forecast return on capital for the 2018/19 to 2022/23 period is shown in Table 15.2.

Table 15.2: Return on capital ($m nominal)

	2018/19	2019/20	2020/21	2021/22	2022/23	Total
Opening RAB	6,405.6	6,525.2	6,725.0	6,952.8	7,212.3	
Return on capital	423.0	430.9	444.1	459.2	476.3	**2,233.5**

Source: TransGrid. Totals may not add due to rounding.

15.1.5 Regulatory depreciation

The calculation of regulatory depreciation is discussed in detail in Chapter 10. The forecast regulatory depreciation is derived from the AER's PTRM. A summary of the forecast depreciation for 2018/19 to 2022/23 is shown in Table 15.3.

Table 15.3: Regulatory depreciation ($m nominal)

	2018/19	2019/20	2020/21	2021/22	2022/23	Total
Regulatory depreciation	108.4	125.5	139.2	146.1	158.9	**678.1**

Source: TransGrid. Totals may not add due to rounding

15.1.6 Operating expenditure

Operating expenditure is discussed in Chapter 6. The forecast operating expenditure for 2018/19 to 2022/23 is summarised in Table 15.4.

Table 15.4: Operating expenditure ($m nominal)

	2018/19	2019/20	2020/21	2021/22	2022/23	Total
Operating expenditure	181.4	187.4	194.6	202.2	209.8	975.4
Debt raising costs	8.2	8.3	8.6	8.9	9.2	43.1
Total	**189.6**	**195.7**	**203.1**	**211.1**	**219.0**	**1,018.5**

Source: TransGrid. Totals may not add due to rounding.

15.1.7 Corporate income tax

Forecast corporate income tax is discussed in Chapter 11. Forecast corporate income tax is shown in Table 15.5.

Table 15.5: Corporate income tax ($m nominal)

	2018/19	2019/20	2020/21	2021/22	2022/23	Total
Corporate income tax	44.5	47.1	49.3	52.2	54.8	**247.9**

Source: TransGrid. Totals may not add due to rounding.

15.1.8 Efficiency Benefit Sharing Scheme

The efficiency benefit sharing scheme (EBSS) is discussed in Chapter 13. A summary of the EBSS carryover amounts is set out in Table 15.6.

Table 15.6: Efficiency carryover ($m nominal)

	2018/19	2019/20	2020/21	2021/22	2022/23	Total
EBSS carryover	26.0	26.6	3.6	9.1	-	**65.3**

Source: TransGrid. Totals may not add due to rounding

15.1.9 Capital Expenditure Sharing Scheme

The capital expenditure sharing scheme (CESS) is discussed in chapter 14. A summary of the CESS amounts is set out in Table 15.7.

Table 15.7: Capital Expenditure Sharing Scheme ($m nominal)

	2018/19	2019/20	2020/21	2021/22	2022/23	Total
CESS	5.0	5.1	5.2	5.3	5.5	**26.1**

Source: TransGrid. Total may not add due to rounding

15.1.10 Revenue decrements arising from shared assets

Shared assets is discussed in chapter 12. The forecast shared assets revenue did not exceed the materiality threshold, accordingly there is no revenue decrement proposed.

15.1.11 Service target performance incentive scheme

The service target performance incentive scheme (STPIS) is calculated annually and is not included in the revenue proposal MAR. The details of STPIS are discussed in chapter 16.

15.2 Maximum Allowed Revenue

TransGrid's proposed unsmoothed revenue requirement for each year of the regulatory control period is calculated as the sum of the building block components. Based on the building blocks outlined in the previous sections, the proposed unsmoothed revenue requirement for 2018/19 to 2022/23 is shown in Table 15.8.

Table 15.8: Unsmoothed revenue requirement ($m nominal)

	2018/19	2019/20	2020/21	2021/22	2022/23	Total
Return on capital	423.0	430.9	444.1	459.2	476.3	**2,233.5**
Return of capital (regulatory depreciation)	108.4	125.5	139.2	146.1	158.9	**678.1**
Operating expenditure	189.6	195.7	203.1	211.1	219.0	**1,018.5**
Revenue adjustments	31.0	31.7	8.8	14.4	5.5	**91.4**
Net tax allowance	44.5	47.1	49.3	52.2	54.8	**247.9**
Annual building block revenue requirement (unsmoothed)	796.5	831.0	844.6	882.9	914.4	**4,269.5**

Source: TransGrid. Totals may not add due to rounding.

15.3 Smoothed Maximum Allowed Revenue

The unsmoothed revenue requirement is required to be smoothed with an x-factor, in accordance with Clause 6A.6.8 of the Rules. TransGrid has proposed x-factors which meet the requirements of the Rules that the smoothed MAR is equal to net present value (NPV) of the annual building block revenue requirement, while ensuring that the expected MAR for the last regulatory year is as close as reasonably possible to the annual building block revenue requirement.

The smoothed revenue requirement and x-factor over a five year regulatory control period are shown in Table 15.9.

Table 15.9: Smoothed revenue requirement ($m nominal)

	2018/19	2019/20	2020/21	2021/22	2022/23	Total
Unsmoothed revenue	796.5	831.0	844.6	882.9	914.4	**4,269.5**
Smoothed revenue	796.5	824.3	853.0	882.7	913.4	**4,269.8**
X-factor	-8.04%	-1.07%	-1.07%	-1.07%	-1.07%	

Source: TransGrid. Totals may not add due to rounding.

15.4 Average price path

TransGrid determines its transmission charges based on the AER's approved revenue and the pricing principles in Clause 6A.23 of the Rules. The average price path is illustrative and estimated using the AER's Post Tax Revenue Model, by dividing the revenue requirement by the energy delivered in New South Wales which is forecast by AEMO.[218] Price movements for individual customers will vary depending on usage and location.

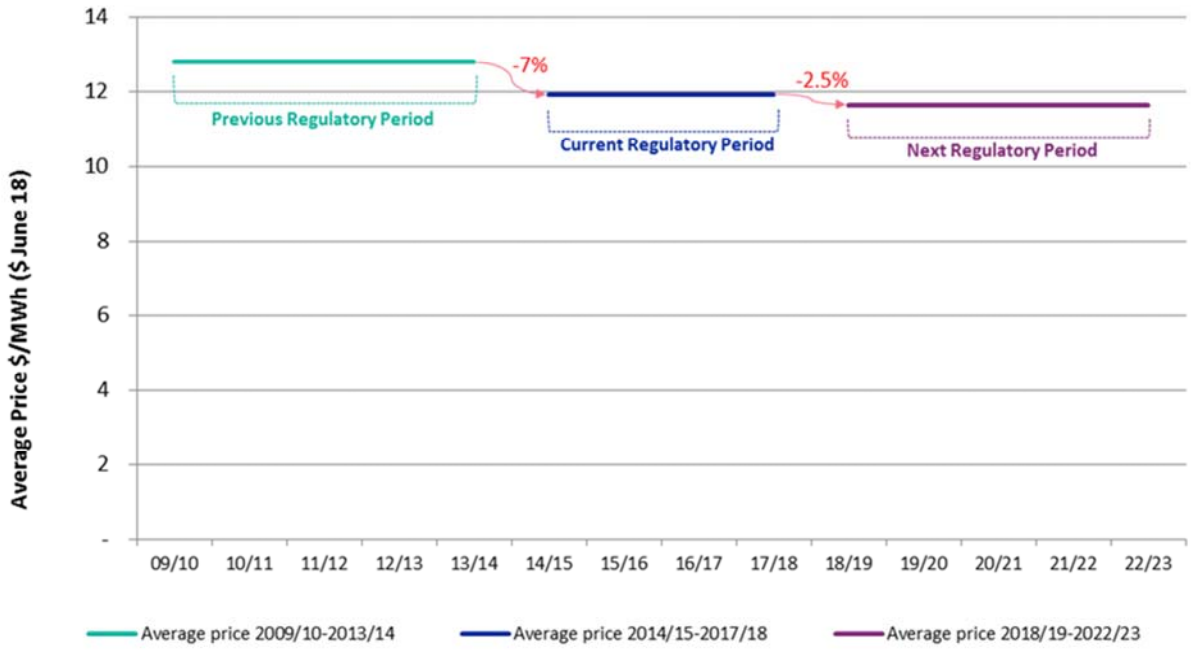
[218] AEMO, *National Electricity Forecasting Report*, 2016. [TransGrid-AEMO-2016 National Electricity Forecasting report-0616-PUBLIC]

As a result of some major Rule changes in 2012, TransGrid's last revenue decision included a transitional year for 2014/15. The final regulatory decision was made very close to the end of the 2014/15 year. The consequence of this was a significant mismatch between the AER's transitional and final decision for the revenue allowance in 2014/15. This led to material corrections for 2014/15 revenue in the remaining years of the regulatory period resulting in revenue for pricing purposes which is materially below the AER's actual revenue allowance for those years.

The correction to the AER's final decision to take account of the impact of the transitional decision has meant that revenue collected in 2017/18 is in the order of $61 million lower than it should have been. As a result prices in 2018/19 will increase by 5%.

This proposal reflects the third consecutive regulatory period of reductions in average annual prices. Prices dropped by 7% from the prior regulatory period to the current period, and on the basis of this proposal will reduce again by 2.5%. The average price path over the upcoming revenue period is shown in Figure 15.1.

Figure 15.1 Real price change between regulatory periods



Source: TransGrid. Determined prices shown for 2009/10 to 2017/18. Forecast prices shown for 2018/19 to 2022/23

15.5 Revenue cap adjustments

In accordance with the Rules, TransGrid's revenue cap determined by the AER will be subject to adjustment during the regulatory control period as follows:

- the revenue cap is calculated each year using actual CPI.
- the revenue cap is calculated each year using updated return on debt.
- network support costs are treated as a pass through cost. Clause 6A.7.2 of the Rules requires that any changes in network support costs will be subject to a pass through application. The application will seek to vary the annual MAR each year based on the difference between forecast and actual network support expenditure.
- Clause 6A.7.3 of the Rules allows the pass through of other approved costs related to:

- regulatory change event
- service standard event
- tax change event
- insurance event
- any other event specified in a transmission determination as a pass through event for the determination.

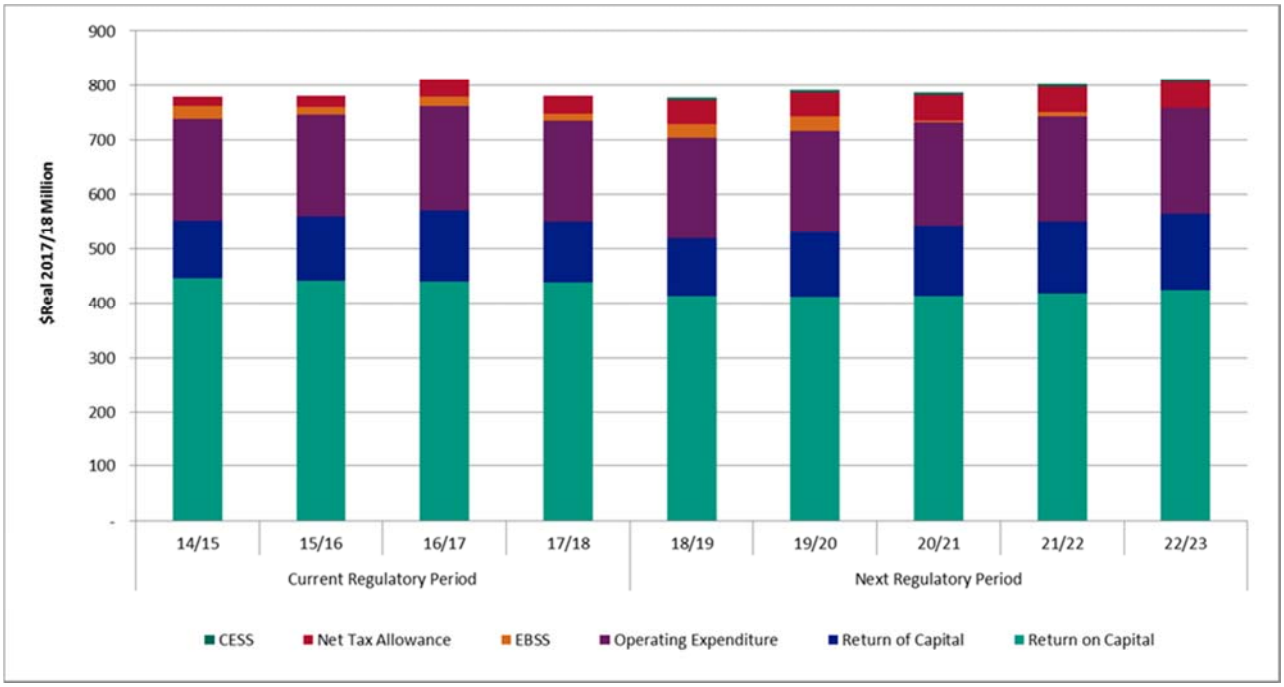
Clause 6A.8.2 of the Rules allows amendment of the revenue determination for contingent projects. Contingent projects are discussed in Chapter 5. If a trigger event for a contingent project occurs, TransGrid will assess the projects using the RIT-T, where applicable, and lodge an application to the AER requesting a revised MAR in accordance with Clause 6A.8.2 of the Rules.

15.6 Comparison of revenue

TransGrid's current regulatory period is four years compared to the five year period in this proposal for 2018/19 to 2022/23. The maximum allowed revenue in the current period is $3,140 million, or $785 million on average each year. This compares with a proposed maximum allowed revenue of $3,973 million, or $795 million on average each year in the next period.

This annual 1% real increase reflects investments made in the network over the last five years that have been necessary to maintain an appropriate level of reliability, safety and environmental performance and operating expenditure to meet new obligations.

Figure 15.2: Comparison of revenue ($June 2018)



Source: TransGrid.

16. Service Target Performance Incentive Scheme

The service target performance incentive scheme (STPIS) provides incentives for transmission network service providers to improve and maintain the performance of the network for the benefit of consumers. The scheme incentivises the business to outperform relative to its own previous performance which becomes increasingly challenging over time.

TransGrid has participated in the service target performance incentive scheme since 2004. It has responded to the incentives to maintain or improve reliability in accordance with the service component, it has reduced transmission congestion during equipment outages in accordance with the market impact component. In the current regulatory period TransGrid has also delivered all of the approved network capability projects.

16.1 Version of the scheme

In 2014/15, TransGrid was subject to transitional arrangements as set out in the AER's position paper, Service Target Performance Incentive Scheme for Transmission Businesses: Early Application of Version 4. The transitional arrangements applied version 2 of the service component, version 4 of the market impact component and version 4 of the network capability component in 2014/15.

From 2015/16, TransGrid is now subject to version 4 of the STPIS in its entirety. This includes a revised service component, revised market impact component and the new network capability component.

From 2018/19, TransGrid will be subject to version 5 of the STPIS. This includes further revisions to all components.

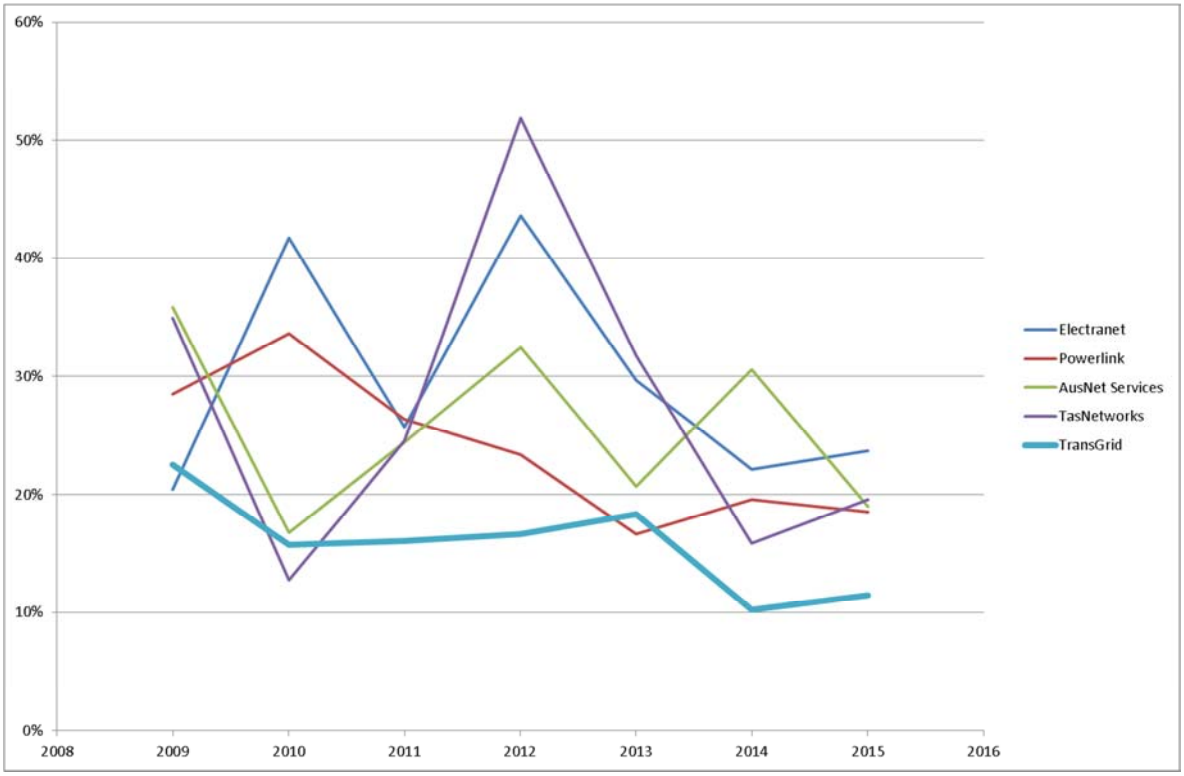
16.2 Proposed application

16.2.1 Service component

TransGrid has a highly reliable transmission network and is a leader in the NEM on each sub-parameter relating to the fault outage rate[219] as shown in figures 16.1 to 16.3. There is potential to incrementally further improve performance in loss of supply events and outage duration following the establishment of the Asset Monitoring Centre and increasing use of active monitoring technologies.

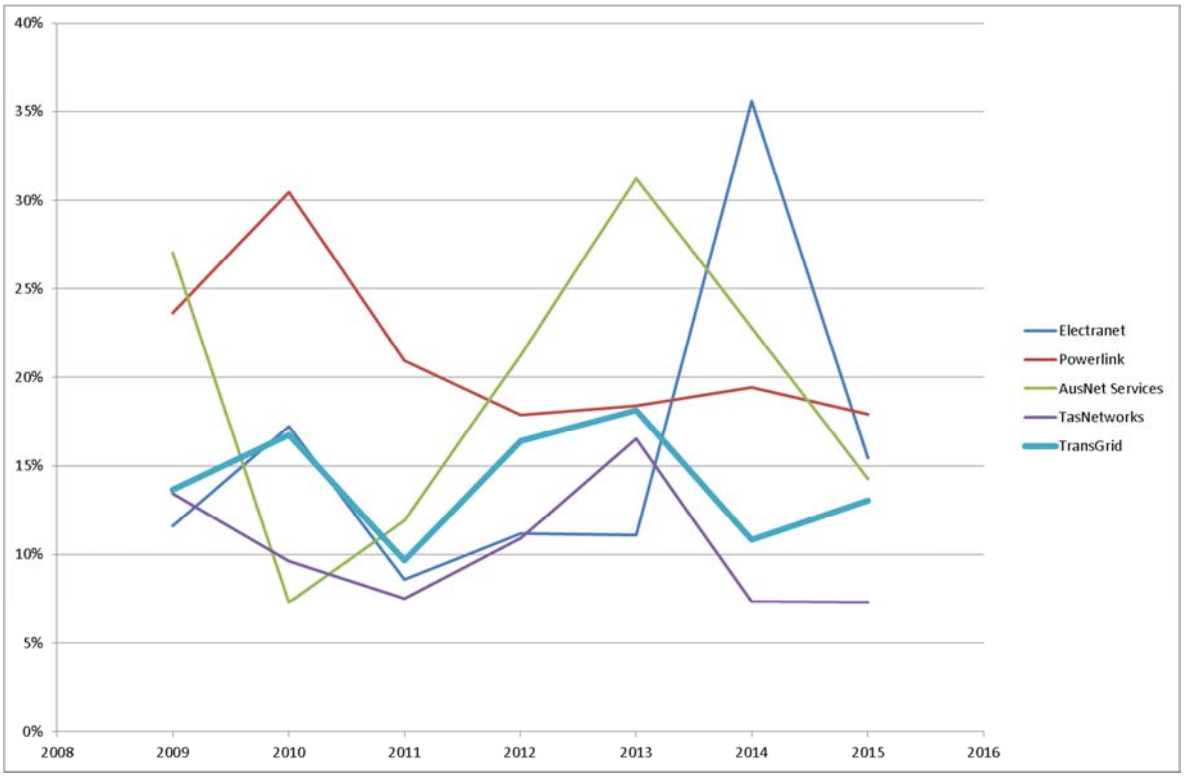
[219] This data is available in TNSP RINs published on the AER's website - https://www.aer.gov.au/taxonomy/term/1495

Figure 16.1: Fault outage rates – transmission lines



Source: TransGrid using data from AER published TNSP RINs

Figure 16.2: Fault outage rates – transformers



Source: TransGrid using data from AER published TNSP RINs

Figure 16.3: Fault outage rates – reactive plant

Source: TransGrid using data from AER published TNSP RINs

16.2.1.1 Approach to setting service component targets

TransGrid has used the approach set out in the STPIS guideline to calculate targets, caps and floors for the service component of the STPIS.

TransGrid engaged WSP Parsons Brinckerhoff to review TransGrid's historical performance under the sub-parameters in version 5 of the STPIS, determine statistical distributions that best fit its historical performance under each sub-parameter, and to propose caps and floors. WSP Parsons Brinckerhoff's expert paper setting out the detailed analysis is included as Appendix X.

16.2.1.2 Service component values

A summary of the proposed targets, caps and floors for the service component is shown in Table 16.1.

The weightings applied are those that have been set in the STPIS guideline.

Table 16.1: Proposed service component values

Parameter	Floor	Target	Cap	Weighting (% MAR)
Unplanned outage circuit event rate:				**0.75**
Lines event rate – fault	20.4%	14.00%	9.1%	0.20
Transformer event rate – fault	20.5%	15.60%	10.1%	0.20
Reactive plant event rate– fault	17.9%	12.40%	7.9%	0.10
Lines event rate – forced	27.1%	15.40%	1.4%	0.10
Transformer event rate – forced	41.0%	26.60%	15.3%	0.10
Reactive plant event rate– forced	29.0%	22.70%	15.6%	0.05
Loss of supply event frequency				**0.30**
> 0.05 system minutes	7	3	1	0.15
> 0.25 system minutes	3	1	0	0.15
Average outage duration	**299**	**134**	**41**	**0.20**
Proper operation of equipment				**0.00**
Failure of protection system	27	20	13	0.00
Material failure of supervisory control and data acquisition (SCADA) system	24	8	0	0.00
Incorrect operational isolation of primary or secondary equipment	12	7	3	0.00

Source: TransGrid. Totals may not add due to rounding

16.2.2 Market impact component

TransGrid has participated in the market impact component since 2009, and has made significant improvements to the management of transmission congestion in response to the component. However, in recent years, this has become more challenging.

Several TNSPs have found that performance against the market impact component can be materially affected depending on the areas of the network in which significant works are undertaken in any year. This is reflected in the large spread of results for each TNSP since the scheme was introduced.

For TransGrid, its performance over the last two calendar years reflects planned work to alleviate network constraints (including priority projects under the network capability component) and planned asset renewal. While TransGrid has continued to plan outages in such a way that minimises market impact, the incidence of market impact dispatch intervals has been unavoidable while delivering work to achieve overall benefits. TransGrid has observed similar effects in the performance of other TNSPs.

16.2.2.1 Market impact component weighting

In version 5 of the STPIS, which the AER has proposed to apply to TransGrid from 2018/19, the default weighting of the market impact component has been changed to ±1% (compared to 0% to 2% in version 4). Given the above observations on the recent operation of the scheme, TransGrid is concerned that the introduction of a penalty for the market impact component would be likely to penalise TNSPs during planned works to alleviate network constraints. In effect, TNSPs would be penalised for undertaking works that are in the long term interests of consumers. This would be contrary to the National Electricity Objective and objectives of the STPIS.

TransGrid requests the AER to further consider the recent operation of the scheme, and defer the introduction of a penalty for the market impact component pending further consideration of perverse incentives this appears to create. TransGrid proposes the continuation of the 0% to 2% weighting applied in version 4 of the STPIS until this can be considered and resolved.

16.2.2.2 Market impact component performance target.

Under version 5 of the STPIS of the market impact component (MIC), the performance target is set based on the average of the median five years from the most recent seven years of historical performance. The unplanned outage event limit is calculated as 17% of the final performance target. The dollar per dispatch interval incentive ($/DI) is calculated by dividing 1% of the MAR for the first year of the regulatory period by the proposed performance target. The final target will be set after the annual STPIS performance review process in 2018. The proposed values below are based on performance to date.

The table below shows the number of “included limiting dispatch intervals” used in the calculation of the performance target. This will be updated in the revised proposal for 2016 final numbers.

Table 16.2: Historical market impact component performance

	2010	2011	2012	2013	2014	2015	2016
Included Limiting Dispatch Intervals	780	870	773	593	750	1,329	1,832 est

Source: TransGrid.

The proposed performance target, calculated in accordance with version 5 of STPIS is 900 dispatch intervals. The proposed unplanned outage event limit is 153. The proposed dollar per dispatch interval incentive is $8,641.

16.2.3 Network capability component

The network capability component continues to apply in version 5 of the STPIS which funds and rewards low cost projects to improve network capability, it also includes a penalty for non-delivery.

A Network Capability Incentive Parameter Action Plan (NCIPAP), to support network capability, has been developed in consultation with AEMO and is included as Appendix Y - Network Capability Incentive Parameter Action Plan. AEMO approved the NCIPAP as submitted to the AER on 21 December 2016. AEMO’s approval letter is attached to the NCIPAP.

17. Pass Through Events

Cost pass through arrangements provide for adjustments to the allowed revenue if a non-controllable predefined event occurs that leads to a material change in TransGrid's costs.

This chapter presents the identified risks that TransGrid proposes to nominate as cost pass through events for the 2018/19 to 2022/23 regulatory control period.

17.1 National Electricity Rules requirements

Clause 6A.7.3 of the Rules gives Transmission Network Service Providers (TNSPs) the ability to nominate specific pass through events as part of their revenue proposals. It is intended for a TNSP to recover at least the efficient costs of uncontrollable, material events that either cannot be insured for or where the establishment of self-insurance is not economically viable.

The AER must take into account the nominated pass through event considerations in Chapter 10 of the Rules when determining whether to accept TransGrid's nominated pass through events.

17.2 Proposed nominated events

Clause 6A.7.3 of the Rules provides the following list of prescribed pass through events:

- Regulatory change event
- Service standard event
- Tax change event
- Insurance event
- Any other event specified in a transmission determination as a pass through event for the determination.

The Rules give TNSPs the ability to nominate additional pass through events as part of their revenue proposals.

Chapter 10 of the Rules sets out the nominated cost pass through considerations, these include whether the event:

- is already covered by the pass through Rules
- can be clearly identified at the time the revenue determination is made
- could reasonably be prevented or the cost mitigated
- could be covered by insurance or self-insurance.

TransGrid proposes the following four additional pass through events with proposed definitions set out in Table 17.1:

1. Insurance cap events
2. Terrorism events
3. Insurer credit risk event
4. Natural disaster event.

TransGrid considers that the above pass through events are consistent with the considerations and the intent of the Rules. TransGrid is aware of these risks and has in in place risk mitigation processes.

The occurrence of the proposed nominated events listed in Table 17.1 below will be beyond the control of a prudent network service provider.

Table 17.1 Nominated pass through events

Pass through events	Proposed definition
Insurance cap events	An insurance cap event occurs if: 1. TransGrid makes a claim or claims and receives the benefit of a payment or payments under a relevant insurance policy 2. TransGrid incurs costs beyond the policy limit of the relevant insurance policy at the time of the event that gives rise to the relevant claim 3. the costs beyond the relevant policy limit materially increase the costs to TransGrid in providing prescribed transmission services. For this insurance cap event: > a relevant insurance policy is an insurance policy held during the 2018/19 – 2022/23 regulatory control period or a previous regulatory control period in which TransGrid was regulated. Note: in making a determination on an insurance cap event, the AER will have regard to, amongst other things: ii. the insurance policy for the event iii. the level of insurance that an efficient and prudent TNSP would obtain in respect of the event iv. any assessment by the AER of TransGrid's insurance documented in respect of its transmission determination for the relevant period.
Terrorism events	A terrorism event occurs if: An act (including, but not limited to, the use of force or violence or the threat of force or violence) of any person or group of persons (whether acting alone or on behalf of or in connection with any organisation or government), which from its nature or context is done for, or in connection with, political, religious, ideological, ethnic or similar purposes or reasons (including the intention to influence or intimidate any government and/or put the public, or any section of the public, in fear) and which increases the costs to TransGrid in providing prescribed transmission services. Note: In assessing a terrorism event pass through application, the AER will have regard to, amongst other things: i. whether TransGrid has insurance against the event ii. the level of insurance that an efficient and prudent NSP would obtain in respect of the event iii. whether a declaration has been made by a relevant government authority that an act of terrorism has occurred.

Pass through events	Proposed definition
Insurer credit risk events	An insurer's credit risk event occurs if: A nominated insurer of TransGrid becomes insolvent, and as a result, in respect of an existing, or potential, claim for a risk that was insured by the insolvent insurer, TransGrid: 1. is subject to a materially higher or lower claim limit or a materially higher or lower deductible than would have otherwise applied under the insolvent insurer's policy; or 2. incurs additional costs associated with self-funding an insurance claim, which would otherwise have been covered by the insolvent insurer. Note: In assessing an insurer's credit risk event pass through application, the AER will have regard to, amongst other things: i. TransGrid's attempts to mitigate and prevent the event from occurring by reviewing and considering the insurer's track record, size, credit rating and reputation, and ii. in the event that a claim would have been made after the insurance provider became insolvent, whether TransGrid had reasonable opportunity to insure the risk with a different provider.
Natural disaster event	Natural Disaster Event means any natural disaster including but not limited to fire, flood or earthquake that occurs during the 2018/19 – 2022/23 regulatory control period that increases the costs to TransGrid in providing prescribed transmission services, provided the fire, flood or other event was not a consequence of the acts or omissions of the service provider. Note: In assessing a Natural Disaster Event pass through application, the AER will have regard to, amongst other things: i. whether TransGrid has insurance against the event; and ii. the level of insurance that an efficient and prudent NSP would obtain in respect of the event.

18. Glossary

Acronym/Term	Definition
ABS	Australian Bureau of Statistics
ACT	Australian Capital Territory
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
ALARP	As Low As Reasonably Practicable
ARORO	Allowed Rate of Return Objective
ASX	Australian Securities Exchange
ATO	Australian Taxation Office
AWE	Average Weekly Earnings
BEE	Benchmark Efficient Entity
BSP	Bulk Supply Points
Capex	Capital Expenditure
CAPM	Capital Asset Pricing Model
CBD	Central Business District
CDN	Corporate Data Network
CDPQ	Caisse de dépôt et placement du Québec
CESS	Capital Expenditure Sharing Scheme
CGS	Commonwealth Government Securities
CIGRE	Conseil International des Grands Réseaux Électriques (known as “International Council on Large Electrical Systems”)
CPI	Consumer Price Index
CUARP	Communications Upgrade and Replacement Project
DER	Distributed Energy Resources
DG	Decision Gate
DGM	Dividend Growth Model
DNSP	Distribution Network Service Provider

Acronym/Term	Definition
EA	Enterprise Agreement
EBSS	Efficiency Benefit Sharing Scheme
EGWWS	Electricity, Gas, Water and Waste Services
EI	Economic Insights
ENA	Energy Networks Association
ERA	Economic Regulation Authority of Western Australia
ERP	Enterprise Resource Planning
EUAA	Energy Users Association of Australia
FCAS	Frequency Control Ancillary Services
FTE	Full Time Equivalent
GIS	Gas Insulated Switchgear
GWh	Giga Watt Hour
ICT	Information, Operating and Communications Technology
IEA	International Energy Association
IPART	Independent Pricing and Regulatory Tribunal
ISO	International Organisation for Standardisation
IT	Information Technology
ITOMS	International Transmission Operations and Maintenance Study
kV	Kilo Volts
kW	Kilo Watt
kWh	Kilo Watt Hours
LRMC	Long Run Marginal Costs
MAR	Maximum Allowed Revenue
MIC	Market Impact Component
MRP	Market Risk Premium
MVA	Mega Volt Amps
MW	Mega Watt
MWh	Mega Watt Hours
NAS	Net Advocacy Score

Acronym/Term	Definition
NCIPAP	Network Capability Incentive Parameter Action Plan
NCOSS	NSW Council of Social Service
NEFR	National Energy Forecasting Report
NEL	National Electricity Law
NEM	National Electricity Market
NEO	National Electricity Objective
NERA	NERA Economic Consulting
NOS	Need/Opportunity Statement
NPV	Net Present Value
NSCAS	Network Support and Control Ancillary Services
NSI	NSW to South Australia Interconnector
NSP	Network Service Provider
NSW	New South Wales
NSWEN	NSW Electricity Networks
NTNDP	National Transmission Network Development Plan
NZ	New Zealand
OER	Options Evaluation Report
OFGEM	Office of Gas and Electricity Markets in the UK
OFR	Options Feasibility Requests
OHS	Occupational Health and Safety
Opex	Operating Expenditure
OSA	Options Screening Assessments
OSR	Options Screening Report
PAS 55	Publicly Available Specification 55 (Asset Management)
PIAC	Public Interest Advocacy Centre
PB	Parsons Brinckerhoff
PoE	Probability of Exceedance
PEG	Pacific Economics Group
PMBoK	Project Management Body of Knowledge

Acronym/Term	Definition
PSCR	Project Specification Consultation Report
PSS	Project Scoping Study
PTRM	Post-Tax Revenue Model
PV	Photovoltaics
Qld	Queensland
QNI	Queensland to New South Wales Interconnector
RAB	Regulatory Asset Base
RAM	Risk Assessment Methodology
RBA	Reserve Bank of Australia
RFM	Roll Forward Model
RCP	Regulatory Control Period
RIN	Regulatory Information Notice
RIT-T	Regulatory Investment Test for Transmission
RPGW	Revenue Proposal Working Group
RPP	Revenue and Pricing Principles
RPS	Request for Project Services
Rules	National Electricity Rules
STPIS	Service Target Performance Incentive Scheme
SA	South Australia
SCADA	Supervisory Control and Data Acquisition
SFAIRP	So Far As Is Reasonably Practicable
SKM	Sinclair Knight Merz
SL-CAPM	Sharpe-Lintner Capital Asset Pricing Model
SSB	Secondary System Buildings
STPIS	Service Target Performance Incentive Scheme
SVC	Static VAR Compensator
TAC	TransGrid Advisory Council
TAPR	Transmission Annual Planning Report
Tas	Tasmania

Acronym/Term	Definition
TNSP	Transmission Network Service Provider
Tribunal	Australian Competition Tribunal
TUOS	Transmission Use of System
TW	Tera Watt
TWh	Tera Watt Hour
UK	United Kingdom
US	United States
Vic	Victoria
VCR	Value of Customer Reliability
WACC	Weighted Average Cost of Capital
WPI	Wage Price Index

19. Appendices

Appendix	Topic	Author
A	Network Vision 2056	TransGrid
B	Powering Sydney's Future	TransGrid
C	Consumer engagement activities, feedback and TransGrid's response	TransGrid
D	Off Easement Risk Management - Opex Step Change	TransGrid
E	Efficiency of capital expenditure	Aurecon
F	Review of the AER's 2016 Benchmarking Results	Frontier Economics
G	Capital expenditure projects	TransGrid
H	Wage forecasts to 2023	BIS Shrapnel
I	Review and test of AusGrid's connection point demand forecast	GHD
J	Operating expenditure forecast starting point – technical advice	Frontier Economics
K	Operating expenditure forecast - legal advice	Herbert Smith Freehills
L	Debt raising costs	Incenta
M	Benchmarking (ITOMS)	UMS Group
N	IT Benchmarking of Australian Utilities	KPMG
O	Assurance of maintenance and asset management practices and strategy for 2016/17	Aurecon
P	IT Benchmarking of Global Businesses	CEB
Q	An equity beta estimate for the benchmark efficient entity	Frontier Economics
R	Low Beta Bias	Frontier Economics
S	The market risk premium	Frontier Economics
T	Return on debt transition	Frontier Economics
U	An updated dividend drop-off estimate of theta	Frontier Economics

Appendix	Topic	Author
V	Estimating gamma for regulatory purposes	Frontier Economics
W	Depreciation Schedule	TransGrid
X	STPIS: Fitting probability curves to reliability data	WSP Parsons Brinckerhoff
Y	Network Capability Incentive Parameter Action Plan	TransGrid
Z	Directors certification of the reasonableness of the key assumptions of the proposal	TransGrid