

VICTORIAN ANNUAL PLANNING REPORT

ELECTRICITY TRANSMISSION NETWORK PLANNING FOR
VICTORIA

Published: **June 2015**





Purpose

The purpose of this publication is to provide information relating to electricity supply, demand, network capability and development for Victoria's electricity declared shared network.

AEMO publishes the Victorian Annual Planning Report (VAPR) in accordance with clause 5.12 of the National Electricity Rules. This publication is based on information available to AEMO as at 31 March 2015, although AEMO has incorporated more recent information where practical.

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Acknowledgement

AEMO acknowledges the support, cooperation and contribution of all electricity industry participants in providing data and information used in this publication.



EXECUTIVE SUMMARY

The Australian Energy Market Operator (AEMO) is responsible for planning and directing augmentations to the Victorian electricity transmission declared shared network (DSN).

In the Victorian Annual Planning Report (VAPR), AEMO considers the adequacy of the DSN to meet its reliability requirements over the next 10 years, and identifies a range of possible network and non-network investment opportunities to address emerging network constraints.

Emerging investment opportunities

Although growth in maximum demand is slowing across the Victorian region, there are areas such as western Melbourne where growth in maximum demand still necessitates investment. This is mainly due to population growth. The 2015 VAPR identifies the following investment opportunities to address constraints in the network over the next 10 years:

- Constraints on the Keilor – Deer Park – Geelong lines, which will service parts of western Melbourne.
- Constraints on the Ballarat–Horsham lines servicing parts of regional Victoria, which affect export capacity to New South Wales.

The VAPR also identifies the following area of network congestion which requires further investigation:

- Constraints on the South Morang 500 / 330 kV F2 transformer, which limit the export capacity to New South Wales.

Network charges

Over the coming 10-year period, AEMO expects transmission network charges to customers (generally some 5% of a typical residential electricity bill) to reduce by up to 1.9% per annum under the high growth scenario, reduce by 1.3% per annum under the medium growth scenario, and rise by 0.5% per annum under the low growth scenario.

These forecast changes to transmission network charges demonstrate the pricing impacts of Victorian transmission asset renewal and augmentation projects over the next 10 years. Most transmission network expenditure will relate to asset renewal rather than network augmentation, due to lower growth in demand forecast within Victoria.

Deferred investments

In July 2014, AEMO sought tenders for the acquisition of non-market ancillary services in regional Victoria, as the third stage of a proposed solution to manage identified constraints on the Ballarat–Bendigo 220 kV line and the Moorabool-Ballarat No.1 220 kV line, possible under a combination of conditions. The final regulatory investment test for transmission (RIT-T) report on these network constraints was the Regional Victorian Thermal Capacity Upgrade RIT-T Stage 3 Report, published on 12 June 2014.

After reviewing current and forecast network conditions and potential solutions, AEMO finds that, at this stage, the acquisition of services to address the third stage of the Regional Victorian Thermal Capacity Upgrade RIT-T does not deliver net economic benefits to Victorian customers and can therefore be deferred.

Asset renewal

In its capacity as the Victorian transmission planner, AEMO conducted a review of AusNet Services' asset renewal plan to provide an independent view of the transmission network investment needs in Victoria. AEMO has published AusNet Services' latest asset renewal plan, as required under the National Electricity Rules.



CONTENTS

EXECUTIVE SUMMARY	1
CHAPTER 1. INTRODUCTION	3
1.1 Supporting Material	3
CHAPTER 2. NETWORK DEVELOPMENT	4
2.1 Deferred Investment	4
2.2 Completed Projects	4
2.3 Future Projects	5
2.4 Potential Locations for New Terminal Stations in Victoria	6
2.5 Network Support and Control Ancillary Services	8
CHAPTER 3. ASSET RENEWAL PROJECTS	9
CHAPTER 4. TRANSMISSION CHARGES	9
MEASURES AND ABBREVIATIONS	11
GLOSSARY	12

TABLES

Table 1 2015 VAPR resource suite	3
Table 2 Generation connection enquiries and applications	7
Table 3 Proposed new terminal stations for generation connection enquiries and applications	7
Table 4 Proposed new terminal stations for connecting load	7
Table 5 Large projects proposed for asset renewal	9

FIGURES

Figure 1 Projection of Victorian Transmission Charges	10
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CHAPTER 1. INTRODUCTION

The Australian Energy Market Operator (AEMO) is responsible for planning and directing augmentations to the Victorian electricity transmission declared shared network (DSN). The Victorian Annual Planning Report (VAPR) supports Victorian energy investment decision-making by providing electricity network planning information over a 10-year outlook period.

Chapter 2 of the VAPR identifies investment opportunities to address emerging limitations, provides updates on current regulatory investment tests for transmission (RIT-T), and highlights deferred projects. It also lists the latest generation connection enquiries and applications, as well as proposed new terminal stations.

Chapter 3 gives an overview of AusNet Services' asset renewal projects planned for the coming 10-year period, which have been independently reviewed by AEMO.

Chapter 4 discusses future transmission charges for Victorian electricity consumers.

1.1 Supporting Material

A suite of resources has been published on the AEMO website¹ to support the content in this report.

Table 1 2015 VAPR resource suite

Resource	Description
Interactive NEM Map	The interactive NEM map ² provides data and analysis for a range of National Electricity Market (NEM) topics including emerging investment opportunities, transmission connection point forecasts, short-circuit levels and national transmission plans.
Historical DSN ratings workbook	The historical DSN ratings workbook ³ presents continuous and short-term line and transformer ratings and loadings for the 2014–15 high demand and high export periods presented on the interactive map.
DSN limitation detail	This spreadsheet ³ includes background, technical details, possible options, triggers, and recommendations for transmission network limitations that might arise in the coming 10-year period.
Victorian Distribution Network Planning	This document ³ lists the preferred connection modifications from the 2014 Transmission Connection Planning Report ⁴ , and the potential DSN impacts and considerations.
AusNet Services Asset Renewal Plan	This plan ³ outlines AusNet Services' transmission asset renewal process and provides a list of their planned asset renewal projects for the next 10-year period, including the changes since last year and the various options considered.
Short-circuit levels report & workbook	This material ³ provides information on the capability of Victoria's electricity transmission network to withstand short-circuit currents over a five-year outlook period from 2015 to 2019.
Demand Forecasts	Victorian demand forecasts ⁵ developed by Distribution Network Service Providers (DNSPs), and independent forecasts developed by AEMO, are provided on AEMO's website.
Constraint Reports	AEMO uses constraint equations to operate the DSN securely within power system limitations. The constraint equations are implemented in the National Electricity Market Dispatch Engine (NEMDE), which dispatches generation to ensure operation within the bounds of power system limitations. AEMO's annual ⁶ and monthly constraint reports ⁷ detail the historical performance of these constraint equations.

¹ AEMO. Victorian Annual Planning Report. Available at: <http://www.aemo.com.au/Electricity/Planning/Victorian-Annual-Planning-Report>.

² AEMO. Interactive Map. Available at: <http://www.aemo.com.au/electricity/planning/interactive-map>.

³ AEMO. 2015 VAPR Supporting Information.

Available at: <http://www.aemo.com.au/Electricity/Planning/Victorian-Annual-Planning-Report/VAPR-Supporting-Information>.

⁴ Jemena, CitiPower, Powercor, AusNet Services, United Energy. 2014 Transmission Connection Planning Report.

Available at: [http://www.ausnetservices.com.au/CA257D1D007678E1/Lookup/Projects/\\$file/TCPR%20Report.pdf](http://www.ausnetservices.com.au/CA257D1D007678E1/Lookup/Projects/$file/TCPR%20Report.pdf).

⁵ AEMO. Forecasting Victoria. Available at: <http://www.aemo.com.au/Electricity/Planning/Related-Information/Forecasting-Victoria>.

⁶ AEMO. Annual NEM Constraint Report.

Available at: <http://www.aemo.com.au/Electricity/Market-Operations/Dispatch/Annual-NEM-Constraint-Report>.

⁷ AEMO. Monthly NEM Constraint Report.

Available at: <http://www.aemo.com.au/Electricity/Market-Operations/Dispatch/Monthly-Constraint-Report>.

CHAPTER 2. NETWORK DEVELOPMENT

2.1 Deferred Investment

In July 2014, AEMO sought tenders for the acquisition of non-market ancillary services in regional Victoria, as the third stage of a proposed solution to manage identified constraints on the Ballarat–Bendigo 220 kV line and the Moorabool–Ballarat No.1 220 kV line, possible under a combination of conditions. The final RIT-T report on these network constraints was the Regional Victorian Thermal Capacity Upgrade RIT-T Stage 3 Report, published 12 June 2014.

After reviewing current and forecast network conditions and potential solutions, AEMO finds that, at this stage, the acquisition of services to address the third stage of the Regional Victorian Thermal Capacity Upgrade RIT-T does not deliver net economic benefits to Victorian customers and can therefore be deferred.

Investments previously identified as emerging

The 2014 VAPR identified six emerging investment opportunities for the coming 10-year period. Due to reduced demand forecasts, four of these emerging investment opportunities have been deferred beyond the 10-year outlook. These limitations will continue to be monitored (see section 2.3). The deferred investment opportunities are:

- Constraints on the Rowville–Malvern lines, which service Malvern and surrounding metropolitan areas.
- Constraints on the Rowville–Springvale–Heatherston lines, which service the metropolitan Springvale and Heatherston areas.
- Constraints on the Dederang–Shepparton line, which services parts of regional Victoria.
- Constraints on the Rowville A1 500/220 kV transformer, which services parts of eastern Melbourne metropolitan areas.

2.2 Completed Projects

In February 2015, wind monitoring was installed on the Ballarat–Bendigo 220 kV line, allowing an increase in line rating. The project was identified through the Regional Victorian Thermal Capacity Upgrade RIT-T process as the first stage of the preferred option.⁸

⁸ AEMO. Regional Victorian Thermal Capacity Upgrade. Available at: <http://www.aemo.com.au/Electricity/Planning/Regulatory-Investment-Tests-for-Transmission/Regional-Victorian-Thermal-Capacity-Upgrade>.

2.3 Future Projects

Committed projects

The following projects have advanced to the point where proponents have secured land and planning approvals, entered into contracts for finance and generating equipment, and either started construction or set a firm date:

- Heywood interconnector upgrade (mid-2016).⁹
- Additional Moorabool–Ballarat 220 kV transmission line (early 2017).¹⁰
- Brunswick terminal station 66 kV connection (late 2016).¹¹
- Deer Park terminal station (late 2017).¹²

Current investment opportunities

AEMO currently has no open tenders and no active RIT-Ts relating to the Victorian DSN.

Emerging investment opportunities

Although growth in maximum demand is slowing across the Victorian region, there are areas such as western Melbourne where growth in maximum demand (mainly due to population growth) necessitates network investment.

Accordingly, the 2015 VAPR identifies the following investment opportunities to address constraints in the network over the next 10 years. More details regarding these emerging investment opportunities can be found on AEMO's interactive map and in the DSN limitation detail spreadsheet (see section 1.1).

Constraints on the Ballarat–Horsham 66 kV lines servicing parts of regional Victoria, which affect export capacity to NSW

The capability of the Victorian transmission network to export to New South Wales can be limited by the 66 kV network between Ballarat and Horsham. A reduction of equipment ratings in the area increased the market impact of this limitation during January and February 2015. Following a partial resolution to the matter, an automatic bus-splitting control scheme at Challicum Hills 66 kV substation will be pursued to address this limitation. The total cost of this scheme is estimated to be less than \$300,000, and will be progressed through 2015–16 as a non-contestable augmentation.

Constraints on the Keilor – Deer Park – Geelong 220 kV lines, which will service parts of western Melbourne

Following the establishment of the Deer Park terminal station in 2017, customer demand in surrounding areas is forecast to exceed network capacity under peak demand scenarios from early 2020. This will be addressed by implementing a 5-minute rating on the Keilor – Deer Park – Geelong 220 kV line, or through contestable non-network solutions.

⁹ AEMO. Heywood Interconnector RIT-T. Available at: <http://www.aemo.com.au/Electricity/Planning/Regulatory-Investment-Tests-for-Transmission/Heywood-Interconnector-RIT-T>.

¹⁰ AEMO. Regional Victorian Thermal Capacity Upgrade. Available at: <http://www.aemo.com.au/Electricity/Planning/Regulatory-Investment-Tests-for-Transmission/Regional-Victorian-Thermal-Capacity-Upgrade>.

¹¹ NERA consulting. Proposed augmentation for Melbourne inner suburbs and CBD supply. Available at: <http://www.aemo.com.au/Consultations/Network-Service-Provider/Joint/Proposed-Augmentation-for-Melbourne-Inner-Suburbs-and-CBD-Supply>.

¹² Powercor, Jemena and AEMO. Joint regulatory test report. Available at: <http://www.aemo.com.au/Consultations/Network-Service-Provider/Joint/Joint-Consultation-Paper-Western-Metropolitan-Melbourne-Transmission-Connection-and-Subtransmission>.

Monitored investment opportunities

AEMO identifies and monitors investment opportunities which:

- Are not expected to significantly affect power system and market performance.
- Have no identified credible solutions within the next five to 10 years that can deliver positive net market benefits.

AEMO will not undertake further detailed assessment on these opportunities within the next 12 months, but will continue to monitor triggering conditions. Monitored investment opportunities are detailed on AEMO's interactive map and in the DSN limitation detail spreadsheet (See section 1.1).

Constraints on the South Morang 500/330 kV F2 transformer, which limit export capacity to NSW

AEMO is currently monitoring network congestion relating to the South Morang 500/330 kV F2 transformer. The market impact of this constraint does not currently justify augmenting the network, but warrants further investigation. AEMO will continue to monitor the performance of this constraint and explore options to increase the export limit to New South Wales. These options are likely to include projects to address thermal limits on the 330 kV network and transient stability limits, and are expected to primarily be contestable augmentations.

2.4 Potential Locations for New Terminal Stations in Victoria

AEMO's policy and guidelines for establishing new terminal stations in Victoria¹³ streamline the process for connecting generators and loads, and increase the economic efficiency of transmission network augmentations.

New terminal stations can be initiated by:

- A Transmission Network Service Provider (TNSP) identifying the need for DSN augmentations to deliver future capacity requirements.
- Applications to connect generation or major loads to the DSN.
- Plans for new terminal stations necessary to meet distribution network demand, as outlined in the 2014 Transmission Connection Planning Report.¹⁴

Table 2 (following) summarises the latest generation connection enquiries and applications that AEMO is actively assessing for development over the next 10 years. More information on generation projects and project advancement criteria is available on AEMO's generation information page.¹⁵

¹³ AEMO. Guidelines for Establishing Terminal Stations in Victoria. Available at: http://www.aemo.com.au/~media/Files/Other/network_connections/0174-0018%20pdf.ashx.

¹⁴ Jemena, CitiPower, Powercor, AusNet Services and United Energy. 2014 Transmission Connection Planning Report. Available at: [http://www.ausnetservices.com.au/CA257D1D007678E1/Lookup/Projects/\\$file/TCPR%20Report.pdf](http://www.ausnetservices.com.au/CA257D1D007678E1/Lookup/Projects/$file/TCPR%20Report.pdf).

¹⁵ AEMO. Generator Information. Available at: <http://www.aemo.com.au/Electricity/Planning/Related-Information/Generation-Information>.

Table 2 Generation connection enquiries and applications

Project	Capacity (MW)	Location	Service date
Mount Gellibrand Wind Farm	132	At Mt. Gellibrand, connecting into a new terminal station.	March 2017
Ararat Wind Farm	242	Approximately 9–17 km north-east of Ararat in Western Victoria.	July 2016
Bulgana Wind Farm	189	Within the Joel Joel, Joel South, Bulgana and Great Western districts of south-west Victoria.	TBA
Crowlands Wind Farm	123	Approximately 20–25 km north-east of Ararat in Western Victoria.	TBA
Dundonnell Wind Farm	300	Approximately 25 km north-east of Mortlake in the Western District of Victoria.	TBA
Hawkesdale Wind Farm	62	Approximately 4 km south of Hawkesdale in Western Victoria.	TBA
Penshurst Wind Farm	758	Approximately 3 km south-west of the township of Penshurst.	TBA
Ryan Corner Wind Farm	134	Approximately 8 km east of Yambuk in Western Victoria.	TBA
Stockyard Hill Wind Farm	392.5	Approximately 35 km west of Ballarat.	TBA

To achieve the most cost-effective outcome, AEMO prefers to connect generation developments within the same vicinity (within a radius of approximately 30–50 km) to a single terminal station.

Table 3 (below) lists likely terminal station locations selected to support this preference over the next 10 years.

Table 3 Proposed new terminal stations for generation connection enquiries and applications

Terminal station	Possible line cut-in and location	Project and approximate distance to terminal station	Service date
Ararat Terminal Station	Ballarat–Waubra–Horsham 220 kV line, approximately 85 km from Horsham.	Ararat Wind Farm (17 km)	July 2016
Mt Gellibrand Terminal Station	Terang–Geelong 66 kV network.	Mt Gellibrand Wind Farm (5 km)	TBA
Stockyard Hill Terminal Station	Moorabool–Heywood/Portland 500 kV No.1 or No. 2 line, approximately 94 km from Moorabool.	Stockyard Hill Wind Farm (50 km)	TBA
Crowlands Terminal Station	Ballarat–Waubra–Horsham 220 kV line, approximately 75 km from Horsham.	Crowlands Wind Farm (1 km)	TBA

Table 4 lists likely terminal station developments to address Victorian demand growth over the next 10 years.

Table 4 Proposed new terminal stations for connecting load¹⁶

Project	Driver	Service date
Deer Park Terminal Station	Offload Altona, Brooklyn, and Keilor terminal stations due to increased demand in the area.	Late 2017

¹⁶ Jemena, CitiPower, Powercor, SP AusNet and United Energy. 2014 Transmission Connection Planning Report. Available at: [http://www.ausnetservices.com.au/CA257D1D007678E1/Lookup/Projects/\\$file/TCPR%20Report.pdf](http://www.ausnetservices.com.au/CA257D1D007678E1/Lookup/Projects/$file/TCPR%20Report.pdf)

2.5 Network Support and Control Ancillary Services

The 2012 National Transmission Network Development Plan (NTNDP) network support and control ancillary services (NSCAS) assessment¹⁷ identified a potential NSCAS gap, and opportunity to maximise net economic benefits, by relieving the New South Wales to Victoria voltage stability limitation. The 2014 NTNDP¹⁸ NSCAS assessment confirmed this ongoing requirement.

This voltage stability limitation constrains electricity transfer from New South Wales to Victoria. AEMO has been managing this limitation via reactive power support procured through a contract with a generator. AEMO and TransGrid have jointly investigated the performance of the New South Wales to Victoria voltage stability limitation, the use of the contracted reactive power support, and the effect on the limitation of the newly installed capacitor banks at Canberra and Yass. Based on this investigation, AEMO and TransGrid have determined that the current arrangement remains appropriate. AEMO and TransGrid will continue to monitor the New South Wales to Victoria voltage stability limitation.

¹⁷ AEMO. Network Support and Control Ancillary Services Assessment.
Available at: <http://www.aemo.com.au/Electricity/Planning/Archive-of-previous-Planning-reports/2012-National-Transmission-Network-Development-Plan/Network-Support-and-Control-Ancillary-Services-Assessment-2012>.

¹⁸ AEMO. 2014 National Transmission Network Development Plan (NTNDP).
Available at: <http://www.aemo.com.au/Electricity/Planning/National-Transmission-Network-Development-Plan>.

CHAPTER 3. ASSET RENEWAL PROJECTS

This section outlines AusNet Services' transmission asset renewal projects for the next 10-year period. AusNet Services' asset renewal plan is based on asset performance, condition, failure risk, and other operational factors affecting the assets' economic life. Information about how asset renewals are integrated into augmentation planning is available on AEMO's website.¹⁹

Asset renewal comprises approximately three-quarters of transmission asset spending in Victoria. In the asset renewal plan, AusNet Services forecasts that approximately \$1.07 billion investment will be required to replace assets, with 62 proposed projects over the coming 10-year period. Approximately 50% of this investment is required for the seven projects detailed below.

Table 5 Large projects proposed for asset renewal

Project	Purpose	Target Completion	Total Cost (\$M)
Heatherton Redevelopment	Station redevelopment project. Project addresses supply, safety, environmental and collateral plant damage risk.	2017	59
Richmond Redevelopment	Station redevelopment project. Project addresses supply, safety, environmental and collateral plant damage risk.	2018	175
South Morang 330/220 kV Transformer Replacement (Stage 1)	Project addresses supply, safety, environmental and collateral plant damage risk.	2018	34
Fishermans Bend Transformer and Circuit Breaker Replacement	Project addresses supply, safety, environmental and collateral plant damage risk.	2020	43
Templestowe B2 Transformer and 66 kV CB Replacement	Project addresses supply, safety, environmental and collateral plant damage risk.	2020	34
West Melbourne Redevelopment	Station redevelopment project. Project addresses supply, safety, environmental and collateral plant damage risk.	2021	111
Springvale Redevelopment	Station redevelopment project. Project addresses supply, safety, environmental and collateral plant damage risk.	2021	77

The complete asset replacement plan is presented on AEMO's website (see section 1.1), and includes details of alternative options that were assessed, and material changes since the plan's previous publication.

AEMO has independently reviewed AusNet Services' asset renewal plan. AEMO conducted this review in its capacity as the Victorian transmission planner. The review assessed the extent to which proposed investments are required to address transmission network needs, and considered whether alternative options could better address these needs. AusNet Services took feedback from AEMO's review into account in its asset renewal plan published with this VAPR²⁰.

¹⁹ AEMO. Victorian Electricity Planning Approach. Available at: <http://www.aemo.com.au/Electricity/Policies-and-Procedures/Planning/Victorian-Electricity-Planning-Approach>.

²⁰ AEMO. 2015 VAPR Supporting Information. Available at: <http://www.aemo.com.au/Electricity/Planning/Victorian-Annual-Planning-Report/VAPR-Supporting-Information>.

CHAPTER 4. TRANSMISSION CHARGES

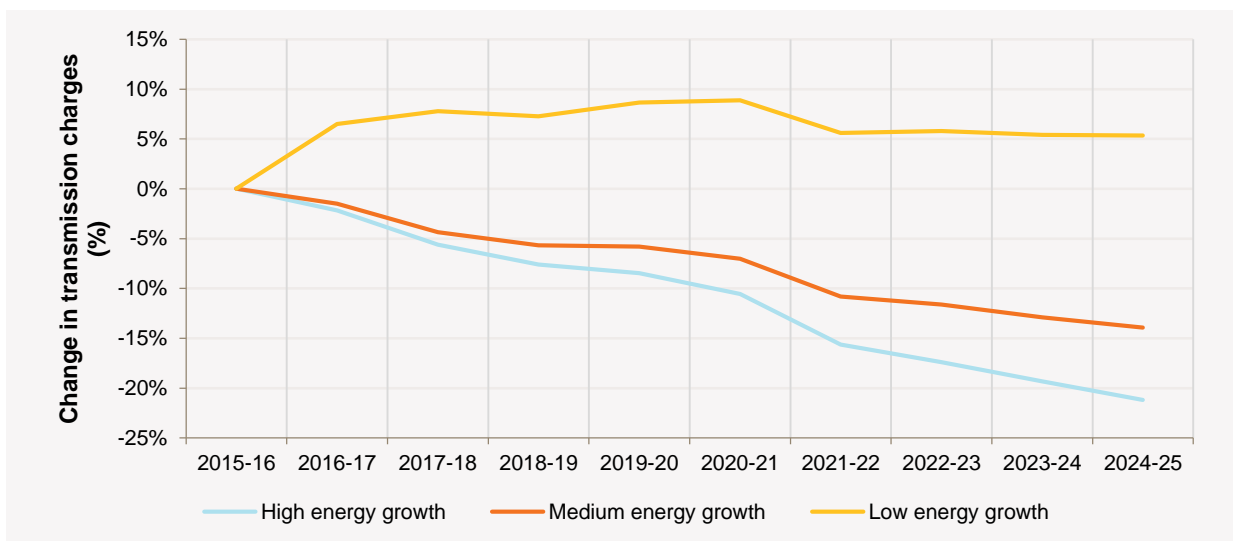
Most electricity bills in Victoria can be broken down into four distinct components:

- Generation (electricity generators create electricity from fuel sources).
- Transmission (electricity is transported through the transmission network to major distribution points).
- Distribution (distribution networks deliver electricity from distribution connection points to consumers).
- Retail (retailers buy electricity in bulk and sell it to consumers).

The information here relates to charges associated with developing and maintaining the electricity transmission network in Victoria, which account for approximately 5% of a typical electricity bill for Victorian residents.

The following figure forecasts the expected change in transmission charges for a typical electricity bill under three energy growth scenarios from the 2015 National Electricity Forecasting Report (NEFR)²¹. Revenue data used in this projection was derived from AusNet Services' 2014 to 2017 regulatory proposal²², and supplemented by AEMO's expected capital expenditure for growth related augmentation projects²³.

Figure 1 Projection of Victorian Transmission Charges



Total transmission expenditure is similar between all three energy growth scenarios because maximum demand in Victoria is forecast to be relatively flat²⁴. Transmission charges are highest in the low energy growth scenario because the total expenditure is spread across a smaller customer base.

This charge is forecast to reduce by up to 1.9% per annum under the high growth scenario, reduce by 1.3% per annum under the medium growth scenario, and rise by 0.5% per annum under the low growth scenario. Most transmission network expenditure will relate to asset renewal rather than network augmentation, due to low growth in maximum demand forecast in Victoria.

²¹ AEMO. 2015 NEFR. Available at: <http://www.aemo.com.au/Electricity/Planning/Forecasting/National-Electricity-Forecasting-Report>

²² Price projections are based on AER approved revenue for years 2014–15 to 2016–17. From 2017–18 onwards, a 6.8% weighted average cost of capital (WACC) has been used with a flat (in real terms) profile for AusNet Services' expenditure.

²³ Includes proposed Deer Park Terminal Station, Brunswick Terminal Station, and Stage 2 of Regional Victorian Thermal Capacity Upgrade RIT-T.

²⁴ Future capital expenditure driven by demand growth accounts for less than 1% of the total revenue.



MEASURES AND ABBREVIATIONS

Abbreviation	Expanded name
AEMO	Australian Energy Market Operator
DSN	Declared Shared Network (electricity)
km	Kilometres
kV	Kilovolts
MW	Megawatts
NEFR	National Electricity Forecasting Report
NEM	National Electricity Market
NEMDE	National Electricity Market Dispatch Engine
NSCAS	Network Support and Control Ancillary Service
NTNDP	National Transmission Network Development Plan
RIT-T	Regulatory investment test for transmission
VAPR	Victorian Annual Planning Report
WACC	Weighted average cost of capital



GLOSSARY

Term	Definition
Active power	Active power is a measure of the instantaneous rate at which electrical energy is consumed, generated or transmitted. In large electric power systems it is measured in megawatts (MW).
Annual planning report	An annual report providing forecasts of gas or electricity (or both) supply, network capacity and demand, and other planning information.
Constraint	A limitation on the capability of a network, load, or a generating unit such that it is unacceptable to either transfer, consume or generate the level of electrical power that would occur if the limitation was removed.
Contestable Augmentation	An electricity transmission network augmentation for which the capital cost is reasonably expected to exceed \$10 million and that can be constructed as a separate augmentation (i.e., the assets forming that augmentation are distinct and definable).
Limitation (electricity)	Any limitations on the operation of the transmission system that could give rise to unserved energy or to generation re-dispatch costs.
Maximum demand	The highest amount of electrical power delivered, or forecast to be delivered, over a defined period (day, week, month, season, or year) either at a connection point, or simultaneously at a defined set of connection points.
National Electricity Market	The wholesale market for electricity supply in Queensland, New South Wales, the Australian Capital Territory, Victoria, Tasmania, and South Australia.
Reactive power	Reactive power, which is different to active power, is a necessary component of alternating current electricity. It is predominantly consumed in the creation of magnetic fields in motors and transformers. Management of reactive power is necessary to ensure network voltage levels remain within required limits, which is in turn essential for maintaining power system security and reliability.
Unserved energy	The amount of energy that cannot be supplied because there is insufficient generation or network capacity to meet demand.