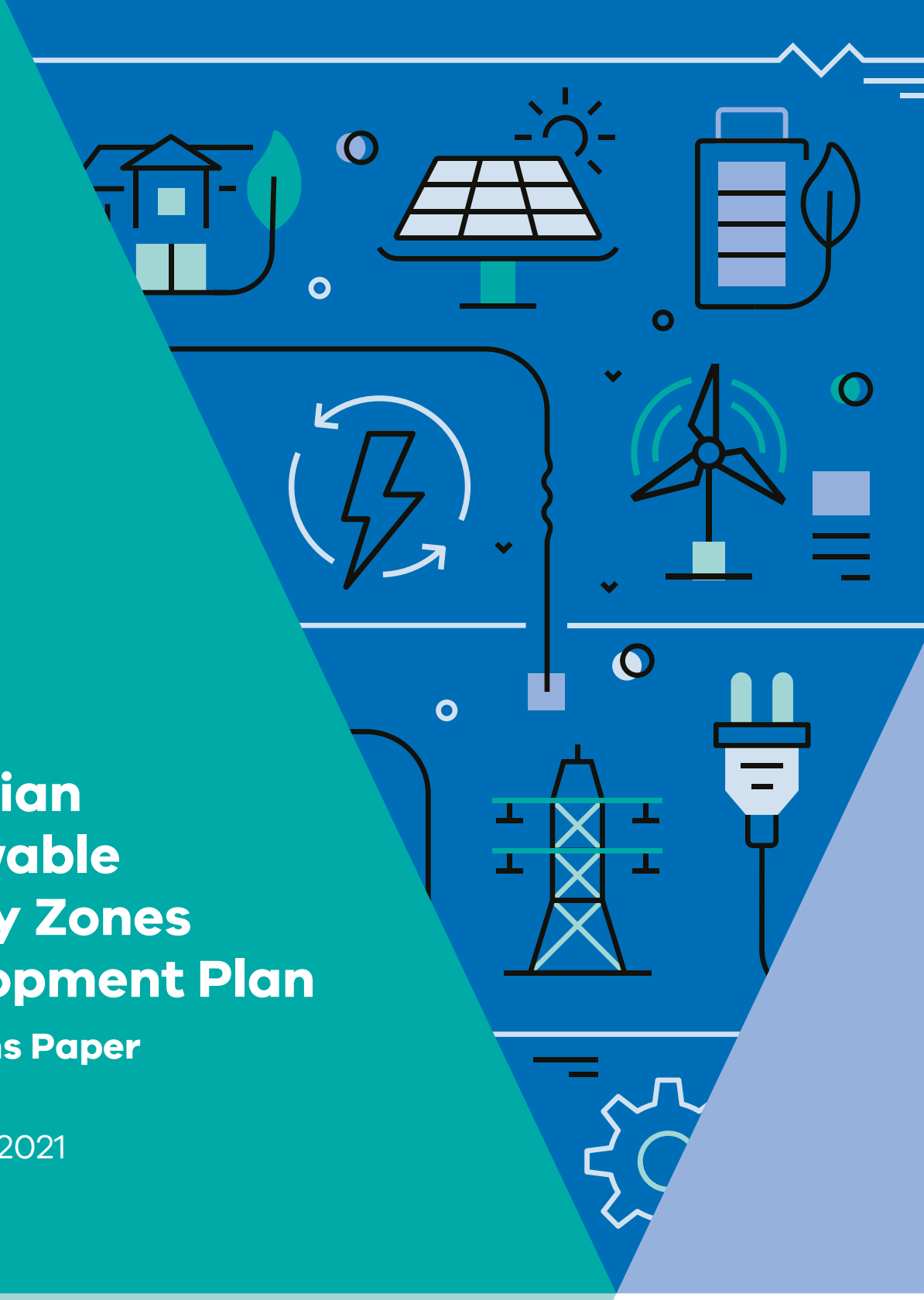

Victorian Renewable Energy Zones Development Plan

Directions Paper

February 2021

VICTORIA State Government
Environment, Land, Water and Planning

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1. Purpose of this Directions Paper

The Victorian Government is committed to the development of its Renewable Energy Zones (REZs). The purposeful development of REZs will allow new renewable energy projects to be connected in a timely manner, reducing risk premiums for investors, achieving better energy affordability and reliability outcomes for consumers, helping to achieve our climate change goals and furthering regional economic development goals.

The plan outlined in this Directions Paper will unlock 10 GW of new renewable energy capacity in Victoria, taking the total capacity across Victorian REZs to 16 GW. This will be enabled by the Victorian Government's $540 million REZ Fund to invest in needed REZ network infrastructure and the establishment of a new body, VicGrid, to actively plan and develop Victorian REZs.

As part of this development the Government seeks to deliver better outcomes for local communities by supporting locally appropriate network investment and renewable energy development, and will build consultation with local residents, industry and farming communities into its REZ planning.

This Directions Paper outlines three key actions that the Victorian Government intends to undertake to fully develop REZs in Victoria, as well as seeking feedback from key stakeholders on certain issues:

1. **The Government has prepared an initial REZ Development Plan that includes network investments that could be delivered immediately.**

   The Government has worked with the Victorian transmission network planner, the Australian Energy Market Operator (AEMO), to produce an initial REZ Development Plan (RDP) which outlines network investments that enable the full development of Victorian REZs.

   Included in this initial RDP are key network investments that the Victorian Government could progress immediately, as well as medium term projects that VicGrid will continue to plan and develop.

   Stakeholder views are sought on the potential network investments outlined in the RDP and the Victorian Government's identification of key projects for immediate investment, as well as procurement and cost recovery options for priority projects.

2. **The Government will establish VicGrid to actively plan and develop Victoria's REZs.**

   The Government is establishing VicGrid to actively plan and develop Victoria's REZs, including planning and investing in REZ network infrastructure, identifying and applying appropriate procurement, cost recovery and co-funding approaches, facilitating renewable energy generation projects in Victorian REZs, and working with communities to plan REZs and ensure local benefits from REZ development.

   This Directions Paper invites feedback from stakeholders on the structure and functions of VicGrid needed to achieve its objectives.

3. **The Government will release an Implementation Plan that will outline how Victoria will plan, develop and invest in Victorian REZs**

   Following feedback from stakeholders on this initial RDP, the Government will undertake further assessment of identified priorities for investment and release details of projects for immediate funding under the REZ Fund in May 2021, including the procurement and cost recovery models for such investment, including local content requirements.

   This will be followed by a broader REZ Implementation Plan that will be released in July 2021 which will update the RDP, establish and outline the work agenda of VicGrid, set out the framework for determining future investment and government funding in RDP projects, outline the ongoing process for delivering and updating the RDP, establish how VicGrid will engage and work with local governments, communities and businesses, and lay out the Government's broader approach to planning and developing Victorian REZs.

   Through this Directions Paper, the Victorian Government is seeking the views of renewable energy development proponents and energy businesses on the network projects and financing options identified in the initial RDP. The Government is also interested in hearing from a wide range of stakeholders including energy market participants, as well as local governments and consumer, environmental and local community groups on VicGrid's establishment and broader REZ development matters.

2. Context

2.1 Victoria's renewable energy transformation

Victoria's coal-fired power stations are increasingly aged and unreliable. The future reliability of Victoria's energy supply, and the economic and social benefits that this provides, is contingent on the development of a diverse, secure and affordable state-wide generation portfolio, delivered in a timely fashion.

Victoria is delivering on an ambitious agenda to increase the share of electricity produced from renewable sources. The Victorian Government has legislated renewable energy targets (VRET) of 25 per cent of electricity generation by 2020, 40 per cent by 2025, and 50 per cent by 2030. The 2020 target has been achieved and we are on track to achieve the 2025 and 2030 targets.

Significant investments have been made to support the achievement of the VRET, including the Victorian Renewable Energy Auction Scheme which has contracted for 928MW installed generation capacity. This year, the Government will be holding its second VRET auction, to deliver at least 600MW of new renewable generation. The Government has also partnered with industry to implement large scale battery projects in key areas of the state, including the 300MW Victorian Big Battery near Geelong.

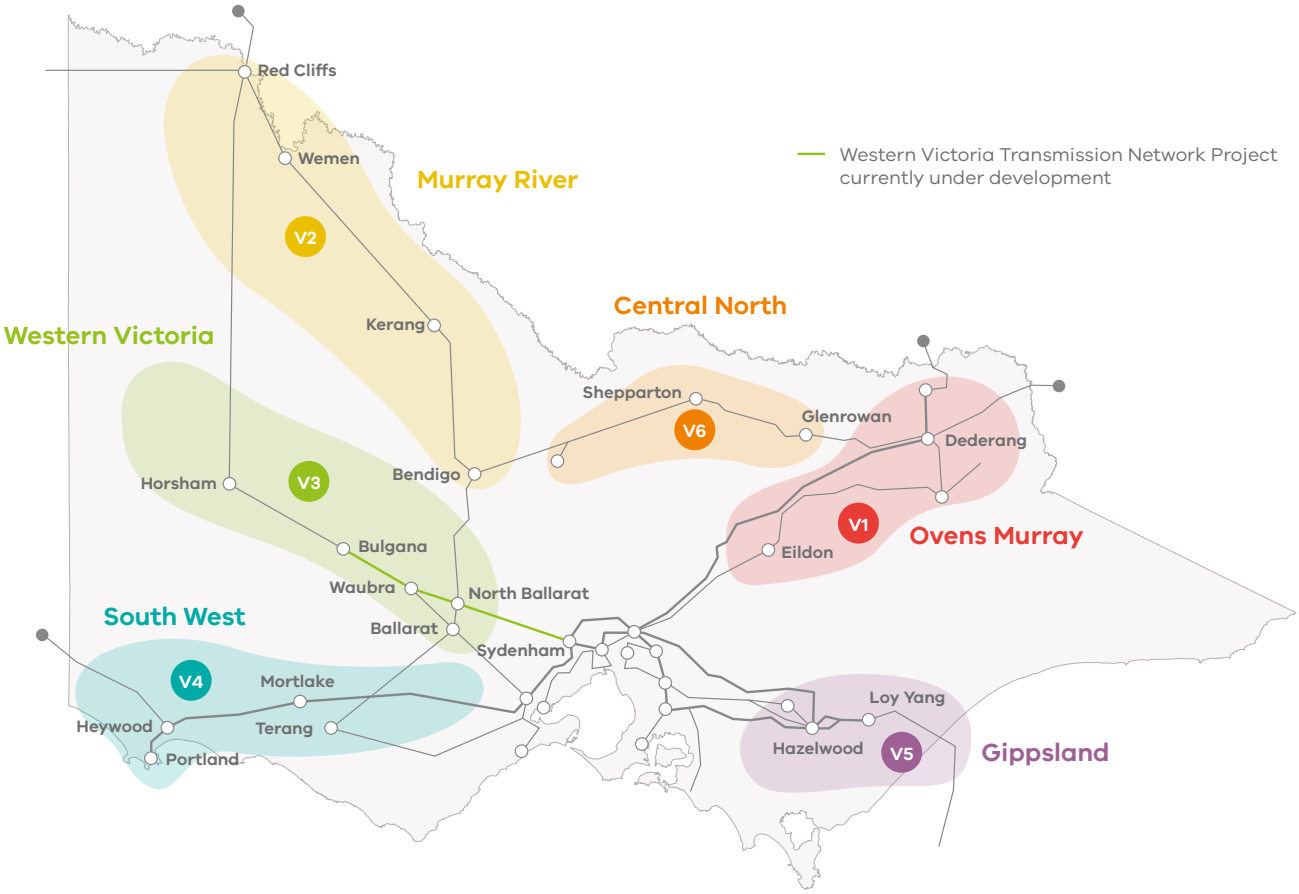
The benefits of this energy transformation are clear. As well as being vital to Victoria's need to decarbonise its economy to reduce the risks of climate change, the transition to renewable energy provides a key economic development opportunity for the state, and in particular regional Victoria. The steady increase in renewable energy projects in Victoria is contributing to lower prices and greater reliability for consumers. The REZ Development Plan will be designed to ensure this trend can continue.

The development of REZs across the state is a key initiative in Victoria's energy transformation. REZs are areas of abundant renewable energy resources such as solar and wind, the full development of which can ensure the timely and cost-effective delivery of secure and clean energy for Victoria. Figure 1 shows a map of the six REZs that have been identified in Victoria through the AEMO Integrated System Plan (ISP): South West Victoria, Western Victoria, Murray River, Central North, Ovens Murray and Gippsland.

The benefits of developing Victoria's REZs extend beyond direct increases to renewable energy generation, to include supporting investment in local economies, creating local jobs, and strengthening local supply chains. Victoria currently leads other states in renewable energy jobs, accounting for 7,800 jobs in 2020, or 30 per cent of total jobs in the renewables sector in Australia. The development of the Renewable Energy Zones will generate thousands of construction jobs right across regional Victoria, as workers build our next generation of solar and wind farms, energy storage and connecting transmission infrastructure.

Developing the renewable energy opportunities presented in all regions will necessitate transformation from a power system that has traditionally supplied electricity from a small number of very large electricity generators to a new system that connects the many new generation projects geographically dispersed across REZs. This will involve significant investment in transmission network infrastructure in areas that currently have limited capacity to carry energy from these new projects.

Figure 1 Victoria's Renewable Energy Zones



2.2 Barriers to the transition

Many renewable energy projects in Victoria are experiencing long and costly connection processes and/or restrictions due to a lack of thermal capacity and/or low network system strength in some REZs.

AEMO's 2020 Victorian Annual Planning Report (VAPR) includes network projects that will deliver system requirements and legislated policy targets, as prescribed under the current regulatory framework. However, AEMO notes that there continues to be strong developer interest beyond this expansion plan, often in locations with excellent renewable resources such as REZs.

AEMO notes that the current regulatory framework can result in extended generator constraints when imbalance between network and generation investment emerge, which could lead to less efficient utilisation of the state's renewable resources and higher project risk premiums that could be passed through into electricity market prices.

Internationally, jurisdictions are recognising the need for the anticipatory development of efficient transmission infrastructure to support the development of renewable energy zones. However, the current national regulatory framework for investment in transmission network infrastructure in Australia is designed for incremental transmission augmentation in response to generation-led investment.

This framework does not encourage centrally coordinated scale efficient solutions and anticipatory investments that pave the way for the transformation required in Victoria by 2030, and results in complex connection processes, increased investor risk and therefore reduced incentives for renewable energy investment.

A coordinated approach, beyond the constraints of traditional network planning, will help enable Victoria's strong pipeline of new power supply to be built and to be operating in time to provide reliable power when large ageing generators retire.

2.3 Victorian Government actions to date to support the transformation

In response to barriers to timely delivery of transmission network hosting capacity and REZ development in Victoria, the Victorian Government has actively pursued several strategies:

- **Driven changes to national reform processes**

  The Victorian Government has already taken significant foundational steps to achieve better coordination of network investments and generation. It has driven changes to national reform processes to bring forward Energy Security Board (ESB) reforms for transmission including the Actionable ISP rule change which streamlines and adjusts the RIT-T (Regulatory Investment Test for Transmission) to improve delivery timeframes for ISP projects, and a Renewable Energy Zone rules package which requires jurisdictional planning bodies (AEMO for Victoria) to prepare REZ development plans for priority REZs. Victoria has also taken a lead role in advocating for the ESB's Post 2025 National Electricity Market Review.

- **Introduced NEVA legislation to ensure necessary network development**

  In March 2020 the Government passed amendments to the National Electricity (Victoria) Act 2005 (NEVA) to allow it to depart from the national electricity rules where needed to expedite necessary network investments. So far the Government has utilised its powers under the amended NEVA to fast track the AEMO's procurement of a 300MW battery to enable increased import capacity of the Victoria New South Wales Interconnector (VNI) by 250MW in peak demand periods. The battery will be installed at the Moorabool Terminal Station, near Geelong, ahead of the 2021-22 summer period.

- **MOU with the Commonwealth Government to support the development of VNI West via KerangLink**

  On 22 November 2020 a memorandum of understanding (MOU) was announced between the Victorian and the Commonwealth Governments to support the development of VNI West via KerangLink. VNI West is a proposed new 500 kilovolt (kV) electricity transmission interconnector between Victoria and NSW. It will increase power export capacity to NSW by 1930MW and capacity to Victoria by 1800MW as well as unlocking investment in over 2000MW of renewable energy projects.

  The two governments have agreed to jointly underwrite up to $200 million to enable immediate progress on early works including detailed design and specifications, field, geotechnical and environmental assessments, negotiation of easement and land acquisitions and equipment ordering.

  KerangLink will facilitate the development of Victorian Renewable Energy Zones and this agreement will help to bring forward significant network capacity to connect renewable energy projects in Victoria and support regional jobs.

- **Regional Renewable Energy Roadmaps**

  The Victorian Government supported development of Regional Renewable Energy Roadmaps across regional Victoria. Specific to each region, these Roadmaps were developed in consultation with local communities and include analysis of supply chain opportunities, skills, infrastructure, manufacturing and transmission opportunities. Each Roadmap provides critical intelligence to business, industry and communities seeking to establish or expand new energy technology development, manufacturing or renewable energy generation in Victoria.

2.4 New initiatives

The Victorian Government as part of the 2020-21 State Budget further announced a number of initiatives to develop REZs across the state.

These initiatives will actively plan, invest and develop Victorian REZ electricity network infrastructure, and facilitate beneficial renewable energy generation in each REZ. Together these initiatives aim to reduce costs and complexity in connecting renewable energy projects to the grid, ensure that the REZ network is capable of hosting the generation required to achieve the state's energy transformation, enable strong community engagement, and support local economic and social benefits from renewable energy development across Victoria.

This REZ development work agenda includes:

- **Release of a REZ Development Plan**

  The Government is determined to bring forward network solutions that support the efficient development and connection of renewable energy projects in REZs, and is creating a REZ Development Plan (RDP) to achieve this. The RDP will identify key investments or other solutions that should be made on the Victorian network, where necessary extending beyond the initiatives in current planning documents such as the national ISP and the VAPR produced by AEMO. The RDP will provide appropriate solutions to:

  a. improve system strength and alleviate immediate connection and curtailment constraints in the short-term; and

  b. facilitate scale efficient and anticipatory investment in preparation for more renewables in the electricity system in the medium-term.

  This Directions Paper includes an initial RDP that includes potential short-term priority network improvements that could be made. Following stakeholder feedback a final RDP will be released as part of the REZ Implementation Plan in July 2021.

- **Establishment of VicGrid to actively plan and develop Victoria's REZs**

  The Government is establishing VicGrid to actively plan and develop Victoria's REZs, including planning and investing in REZ network infrastructure, identifying and applying appropriate procurement, cost recovery and co-funding approaches, facilitating renewable energy generation projects in Victorian REZs, and working with communities to plan REZs and ensure local benefits from REZ development.

- **$540m REZ Fund to assist financing of REZ network investments, including immediate priority projects.**

  As part of the 2020-21 State Budget, $540 million has been made available over four years for the Victorian Government to invest in network solutions in REZs. The Victorian Government will identify funding pathways for beneficial investments in network solutions, including the appropriate use of NEVA powers and government funding.

  Importantly, any project that is considered for government support must demonstrate a net benefit. When assessing the use of the REZ Fund, the Government will consider the benefits of public funding in REZ infrastructure including: network and consumer benefits; support for achieving government VRET targets; economic and industry development objectives; the priorities of local communities; local content opportunities; and the ability to provide value for taxpayer funding.

  Cost recovery options will be actively considered where government financing is provided for projects. The Government will explore options that can leverage its investment, and complementarity with other government initiatives such as the Energy Innovation Fund and possible Clean Energy Finance Corporation or Australian Renewable Energy Agency support will also be investigated.

3. Initial REZ Development Plan

The Victorian Government has worked with AEMO to identify potential network investments that support more timely and efficient development of Victoria's REZs. Together these investments could enable an additional 10GW of renewable energy generation capacity in Victorian REZs, taking total REZ capacity to 16GW. These are potential network solutions that have been identified in addition to those in current Victorian transmission planning documents such as the AEMO VAPR and ISP, and options to bring those planned projects forward, to assist efficient renewable energy transition.

The potential solutions identified reflect both anticipatory medium-term transmission developments to enable future REZ development, as well as technical solutions that could be progressed in the near term to support the efficient connection of Victoria's existing pipeline of renewable energy projects. This initial RDP exclusively focuses on transmission network development within Victorian REZs and is divided into two stages:

- Stage 1 projects are investments that the Victorian Government could immediately progress to deliver shorter-term grid remediation solutions in areas where network limitations are impeding renewable energy projects.
- Stage 2 projects are potential medium-term investments in REZ infrastructure that will involve further assessment and community and stakeholder consultation.

This initial plan will be developed further following consultation and further detailed analysis, and a final RDP will be released along with a broader REZ Implementation Plan in July 2021. The RDP will be maintained and updated by VicGrid when it is established as part of new institutional arrangements.

There are also significant opportunities for the development of renewable generation and storage projects in REZs that have good hosting capacity such as in Ovens Murray and Gippsland. From a network perspective the Ovens Murray REZ is not experiencing immediate system strength issues and has adequate network capacity to accommodate expected generation development. VicGrid will play an active role in planning and facilitating significant renewable energy development in all six REZs including the need for continued monitoring of emerging required network investments.

3.1 Stage 1: Immediate priority projects to support REZs

The Victorian Government and AEMO have worked together to develop a list of potential immediate priority transmission network upgrade projects to support existing and future renewable energy generation development in Victoria's REZs. These investments aim to strengthen the Victorian transmission network and resolve the network connection issues that are causing significant project delays and acting as an impediment to timely development in REZs.

Stage 1 candidate projects have been identified using the following criteria:

- able to be delivered by 2025;
- address a present or projected need due to progression of generator projects in the connections pipeline (e.g. system strength, hosting capacity shortfall etc);
- provide standalone benefits to the network and/or connecting parties which are not dependent on future long-lead time network upgrade plans from either AEMO's 2020 VAPR or ISP; and
- can efficiently meet planning and environmental requirements as well as community expectations (for example, they have existing site or land available to deliver, and likely do not require complex planning or environmental assessments).

Projects that could be delivered by the market or where the commercial model is more complex, for example battery storage projects, are not included in Stage 1.

A coordinated approach, beyond the constraints of traditional network planning, will help enable Victoria's strong pipeline of new power supply to be built and operating in time to provide reliable power when large ageing generators retire.

By supporting these investments sooner than the long timeframes of regulatory investments, such as the RIT-T, means more lower cost renewable generation can enter the market for the benefit of consumers, as well as providing non-market benefits such as local economic activity and jobs. Such scale efficient investments can also reduce connection costs and improve connection certainty for generators, reducing project development costs which flow down to lower energy costs for consumers, overcoming the barriers that exist in the current national regulatory framework.

Stage 1 projects have been further divided into two categories. The first category includes projects aimed at immediate grid operation, system strength and curtailment issues which the Government is considering financing via the $540 million REZ Fund. Following stakeholder feedback on these projects, further technical analysis and detailed assessment of their costs and benefits, the Government intends to release details of approved projects for immediate financing from the REZ Fund in May 2021, including procurement and cost recovery models for each investment, including local content requirements.

Table 1 details the seven candidate Stage 1 projects that are being considered for immediate REZ Fund financing. These are grouped by REZ with several key metrics associated with each project - capital costs, expected benefits, delivery timeframe and delivery risk. Delivery risk is generally determined by assessing the project against environmental, planning and community criteria. These projects are expected to be developed at established sites and not require new land or easements and should generate minimal community concern.

Individual project overviews, which contain more detailed project information, are available at the Appendix.

Table 1 Stage 1 Projects – REZ Fund immediate network investments

Project	Capital Cost ($M)	Expected network benefit	Delivery timeframe (years)	Delivery risk (low, medium, high)
Murray River: V2				
125MVAr synchronous condenser at Red Cliffs	$42-$98	Scale efficient solution to address system strength and connection issues. This is estimated to benefit up to 761MW of renewable energy generation and save $38M* on capital costs through scale efficiency.	2-3	Medium
Minor augmentation	$1-$3	43-67MW of added network capacity, thereby avoiding generator curtailment due to network thermal limitations.	2-3	Low
Western: V3				
250MVAr synchronous condenser at Horsham	$32-$76[1]	Scale efficient solution to address system strength and connection issues. This is estimated to benefit up to 1818MW of renewable energy generation and save $29M* on capital costs through scale efficiency.	2.5-4	Low
South West: V4				
Minor augmentation	$10-$24	25-40MW of added network capacity, thereby avoiding generator curtailment due to network thermal limitations.	3-4	Low
South West communications upgrade	$3-$8	Enable connecting generators to meet their GPS obligations relating to remote control, protection.	3-4	Low
250MVAr synchronous condenser at Haunted Gully	$40-$140	Scale efficient solution to address system strength and connection issues. This is estimated to benefit up to 3202MW of renewable energy generation and save $54M* on capital costs through scale efficiency.	2.5-4	Medium
Central North: V6				
Minor augmentations	$1-$3	18MW of added network capacity, thereby avoiding generator curtailment due to network thermal limitations.	2-3	Low

[1] This cost assumes coordination with a planned AusNet network augmentation

* Calculated as 35% reduction in capital costs from individual system strength investments based on AEMO advice.

The second category of Stage 1 projects includes priority line upgrades that enable the connection of additional renewable energy capacity in the West and South West REZs. These REZs currently have thermal constraints that are preventing connection of immediate and future renewable energy projects.

The Government will consider how current regulatory arrangements can progress these projects. If it is evident that these projects are not able to be delivered effectively under the current national regulatory framework to enable significant new renewable energy capacity to connect, and that the projects are assessed to provide net benefits, the Government will consider further options to deliver them, including the use of NEVA powers.

The Government will undertake further detailed analysis and provide an update on its assessment of these projects in May 2021 when REZ Fund announcements are made for the other Stage 1 projects. The Government will announce a decision on funding for these projects in the REZ Implementation Plan to be released in mid 2021.

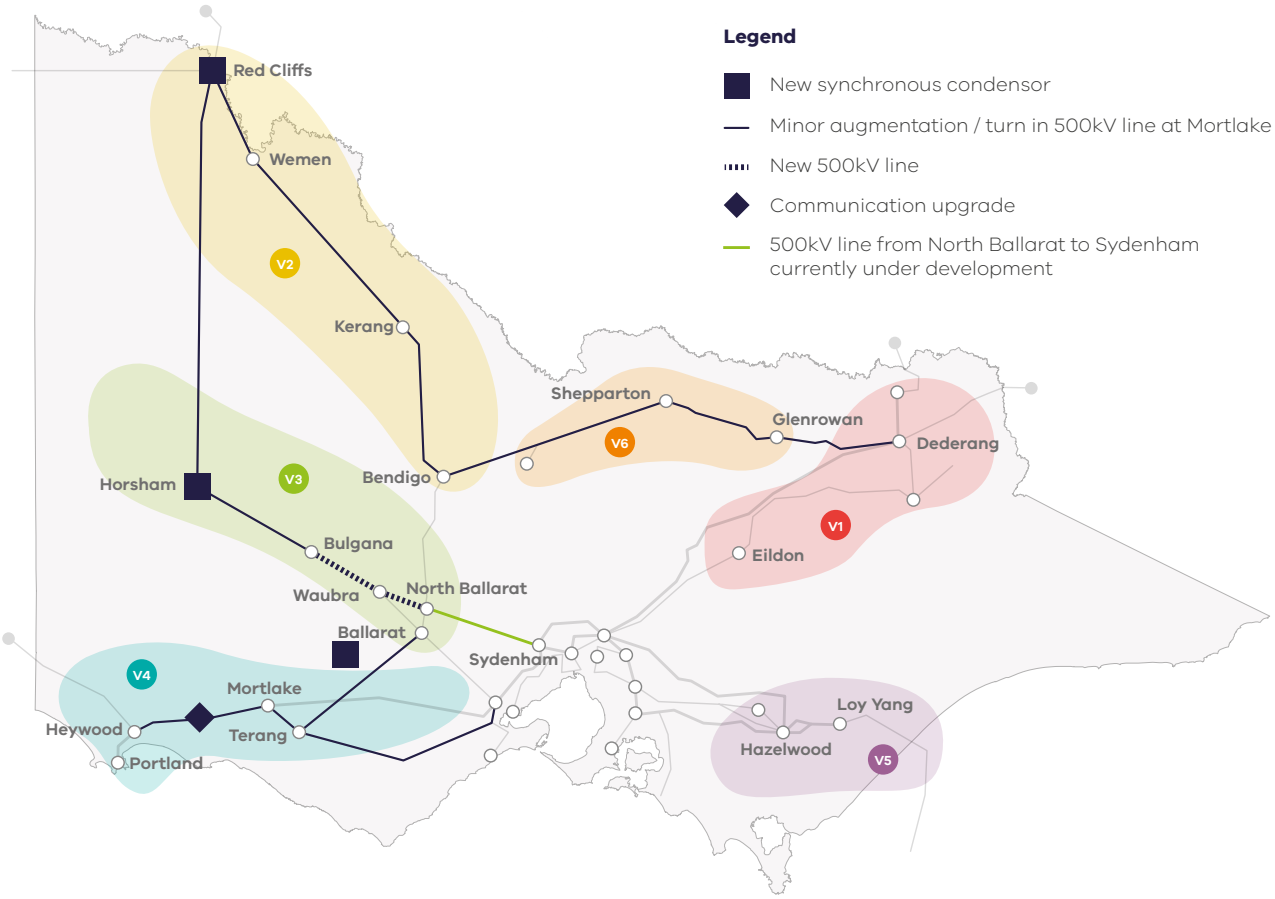
Table 2 below details the two proposed Stage 1 network augmentation projects. These are grouped by REZ with several key metrics associated with each project - capital costs, expected benefits, delivery timeframe and delivery risk (environmental, planning and community). Individual project overviews, which contain more detailed project information, are available at the Appendix.

Table 2 Stage 1 Projects – larger network augmentations with alternative delivery options

Project	Capital Cost ($M)	Expected benefit	Delivery timeframe (years)	Delivery risk (low, medium, high)
Western: V3				
Increase the rating of the Western Victoria Transmission Network Project (WVTNP) from 220kV to 500kV from North Ballarat to Bulgana[2]	$132-$308	Enable the connection of up to 1200MW of renewable energy projects above the existing WVTNP.	5[3]	High
South West: V4				
Turn in existing Haunted Gully to Tarrone 500kV line at Mortlake	$15-$35	2500MW of additional network capacity thereby reducing generator curtailment due to network stability limitations.	2-3	Medium

[2] This project is subject to the existing WVTNP and will only progress if it does not delay the delivery of the existing WVTNP, and will be the subject to EES processes.
[3] Ausnet estimate of project delivery.

Figure 2 Victoria's REZs overlaid with immediate network solutions



3.2 Stage 2: Future projects to support REZs

Stage 2 of the RDP focuses on potential medium-term REZ network projects that could be implemented to fully develop Victorian REZs.

These Stage 2 projects require further technical analysis, assessment of costs and benefits, as well as analysis of appropriate funding and business models and significant stakeholder and community consultation. These projects include:

- significant anticipatory augmentations to Victorian REZ transmission infrastructure which require complex planning and financial considerations or are subject to the outcome of other RIT-T projects (Victoria New South Wales interconnector (VNI) West, WVTNP, etc.);
- battery energy storage system (BESS) projects that may be funded by the private sector or may require innovative business models and tailored funding mechanisms to attract private sector investment; and
- smaller scale efficient system strengthening projects that require further analysis.

VicGrid will be responsible for the future development and possible delivery of projects identified in Stage 2 of the RDP. This will involve identifying priorities for next stage development and determining appropriate funding and delivery models for identified projects, including through the use of public funds. VicGrid will also actively consider cost recovery and ownership models for these assets.

Table 3 details the candidate projects for Stage 2 development under the RDP. These are grouped by REZ with several key metrics associated with each project - capital costs, expected benefits, delivery timeframe and delivery risk (environmental, planning and community). Individual project overviews, which contain more detailed project information, are available at the Appendix.

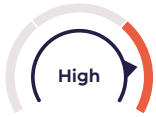
The Stage 2 project list is not exhaustive or limiting and more projects may be included either through this consultation process or through further detailed analysis conducted by VicGrid over time.

Table 3 Stage 2 Projects - potential medium-term investments[4]

Project	Capital Cost ($M)	Expected benefit	Delivery timeframe (years)	Delivery risk (low, medium, high)
Murray River: V2				
450MW × 3h of storage capacity (assuming BESS)	$354-$826	Increase utilisation of renewable energy by enabling the absorption of excess energy from renewable generation during periods of negative demand. This is expected to increase utilised renewable energy by 493GWh annually and provide benefit of 2015MW to renewable energy generation.	2.5-4	Low
**New 220kV OH line from Kerang to Red Cliffs via Wemen (~230km)	$308-$720	Provide up to 800MW of anticipatory network capacity for future renewable energy generation projects. This is expected to increase utilised renewable energy by 2365GWh annually.	5.5-7	High
125MVAr synchronous condenser at Kerang	$42-$98	Scale efficient solution to address system strength and connection issues. This is estimated to benefit up to 1000MW of renewable energy generation and save $38M* on capital costs through scale efficiency.	2-3	Low
Second 350MW × 3h of storage capacity (assuming BESS)	$194-$454	Increase utilisation of renewable energy by enabling the absorption of excess energy from renewable generation during periods of negative demand. This is expected to increase utilised renewable energy by 383GWh annually and provide benefit of a further 2698MW to renewable energy generation.	2.5-4	Low
Western: V3				
125MVAr synchronous condenser at Murra Warra	$40-$105	Scale efficient solution to address system strength and connection issues. This is estimated to benefit up to 2344MW of renewable energy generation and save $40M* on capital costs through scale efficiency.	2-5-4	Low
350MW × 3h of storage capacity (assuming BESS)	$275-$643	Increase utilisation of renewable energy by enabling the absorption of excess energy from renewable generation during periods of negative demand. This is expected to increase utilised renewable energy by 383GWh annually and provide benefit to 1765MW of renewable energy generation.	2.5-4	Low
**New 220kV OH DCCT line from Murra Warra to Bulgana via Horsham (~125km)	$170-$396	Provide up to 1000MW of anticipatory network capacity for future renewable energy generation projects. This is expected to increase utilised renewable energy by 3835GWh annually.	5-6	High
Second 350MW × 3h of storage capacity (assuming BESS)	$194-$454	Increase utilisation of renewable energy by enabling the absorption of excess energy from renewable generation during periods of negative demand. This is expected to increase utilised renewable energy by 383GWh annually and provide benefit to a further 1765MW of renewable energy generation.	2.5-4	Low

[4] Key acronyms in project names include the following: DCCT = Double circuit, SCCT = Single circuit, OH = Overhead
* Calculated as 35% reduction in capital costs from individual system strength investments based on AEMO advice
** Subject to outcome of other RIT-T projects (VNI West, WVTNP, etc.)

Project	Capital Cost ($M)	Expected benefit	Delivery timeframe (years)	Delivery risk (low, medium, high)
South West: V4				
250MVAr synchronous condenser at South Morang	$60-$140	Scale efficient solution to address system strength and connection issues. This is expected to provide benefit to 1906MW of renewable energy generation and save $54M* on capital costs through scale efficiency.	2.5-4	Low
Second 300MW × 3h of storage capacity (assuming BESS)	$167-$389	Increase utilisation of renewable energy by enabling the absorption of excess energy from renewable generation during periods of negative demand. This is expected to increase utilised renewable energy by 329GWh annually and provide benefit to a further 2587MW of renewable energy generation.	2.5-4	Low
350MW × 3h of storage capacity (assuming BESS)	$275- $643	Increase utilisation of renewable energy by enabling the absorption of excess energy from renewable generation during periods of negative demand. This is expected to increase utilised renewable energy by 383GWh annually and provide benefit to 2587MW of renewable energy generation.	2.4-4	Low
Additional 220kV SCCT from Elaine to Moorabool (~43km)	$54-$126	Provide up to 600MW of anticipatory network capacity for future renewable energy generation projects. This is expected to increase utilised renewable energy by 630GWh annually.	5-6	Medium
**New 500kV OH SCCT line from Mortlake to North Ballarat (~130km)	$318-$742	Provide up to 3000MW of anticipatory network capacity for future renewable energy generation projects. This is expected to increase utilised renewable energy by 4920GWh annually.	5-6.5	High
**500kV OH line from Bulgana to Mortlake	$398-$930	Provide up to 2500MW of anticipatory network capacity for future renewable energy generation projects. This is expected to increase utilised renewable energy by 4290GWh annually.	5-6.5	High
Gippsland: V5				
New 500kV OH DDCT from Hazelwood or Loy Yang to Gippsland (-65km)	$300-$700	Provide up to 2100MW of anticipatory network capacity for future renewable energy generation projects. This is expected to increase utilised renewable energy by 7270GWh.	4-5	High

Project	Capital Cost ($M)	Expected benefit	Delivery timeframe (years)	Delivery risk (low, medium, high)
Central North: V6				
200MW × 3h of storage capacity (Assuming BESS)	$157-$367	Increase utilisation of renewable energy by enabling the absorption of excess energy from renewable generation during periods of negative demand. This is expected to increase utilised renewable energy by 219GWh annually and provide benefit to 778MW of renewable energy generation.	2.5-4	
Second 300MW × 3h of storage capacity (Assuming BESS)	$167-$390	Increase utilisation of renewable energy by enabling the absorption of excess energy from renewable generation during periods of negative demand. This is expected to increase utilised renewable energy by 329GWh annually and provide benefit to a further 1580MW of renewable energy generation.	2.5-4	
**New 220kV SCCT from Shepparton to Dederang via Glenrowan	$260-$608	Provide up to 800MW of anticipatory network capacity for future renewable energy generation projects. This is expected to increase utilised renewable energy by 1708GWh annually.	5.5-7	
**New 220kV DCCT from Bendigo to Shepparton (~120km)	$205-$480	Provide up to 800MW of anticipatory network capacity for future renewable energy generation projects. This is expected to increase utilised renewable energy by 1576GWh annually.	5.5-7	
125MVAr synchronous condenser at Shepparton	$42-$98	Scale efficient solution to address system strength and connection issues. This is estimated to benefit up to 863MW of renewable energy generation and save $38M* on capital costs through scale efficiency	2.5-4	
Second 125MVAr syncon at Shepparton	$42-$98	Scale efficient solution to address system strength and connection issues This is estimated to benefit up to a further 1506MW of renewable energy generation and save $38M* on capital costs through scale efficiency	2.5-4	

Questions:

- What are stakeholder views on the Stage 1 projects prioritised for immediate investment for example type, location and feasibility?
- What are stakeholder views on the appropriate procurement, and cost recovery and asset ownership mechanisms for these prioritised projects?
- Are there alternative medium-term investments to the above that should be considered in the RDP?

4. REZ Governance and Funding

As part of the 2020-21 Budget, the Victorian Government announced two major new initiatives that will deliver faster and better coordinated development of REZs. These two measures are:

- The creation of a REZ development body responsible for actively delivering Victorian REZs (VicGrid); and
- The $540 million REZ Fund, to invest in REZ network infrastructure solutions.

VicGrid will build on the Victorian Government's existing leadership to address barriers to the timely delivery of transmission network hosting capacity and REZ development in Victoria. VicGrid will seek to leverage and complement initiatives such as the Energy Security Board's REZ framework and the proposed 'efficient management of system strength' rule change currently being assessed by the Australian Energy Market Commission to enable timely and efficient development of Victoria's REZs.

4.1 Establishing VicGrid

The Victorian Government will establish VicGrid in mid 2021, tasked with the overarching planning and development of Victorian REZs. VicGrid will actively engage with regional communities to ensure appropriate and beneficial development in each REZ.

The Government is currently considering the precise form, functions and powers of VicGrid, and will look to other jurisdictions in Australia and internationally for key insights and learnings. The Government is seeking further feedback through this consultation process on options for VicGrid to effectively achieve its objectives, including consideration of VicGrid's role in the Victorian Transmission Planning Framework.

The role and powers of VicGrid could include:

- broadly planning, developing and delivering timely and coordinated transmission, generation, storage and network firming projects in REZ areas;
- facilitating delivery of renewable energy projects in REZ areas;
- leading community engagement and benefit sharing from REZ development;
- supporting state and regional economic development opportunities through REZ development;
- identifying and applying appropriate procurement, cost recovery and co-funding approaches; and
- financial support for REZ development projects.

Questions:

- What functions would stakeholders like VicGrid to perform and what governance model would be appropriate?
- Are there effective features of REZ development bodies in other jurisdictions in Australia and internationally which stakeholders consider would be most effective for Victoria's VicGrid?
- How best should VicGrid engage with local communities, businesses and local governments to ensure appropriate and beneficial REZ development?
- Victoria is contributing to national market and regulatory reforms in REZ development and careful consideration will be given to these arrangements. What features are important for consideration in the establishment of VicGrid to support complementarity of these reforms and effective outcomes in Victorian renewable energy development?

4.2 Funding pathways for RDP projects and REZ Fund

The Government intends to release details of the Stage 1 RDP projects for immediate financing from the REZ Fund in May 2021, including procurement and cost recovery models for each investment, including local content requirements. Projects outlined in Stage 2 of the RDP could be financed through several pathways, including the use of regulatory powers (e.g. use of Victorian NEVA powers to modify or disapply the RIT-T process), public funding (including the REZ fund), private investment or a combination of these pathways.

Future development and financing of network projects in the RDP will be guided by an assessment of net beneficial investment for Victoria, aligned with supporting efficient and sustainable renewable energy development in the REZs, and achieving value for money for taxpayers and electricity consumers. Funding pathways for projects identified in the RDP will be case-specific in order to achieve the above objectives.

The Government is developing a framework to guide investment in RDP projects and to determine the most appropriate funding pathways and government funding options for RDP projects once approved. This framework will be released as part of the REZ Implementation Plan in July 2021. Initial development suggests several factors will be considered when determining the most appropriate funding pathway, including whether:

1. the investment can be undertaken under the existing regulatory framework;
2. the investment is scale efficient and enables multiple new generators to connect to the network, now or in the future;
3. beneficiaries can be readily identified to contribute to the cost of the investment;
4. the investment delivers on key public policy objectives.

The Government's $540m REZ Fund can be used in a variety of different ways to facilitate RDP solutions including:

- funding investment gaps to bring forward network projects under RIT-T processes where appropriate;
- direct grant funding or co-funding of projects; and
- financing of investments with cost recovery from beneficiaries.

Importantly, any project that is considered for government support must demonstrate a net benefit. When assessing the use of the REZ Fund, the Government will consider the benefits of public funding in REZ infrastructure including network and consumer benefits, support for achieving government VRET targets, economic and industry development objectives, the priorities of local communities, local content opportunities, and the ability to provide value for taxpayer funding, including cost recovery of investment.

5. Next Steps

Following feedback from stakeholders on the initial RDP and VicGrid governance, the Victorian Government will undertake the following steps:

- By the end of May 2021, the Government will release details of the priority network projects it intends to immediately finance through the REZ Fund, informed by stakeholder feedback, further detailed technical assessment and analysis of costs and benefits and including procurement and cost recovery models for these projects.
- In July 2021, the Government will establish VicGrid to develop and deliver Renewable Energy Zones for Victoria.
- In July 2021, the Government will release the REZ Implementation Plan which will include the finalised RDP, the establishment of VicGrid, the Government's framework for further investment and funding of RDP projects, the ongoing work agenda of VicGrid in delivering and updating the RDP and further developing Victorian REZs in consultation with local communities.

5.1 How to provide feedback

Thank you for taking the time to engage with this process. All responses are highly appreciated and are welcome before **midnight Wednesday, 31 March 2021**.

Please email REZDevelopment@delwp.vic.gov.au to submit responses to this consultation paper.

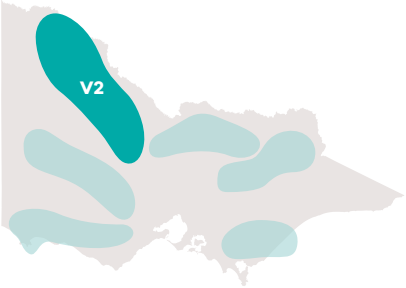
For any queries regarding the process, please email REZDevelopment@delwp.vic.gov.au.

DELWP may publicly release responses to this consultation paper; respondents should indicate where any material is commercial-in-confidence and should not be released.

Appendix: Detailed Project Overviews

Stage 1 | Category 1

125MVAr synchronous condenser at Red Cliffs



REZ
Murray River (V2)

Location
Likely within existing substation or easement within Red Cliffs area

Delivery timeframe
2-3 years

Cost
$42M-98M

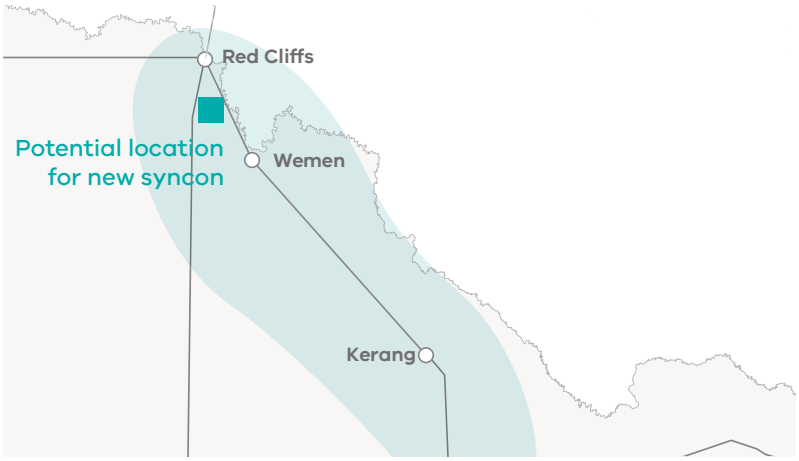
Project description (overview and purpose)

Installation of a new synchronous condenser in the Red Cliffs area.

This project would support the immediate need for more system strength in the area. Following construction of Project EnergyConnect and the associated synchronous condensers at Buronga, this synchronous condenser will provide additional system strength for more renewable energy projects built in the area. This project will increase system strength and ensure sufficient available fault level for new renewable generators to comply with their system strength connection compliance obligations. This project would avoid the need for individual syncons to be constructed and represents a scale-efficient solution to system strength remediation, reducing capital expenditure overall.

Technical specification

125MVAr nameplate rating.



Benefit

Scale efficient solution to address system strength and connection issues.

Estimated to benefit up to 761MW of renewable energy and save $38M on capital costs.

Beneficiaries

Solar (MW)	761
Wind (MW)	0
Total (MW)	761

Risk of delivery

Environment

Greenfield area – vegetation clearing required.

Infrastructure may be close to sensitive areas.

Environmental impacts may be avoided due to flexibility in the asset location.

Planning

Project is located within an existing transmission line easement or substation site.

Uncertainty regarding land availability; new terminal station and easements required, may necessitate compulsory processes – time and cost uncertain.

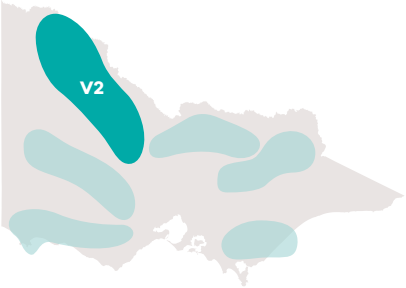
Community

Potential community concerns regarding visual impacts and environmental impacts.

Potential concerns regarding loss of agricultural land.

Stage 1 | Category 1

Minor augmentation projects to support additional capacity



REZ
Murray River (V2)

Location
All upgrades within existing substation and easement sites

Delivery timeframe
2-3 years

Cost
$1M-3M

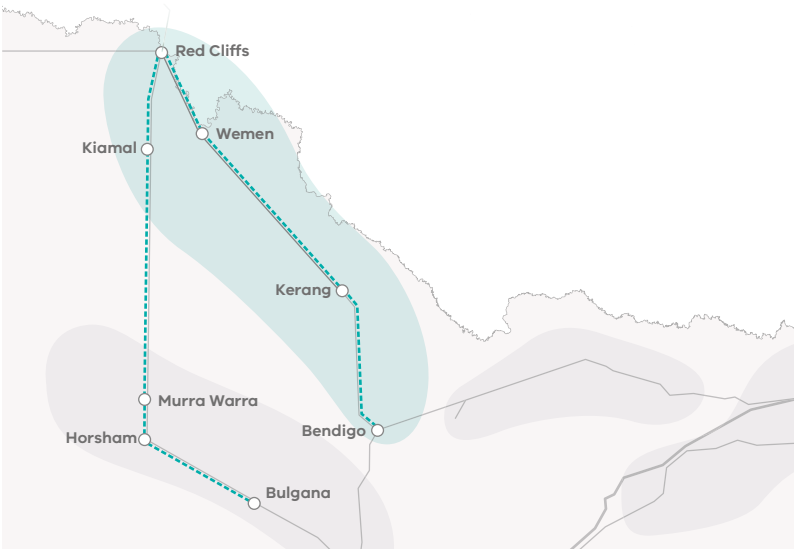
Project description (overview and purpose)

Minor augmentation projects in the Murray River REZ include automatic load and generation tripping and run back schemes for generators. The purpose of these projects is to enable higher levels of existing network capacity utilisation while maintaining system security. These projects are effectively a method of unlocking capacity on the existing network to accommodate greater levels of renewable generation at a lower cost than new network build.

Technical specification

Automatic load/generation tripping/runback schemes to relieve thermal constraints on:

- RCTS-KMTS-MUTS-HOTS-BGTS
- RCTS – WETS – KGTS – BETS



Benefit

43-67 MW of added network capacity, thereby avoiding generator curtailment due to network thermal limitations.

Beneficiaries

Generators in the Murray River REZ.

Risk of delivery

Environment
Greenfield and brownfield secondary systems upgrades only.

Planning
Greenfield and brownfield secondary systems upgrades only.

Community
Greenfield and brownfield secondary systems upgrades only.

Stage 1 | Category 1

250MVAr synchronous condenser at Horsham

REZ
Western (V3)

Location
In Horsham area, likely within existing Horsham substation site

Delivery timeframe
2.5-4 years

Cost
$32M-$76M
(Estimate of the incremental cost of replacing the end-of-life Horsham SVC with a synchronous condenser)

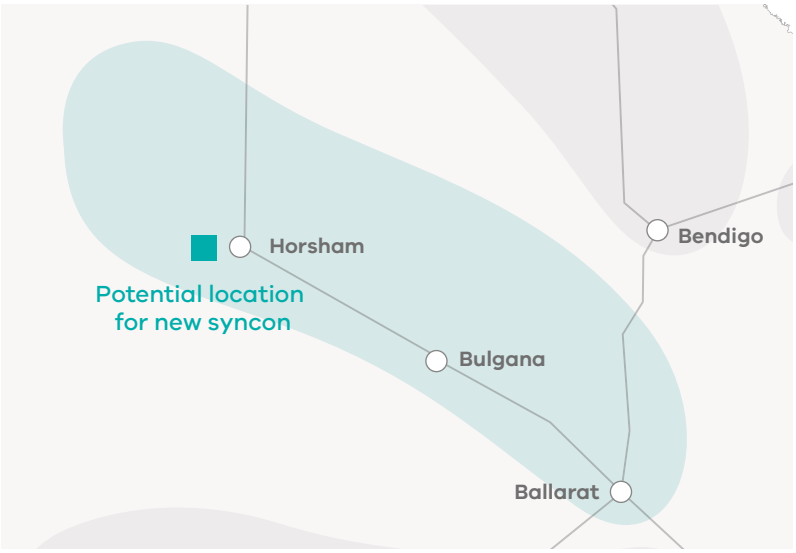
Project description (overview and purpose)

Installation of a new synchronous condenser in the Horsham area.

This project will increase system strength and ensure sufficient available fault level for new renewable generators to comply with their system strength connection compliance obligations. The existing Horsham static VAr compensator (SVC) is reaching end of life. Replacement with a modern equivalent SVC will cost $45M. Replacement with a synchronous condenser rather than a new SVC will would cost $100M. This project would avoid the need for individual synchronous condensers to be constructed and represents a scale efficient solution to system strength remediation, reducing capital expenditure overall.

Technical specification

250MVAr nameplate rating.



Benefit

Scale efficient solution to address system strength and connection issues. Estimated to benefit up to 1818MW of renewable energy generation and save $29M on capital costs.

Beneficiaries

Solar (MW)	365
Wind (MW)	1453
Total (MW)	1818

Risk of delivery

Environment
There is flexibility in the asset location therefore, environmental impacts may be avoided.

Planning
Project is located within the existing Horsham substation site therefore, likely to be low planning risk and land availability risk.

Community
Community concern may be low due to co-location with existing infrastructure at substation.

Stage 1 | Category 1

Minor augmentation projects to support additional capacity

REZ
South West (V4)

Location
Upgrades within existing substations and easements

Delivery timeframe
3-4 years

Cost
$10M-$24M

Project description (overview and purpose)

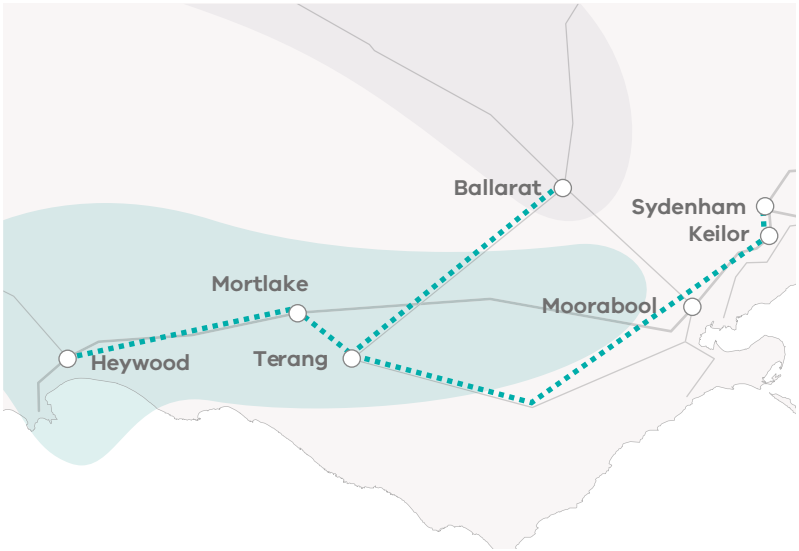
Minor augmentation projects in the South West REZ.

Minor augmentation projects in the South West REZ include automatic load and generation tripping and run back schemes for generators. Secondary systems bay upgrades are also included to boost the ratings of transformers.

The purpose of these projects is to enable a higher levels of existing network capacity utilisation while maintaining system security. These projects are effectively a method of unlocking capacity on the existing network to accommodate greater levels of renewable generation at a lower cost than new network build.

Technical specification

BATS-TGTS-MLTS line; HYTS-MLTS line; MLTS-GTS-DPTS-KTS line; SYTS-KTS line; MLTS 220kV Transformer; DDTS 330/220kV Transformer.



Benefit

25-40MW of added network capacity, 100MVA to 300MVA for transformers, thereby avoiding generator curtailment due to network thermal limitations.

Beneficiaries

Generators in the South West zone.

Risk of delivery

Environment
Greenfield and brownfield secondary systems upgrades only.

Planning
Greenfield and brownfield secondary systems upgrades only.

Community
Greenfield and brownfield secondary systems upgrades only.

Stage 1 | Category 1

South West communications upgrade

REZ
South West (V4)

Location
Upgrades within existing substations and easements

Delivery timeframe
3-4 years

Cost
$3M-$8M
(Balance of additional $29M will be covered by TNSP RIT-T)

Project description (overview and purpose)

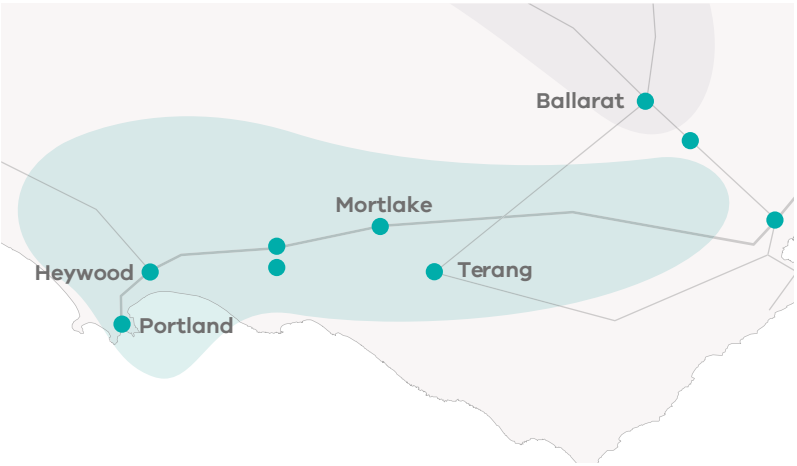
South West telecommunications network upgrade.

This project adds telecommunications network capacity in the South West area to provide the bandwidth to enable SCADA, signaling and protection for new generator connections in the area. This project helps generator connections in the area by pre-building the necessary telecommunications infrastructure required to integrate these generators into the transmission system. Unless built sooner, this investment will be triggered by a replacement expenditure driver in 2024. The cost quoted above is therefore the estimated advancement cost from the nominal replacement expenditure timing.

Technical specification

Replace radio redundant path from Terang (TGTS) to APD with fibre. Involves a redundant path from TGTS to APD underground through road networks etc.

This is listed in the AusNet asset replacement plan (refer to page 8 of asset replacement plan – SDH/PDH replace – South West Region Loop).



Benefit

Enable connecting generators to meet their GPS obligations relating to remote control, protection.

Beneficiaries

New generators connecting in the South West REZ area.

Risk of delivery

Environment

Infrastructure will be located underground within the road reserve, reducing environmental impacts.

Infrastructure may be close to sensitive areas e.g. Enfield State Park. However, siting may avoid impacts to sensitivity areas.

Planning

Conflicting land use: Works could intercept Farming Zone, Rural Activity Zones, Residential and Township Zones, Rural Conversation Zone and Public Conservation and Resource zone.

Native vegetation removal required.

Land unavailable: new easement required, may necessitate compulsory processes – time and cost constraint.

Community

Community concern may be lower due to co-location with existing infrastructure.

Placement of network underground should ease community concerns.

Stage 1 | Category 1

250MVAr synchronous condenser at Haunted Gully

REZ
South West (V4)

Location
Likely located within existing substation or easement in the Haunted Gully area

Delivery timeframe
2.5-4 years

Cost
$40M-$140M

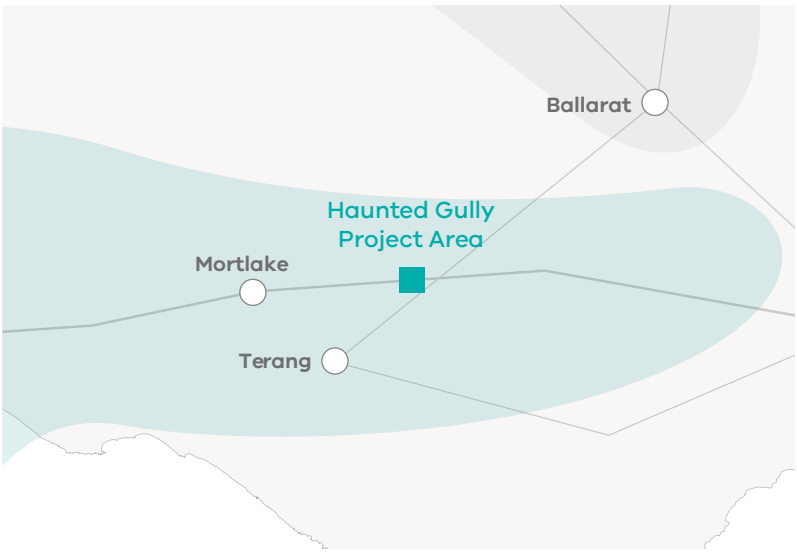
Project description (overview and purpose)

Installation of a new synchronous condenser in the Haunted Gully area.

This project will increase system strength and ensure sufficient available fault level for new renewable generators to comply with their system strength connection compliance obligations. This project would avoid the need for individual synchronous condensers to be constructed and represents a scale efficient solution to system strength remediation, reducing capital expenditure overall.

Technical specification

250MVAr nameplate rating.



Benefit

This is estimated to benefit up to 3202MW of renewable energy generation and save $54M on capital costs through scale efficiency.

Beneficiaries

Solar (MW)	0
Wind (MW)	3202
Total (MW)	3202

Risk of delivery

Environment

Project location within cleared agriculture land may minimises environmental risk.

Planning

Conflicting land use: works could intercept Farming Zone.

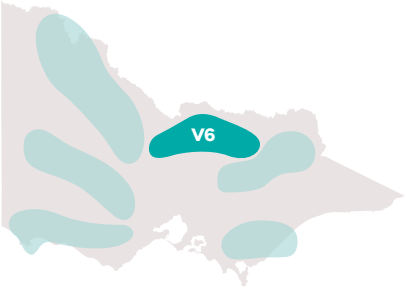
Project is not within an existing easement therefore land availability is not guaranteed.

Community

Potential concerns regarding loss of agricultural land.

Stage 1 | Category 1

Minor augmentation projects to support additional capacity



REZ
Central North (V6)

Location
All upgrades within existing substations or easements

Delivery timeframe
2-3 years

Cost
$1M-3M

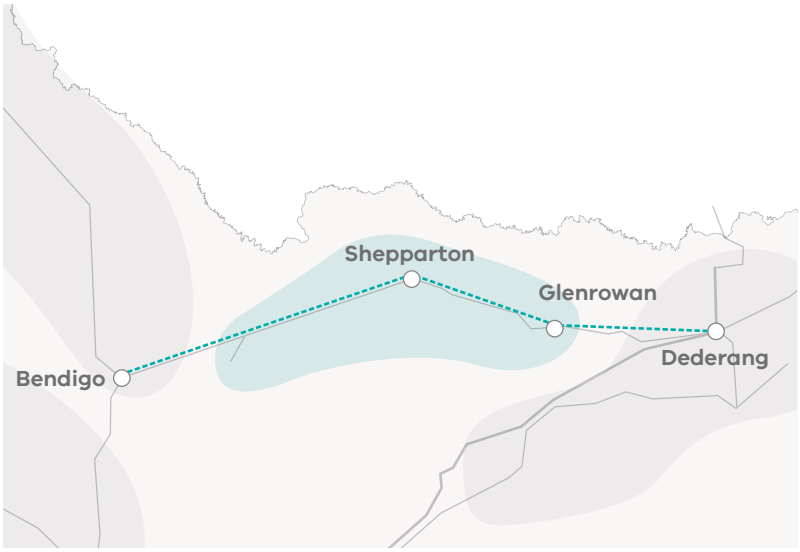
Project description (overview and purpose)

Minor augmentation projects in the Central North REZ.

The project include automatic load and generation tripping and run back schemes for generators. The purpose of these projects is to enable higher levels of existing network capacity utilisation while maintaining system security. These projects are effectively a method of unlocking capacity on the existing network to accommodate greater levels of renewable generation at a lower cost than new network build.

Technical specification

DDTS-GNTS-SHTS-BETS line: Automatic load/generation tripping/runback schemes.



Benefit

18MW of added network capacity, thereby avoiding generator curtailment due to network thermal limitations.

Risk of delivery

Environment
Greenfield and brownfield secondary systems upgrades only.

Planning
Greenfield and brownfield secondary systems upgrades only.

Community
Greenfield and brownfield secondary systems upgrades only.

Stage 1 | Category 2

Western Victoria Transmission Network Project (WVTNP) North Ballarat to Bulgana

REZ
Western (V3)

Location
New easement between Bulgana – North Ballarat

Delivery timeframe
5 years

Cost
$132M-$308M

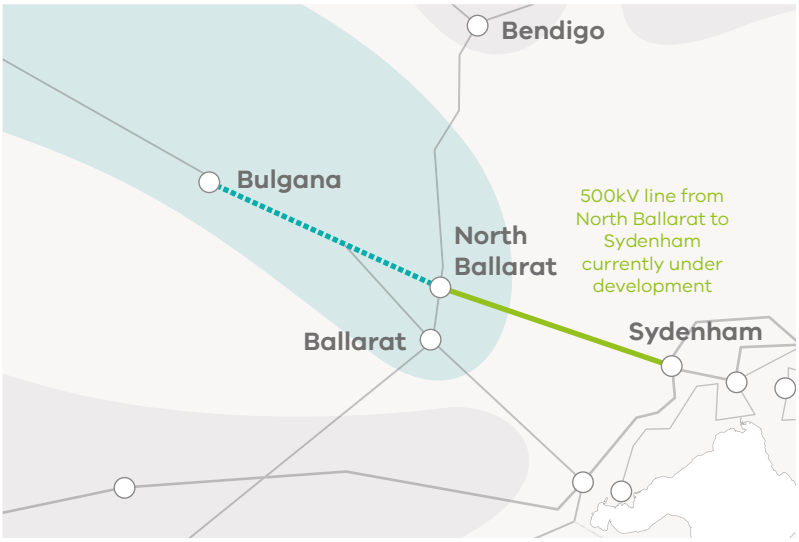
Project description (overview and purpose)

This project involves constructing a new 500kV double circuit overhead transmission line from North Ballarat to Bulgana.

This represents an alternative to the existing WVTNP which is presently a 220kV upgrade from North Ballarat to Bulgana and a 500kV upgrade from North Ballarat to Sydenham. Additional new wind and solar project connections along the route will require increased network capacity to support unconstrained transmission of power. This project is aimed at preventing generator curtailment during high levels of renewable generation due to network capacity limitations, thereby supporting unconstrained operation of generators in the area.

Technical specification

112-125km line length, 500kV voltage rating.
3000MVA Nominal rating (per circuit) (35°C).



Benefit

Enable the connection of up to 1200MW of renewable energy projects above the existing WVTNP.

Beneficiaries

Solar (MW)	365
Wind (MW)	1453
Total (MW)	1818

Risk of delivery

Environment

Corridor assessment and constraint analysis for WVTNP will need to be updated.

Project within greenfield area therefore vegetation clearing required.

Infrastructure close to sensitive areas.

Planning

Planning assessments underway as part of WVTNP need to be amended to include 500kV to Bulgana.

Conflicting land use.

Potential conflicting regarding future residential development.

Land unavailable – new terminal station and easements required.

Community

Potential community concerns regarding increased visual impacts and environmental impacts.

Potential concerns regarding increased loss if agriculture land.

Stage 1 | Category 2

Turn in existing Haunted Gully to Tarrone 500kV line at Mortlake

REZ
South West (V4)

Location
Within existing TL easement

Delivery timeframe
2-3 years

Cost
$15-35M*
(Capital cost developed by AusNet Services)

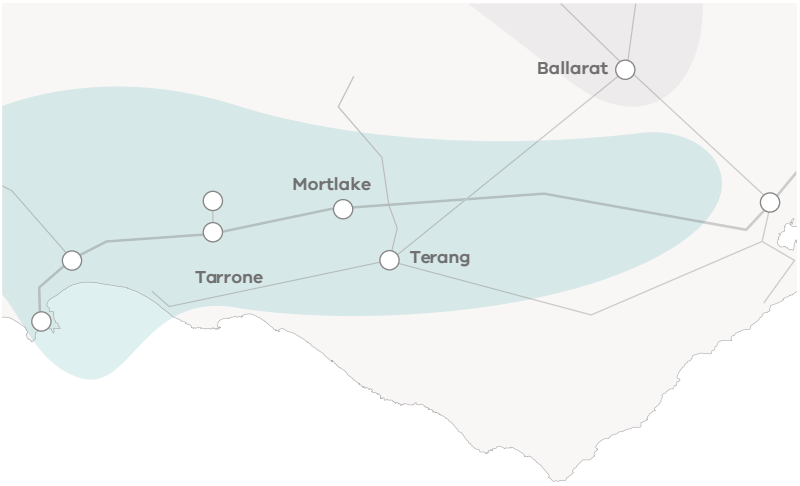
Project description (overview and purpose)

Turn the existing 500kV Tarrone to Moorabool line in at Mortlake terminal station.

Additional new wind and solar project connections within the state will require increased network capacity and enhanced system stability to allow unconstrained transmission of power. This project is aimed at preventing generator curtailment during high levels of renewable generation due to network stability limitations, thereby supporting unconstrained operation of generators in the South West REZ.

Technical specification

Upgrade substation equipment/protection to achieve higher rating; Implement dynamic line rating; Stringing and adjustment to switchgear for 500kV assets in existing substation.



Benefit

Increase thermal limits, enabling between 2500MW of additional renewable energy projects to connect.

Beneficiaries

State-wide beneficiaries when combined with 500kV Mortlake – North Ballarat, or 500kV Mortlake – Bulgana options.

Risk of delivery

Environment

Project located within existing transmission line easement – may minimize environmental impacts.

Infrastructure may be close to sensitive areas.

Planning

Conflicting land use and work could intercept Farming Zone.

Co-location with existing infrastructure may reduce approvals complexity.

Native vegetation removal required.

Moyne Shire Council preference for underground transmission.

Community

Community concern may be lower due to co-location with existing infrastructure.

Potential concerns regarding loss of agriculture land.

Stage 2

450MW x 3h of storage capacity (assuming BESS)

REZ
Murray River V2

Location
Likely located within existing easement or substation site

Delivery timeframe
2.5-4 years

Cost
$354M-$826M

Project description (overview and purpose)

Construction of a new Battery Energy Storage System (BESS) installation within the Murray River REZ.

Note: These will be staged in line with renewables buildout.

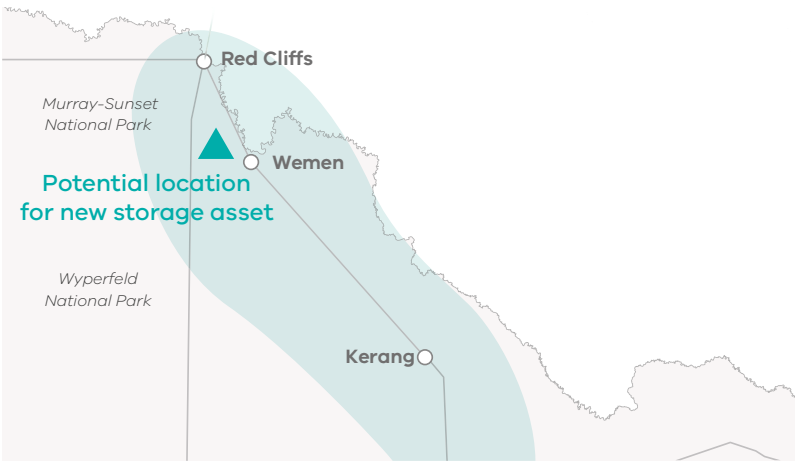
These BESS projects will enable the absorption of excess energy from transmission connected renewable generation during periods of negative demand at the customer level due to rooftop solar PV. It is expected these batteries will discharge during the night as scheduled, dispatchable generation or as required by the market.

These batteries will avoid large scale renewables (solar in particular) from being switched off during periods of negative demand and will also improve marginal loss factors for generators in the area.

Additionally, the batteries may be used to manage network loading to better utilise existing network capacity prior to new transmission lines being constructed. Operating the batteries in this manner will require additional refinement on sizing and operating protocols.

Technical specification

450MW nominal MW capacity rating, 1350MWh storage capacity. Expected operating protocol is to charge during periods of solar peak (e.g. 11am to 3pm) discharge during evenings.



Benefit

Increase utilisation of renewable energy by enabling the absorption of excess energy from renewable generation during periods of negative demand. This is expected to increase utilised renewable energy by 493GWh annually and provide benefit to 2015MW of renewable energy generation.

Beneficiaries

Solar (MW)	1943
Wind (MW)	72
Total (MW)	2015

Risk of delivery

Environment

There is flexibility in the asset location – environmental impacts may be avoided.

Planning

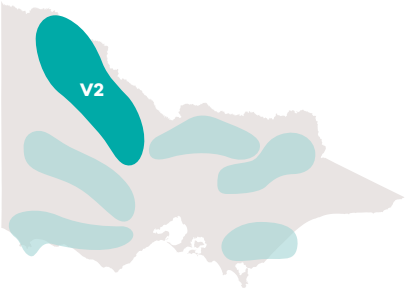
Project is likely located within an existing transmission line easement or substation site – likely to be low planning risk and land availability risk.

Community

Community concern may be lower due to co-location with existing infrastructure.

Stage 2

New 220kV double circuit overhead line from Kerang to Red Cliffs via Wemen



REZ
Murray River V2

Location
New easement required

Delivery timeframe
5.5-7 years

Cost
$308M-$720M

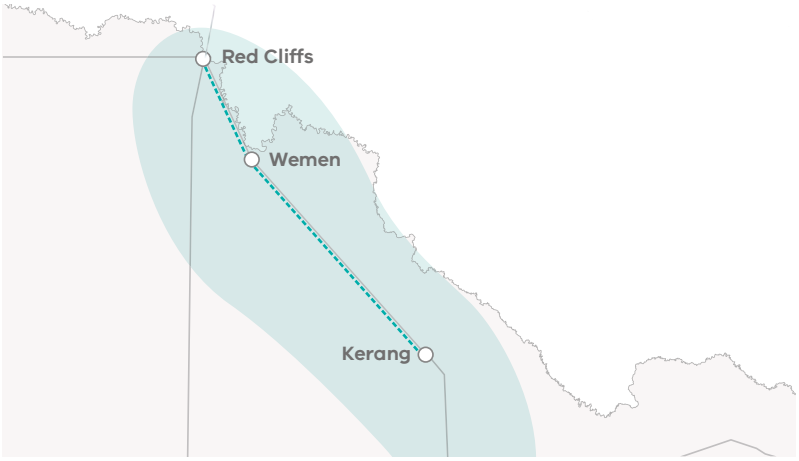
Project description (overview and purpose)

This project involves constructing a new 220kV double circuit overhead transmission line from Red Cliffs to Kerang.

Additional new wind and solar project connections along the route will require increased network capacity to allow unconstrained transmission of power. This project is aimed at preventing generator curtailment during high levels of renewable generation due to network capacity limitations, thereby supporting unconstrained operation of generators in the area.

Technical specification

~230km line length 220kV voltage rating.
800MVA Nominal rating (per circuit) (35°C).



Benefit

Provide up to 1200MW of anticipatory network capacity for future renewable energy generation projects. This is expected to increase utilised renewable energy by 2365GWh annually.

Beneficiaries

Solar (MW)	1937
Wind (MW)	0
Total (MW)	1937

Risk of delivery

Environment

Project located within greenfield area; native vegetation clearing required.

Infrastructure may be close to sensitive areas – Euston Regional Park, Hattah-Kulkyne National Park and Ramsar Wetlands

Planning

Conflicting land use – Use and works could intercept Farming Zone, Residential and Township Zones, Public Conservation.

Native vegetation removal required

Land unavailable; new terminal station and easement required, may necessitate compulsory processes.

Community

Potential community concerns regarding environmental impacts

Potential concerns regarding loss of agriculture land.

Stage 2

125MVAr synchronous condenser at Kerang

REZ
Murray River V2

Location
Likely within existing substation or easement in Kerang area

Delivery timeframe
2-3 years

Cost
$42M-$98M

Project description (overview and purpose)

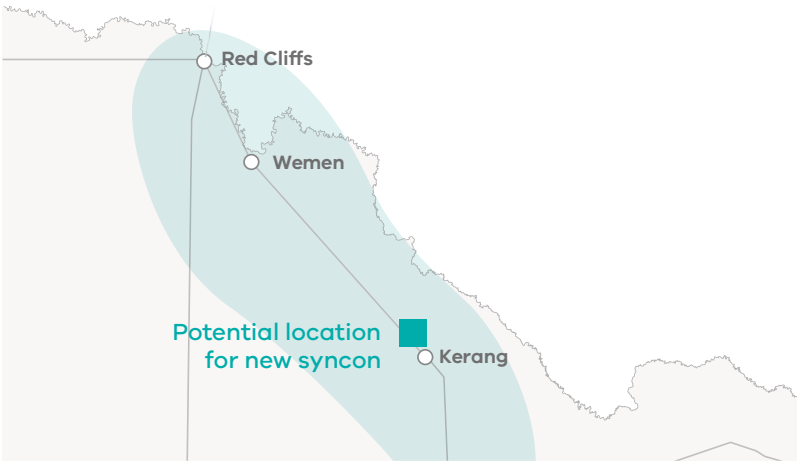
Installation of a new synchronous condenser in the Kerang area.

This project will increase system strength and ensure sufficient available fault level for new renewable generators to comply with their system strength connection compliance obligations.

This project would avoid the need for individual synchronous condensers to be constructed and represents a scale efficient solution to system strength remediation, reducing capital expenditure overall.

Technical specification

125MVAr nameplate rating.



Benefit

Scale efficient solution to address system strength and connection issues. This is estimated to benefit up to 761MW of renewable energy generation and save $38M on capital costs through scale efficiency.

Beneficiaries

Solar (MW)	1000
Wind (MW)	0
Total (MW)	1000

Risk of delivery

Environment

There is flexibility in the asset location therefore environmental impacts may be avoided.

Planning

Project is likely located within an existing transmission line easement or substation site therefore likely to be low planning risk and land availability risk.

Community

Community concern may be lower due to co-location with existing infrastructure.

* Subject to outcome of other RIT-T projects (VNI West, WVTNP, etc.)

Stage 2

Second 350MW x 3h of storage capacity (assuming BESS)

REZ
Murray River V2

Location
Likely within existing substation or easement in Kerang area

Delivery timeframe
2.5-4 years

Cost
$194M-$454M

Project description (overview and purpose)

Construction of a new Battery Energy Storage System (BESS) installation.

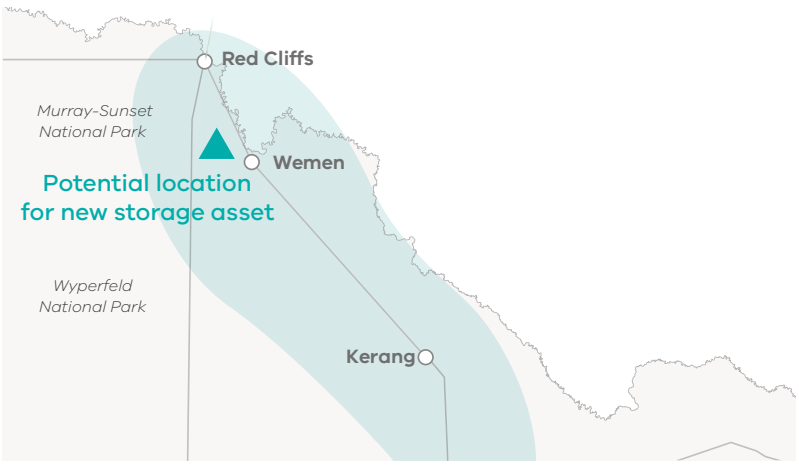
This BESS project will enable the absorption of excess energy from transmission connected renewable generation during periods of negative demand at the customer level due to rooftop solar PV. It is expected the battery will discharge during the night as scheduled, dispatchable generation or as required by the market.

The batteries will avoid large scale renewables (solar in particular) from being switched off during periods of negative demand and will also improve marginal loss factors for generators in the area.

Additionally, the batteries may be used to manage network loading to better utilise existing network capacity prior to new transmission lines being constructed. Operating the batteries in this manner will require additional refinement on sizing and operating protocols.

Technical specification

350MW nominal MW capacity rating, 1050MWh storage capacity. Expected operating protocol is to charge during periods of solar peak (e.g. 11am to 3pm) and discharge during evenings.



Benefit

Increase utilisation of renewable energy by enabling the absorption of excess energy from renewable generation during periods of negative demand. This is expected to increase utilised renewable energy by 3771GWh annually and provide benefit to 2698MW of renewable energy generation.

Beneficiaries

Solar (MW)	2626
Wind (MW)	72
Total (MW)	2698

Risk of delivery

Environment

There is flexibility in the asset location therefore environmental impacts may be avoided.

Planning

Project is likely located within an existing transmission line easement or substation site therefore likely to be low planning risk and land availability risk.

Community

Community concern may be lower due to co-location with existing infrastructure.

Stage 2

New 125MVAr synchronous condenser at Murra Warra

REZ
Western (V3)

Location
Likely location for synchronous condenser at Murra Warra substation

Delivery timeframe
2.5-4 years

Cost
$40M-$105M

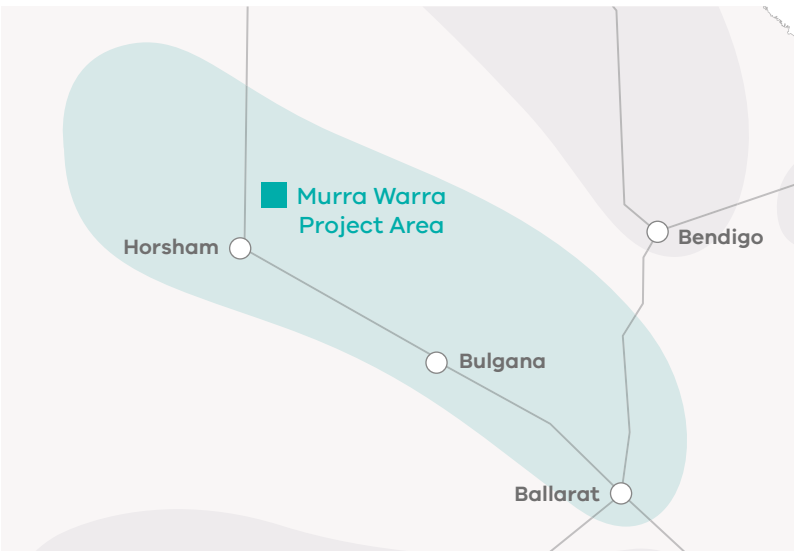
Project description (overview and purpose)

Installation of a new synchronous condenser in the Murra Warra area.

This project will increase system strength and ensure sufficient available fault level for new renewable generators to comply with their system strength connection compliance obligations. The project is expected to be required when the proposed Horsham synchronous condenser's capacity has been fully utilised if generator projects in the connections pipeline progress. This project would avoid the need for individual synchronous condensers to be constructed and represents a scale efficient solution to system strength remediation, reducing capital expenditure overall.

Technical specification

125MVAr nameplate rating.



Benefit

Scale efficient solution to address system strength and connection issues. This is estimated to benefit up to 2344MW of renewable energy generation and save $40M on capital costs through scale efficiency.

Beneficiaries

Solar (MW)	644
Wind (MW)	1700
Total (MW)	2344

Risk of delivery

Environment

There is flexibility in the asset location – environmental impacts may be avoided.

Planning

Project is likely located within the Murra Warra Wind Farm substation (MWTS) – likely to be low planning and land availability risk.

Potential native vegetation removal.

Community

Community concern may be lower due to co-location with existing infrastructure at substation.

Stage 2

350MW x 3h of storage capacity (assuming BESS)

REZ
Western (V3)

Location
Likely located within existing easement or substation in the Horsham area

Delivery timeframe
2.5-4 years

Cost
$275M-$643M

Project description (overview and purpose)

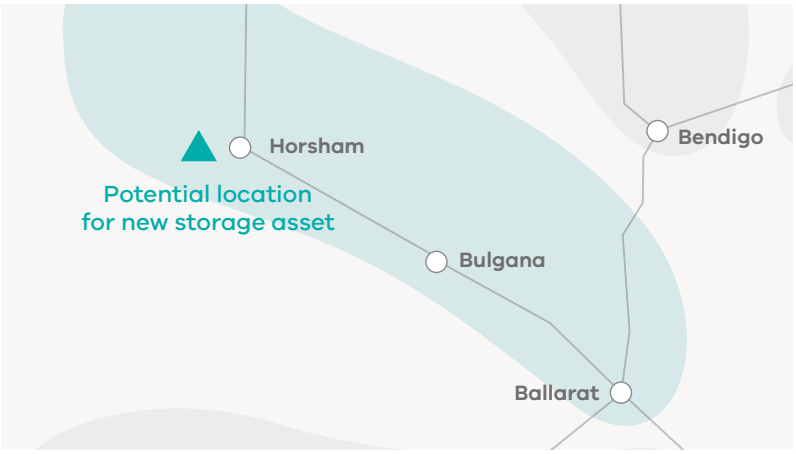
Construction of a newBattery Energy Storage System (BESS) installation within the Western REZ.

This BESS project will enable the absorption of excess energy from transmission connected renewable generation during periods of negative demand at the customer level due to rooftop solar PV. It is expected that this battery will discharge during the night as scheduled, dispatchable generation or as required by the market. This battery will avoid large scale renewables (solar in particular) from being switched off during periods of negative demand and will also improve marginal loss factors for generators in the area.

It is expected that a second battery would be required in the area following staged build-out of renewables. Additionally, the batteries may be used to manage network loading to better utilise existing network capacity prior to new transmission lines being constructed. Operating the batteries in this manner will require additional refinement on sizing and operating protocols.

Technical specification

350MW nominal MW capacity rating, 1050MWh storage capacity. Expected operating protocol is to charge during periods of solar peak (e.g. 11am to 3pm) discharge during evenings.



Benefit

Increase utilisation of renewable energy by enabling the absorption of excess energy from renewable generation during periods of negative demand. This is expected to increase utilised renewable energy by 383GWh annually and provide benefit to 1765MW of renewable energy generation.

Beneficiaries

Solar (MW)	365
Wind (MW)	1400
Total (MW)	1765

Risk of delivery

Environment

There is flexibility in the asset location – environmental impacts may be avoided.

Planning

Project is likely located within an existing transmission line easement or substation site – likely to be low planning and land availability risk.

Community

Community concern may be lower due to co-location with existing infrastructure at substation.

Stage 2

New 220kV double circuit overhead line from Murra Warra to Bulgana via Horsham (~125km)

REZ
Western Victoria (V3)

Location

Delivery timeframe
5-6 years

Cost
$170M-$396M

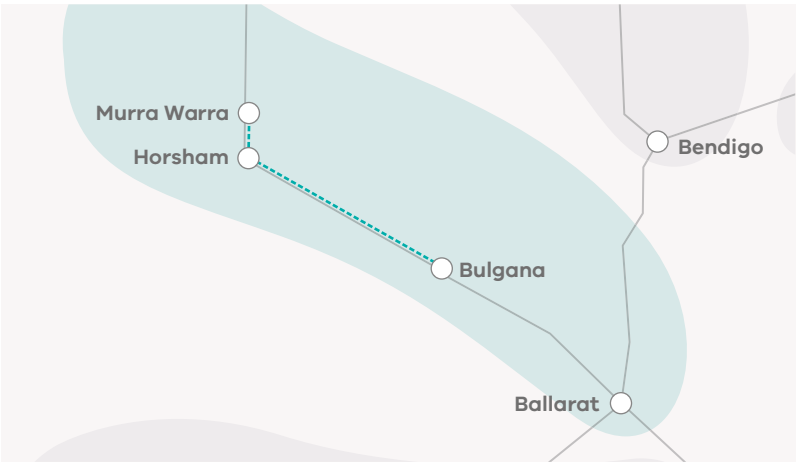
Project description (overview and purpose)

This project involves constructing a new double circuit overhead transmission line from Murra Warra to Bulgana, via Horsham.

Additional new wind and solar project connections around Horsham and Murra Warra will require increased network capacity to allow unconstrained transmission of power. This project is aimed at preventing generator curtailment during high levels of renewable generation due to network capacity limitations, thereby supporting unconstrained operation of generators in the area.

Technical specification

125km line length, 800MVA nominal rating (per circuit).
220kV nominal voltage rating.



Benefit

Provide up to 1000MW of anticipatory network capacity for future renewable energy generation projects. This is expected to increase utilised renewable energy by 3835GWh annually.

Beneficiaries

Solar (MW)	1126
Wind (MW)	907
Total (MW)	2033

Risk of delivery

Environment

Project located within greenfield area – vegetation clearing required.

Infrastructure may be close to sensitive areas.

Planning

Conflicting land use ad works could intercept farming zone, residential and rural living zones and, public conservation and resources zone.

Community

Potential community concerns regarding environmental impacts.

Potential concerns regarding loss of agriculture.

Stage 2

Second 350MW x 3h of storage capacity (assuming BESS)

REZ
Western (V3)

Location

Delivery timeframe
2.5-4 years

Cost
$194M-$454M

Project description (overview and purpose)

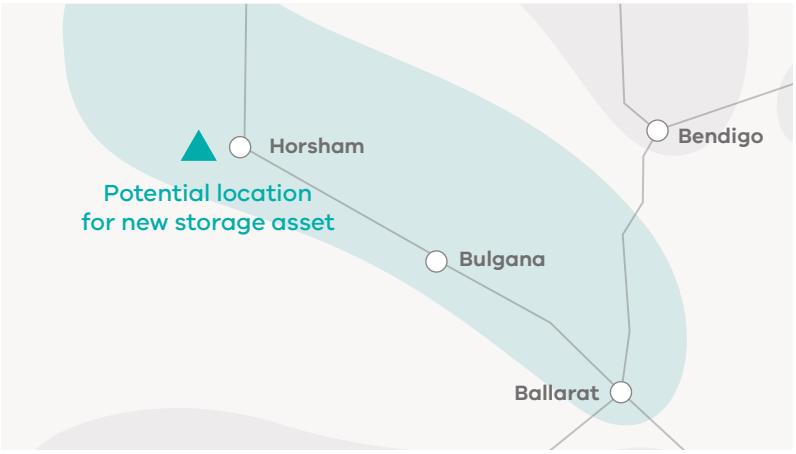
Construction of a new Battery Energy Storage System (BESS) installation within the Western REZ.

This BESS project will enable the absorption of excess energy from transmission connected renewable generation during periods of negative demand at the customer level due to rooftop solar PV. It is expected that this battery will discharge during the night as scheduled, dispatchable generation or as required by the market. This battery will avoid large scale renewables (solar in particular) from being switched off during periods of negative demand and will also improve marginal loss factors for generators in the area.

It is expected that a second battery would be required in the area following staged build-out of renewables. Additionally, the batteries may be used to manage network loading to better utilise existing network capacity prior to new transmission lines being constructed. Operating the batteries in this manner will require additional refinement on sizing and operating protocols.

Technical specification

350MW nominal MW capacity rating, 1050MWh storage capacity. Expected operating protocol is to charge during periods of solar peak (e.g. 11am to 3pm) and discharge during evenings.



Benefit

Increase utilisation of renewable energy by enabling the absorption of excess energy from renewable generation during periods of negative demand. This is expected to increase utilised renewable energy by 383GWh annually and provide benefit to 1765MW of renewable energy generation.

Beneficiaries

Solar (MW)	365
Wind (MW)	1400
Total (MW)	1765

Risk of delivery

Environment

There is flexibility in the asset location – environment impacts may be avoided.

Planning

Project is likely located within an existing transmission line easement or substation site – likely to be low planning and land availability risk.

Community

Community concern may be lower due to co-location with existing infrastructure.

Stage 2

South Morang 250MVAr synchronous condenser

REZ
South West (V4)

Location
Likely located within existing substation or easement in the South Morang area

Delivery timeframe
2.5-4 years

Cost
$60M-$140M

Project description (overview and purpose)

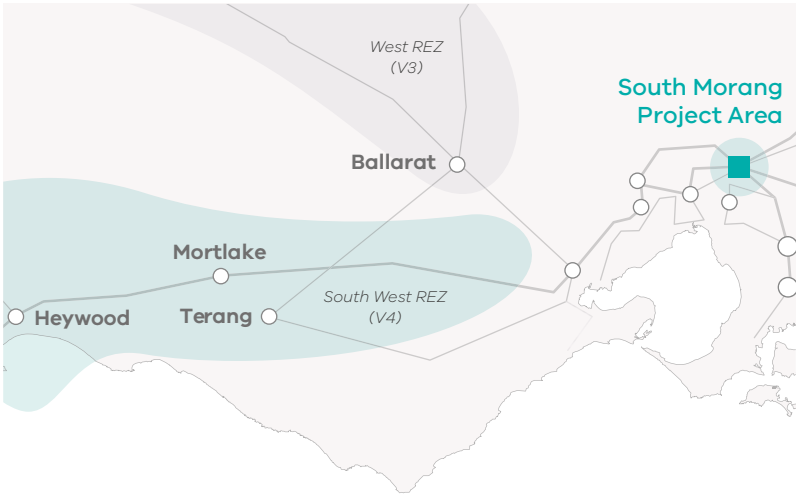
Installation of a new synchronous condenser in the South Morang area.

This project will increase system strength and ensure sufficient available fault level for new renewable generators to comply with their system strength connection compliance obligations.

This project would avoid the need for individual synchronous condensers to be constructed and represents a scale efficient solution to system strength remediation, reducing capital expenditure overall.

Technical specification

250MVAr nameplate rating.



Benefit

Scale efficient solution to address system strength and connection issues. This is estimated to benefit up to 1906MW of renewable energy generation and save $54M on capital costs through scale efficiency.

Beneficiaries

Solar (MW)	1051
Wind (MW)	855
Total (MW)	1906

Risk of delivery

Environment

There is flexibility in the asset location – environment impacts may be avoided.

Planning

Project is likely located within an existing transmission line easement or substation site – likely to be low planning and land availability risk.

Community

Community concern may be lower due to co-location with existing infrastructure.

Stage 2

300MW × 3h of storage capacity (assuming BESS)

REZ
South West (V4)

Location
Likely located within existing substation or easement

Delivery timeframe
2.5-4 years

Cost
$167M-$389M

Project description (overview and purpose)

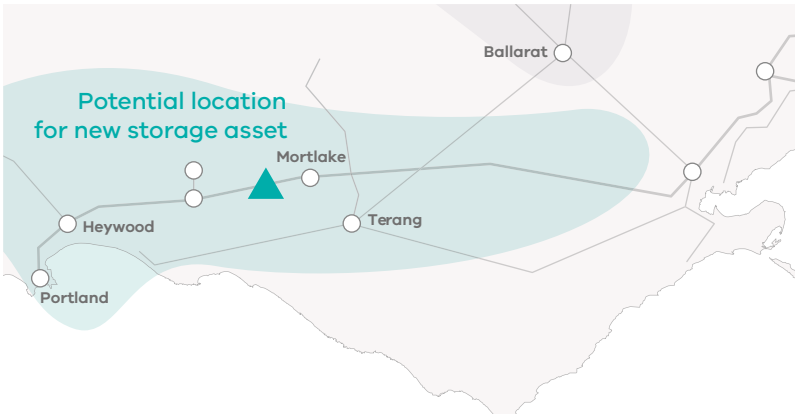
Construction of new Battery Energy Storage System (BESS) installation within the South West REZ.

This BESS project will enable the absorption of excess energy from transmission connected renewable generation during periods of negative demand at the customer level due to rooftop solar PV. It is expected this battery will discharge during the night as scheduled dispatchable generation, or as required by the market. The battery will avoid large-scale renewables from being switched off during periods of negative demand and will also improve MLFs for generators in the area. Additionally, the batteries may be used to manage network loading to better utilise existing network capacity prior to new transmission lines being constructed. Operating the batteries in this manner will require additional refinement on sizing and operating protocols.

Technical specification

300MW/120MVAr nominal capacity rating, 900MWh storage capacity.

Expected operating protocol is to charge during periods of solar peak (e.g. 11am to 3pm) and discharge during evenings.



Benefit

Increase utilisation of renewable energy by enabling the absorption of excess energy from renewable generation during periods of negative demand. This is expected to increase utilised renewable energy by 329GWh annually and provide benefit to 2587MW of renewable energy generation.

Beneficiaries

Solar (MW)	0
Wind (MW)	2587
Total (MW)	2587

Risk of delivery

Environment

There is flexibility in the asset location – environment impacts may be avoided.

Planning

Project is likely located within an existing transmission line easement or substation site – likely to be low planning and land availability risk.

Community

Community concern may be lower due to co-location with existing infrastructure.

Stage 2

350MW × 3h of storage capacity (assuming BESS)

REZ
South West (V4)

Location
New easement required

Delivery timeframe
2.5-4 years

Cost
$275M-$643M

Project description (overview and purpose)

Construction of new Battery Energy Storage System (BESS) installation within the South West REZ.

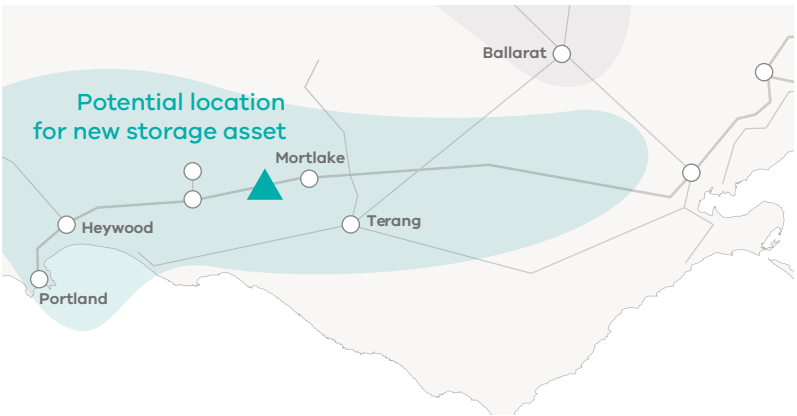
This BESS project will enable the absorption of excess energy from transmission connected renewable generation during periods of negative demand at the customer level due to rooftop solar PV. It is expected this battery will discharge during the night as scheduled, dispatchable generation or as required by the market. The battery will avoid large scale renewables (solar in particular) from being switched off during periods of negative demand and will also improve marginal loss factors for generators in the area.

Additionally, the batteries may be used to manage network loading to better utilise existing network capacity prior to new transmission lines being constructed. Operating the batteries in this manner will require additional refinement on sizing and operating protocols.

Technical specification

350MW/138MVAr nominal capacity rating, 1050MWh storage capacity.

Expected operating protocol is to charge during periods of solar peak (e.g. 11am to 3pm) and discharge during evenings.



Benefit

Increase utilisation of renewable energy by enabling the absorption of excess energy from renewable generation during periods of negative demand. This is expected to increase utilized renewable energy by 383GWh annually and provide benefit to 2587MW of renewable energy generation.

Beneficiaries

Solar (MW)	0
Wind (MW)	2587
Total (MW)	2587

Risk of delivery

Environment

There is flexibility in the asset location – environment impacts may be avoided.

Planning

Project location is likely within an existing transmission line easement or substation site, therefore likely to be lower planning and land availability risk.

Community

Community concern may be lower due to co-location with existing infrastructure.

Stage 2

Additional 220kV single circuit overhead line from Elaine to Moorabool (~43km)

REZ
South West (V4)

Location
Within existing Elaine – Moorabool transmission line easement

Delivery timeframe
5-6 years

Cost
$54M-$126M

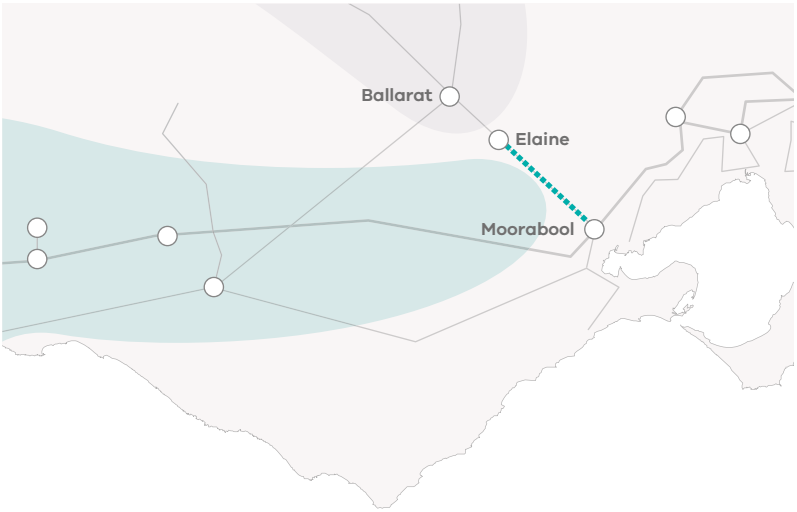
Project description (overview and purpose)

This project involves constructing a new 220kV single circuit overhead transmission line from Elaine to Moorabool.

Additional new wind and solar project connections along the route will require increased network capacity to support unconstrained transmission of power. This project is aimed at preventing generator curtailment during high levels of renewable generation due to network capacity limitations, thereby supporting unconstrained operation of generators in the area.

Technical specification

~43km line length, 220kV. 800MVA Nominal rating (per circuit).



Benefit

Provide up to 600MW of anticipatory network capacity for future renewable energy generation projects. This is expected to increase utilised renewable energy by 630GWh annually.

Beneficiaries

Solar (MW)	365
Wind (MW)	1987
Total (MW)	2352

Risk of delivery

Environment

Project located within existing transmission line easement which may minimise environmental impacts.

Planning

Conflicting land use – intercept farming zone, residential, township and rural living zone, public conservation and resource zone.

Potential concern regarding impact on future development in activity area.

Co-location with existing infrastructure may reduce approvals complexity.

Likely native vegetation removal.

Community

Community concern may be lower due to co-location with existing infrastructure.

Stage 2

New 500kV single circuit overhead line from Mortlake to North Ballarat (~130km)

REZ
South West (V4)

Location
New easement required

Delivery timeframe
5-6.5 years

Cost
$318M-$742M

Project description (overview and purpose)

This project involves constructing a new 500kV single circuit overhead transmission line from Mortlake to North Ballarat.

Additional new wind and solar project connections within the state will require increased network capacity and enhanced system stability to support unconstrained transmission of power. This project is aimed at preventing generator curtailment during high levels of renewable generation due to network stability limitations, thereby supporting unconstrained operation of generators in the South West REZ.

Technical specification

~130km line length, 500kV; 3000MVA Nominal rating (per circuit) .

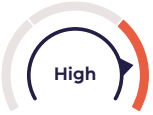
Benefit

Provide up to 3000MW of anticipatory network capacity for future renewable energy generation projects. This is expected to increase utilised renewable energy by 4920GWh annually.

Beneficiaries

State-wide beneficiaries.

Risk of delivery



Environment

Project within greenfield area – native vegetation clearing required.

Infrastructure may be close to sensitive areas.

Planning

Conflicting land use – intercept farming zone, residential, township and rural living zone, public conservation and resource zone.

Native vegetation removal required.

Moyne Shire Council preference for underground transmission.

Land unavailable; new terminal station and easements required.

Community

Potential community concerns regarding visual and other impacts.

Potential concerns regarding loss of agriculture land.

Stage 2

500kV double circuit overhead line from Bulgana to Mortlake

REZ
South West (V4)

Location
New easement required

Delivery timeframe
5-6.5 years

Cost
$398M-$930M

Project description (overview and purpose)

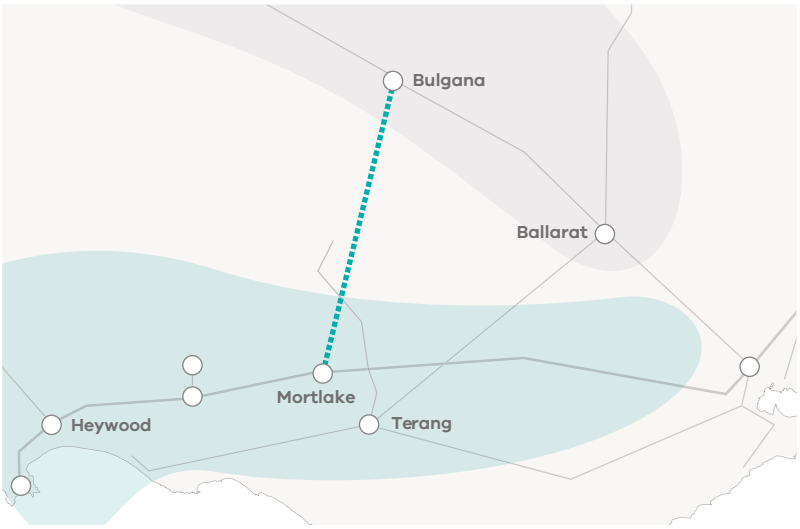
This project involves constructing a new 500kV double circuit overhead transmission line from Mortlake to Bulgana.

Additional new wind and solar project connections along the route will require increased network capacity to support unconstrained transmission of power.

This project is aimed at preventing generator curtailment during high levels of renewable generation due to network capacity limitations, thereby supporting unconstrained operation of generators in the area. Project will enable a 500kV loop in the South West area which will improve network security, system strength and stability within this REZ.

Technical specification

~119km line length, 500kV. 3000MVA Nominal rating (per circuit).



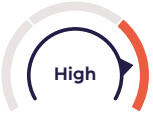
Benefit

Provide up to 2500MW of anticipatory network capacity for future renewable energy generation projects. This is expected to increase utilised renewable energy by 4290GWh annually.

Beneficiaries

State-wide beneficiaries.

Risk of delivery



Environment

Project within greenfield area – native vegetation clearing required

Infrastructure may be close to sensitive areas, e.g. Woorndoo-Hopkins Wetlands. Complete avoidance of impacts unlikely.

Planning

Conflicting land use – intercept farming zone, residential, township and rural living zone, public conservation and resource zone.

Native vegetation removal required.

Moyne Shire Council preference for underground transmission.

Land unavailable; new terminal station and easements required.

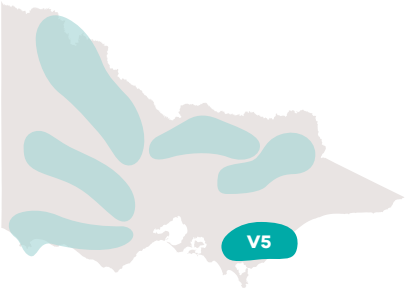
Community

Potential community concerns regarding visual impacts.

Potential concerns regarding loss of agriculture land.

Stage 2

New 500kV double circuit overhead line from Hazelwood or Loy Yang to Gippsland



REZ
Gippsland (V5)

Location
New easement required

Delivery timeframe
4-5 years

Cost
$300M-$700M

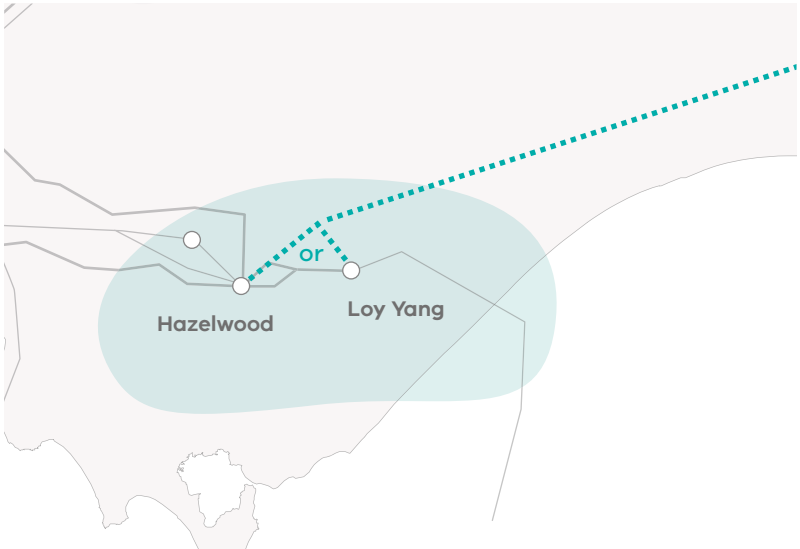
Project description (overview and purpose)

The project involves the construction of a new double circuit 500kV overhead transmission line from the Latrobe Valley (either Hazelwood or Loy Yang) to Gippsland.

The project targets renewable developments in Gippsland that have access to a good and diverse wind resource in the region as well as potential solar and storage projects. The projects require an extension of the transmission network to provide access to a strong and unconstrained part of the network. Project will provide a REZ with access to wind to developments that provide diversity to the Western Victoria and South West Victoria REZs.

Technical specification

65km in length, 500kV, 3000MVA nominal rating per circuit.



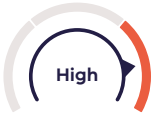
Benefit

Provide up to 2100MW of anticipatory network capacity for future renewable energy generation projects. This is expected to increase utilised renewable energy by 7270GWh annually.

Beneficiaries

Wind and solar projects in the Gippsland REZ.

Risk of delivery



Environment

Project within greenfield area – native vegetation clearing required.

Infrastructure may be close to sensitive areas – e.g. Holey Plains State Park, Stradbroke Flora and Fauna Reserve and Mullungdung State Forest.

Planning

Conflicting land use – intercept farming zone, residential, township and rural living zone, public conservation and resource zone, and public park and recreational zone.

Land unavailable; new terminal station and easements required, may necessitate compulsory processes – time and cost uncertain. Potential native vegetation removal.

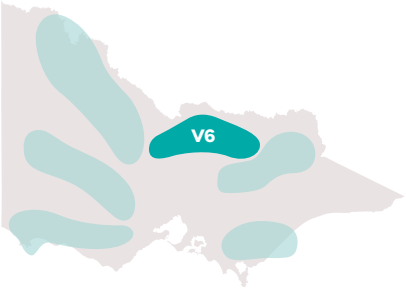
Community

Potential community concerns regarding visual impacts.

Potential concerns regarding loss of agriculture land.

Stage 2

200MW × 3h of storage capacity (assuming BESS)



REZ
Central North (V6)

Location
Likely location within existing substation or easement

Delivery timeframe
2.5-4 years

Cost
$157M-$367M

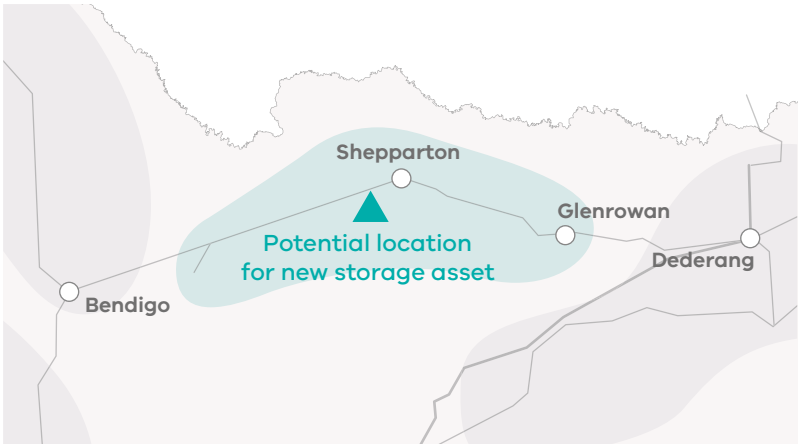
Project description (overview and purpose)

Construction of new Battery Energy Storage System (BESS) installations within the Central North REZ.

These BESS projects will enable the absorption of excess energy from transmission connected renewable generation during periods of negative demand at the customer level due to rooftop solar PV. It is expected these batteries will discharge during the night as scheduled, dispatchable generation or as required by the market. These batteries will avoid large scale renewables (solar in particular) from being switched off during periods of negative demand and will also improve marginal loss factors for generators in the area. Additionally, the batteries may be used to manage network loading to better utilise existing network capacity prior to new transmission lines being constructed. Operating the batteries in this manner will require additional refinement on sizing and operating protocols.

Technical specification

200MW nominal MW capacity rating, 600MWh storage capacity. Expected operating protocol is to charge during periods of solar peak (e.g. 11am to 3pm) and discharge during evenings.



Benefit

Increase utilisation of renewable energy by enabling the absorption of excess energy from renewable generation during periods of negative customer demand. This is expected to increase utilised renewable energy by 219GWh annually and provide benefit to 778MW of renewable energy generation.

Beneficiaries

Solar (MW)	778
Wind (MW)	0
Total (MW)	778

Risk of delivery

Environment

There is flexibility in the asset location – environment impacts may be avoided.

Planning

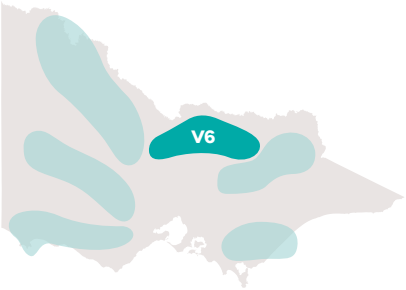
Project is likely located within an existing transmission line easement or substation site – likely to be low planning and land availability risk.

Community

Community concern may be lower due to co-location with existing infrastructure.

Stage 2

Second 300MW × 3h of storage capacity (assuming BESS)



REZ
Central North (V6)

Location
Likely location within existing substation or easement

Delivery timeframe
2.5-4 years

Cost
$167M-$390M

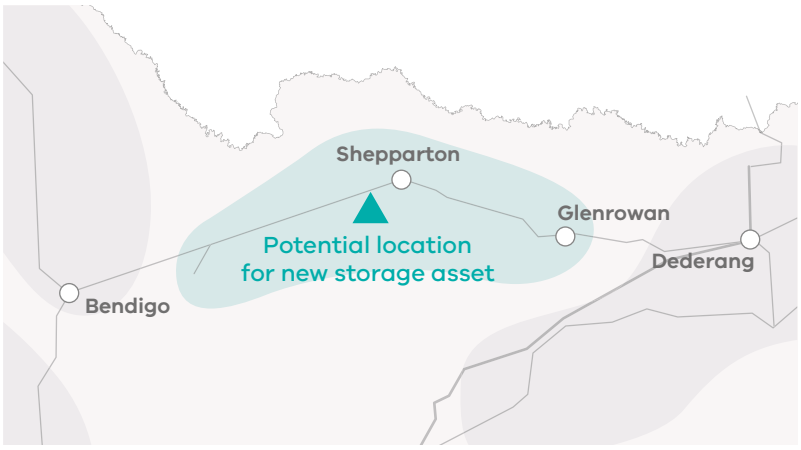
Project description (overview and purpose)

Construction of a second stage of Battery Energy Storage System (BESS) installation within the Central North REZ.

This BESS project will enable the absorption of excess energy from transmission connected renewable generation during periods of negative demand at the customer level due to rooftop solar PV. It is expected these batteries will discharge during the night as scheduled, dispatchable generation or as required by the market. These batteries will avoid large scale renewables (solar in particular) from being switched off during periods of negative demand and will also improve marginal loss factors for generators in the area. Additionally, the batteries may be used to manage network loading to better utilise existing network capacity prior to new transmission lines being constructed.

Technical specification

300MW nominal MW capacity rating, 900MWh storage capacity. Expected operating protocol is to charge during periods of solar peak (e.g. 11am to 3pm) and discharge during evenings.



Benefit

Increase utilisation of renewable energy by enabling the absorption of excess energy from renewable generation during periods of negative customer demand. This is expected to increase utilised renewable energy by 329GWh annually and provide benefit to 1580MW of renewable energy generation.

Beneficiaries

Solar (MW)	1580
Wind (MW)	0
Total (MW)	1580

Risk of delivery

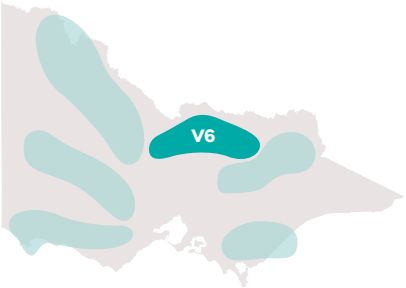
Environment
There is flexibility in the asset location – environment impacts may be avoided.

Planning
Project location is likely within an existing transmission line easement or substation site, therefore likely to be low planning and land availability risk.

Community
Community concern may be lower due to co-location with existing infrastructure.

Stage 2

New 220kV single circuit overhead line from Shepparton to Dederang via Glenrowan



REZ
Central North (V6)

Location
Located within existing easement

Delivery timeframe
5.5-7 years

Cost
$260M-$608M

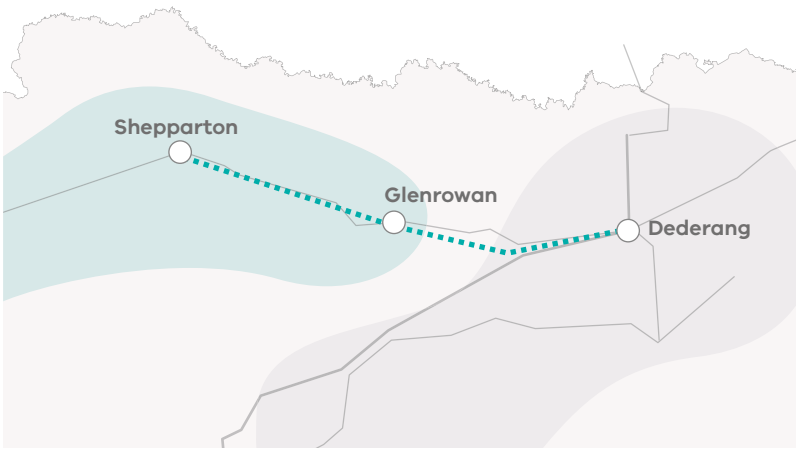
Project description (overview and purpose)

This project involves constructing a new single circuit overhead transmission line from Shepparton to Dederang, via Glenrowan.

Additional new wind and solar project connections around Shepparton and Glenrowan will require increased network capacity to support unconstrained transmission of power. This project is aimed at preventing generator curtailment during high levels of renewable generation due to network capacity limitations, thereby supporting unconstrained operation of generators in the area.

Technical specification

150km line length, 800MVA nominal rating (per circuit) (35°C).
220kV nominal voltage rating



Benefit

Provide up to 800MW of anticipatory network capacity for future renewable energy generation projects. This is expected to increase utilised renewable energy by 1708GWh annually.

Beneficiaries

Solar (MW)	1495
Wind (MW)	0
Total (MW)	1495

Risk of delivery

Environment

Project is likely located within an existing transmission line easement which may minimise environmental impacts.

Infrastructure may be close to sensitive areas.

Planning

Conflicting land use – intercept farming zone, residential, township and rural living zone, public conservation and resource zone.

Native vegetation removal required.

Project is likely located within an existing transmission line – land availability risk.

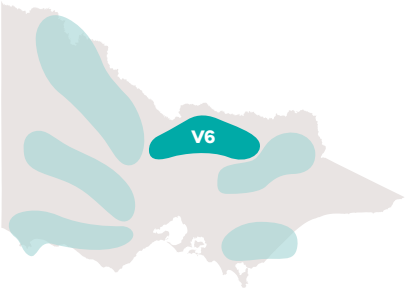
Community

Community concerns may be lower due to co-location with existing infrastructure.

Potential concerns regarding loss of agriculture land.

Stage 2

New 220kV double circuit overhead line from Bendigo to Shepparton (~120km)



REZ
Central North (V6)

Location
Not within existing easement

Delivery timeframe
5.5-7 years

Cost
$205M-$690M

Project description (overview and purpose)

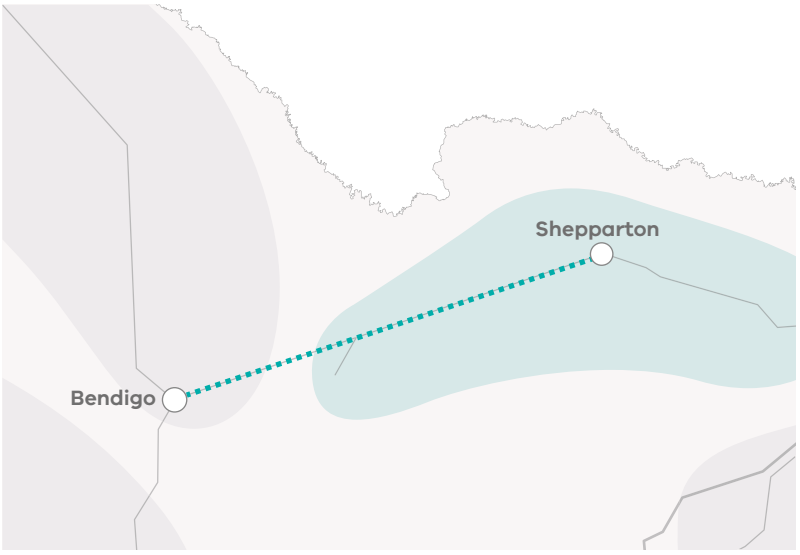
This project involves constructing a new double circuit overhead transmission line from Shepparton to Bendigo.

Additional new wind and solar project connections around Shepparton will require increased network capacity to support unconstrained transmission of power.

This project is aimed at preventing generator curtailment during high levels of renewable generation due to network capacity limitations, thereby supporting unconstrained operation of generators in the area.

Technical specification

~120km line length, 800MVA nominal rating (per circuit) (35°C). 220kV nominal voltage rating.



Benefit

Provide up to 800MW of anticipatory network capacity for future renewable energy generation projects. This is expected to increase utilised renewable energy by 1576GWh annually.

Beneficiaries

Solar (MW)	1495
Wind (MW)	0
Total (MW)	1495

Risk of delivery

Environment

Project is likely located within an existing transmission line easement which may minimise environmental impacts.

Infrastructure may be close to sensitive areas.

Planning

Conflicting land use – intercept farming zone, residential, township and rural living zone, public conservation and resource zone.

Native vegetation removal required.

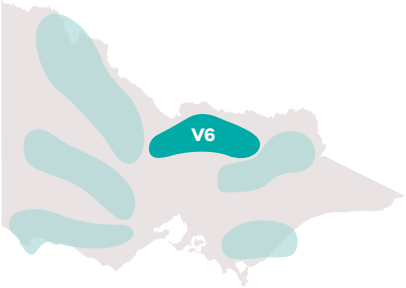
Land unavailable; new terminal station and easements required, may necessitate compulsory processes.

Community

Potential concerns regarding loss of agriculture land.

Stage 2

125MVAr synchronous condenser at Shepparton



REZ
Central North (V6)

Location
Likely to be located within an existing substation or easement

Delivery timeframe
2.5-4 years

Cost
$42M-$98M

Project description (overview and purpose)

Installation of a new synchronous condenser in the Shepparton area.

This project will increase system strength and ensure sufficient available fault level for new renewable generators to comply with their system strength connection compliance obligations. This project would avoid the need for individual synchronous condensers to be constructed and represents a scale efficient solution to system strength remediation, reducing capital expenditure overall.

Technical specification

125MVAr nameplate rating.

Benefit

Scale efficient solution to address system strength and connection issues. This is estimated to benefit up to 863MW of renewable energy generation and save $38M on capital costs through scale efficiency.

Beneficiaries

Solar (MW)	863
Wind (MW)	0
Total (MW)	863

Risk of delivery

Environment

There is flexibility in the asset location therefore, environmental impacts may be avoided.

Planning

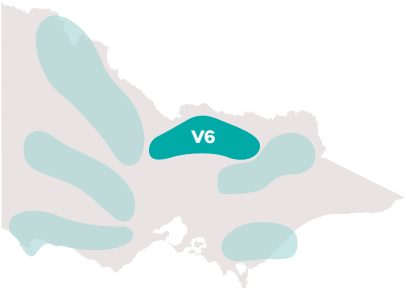
Project is located within the existing Shepparton substation site therefore, likely to be low planning risk and land availability risk.

Community

Community concern may be low due to co-location with existing infrastructure at substation.

Stage 2

Second 125MVAr synchronous condenser at Shepparton



REZ
Central North (V6)

Location
Likely to be located within an existing substation or easement

Delivery timeframe
2.5-4 years

Cost
$42M-$98M

Project description (overview and purpose)

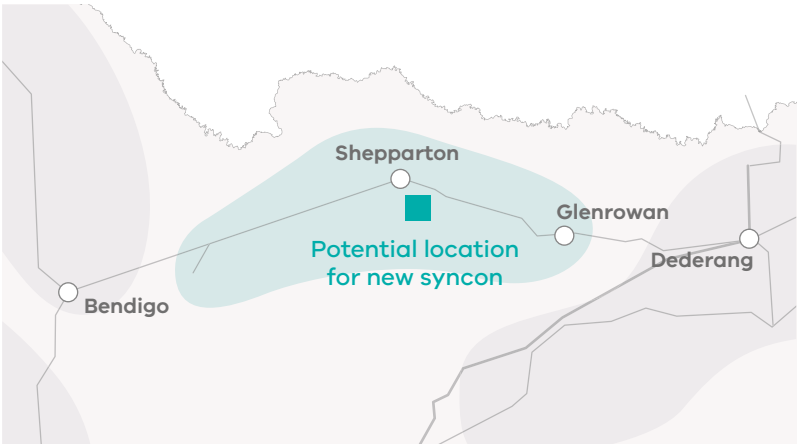
Installation of a second synchronous condenser in the Shepparton area.

This project will increase system strength and ensure sufficient available fault level for new renewable generators to comply with their system strength connection compliance obligations. The project is expected to be required when the first 125MVAr Shepparton synchronous condenser's capacity has been fully utilised, from additional renewables buildout.

This project would avoid the need for individual synchronous condensers to be constructed and represents a scale efficient solution to system strength remediation, reducing capital expenditure overall.

Technical specification

125MVAr nameplate rating.



Benefit

Scale efficient solution to address system strength and connection issues. This is estimated to benefit up to 863MW of renewable energy generation and save $38M on capital costs through scale efficiency.

Beneficiaries

Solar (MW)	1506
Wind (MW)	0
Total (MW)	1506

Risk of delivery

Environment

There is flexibility in the asset location – environment impacts may be avoided.

Planning

Project is likely located within an existing transmission line easement or substation site – likely to be low planning and land availability risk.

Community

Community concern may be lower due to co-location with existing infrastructure.