Victorian Electricity Planning Approach

2026

VicGrid

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Acknowledgment of Traditional Owners

We acknowledge and respect Victoria's Traditional Owners as the original custodians of Victoria's land and waters, their unique ability to care for Country and deep spiritual connection to it. We honour Elders past and present whose knowledge and wisdom has ensured the continuation of culture and traditional practices.

We are committed to genuinely partnering and meaningfully engaging with Victoria's Traditional Owners and First Peoples to support the protection of Country, the maintenance of spiritual and cultural practices and their broader aspirations in the 21st century and beyond.

Contents

Acronyms

Term	Definition
AEMO	Australian Energy Market Operator
CBA	cost benefit analysis
DNSP	distribution network service provider
DSN	declared shared network
ESOO	Electricity Statement of Opportunities
IASR	Inputs, Assumptions and Scenarios Report
ISP	Integrated System Plan
NEL	National Electricity Law
NEM	National Electricity Market
NEO	National Electricity Objective
NER	National Electricity Rules
NSP	network service provider
POE	probability of occurrence
POF	probability of event
RIT-T	Regulatory Investment Test for Transmission
TCPR	Transmission Connection Planning Report
TPSS	Transition Plan for System Security
TUoS	Transmission Use of System
VAPR	Victorian Annual Planning Report
VCR	value of customer reliability
VTP	Victorian Transmission Plan

1 Introduction

1.1 Electricity planning

On 1 November 2025, responsibility for planning Victoria's declared shared network (DSN) and all declared network functions under the National Electricity Law (NEL) transferred from the Australian Energy Market Operator (AEMO) to VicGrid by legislation. This document sets out the planning criteria VicGrid will use in performing its declared network functions under clause 8.11.4(a) of the National Electricity Rules (NER).

Pursuant to clause 8.11.4(b) of the NER, the planning criteria sets out:

- the principles on which VicGrid will carry out a cost benefit analysis of a proposed augmentation under section 50F of the NEL
- how VicGrid proposes to apply a probabilistic approach in determining the benefit of a proposed augmentation
- describes the kind of circumstances in which a probabilistic approach will be regarded as inappropriate
- outlines other aspects of VicGrid's declared network functions

1.2 Planning purpose and objective

To manage a power system, system operators need to make short-term decisions that have safety and security consequences for equipment, individuals (and the public) and the National Electricity Market (NEM) as a whole.

Network planning attempts to forecast these operating conditions and develop networks to deal with them efficiently over a longer-term, typically five years or longer, considering the effect of uncertainty within these forecasts. To meet its obligations under the NEL and NER, and to facilitate clear and transparent planning processes, VicGrid publishes different planning reports on current network constraints and investment opportunities in Victoria. These reports include:

(1) the Victorian Annual Planning Report

(2) The Victorian Transmission Plan

(3) Victorian Investment Consultation Reports

In addition, VicGrid considers the following NEM-wide planning reports:

(1) The Integrated System Plan

(2) The Inputs, Assumptions and Scenarios Report

(3) The Transitional Plan for System Security

(4) The Electricity Statement of Opportunities

1.2.1 Victorian annual planning reports

VicGrid publishes a Victorian Annual Planning Report (VAPR) annually[1] in July. The VAPR analyses (among other things) the DSN and assesses its ability to supply forecast demand at each transmission connection point over the next 10 years under credible system conditions. DSN limitations can cause unserved energy at transmission connection points, and economically inefficient dispatch of generation to meet demand[2]. The VAPR assesses the magnitude, probability and cost of that expected unserved energy, and the expected costs from inefficient generation dispatch caused by each network limitation. The VAPR also looks at the longer-term adequacy of the DSN under different potential supply and demand scenarios to determine triggers likely to cause and require transmission network investment.

The five distribution network service providers (DNSPs)[3] are responsible for planning and directing transmission connection point asset (facilities that connect distribution systems to the DSN) augmentations in Victoria for the supply of distribution customers. They jointly publish an annual Transmission Connection Planning Report (TCPR) that details their anticipated energy needs for the next 10 years. The VAPR and TCPR provide information about the DSN's ongoing ability to supply customer load.

The VAPR generally includes information to meet requirements under NER rule 5.12. The TCPR focuses on each transmission connection point's capacity to meet forecast demand over the next 10 years, assessing the magnitude, probability and cost of expected unserved energy due to insufficient connection point capacity.

Together, the VAPR and TCPR provide information about transmission limitations to efficient network development that will best meet consumer needs, with the TCPR primarily focusing on individual connection nodes and the VAPR considering the more holistic needs for the transmission network.

VicGrid also carries out an annual short-circuit level review to identify maximum short-circuit levels (prospective three-phase and single-phase-to-ground maximum short-circuit currents) for all Victorian transmission connection points for the next five years. It also provides information relating to the DSN's capability to withstand short-circuit currents. This review is shared with the Victorian network service providers (NSPs) and, where relevant, results and projects identified by this review are included in the VAPR.

1.2.2 Victorian investment consultation reports

VicGrid publishes various information and public consultation reports when considering DSN augmentations. These include consultation reports for the purposes of the Regulatory Investment Test for Transmission (RIT-T)[4].

[1] As required by clause 5.12.2(a) of the NER, at http://aemc.gov.au/Electricity/National-Electricity-Rules/Current-Rules.html.
[2] In the long term, transmission network congestion may also impact generation investment decisions. These impacts are assessed in the ISP and RIT-T assessments.
[3] CitiPower, Powercor, AusNet Services, Jemena Electricity Networks (Vic) Ltd, and United Energy Distribution.
[4] See http://www.aemo.com.au/Electricity/Planning/Regulatory-Investment-Tests-for-Transmissionhttps://www.vicgrid.com.au/transmission-planning/planning-the-energy-grid.

1.2.3 NEM-wide planning reports

AEMO produces the Integrated System Plan (ISP), the Inputs, Assumptions and Scenarios Report (IASR), the Transition Plan for System Security (TPSS), and the Electricity Statement of Opportunities (ESOO):

- The ISP details AEMO's view on efficient development of the national transmission system for a range of credible scenarios[5] over a minimum 20-year horizon.
- The IASR provides detail on how inputs, scenarios and key assumptions for AEMO's planning studies, which are inputs to AEMO's key publications, were developed and updated, to mitigate risks associated with data latency and maintain publication relevance.
- The TPSS provides an outlook for managing power system security over at least the next 10 years with a particular focus on navigating key transition points in the energy sector as the NEM moves towards lower emissions. This report also covers system strength, inertia and network support and control ancillary services.
- The ESOO investigates supply adequacy, provides supply and demand information about energy resources and identifies system reliability gap affecting the NEM over the next 10 years.

Victorian planning reports consider and further explore the relevant findings from the ISP and ESOO, using assumptions and scenarios broadly aligned with IASR.

1.2.4 The Victorian Transmission Plan

The Victorian Transmission Plan (VTP) is produced by VicGrid and plans to a 25-year planning horizon pursuant to the National Electricity (Victoria) Act 2005. Unlike the other planning documents outlined above, it applies the Victorian Transmission Planning Objective, which is, in relation to Victoria:

(a) 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

(i) price, quality, safety, reliability and security of supply of electricity; and

(ii) the reliability, safety and security of the national electricity system; and

(b) The delivery of transmission services consistent with a least-regrets development pathway; and

(c) the achievement of targets set by Victorian legislation

(i) for reducing Victoria's greenhouse gas emissions; or

(ii) that are likely to contribute to reducing Victoria's greenhouse gas emissions

A least-regrets development pathway refers to a process of selecting development pathways having regard to the risks associated with underinvestment or overinvestment in light of the uncertainties reflected across a range of plausible scenarios.

The projects identified in the VTP do not constitute RIT-T projects for the purposes of clause 5.10.2 of the NER. The planning processes discussed in Chapters 2 – 4 of this document are relevant to how VicGrid completes the annual planning review, RIT-Ts and customer funded augmentations. For further information about the planning processes for the VTP refer to the VicGrid website[6].

[5] Where appropriate, the Victorian planning process uses the same scenarios and input assumptions to ensure planned Victorian developments are consistent with the long-term developments the ISP highlights.
[6] See https://www.vicgrid.com.au/__data/assets/pdf_file/0027/790182/Draft-2026-VTP-Guidelines.pdf

2 Economic planning criteria

2.1 Key NEL and NER provisions

The legislative and regulatory framework for VicGrid's declared network functions is set out in the NEL and NER. The key provisions relevant to this assessment are summarised below.

2.1.1 National electricity Objective

The National Electricity Objective (NEO)[7] 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:

(a) price, quality, safety, reliability and security of supply of electricity; and

(b) the reliability, safety and security of the national electricity system; and

(c) the achievement of targets set by a participating jurisdiction:

  (i) for reducing Australia's greenhouse gas emissions; or

  (ii) that are likely to contribute to reducing Australia's greenhouse gas emissions

2.1.2 NEL augmentation approach

Section 50F(2) of the NEL states that, in deciding whether a proposed augmentation to the DSN should proceed, VicGrid[8]:

(a) must undertake a cost benefit analysis; and

(b) must apply a probabilistic (as distinct from a deterministic) approach to determining the benefit of an augmentation unless:

  (i) a probabilistic approach will not produce a materially different result; or

  (ii) it is not reasonably practicable to use a probabilistic approach; or

  (iii) a probabilistic approach is, for some other reason, inappropriate

Section 50F notes that probabilistic planning is not relevant to negotiated network services.

[7] See section 7 of the NEL.
[8] Section 16ZP(4)(k) of the NEVA transfers responsibility from AEMO to VicGrid.

2.1.3 NER planning criteria

Under clause 8.11.4 of the NER:

(a) VicGrid must publish the planning criteria that it proposes to use in performing its declared network functions.

(b) The planning criteria:

(1) must outline the principles on which VicGrid[9] will carry out a cost benefit analysis of a proposed augmentation under section 50F of the NEL; and

(2) must describe how VicGrid proposes to apply a probabilistic approach in determining the benefit of a proposed augmentation; and

(3) must describe the kind of circumstances in which a probabilistic approach will be regarded as inappropriate; and

(4) may deal with any other aspect of planning inherent in, or related to, VicGrid's declared network functions

2.1.4 Network performance requirements

Schedule 5.1 of the NER describes the planning, design and operating criteria that must be applied by NSPs to the transmission networks and distribution networks they plan, own, operate or control.

2.2 Shared transmission services

VicGrid does not own any part of the DSN. It procures transmission services from NSPs and non-network asset owners who provide bundled use of system services to network users (the Victorian DNSPs and network users whose plant is directly connected to the DSN), on a cost pass-through basis[10].

Shared transmission services can be provided as prescribed services or negotiated services:

- Prescribed transmission services are provided for a regulated price and must adhere to the service standards prescribed in the NER. The cost of providing prescribed services is recovered from customers through Transmission Use of System (TUoS) charges. Most TUoS charges are allocated to DNSPs with some allocated to large customers directly connected to the DSN.
- Negotiated transmission services are provided for a price and level of service that is negotiated between an individual, or small group of dedicated users, and VicGrid. Charges associated with those services are recovered directly from users of these services

VicGrid also provides use of system services to network users using assets built as a result of application of the VTIF, which are not subject to the NER planning and approval framework.

[9] Regulation 60 of the National Electricity (Victoria) (VicGrid) Regulations 2025 transfers responsibility from AEMO to VicGrid.
[10] See https://aemo.com.au/-/media/files/electricity/nem/participant_information/fees/revenue-methodology-for-vic.pdf.

2.3 DSN augmentations

An augmentation of a transmission system is defined in section 2(1) of the NEL as work to enlarge the system or to increase its capacity to transmit electricity.

Typically, VicGrid will authorise and contract for DSN augmentation works in two scenarios:

- as provider of shared transmission services, to maintain or enhance the capability of the DSN for the benefit of all users (that is, to provide prescribed transmission services)
- to facilitate the connection of an individual or group of users to a single location where they each have a connection point (i.e. to provide negotiated transmission services)

When deciding whether a proposed DSN augmentation should proceed, section 50F(2) of the NEL requires VicGrid to undertake a cost benefit analysis (CBA) and, unless an exception applies, to apply a probabilistic (as distinct from a deterministic) approach to determining the benefit of the augmentation.

2.3.1 Planning augmentations

Under the first scenario described in section 2.3, these are augmentations for increasing the capacity of the DSN to transmit electricity, to address network needs identified through the annual planning review process or other planning processes, including ISP and System Security Planning[11].

For the purpose of this document, these works are referred to as “planning augmentations”.

2.3.2 Connection augmentations

Under the second scenario described in section 2.3, these are required to facilitate the connection of plant to the DSN. The works associated with this could be enlarging the DSN (and constitute an augmentation), especially where they would include enlargement of the DSN to accommodate the future connections.

For the purpose of this document, these are referred to as “connection augmentations”.

Connection augmentations differ from planning augmentations mainly in:

- The need for connection augmentation works is driven by one or more identified connection applicants (proponents).
- They are not considered to have system-wide benefits, other than potential incidental market benefits arising from the connection itself.
- The final investment decision on the connection augmentation works is made by the proponent together with the investment decision on the connection project as a whole.
- The connection augmentation works would be fully funded by the proponent.

Some examples of connection augmentations include:

- building a new terminal station by cutting into an existing transmission line in the DSN for connecting new generation or loads to the DSN
- building a new DSN double circuit line to a new DSN terminal station which can facilitate more connections in the future
- establishing new connection bay(s) within an existing terminal station to facilitate connection points for new generation or loads to the DSN
- installing a reactive power plant or harmonic filters in the DSN by a connection to meet the agreed access performance standards

[11] See https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/system-security-planning.

2.4 Cost benefit analysis

The requirement for a CBA in section 50F(2) of the NEL is the foundation for an economic planning approach to achieve the planning objective outlined in Section 1.2.

With this approach, VicGrid's investment decision on a planning augmentation will be based on an assessment of the net economic market benefits from the augmentation to customers, that is, whether the augmentation will deliver market benefits that outweigh the cost of the augmentation.

The net economic market benefits from the augmentations include improvement in customer reliability, delays in investment timing, reductions in other costs associated with operation and maintenance, network losses, ancillary service, and renewable energy target penalties, as well as improving market competition.

There is no need for VicGrid to conduct a CBA for connection augmentations because they are for the benefit of, and fully funded by, connection applicants. It is only where there is more than one augmentation option that VicGrid would apply a CBA to determine the most economic option.

2.4.1 Principles – planning augmentations

The following principles apply in determining how VicGrid conducts a CBA for planning augmentations that will provide prescribed transmission services:

Follow the CBA and formal consultation requirements for the RIT-T

- For RIT-Ts for non-ISP actionable projects, the Australian Energy Regulator's (RIT-T application guidelines[12] will be followed in assessing the market benefits of the credible options to address the identified needs.
- For RIT-Ts for ISP actionable projects, the Australian Energy Regulator's CBA guidelines will be followed[13].
- For augmentations exempt from a RIT-T under clause 5.16.3 of the NER (e.g. augmentation identified in the VTP), VicGrid will undertake a CBA on a consistent basis with the economic guidelines under the RIT-T.

VicGrid determine whether a proposed planning augmentation project should proceed based on the net economic benefits:

- The augmentation project will proceed with the preferred option, that is, the option returning the highest net positive economic market benefits (the economic benefit minus the cost of the augmentation).
- The augmentation project can proceed with the preferred option with the least negative net economic market benefit, if the identified need to be addressed by the preferred option is for reliability corrective action[14] or the provision of inertia network services or system strength services.

2.4.2 Principles for connection applications

For connection augmentations that will provide negotiated transmission services, the CBA is generally limited to assessing the costs and benefits of the augmentation options that will meet the connection applicant's needs, including the agreed access standards (which incorporate future network needs), and is consistent with the NEO.

The default augmentation option is the option that can meet the connection needs of known connection applicants at the least cost considering the network's future needs. The known connection applicants include the funder and any other connection applicants who are likely to use the augmentation within the foreseeable future. Options with similar costs and added benefits for any other connection applicant may also be assessed to take into account the longer-term needs of the DSN, beyond the known proponents.

[12] See https://www.aer.gov.au/system/files/AER%20-%20Regulatory%20investment%20test%20for%20transmission%20application%20guidelines%20-%2025%20August%202020.pdf.
[13] See https://www.aer.gov.au/industry/registers/resources/guidelines/cost-benefit-analysis-guidelines
[14] Refer to NER definition of reliability corrective action.

2.5 Probabilistic benefit assessment

The market benefits associated with various planning augmentation options normally depend on assumptions about demand and supply forecasts which, in turn, are sensitive to factors like economic growth, government policies and new technologies. The quality of the market benefit assessment can be greatly improved if it is based on scenarios that cover a wide range of future uncertainties together with the probability of occurrence (POE) of each scenario.

The following aspects distinguish VicGrid's probabilistic planning approach from a deterministic planning approach, in identifying the preferred augmentation option for a RIT-T or ISP actionable project:

- The preferred option is identified using a probabilistic market benefit assessment for each option. With this approach, a number of credible scenarios are predetermined and the market benefit from each option for each scenario would be assessed. The gross market benefit from the option is the weighted sum of the market benefit for individual scenarios, based on the estimated POE of each scenario.
- In the evaluation of market benefits, VicGrid could consider not only the worst single credible contingency, but other contingencies, including high probability single and multiple contingencies.
- Under its probabilistic planning approach, VicGrid allows for a certain level of network congestion or unserved energy. The DSN would only be augmented when the economic benefits of the augmentation arising through avoidance of unserved energy, congestion and other benefit types, equal or exceed the costs of the augmentation, considering the POE of the congestion or expected unserved energy. This way, VicGrid can economically meet its power system security and performance obligations, with an optimal level of reliability, security and congestion.

The value of customer reliability (VCR) measure is used to reflect the value customers place on having a reliable electricity supply. The VCR is combined with data on the probability of an outage to estimate the energy at risk (or expected energy not supplied). The expected benefits of a potential network or non-network investment are then assessed, including reductions in energy at risk to strike an economic balance between the costs of:

- Actions taken to ensure network capabilities are not exceeded (including load shedding and generation re-dispatch)
- Providing sufficient network and non-network capability to minimise the need to limit load

To ensure that Victoria's reliability and security needs are met, VicGrid calculates the market impact of an event by estimating the unserved energy (USE) in megawatt hours (MWh) resulting from the event and multiplying it by the VCR ($/MWh). This is the consequence of the event. The consequence value is then multiplied by the probability of the failure (POF) or similar event occurring to calculate the expected cost of an event in a particular year.

$$\text{Market impact (\$)} = \text{USE (MWh)} \times \text{VCR (\$/MWh)} \times \text{POF}$$

The VCR values used in the market benefit assessment should be consistent with AER's decision in its 2025 VCR review[15], or the latest official update as a result of any future review.

The delivered cost of energy is also minimised by alleviating congestion that affects when more economic generators can supply the market. Congestion levels are directly related to the supply-demand levels and technical capability of the DSN. Congestion on transmission can result in higher market generation prices by preventing low-cost energy from reaching load centres, forcing the dispatch of more expensive generation and higher prices for consumers.

[15] See https://www.aer.gov.au/industry/registers/resources/reviews/values-customer-reliability-2024

3 Planning Process

This chapter describes VicGrid's planning process for the DSN in terms of its two core features:

- The phases of the planning process undertaken to identify potential network limitations and their solutions.
- The way the planning process is applied annually to incorporate changes to the external environment and deliver the required information to the market.

3.1 Planning process

VicGrid's planning process comprises four discrete phases, with each phase narrowing in scope and becoming increasingly detailed. Figure 1 shows the individual phases of this process.

Figure 1 The investigative process

3.1.1.1 Phase 1 – Exploratory

The exploratory investigations, also referred to as screening studies, focus on DSN performance projections under a range of future scenarios to assess the significance and timing of identified network limitations.

The aim is to assess a wide range of future conditions to identify any potentially feasible limitation. At this stage, the DSN is stress-tested by analysing scenarios with high demand growth and extreme generation dispatch.

These investigations also provide information about future conditions or triggers that could cause particular limitations and identify when future work needs to be undertaken. This work is carried out in the annual planning review and published in the VAPR.

3.1.1.2 Phase 2 – Scoping

Scoping investigations help develop feasible network and non-network solutions to address the potential limitations identified at the completion of Phase 1. These investigations include a high-level assessment of each solution's technical effectiveness and viability, as well as estimation of costs and lead times. This scoping work is carried out in the annual planning review and published in the VAPR.

3.1.1.3 Phase 3 – Detailed review

Detailed review investigations are the first stage of the CBA, and establish likely timings and economic justification, as well as the need for an investment test.

Although Phase 3 is a more detailed study, several resource-saving approaches are used, involving (for example) only a small selection of investment options and a limited range of future scenarios. The requirement for detailed review studies is identified as part of the VAPR.

3.1.1.4 Phase 4 – Investment Test

Investment test investigations are the most detailed, identifying all relevant benefits and costs, and all practical implementation considerations to identify the optimal investment, including its timing and staging. For investments in the DSN, VicGrid undertakes analysis in accordance with the NER and the RIT-T framework.

For proposed augmentations where the RIT-T does not apply[16], VicGrid still undertakes a detailed CBA consistent with the RIT-T framework but does not undertake any consultation. The requirement for an investment test is identified by the detailed review phase.

0 summarises the planning process phases, including the type of studies undertaken for each phase and where they are published.

Table 1 Planning process summary

Planning process phase	Focus of studies	Type of studies	Planning publications
Exploratory	Identifying network limitations.	Deterministic: conservative worst-case assumptions.	VAPR
Scoping	Identifying potential solutions.	Deterministic: technical and environmental feasibility.	VAPR
Detailed review	Confirming the need for an investment test or further monitoring.	High-level probabilistic: limited scenarios.	VAPR, individual pre-feasibility reports
Investment test	Identifying optimal investment and timing.	Comprehensive probabilistic: full range of scenarios.	RIT-T reports
Monitoring			VAPR

3.2 Annual planning review

VicGrid's annual planning review considers the impact of changed demand forecasts, new loads, generation and storage connections, switching configuration and augmentations on the DSN. The results are published in the VAPR.

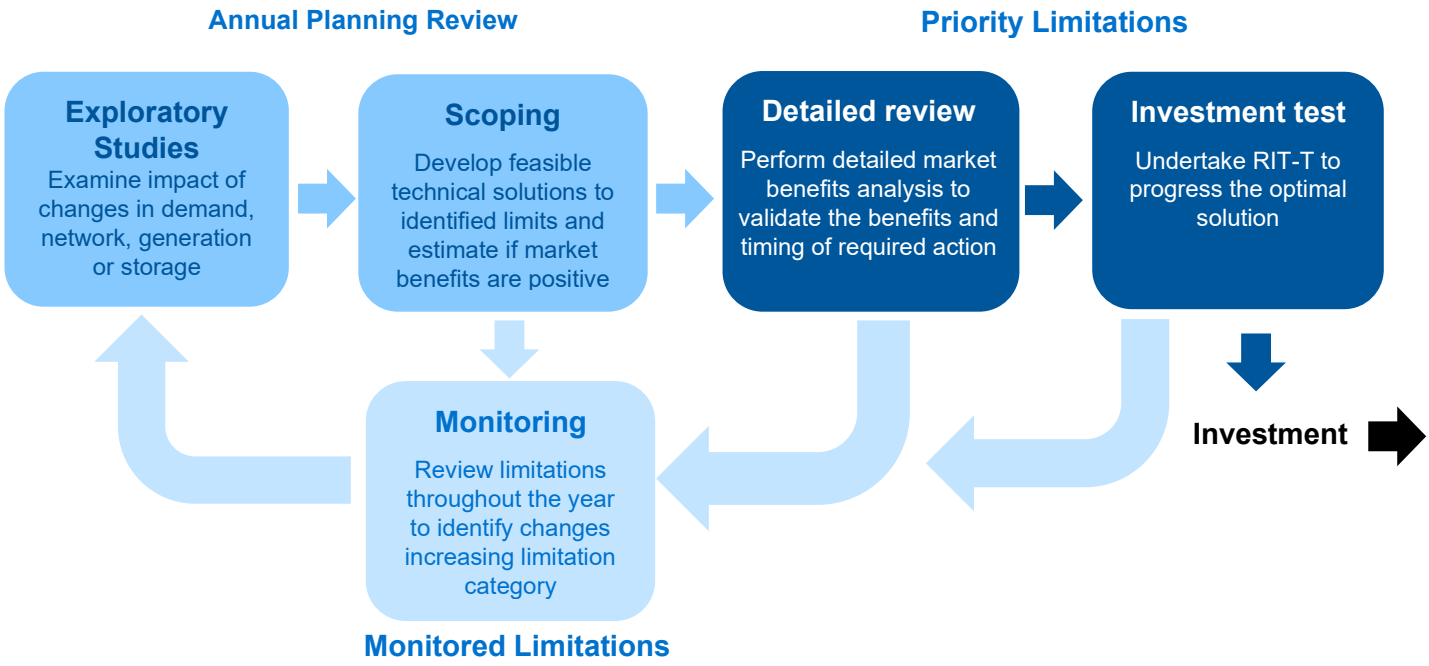
The annual planning review undertakes the exploratory and scoping phase for each network element in the DSN. In the exploratory phase screening, studies are typically undertaken for a base case and a worst-case scenario to capture a wide range of limitations. The worst-case scenario differs, depending on the DSN element under consideration, and is a variation on the base case scenario designed to test that element.

For example, in a particular location the worst-case scenario might be 100% VRE output, while in another the worst case is 0% VRE. In the scope phase, VicGrid identifies credible options to address the identified limitations and estimates the costs of the options. Options are then assessed to determine if they are likely to deliver positive net market benefits.

Based on these assessments, the limitations are categorised as Priority or Monitored. Figure 1 shows the annual planning cycle, and categories of limitations identified by the first two planning phases. Detailed feasibility studies (RIT-Ts) are carried out as required, and each study could take more than 12 months to complete.

[16] Clause 5.16.3(a) of the NER details exceptions where a RIT-T is not required, such as, when the most expensive option to address the identified need which is technically and economically feasible is less than $7 million (as varied in accordance with a cost threshold determination). Regulation 24 of the National Electricity (Victoria)(VicGrid) Regulations 2025 details that an augmentation identified in the Victorian Transmission Plan is not included in the definition of the RIT-T project for the purposes of rule 5.10.2 so the RIT-T framework in chapter 5 does not apply.

Figure 1 **The annual planning cycle**



The limitation categories are:

- **Monitored limitations** could result in supply interruptions or constrain generation periodically, but for which there is currently no known credible solution likely to deliver positive net market benefits in the next 10 years. VicGrid will continue to monitor such a limitation, and either reassess it as part of the next annual planning review or commence detailed analysis if triggered by a new market development.
- **Priority limitations** have credible options to be delivered within the next 10 years that are anticipated to deliver positive net market benefits. VicGrid will commence detailed analysis on options to alleviate this limitation.

4 Planning methodology

This chapter describes how VicGrid identifies network limitations, develops feasible solutions, determines the required time for action, and identifies the optimal solution in the DSN planning process.

4.1 Exploratory investigations – identifying network limitations

Exploratory investigations (screening studies) are carried out as part of the VAPR to identify DSN limitations over the next 10 years. Two different types of studies are used:

- Screening studies to identify limitations
- Trigger studies to identify the conditions that could cause a limitation to emerge

The VAPR always incorporates screening studies and includes trigger studies if necessary. Trigger studies are generally recommended if expected changes in generation, storage, demand, or other planning inputs could have a significant impact on the results.

4.1.1 Screening studies

Screening studies identify limitations by assessing network performance in terms of security and performance obligations under a range of different power system configurations in accordance with the requirements of Schedule 5.1 of the NER. A thermal limitation occurs when a network element that is loaded to 90% of its continuous rating during system normal, or 90% of its short-term rating after a contingency, over the 10-year planning horizon.

Security and performance obligations define the transmission system's technical limitations, for example, voltage ranges, stability limits, maximum fault currents, and fault clearance requirements. These obligations ensure that connected assets (and the power system itself) are designed to operate within known technical limits.

Typically, screening studies are undertaken for a base case and a stress test scenario to capture a wide range of limitations.

4.1.1.1 Inputs for screening studies

For both the high demand and light demand screening studies, the base case uses the transmission connection point demand forecasts developed and published by VicGrid and AEMO. If VicGrid or AEMO forecast is unavailable, the Victorian DNSPs' forecasts provided in their TCPR can be used. VicGrid's connection point forecast is based on the most likely scenario identified in the ESOO.

- For high demand, the forecast assumes a coincident 10% POE summer maximum demand forecast for Victoria[17]
- For light demand the forecast assumes a coincident 90% POE minimum demand forecast
- For both high and light demand the base case scenario incorporates all in-service and committed transmission, generation, storage and load projects, with selected anticipated projects also incorporated when forecast supply in Victoria becomes insufficient

[17] For more information about the Connection Point Forecasts, see https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-planning-data/transmission-connection-point-forecasting/victoria.

4.1.1.2 Stress test scenario

The stress test scenario represents a set of extreme, but credible, operating conditions and would be used for stress testing the DSN element (or group of elements), and to identify potential limitations that wouldn't be visible under the base case operating conditions. It differs depending on the DSN element under consideration and is a variation on the base case scenario designed to test that element.

Some examples of stress test scenarios are:

- maximum and minimum interconnector flows in either direction between Victoria and other NEM regions
- high levels of output of specific types of generators or generators located within a specific area
- maximum and minimum transfer in either direction along specific corridors within Victoria

4.1.1.3 Power system configurations

The screening studies have three main aims:

- Identification of DSN limitations that will lead to a failure to comply with power system operation requirements such as having sufficient outage windows to complete maintenance or facilitate future connections.
- A focus on identifying DSN limitations that, without re-dispatch or a pre-contingent loss of load, will lead to an unsatisfactory operating state or an insecure operating state under N and N-1 conditions. Limited studies are also carried out on DSN limitations that will only occur under N-1-1 conditions, but that will significantly impact the NEM when they do.
- Estimating the scale of market benefits that can be realised by addressing the identified DSN limitations.

The screening studies consider three power system configurations:

- N conditions (system normal), when all system components are in service
- N-1 conditions, which follow a single credible contingency event[18]
- N-1-1 conditions, which follow a single credible contingency event with a prior outage (forced or planned)

The power system should be able to be operated in a secure operating state.

- a satisfactory operating state requires that frequency, voltage, current, protection and other plant forming part of or impacting on the power system be operated within their relevant operating ratings and limits[19]
- when in a satisfactory operating state, the power system is further considered to be secure if the power system will return to a satisfactory operating state following the occurrence of any credible contingency event or protected event[20]

4.1.2 Trigger studies

Trigger studies examine the triggers likely to cause DSN limitations in the longer term. Their main aim is a high-level quantification of the increase in load, generation, import, or export likely to lead to thermal loading or voltage stability limitations within different Victorian electrical grid areas.

The trigger studies that consider the latest VTP and ISP generation, storage and transmission outlook start with a future year (for example, the outlook period's tenth year) and apply the base case demand and generation profile

[18] A contingency event is an event affecting the power system that AEMO expects is likely to involve the failure or removal from operational service of plant, which includes equipment involved in the generation, transmission or distribution of electrical energy (clause 4.2.3(a) of the NER). A credible contingency event is a contingency event AEMO considers reasonably possible in the surrounding circumstances, including the technical envelope (clause 4.2.3(b) of the NER).
[19] See clause 4.2.2 of the NER for a detailed definition.
[20] See clause 4.2.4 of the NER for a detailed definition.

used in the screening studies. The DSN is then tested by increasing demand, generation or interconnector power transfers until it is overloaded or has insufficient reactive margin under N-1 conditions.

4.2 Scoping studies – developing feasible solutions

The scoping studies identify potentially feasible solutions to identified limitations. A list of potential network and non-network options is developed, and power system studies are undertaken if necessary to determine each option's effectiveness in addressing the limitation at a high level.

Factors taken into account when developing the list of options to address DSN limitations include:

- committed and anticipated DSN augmentations and connection projects
- published long-term plans of the DNSPs, including the annual TCPR and Regulatory Investment Test for Distribution reports
- the transmission-connected load contract agreed maximum demand, or load forecasts.
- AusNet Services' asset replacement and refurbishment plans
- the VTP and ISP optimal development path
- strategic land holdings and easement availability
- whether an automatic load shedding control scheme can be used to enable five-minute short-term ratings[21] to effectively address the limitation and defer the need for additional network or non-network investment
- whether post-contingent generation runback control schemes can be used to alleviate the limitation pre-contingency

For each technically feasible solution, a high-level cost and the likely lead time to implement the option are estimated.

4.3 Detailed review studies – determining the need for further investigation

The need for further detailed review studies depends on the costs incurred due to the limitation, and the cost and implementation lead times for available solutions.

The detailed review studies aim to determine if the market benefits of any available solution will be greater than the costs taken to plan, procure and implement within a given timeframe. This enables VicGrid to decide whether starting an investment test in the current planning review cycle is needed.

Due to the uncertainties surrounding demand growth, generation and storage investment, the detailed analysis required for transmission investment decisions is undertaken shortly before the need arises.

4.3.1 Evaluating the market impact of a limitation

For each network limitation identified, the limitation's market impact is assessed under a range of scenarios. Market impacts are caused when a transmission network element is at risk of exceeding its defined limits for N and N-1 conditions, and power flow is curtailed to ensure the network can operate within its performance requirements.

There are two key operational actions, in terms of value or cost to the market:

- energy not supplied to customers through load reduction (unserved energy)
- constrained generation dispatch

[21] In Victoria, transmission lines are typically operated to 15 minute ratings, but the ratings can be increased to five minute ratings with control schemes that can automatically reduce line loading following a contingency by shedding preselected loads or generation.

The market impact assessment uses inputs and assumptions consistent with AEMO's most recent IASR and its associated inputs, assumptions and scenarios workbook for ISP. VAPR studies look into localised unserved energy and constraints that may affect generation dispatch. Studies are typically undertaken over 10 years. The limitations impact, in terms of energy not supplied to customers (unserved energy) as well as the difference in total generation dispatch costs, can then be determined.

Unserved energy is valued using the VCR, which is an estimate of the value electricity consumers place on having a reliable electricity supply. This value is equivalent to the average cost to consumers of having their electricity supply interrupted for a short time.

The constrained generation dispatch cost, determined through energy market model, is valued using the short-run marginal cost of generation.

4.3.1.1 A probabilistic approach to assessing the market impact of network limitations

The detailed review studies use a probabilistic approach to assess the annual gross market benefit of removing each transmission network limitation, where the cost of unserved energy and the cost caused by constrained generation dispatch are weighted by the probability of the limitation occurring.

The probability is determined considering uncertainties including:

- demand forecasts
- renewable generation
- dynamic ratings based on historical weather conditions
- new generation and storage development, based on the VTP and ISP optimal development path and least cost development
- outage rates based on historical generation and transmission forced outage rates
- control scheme failure rates, based on survey and research results, including the failure of multiple control schemes

4.3.2 Evaluating the need for an investment test

In the detailed review phase, the net present value of market benefits associated with removing a limitation is compared with the estimated cost of the feasible solutions, to determine if any feasible solution is likely to be economically justifiable. The studied solutions are assessed at a high level, so the analysis may not capture all benefits associated with removing the limitation or may not consider other binding limitations which can reduce the benefits or increase the costs.

Further market modelling studies may be required to determine the benefits associated with particular solutions more accurately.

A decision on whether to commence an investment test in the current planning cycle will be made based on:

- whether or not the limitation's net present value can justify the cost of the feasible options
- the economic timing of any new investment
- the lead times of the feasible options (that is, the time required to procure, design, plan, construct and commission)
- any operational measures, such as network switching, that can be implemented temporarily if the lead time is not sufficient

4.4 Investment test – identifying the preferred solution

The investment tests are designed to identify the preferred solution for removing or alleviating a limitation, and optimal timing for implementing the solution. Undertaken using the RIT-T framework, the feasibility studies have a series of key objectives:

- economic efficiency, where investments must maximise the present value of net economic benefit to all those who produce, consume and transport electricity in the market
- competitive neutrality, where all credible network and non-network investment options must be considered without bias
- predictability, consistency and transparency, where the test must be capable of being applied in a predictable, consistent and transparent manner
- proportionality, where the level of analysis required should reflect the scale of the investment

Refer to the Australian Energy Regulator's RIT-T application guideline for more information on the classes of transmission investment benefits considered, and the RIT-T process[22].

[22] At https://www.aer.gov.au/system/files/AER%20-%20Regulatory%20investment%20test%20for%20transmission%20application%20guidelines%20-%2025%20August%202020.pdf.

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