Draft Network Infrastructure Strategy

Consulting on a blueprint for transforming the NSW energy sector



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Acknowledgement of Country

The Energy Corporation of NSW acknowledges that it stands on Aboriginal land. We acknowledge the Traditional Custodians of the land and we show our respect for Elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

Foreword



James Hay CEO Energy Corporation of NSW

This is a critical decade of change in the National Electricity Market and the NSW Government has a plan that will ensure our State maximises the opportunities of this transformation. It is essential that our electricity network is modernised and expanded now to set up our State for the decades to come.

Recent international events which have impacted commodity prices and supply chains have shown us that the modernisation of our energy system is now more important than ever. We need to adopt a diverse mix of renewable energy enabled by timely delivery of critical network infrastructure, backed up by sufficient storage to safeguard electricity supplies and consumer prices.

The statutory role of the Energy Corporation of NSW (EnergyCo) is to maximise the opportunities and minimise the impacts created by the transformation of the NSW electricity system by planning the Renewable Energy Zones (REZs) to facilitate coordinated investment in transmission and generation. We want to ensure electricity consumers across our State have access to affordable, clean, and reliable electricity throughout this transformation and that all parties have the best information available to inform relevant decisions and plans. We also want to ensure generation and network developers earn and maintain the essential support from local communities through a safe, environmentally responsible, and culturally respectful approach. Sensitive development of infrastructure and meaningful engagement with the local communities is core to this approach.

EnergyCo is preparing the Network Infrastructure Strategy (NIS) as an important new element of NSW's Electricity Infrastructure Roadmap framework. This Draft NIS marks the start of this process. It commences an engagement process with key stakeholders across industry and in the community. When finalised, the NIS will provide a clear vision of REZ development options in the wider context of a rapidly changing, and at times uncertain, evolution of generation mix and demand.

The NIS is not a plan of approved projects. It sets out an approach and strategy to network infrastructure development that will better inform related plans, proposals and decisions by statutory bodies, investors, and communities.

The NIS process, especially the engagement on this Draft NIS over the next few months, is designed to ensure everyone can shape this strategy and better understand the relevant options, issues, and risks.

This Draft NIS takes a flexible, option-rich approach to development of REZs and the NSW electricity system. It focuses on realistic delivery timelines, costs, and potential 'shocks' to the system. It starts to explore emerging trends, such as new generation, like offshore wind, and the electrification of society including a potential hydrogen economy.

In this Draft NIS we deliberately put forward ideas which we want to seek feedback on. We also want to hear about other ideas so we can consider them as we finalise the NIS.

This is a critical time, but also an exciting time, for the future of our electricity network. I hope you will continue to engage with us on this journey, and I look forward to hearing the outcomes of this consultation.

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Image courtesy of iStock. Farmers with laptop in field examining crops.

Energy Corporation of NSW

The Energy Corporation of New South Wales (EnergyCo) is a statutory body constituted under the *Energy and Utilities Administration Act 1987*. The role of EnergyCo is to maximise the opportunities created by the transformation of the NSW electricity system by planning Renewable Energy Zones (REZs) across the State in order to facilitate coordinated investment in transmission and generation.

The Minister for Energy has appointed EnergyCo as the Infrastructure Planner for two of the first five NSW REZs set out in the *Electricity Infrastructure Investment (EII) Act 2020.* The EII Act also provides for the Minister to appoint EnergyCo as the Infrastructure Planner for the remaining three REZs. In August 2022 EnergyCo was also appointed as Infrastructure Planner for the Hunter Transmission and Waratah Super Battery Priority Transmission Projects. EnergyCo is coordinating the transformation to ensure it happens in an orderly manner and are leading strategic planning and consultation processes, so the new transmission infrastructure needed to realise the State's energy transition is developed in the right place, at the right time, to deliver affordable, clean, and reliable energy to the households and businesses of NSW.

As the appointed Infrastructure Planner under the Electricity Infrastructure Roadmap (the Roadmap), EnergyCo has the following key responsibilities:



Strategic planning, technical and regulatory design

- Contributing to strategic, holistic planning for each REZ.
- Coordinating the technical design of REZs in consultation with the Australian Energy Market Operator (AEMO), Transgrid as the NSW Jurisdictional Planning Body, NSW distribution network service providers (DNSPs) and market participants.
- Strategically improving electricity networks and providing network solutions, including technology solutions, that could optimise the design and performance of REZs.



Community and stakeholder engagement

- Leading community and stakeholder engagement activities to support the delivery of the REZs.
- Delivering tangible benefits for First Nations people and communities.
- Promoting local development opportunities through engagement with local communities and industry.



Infrastructure and investment

- Recommending to the Consumer Trustee network infrastructure projects required for the REZs and recommending to the Minister for Energy Priority Transmission Infrastructure Projects (PTIPs) in the rest of the NSW electricity networks to address Energy Security Target (EST) shortfalls.
- Working with parties such as the Consumer Trustee, AEMO, Transgrid, Network Operators, NSW DNSPs, Councils and community and industry groups to ensure the new network infrastructure to support the REZs and PTIPs is delivered in line with the objects of the Electricity Infrastructure Investment (EII) Act. EnergyCo will do this in a way that seeks to minimise impacts to and maximise opportunities for local communities, industries and workers.
- Investigating potential innovative network infrastructure solutions to optimise the performance of the REZs and PTIPs.
- Overseeing design and implementation of REZ access schemes, including assisting tender processes for access that deliver benefits to generators and to the communities where the REZs are located.

For more information on EnergyCo, PTIPs and REZs, visit: <u>energyco.nsw.gov.au</u>

Executive summary

The National Electricity Market (NEM) is in a critical time of transformation. Investment is needed in generation, storage, network infrastructure, and other new technologies to deliver affordable energy for consumers and maintain grid stability and reliability. New South Wales (NSW) is at the centre of this transformation. Four out of five baseload coal power stations in the State are expected to retire by the mid-2030s and around half the actionable transmission projects in <u>AEMO's Integrated System Plan (ISP)</u> will be built here.¹

The NSW Government released the Electricity Infrastructure Roadmap (the Roadmap) in 2020 to coordinate development of the electricity infrastructure needed in the State to deliver affordable, clean and reliable electricity. The Roadmap is enabled by the *Electricity Infrastructure Investment (EII) Act 2020* which passed into law with strong bi-partisan support.

EnergyCo is developing the Network Infrastructure Strategy (NIS) as an important new component of the NSW-wide system planning process that in turn sits within the NEM and its processes. EnergyCo has published this Draft NIS to introduce the strategy to stakeholders and consult with interested parties on its proposed scope and contents. Going forward, the NIS is proposed to be prepared every two years to support the Infrastructure Investment Objectives (IIO) Report and to ensure continuous improvement that reflects changes in the market.

The NIS has three key objectives:

- 1. Coordinated NSW-wide electricity infrastructure development: The NIS outlines a strategy, informed by engagement with interested parties, for the practical coordination of NSW electricity infrastructure (generation, storage and network infrastructure) in the long-term financial interests of NSW consumers. This will help inform the Consumer Trustee's IIO report and coordinated NSW wide system planning. The NIS provides a set of potential Network Infrastructure Options for REZs and downstream augmentations within the existing shared network needed to achieve the objectives of the Electricity Infrastructure Investment Act (EII Act) and transfer REZ generation to households, businesses, and industry.
- 2. Investor guidance: The NIS incorporates input from, and provides greater transparency to, investors, developers, and electricity infrastructure supply chains on potential network infrastructure options and timing, to drive down the cost of capital and achieve affordable, clean, and reliable electricity for NSW consumers.

3. Meaningful engagement: The NIS outlines an approach for EnergyCo to work with all stakeholders to improve network infrastructure and generation planning so that it not only delivers benefits for NSW electricity consumers and opportunities for the NSW economy but maximises benefits for, and minimises impacts on, host communities.

Coordinated electricity infrastructure development

The Draft NIS provides practically feasible Network Infrastructure Options for expanding transmission and distribution networks to deliver REZs and transfer generation to major load centres. This includes downstream augmentations to the existing shared transmission network and coordinating with projects such as Project EnergyConnect and HumeLink. The NIS draws on input from the Consumer Trustee, Australian Energy Market Operator (AEMO, as National Transmission Planner), Transgrid (as the NSW Jurisdictional Planning Body), the NSW DNSPs and other relevant parties.

It considers issues such as community sentiment, landuse planning, workforce availability and supply chain constraints, within scope, cost and delivery timeframes, in line with the guiding principles outline in the <u>Draft</u> <u>Network Authorisation Guidelines</u>. It also identifies potential Priority Transmission Infrastructure Projects (PTIP) to address possible future shortfalls in NSW's Energy Security Target (EST).

In particular, these options adopt a flexible, or 'optionrich', approach to network planning, which aims to identify potential network options that can be readily expanded at lower cost and delivered in a way that seeks to maximise community benefits while minimising local impacts. This approach means NSW electricity consumers may be less exposed to price and reliability shocks - for example, if existing generators close sooner than anticipated, electrification progresses faster than anticipated (including the development of a hydrogen economy) or individual projects experience delays that place greater reliance on other electricity infrastructure projects. Optionality will also increase competition between generation projects in tenders for long term energy service agreements (LTESA) and Access Rights, and is likely to better lead to affordable, clean and reliable electricity for consumers.

The Network Infrastructure Options have been identified to support the Consumer Trustee when preparing its optimal 20-year Development Pathway for network infrastructure in NSW for the IIO Report and its 10 Year Plan for conducting tenders for LTESAs.

1. As per the Step Change Scenario and the optimal development pathway in AEMO's 2022 Integrated System Plan.

While the first Final NIS will focus largely on network options for connecting electricity supply to replace retiring generators and achieve the current objectives of the EII Act, future editions may expand broader considerations, such as establishment of a large-scale hydrogen economy.

As part of enabling a coordinated approach to network infrastructure development in NSW, the NIS aims to work in conjunction with the ISP, Transmission Annual Planning Report (TAPR) and Distribution Annual Planning Reports (DAPR) to create a holistic view on the investments required. It is envisaged that a feedback loop of project details, inputs and assumptions and market knowledge is developed between the relevant planning bodies, to ensure all parties are best equipped for the transformation ahead.

Investor guidance

Given the number of network projects required across the State in the coming decades, and the scale of investments involved, it is important that EnergyCo and the wider NSW planning process provide sufficient information to prospective investors. By openly communicating the potential options being considered for REZ network infrastructure projects (RNIPs) and other transmission projects in NSW, the NIS will provide early insights and the long-term development direction. While the NIS will not determine the final nature or timing of network projects, it is hoped that earlier visibility of the options is useful for prospective investors to navigate through the forthcoming LTESA, Access Right and Network Operator tenders for REZ's.

Meaningful engagement

The scale of the transformation required in the NSW electricity system is unprecedented and will require detailed and ongoing engagement with communities around NSW. EnergyCo is committed to delivering genuine engagement with communities throughout the planning and delivery of critical network infrastructure that will enable this transformation.

In doing so, EnergyCo also recognises the need to balance the competing views of different stakeholder groups and manage the compatibility of land uses throughout this process. To help inform engagement on these matters and outline the principles that it will apply to the development of network options, the NSW Government is preparing the Draft NSW Transmission Guidelines by the end of 2022. It's important to note that the potential Network Infrastructure Options shown in the Draft NIS are conceptual in nature and focus on the electricity system upgrades needed to support REZ hosting capacities and maintain reliable and affordable electricity supplies for NSW. Prior to further consideration, these options would be subject to separate, detailed consideration and engagement processes. Consultation will help inform the suitability and constructability of infrastructure, and ensure that the strategy balances energy supply, economic growth and community benefits.

Network Infrastructure Options

This draft strategy outlines the approach EnergyCo has taken to develop potential Network Infrastructure Options that may be considered for REZs and downstream augmentations in the existing shared network. EnergyCo has used this approach for the Central-West Orana (CWO), New England (NE), Hunter Central Coast (HCC) and South West regions (SW) of NSW. The Illawarra (ILW) REZ is at an earlier planning stage and will be included in future editions of the NIS. Currently, only CWO REZ and NE REZ have been declared.

The Network Infrastructure Options show a broad portfolio of network augmentations that are potentially available. The first four REZs, for which Network Infrastructure Options have been prepared, have a total initial transfer capacity of approximately 14.5 gigawatts (GW). Taken together, the potential transfer capacity of these four REZs under all development stages could reach up to 50 GW.

It's important to note that the Network Infrastructure Options shown in this draft strategy are at a concept definition stage, except for CWO REZ.² They include consideration of initial feedback provided by local communities and other stakeholders through the 'REZ Declaration' process and by proponents of generator and storage projects through registration of interest processes for REZs. They have not yet been subjected to detailed land-use planning, economic appraisal, or in-depth power system analysis.

The exception to this is the CWO REZ, NSW's pilot REZ. This REZ has been developed with detailed technical and planning analysis to inform its scope. It is currently undergoing a contestable approach for sourcing a Network Operator. As a result of the ongoing refinement of this REZ, the details of the network infrastructure arrangement may differ slightly from the options listed in the Draft NIS. However these options are still indicative of the potential expansion that CWO REZ could incorporate, when appropriate.

2. See Figure 7. Informing the Development pathway with the Network Infrastructure Options.

Draft Network Infrastructure Strategy

EnergyCo, where it is appointed as Infrastructure Planner for a particular REZ, will make recommendations for specific REZ Network Infrastructure Projects to the Consumer Trustee at a later stage. Recommendations by the Infrastructure Planner will be informed by NSW-wide system planning (as laid out within the NIS and IIO Report) amongst many other inputs. This NIS will be informative and is not binding on any party. The Infrastructure Planner will undertake detailed design activities for each REZ, including community and stakeholder engagement,

when preparing each recommended REZ network solution for authorisation by the Consumer Trustee.

Meaningful stakeholder engagement on the Draft NIS will build confidence regarding the future of the REZ, PTIP and other critical infrastructure in NSW. This collaboration will also better inform Network Infrastructure Options, risks, key assumptions, likely timings, and the overall network investment portfolio through to 2040.





- Indicative Renewable Energy Zones (Geographical area yet to be mapped)
- Major Roads and Highways
- Existing 330 kV Network

- Existing 500 kV Network
- **::::** Northern NSW Central NSW options
- Central NSW Sydney, Newcastle and Wollongong options
- **Southern NSW Central NSW options**

Next steps

EnergyCo welcomes feedback on this Draft NIS until 28 October 2022. This will help refine EnergyCo's approach to the practical coordination of NSW electricity infrastructure. The outcome of this consultation will be documented in the Final NIS in Q1 2023.

Further to the consultation, the next step is to gain a view on the benefit that each of the Network Infrastructure Options will provide, as this will drive the sequence in which these projects could be delivered. The Consumer Trustee will carry out generation and transmission optimisation modelling that will inform how a given option will help support the development of new generation and storage to meet the legislated infrastructure investment objectives.

It is proposed that the Consumer Trustee's modelling will include three possible future scenarios:

- A 'Central Case' that broadly adopts the inputs and assumptions from the 'Step Change' scenario of the 2022 ISP.
- 'Early Closure' where it is assumed that all of NSW's coal-fired power stations will be retired earlier than currently anticipated.
- 'Transmission Delay' where key transmission projects are delivered later than currently anticipated.

Figure 2. Timeline of key report publications

From the findings of this modelling activity, EnergyCo will develop a time-sequenced 20-year schedule of potential network infrastructure projects that supports meeting the legislated infrastructure investment objectives and delivers the most benefit to NSW electricity consumers.

Subject to its own independent assessment at the time, the Consumer Trustee may adopt this schedule of network infrastructure projects in the Final NIS within its Development Pathway for its 2023 IIO Report.

Future editions of the NIS are expected to accompany the publication of the IIO Report. However, the first Final NIS may not yet be synchronised with the IIO report. Figure 2 illustrates the potential release timing.



The Network Infrastructure Strategy and Electricity Infrastructure Roadmap

Image courtesy of iStock. Aerial view of solar panels.

Draft Network Infrastructure Strategy

The NSW Government is committed to delivering affordable, clean, and reliable energy, and the NIS sets out this transformation.

NSW Government's commitment to delivering affordable, clean, and reliable energy

The NSW energy system is undergoing a rapid transformation with significant changes expected in the next decade. Four of the State's five coal-fired power stations are expected to progressively close by the mid-2030s, starting with Liddell power station in 2022-23. Up until now, these power stations have played an important role in the energy system. They currently provide around three quarters of NSW's electricity supply and two thirds of the capacity used during summer heat waves.

NSW is in a strong position to deliver an affordable, clean, and reliable electricity system for consumers as these coal-fired power stations close. The opportunity for NSW is enhanced by its abundance of high-quality renewable energy resources, an experienced and skilled workforce, and significant interest from credible global investors to build new electricity infrastructure in this State. NSW REZs set out in the *Electricity Infrastructure Investment Act 2020*.

The energy transformation is part of NSW plans for decarbonisation

In 2020, the NSW Government released the <u>NSW</u> <u>Electricity Infrastructure Roadmap</u> (the Roadmap)³ which is the State's coordinated framework to deliver a modern electricity system that is affordable, clean, and reliable for consumers. The Roadmap works in conjunction with the NSW Government's Net Zero Plan to achieve the State's decarbonisation goals. The <u>Net Zero Plan</u>, which was published in 2021, lays the foundation for action on climate change to halve emissions in NSW by 2030 and chart the path to net zero emissions by 2050. It is consistent with the intent to leverage the transformation of the energy sector as an opportunity to grow the economy and reduce costs for NSW households and businesses.

An expanded transmission network is critical to connect affordable, clean, and reliable electricity to NSW households, businesses, and industry

The transmission network backbone of the NSW electricity system was largely built by government to link coal-fired power stations and the Snowy Hydro Scheme to major cities. Key areas with high quality renewable energy resources are not well served by the existing grid – particularly to the centre and west of the state.

This means that an unprecedented portfolio of network investments is now needed to build a grid that connects to these important regions and meets current and future needs of NSW consumers. According to the <u>AEMO 2022 Integrated System Plan (ISP)</u>, around half of actionable ISP projects in value terms are needed in NSW.

The NSW Government is facilitating NSW's energy transition through the Electricity Infrastructure Roadmap.

3. The Roadmap builds on the foundations of the NSW Electricity Strategy.

Overview of the Electricity Infrastructure Roadmap

The Roadmap is the Government's plan to deliver the major electricity infrastructure needed to modernise the electricity system and power the economy. It is built on five foundational pillars:

- Driving investment in regional NSW by supporting the regions as the State's economic and energy powerhouse.
- Delivering energy storage infrastructure by supporting long-term energy storage in NSW.
- Delivering Renewable Energy Zones by coordinating transmission and renewable generation in the right places for local communities.
- Keeping the grid secure and reliable by backing the system with gas, batteries or other reliable sources as needed.
- Harnessing opportunities for industry by empowering new and revitalised industries with affordable, reliable and low emissions electricity.

The goal is to introduce a coordinated, 'whole-ofsystem' approach to delivering electricity infrastructure. As shown in Figure 3, this approach ensures that the location and timing of generation, storage and firming infrastructure are harmonised to maximise benefits to NSW electricity consumers. It also delivers broader economic and social benefits for regional communities.

The Roadmap, through the Ell Act, introduces new statutory roles and builds on existing roles. Conceptualised in Figure 4, the new governance arrangements are crucial to enabling the practical coordination of electricity infrastructure in the NSW context. The Infrastructure Planner supports the delivery of five REZs. EnergyCo has currently been appointed in this role for Central-West Orana (CWO) and New England (NE) REZs. AEMO Services Limited, a subsidiary of AEMO, has been appointed as the independent Consumer Trustee to act in the long-term financial interests of NSW electricity Consumers. The Australian Energy Regulator (AER) builds on its existing role and has been appointed as the Regulator in NSW. For a detailed list of relevant entities under this governance structure, please see Appendix E.

Figure 3. The relationship between renewable energy zone generation, storage and transmission, and the benefits to NSW consumers and regional communities



Figure 4. NSW framework entities coordinate the delivery of generation, storage, and transmission infrastructure for RNIPs



Overview of NSW-wide system planning

The EII Act has introduced a new approach to planning the NSW electricity system. A key planning document introduced in this approach is the IIO Report. The IIO Report is prepared by the Consumer Trustee every two years to set out a Development Pathway for development of generation and long duration storage infrastructure over 20 years to achieve the infrastructure investment objectives (see Box 1). The inaugural <u>IIO Report</u> was published in December 2021.

The IIO Report also sets out network infrastructure projects necessary to give effect to the Development Pathway. Going forward, EnergyCo will prepare the NIS to inform the preparation of the Development Pathway by the Consumer Trustee by providing network options to deliver REZs, PTIPs and other critical network infrastructure projects in NSW. The scope of the NIS includes network infrastructure to deliver REZs and downstream augmentations that support REZs to transfer electricity to households, businesses, and industry. The interaction between the relevant Roadmap entities and documents is detailed in Figure 4.

Together, the IIO Report and the NIS serve a similar purpose for NSW as AEMO's ISP does for the wider NEM. They set out an optimised 20-Year Development Pathway for NSW that minimises electricity prices for NSW consumers and ensures reliability – a blueprint for the NSW electricity system.

Box 1: Infrastructure Investment Objectives

The Electricity Infrastructure Investment Act (EII Act) sets out minimum objectives for the construction of electricity infrastructure by the end of 2029 including:

- at least the same amount of generation as 12 GW of renewable energy or approximately 33,600 GW hours per year⁴
- at least 2 GW of long-duration storage.

The EII Act also includes overall objectives to construct:

• generation infrastructure to minimise electricity costs for NSW electricity consumers

- long-duration storage infrastructure to meet the reliability standard
- firming infrastructure to meet the energy security target and reliability standard.

Achieving the infrastructure investment objectives will require construction of accompanying network infrastructure. The NIS will inform the Infrastructure Investment Objectives Report which will outline potential network infrastructure development required to meet these objectives.

Overview of the Network Infrastructure Projects framework

The EII Act establishes a NSW Framework for the planning, development, construction, and cost recovery of network infrastructure projects. The NSW Framework contemplates two types of network infrastructure projects:

- REZ network infrastructure projects (RNIPs) distribution or transmission infrastructure that provides network capacity for a declared REZ and is made up of different classes of network infrastructure.
- Priority transmission infrastructure projects (PTIPs)

 non-REZ transmission infrastructure projects in NSW and identified in, or part of a project identified in, the most recent ISP published by AEMO.

The NSW Framework allows for selecting network infrastructure projects (the recommendation and authorisation process), calculating their prudent, efficient, and reasonable capital costs (the Transmission Efficiency Test (TET)) and determining the overall costs that can be recovered from consumers (the determination process). This process is informed by the identification of network infrastructure projects through NSW-wide system planning (as described above), and is carried out instead of the Regulatory Investment Test for Transmission (RIT-T).

The NSW Framework gives the State greater control of the planning and investment processes for network infrastructure projects to ensure timely delivery of REZ infrastructure that improves affordability for consumers while also accounting for the needs of local communities.

The four regulatory pathways for delivering network infrastructure projects in NSW are summarised in Table 1.

The NIS considers projects under all four delivery regulatory pathways in forming its NSW-wide view of the network and how it might be augmented to support the 20-year Development Pathway.

These regulatory pathways will facilitate the delivery of REZs and PTIPs, contribute to maintaining system reliability in NSW and are important in the context of the Network Infrastructure Options (outlined in Chapter 4).



Image courtesy of iStock. Darling Harbour, Sydney at dusk.

Table 1. Regulatory pathways for delivering transmission infrastructure projects in NSW

Framework	NSW		National	
Project type	REZ Network Infrastructure Projects (RNIP).	Priority Transmission Infrastructure Projects (PTIP).	Actionable ISP projects in NSW.	Other ISP projects in NSW or projects initiated by the Transmission Network Service Providers (TNSPs) / DNSPs in NSW.
Need identification	Transmission or distribution infrastructure to support generation and storage within a declared REZ (may be identified in the ISP).	Transmission infrastructure to address a likely breach in the NSW Energy Security Target (must be identified in the ISP).	Network infrastructure identified in AEMO's ISP to address transmission constraints, such as interconnectors.	Network infrastructure identified in AEMO's ISP, which are not yet actionable (e.g., Future projects). Network projects identified by the TNSPs/DNSPs to maintain the operation of the existing network.
Option selection	Infrastructure Planner appointed for REZ (for RNIPs) or PTIP makes assessments about project matters, including project options and a Network Operator to carry out the project (via a competitive procurement process, if appropriate) and then recommends preferred project and network operator to Consumer Trustee (REZs) and Minister (PTIPs).		The relevant TNSP/DNSP is responsible for selecting credible project options and acting as the proponent for project.	
Cost recovery	Following an authorisation by the Consumer Trustee or a direction by the Minister, Regulator makes a revenue determination.	Following an authorisation or direction by Minister, Regulator makes a revenue determination.	Revenue determination made by the AER under Chapter 6A of the NER (including the Actionable-ISP Regulatory Investment Test for Transmission (RIT-T).	Revenue determination made by the AER under Chapter 6A of the NER (including RIT-T/Regulatory Investment Test for Distribution.

REZ network infrastructure projects

The delivery framework seeks to inform stakeholders on the overall delivery status of REZs in NSW (see Chapter 4) and builds on the guidelines to establish 'plan, develop, deliver' phases of implementation via a five-step process.

More information about the five-step process that takes a RNIP from concept and consultation to detailed design, regulatory approval and delivery is shown in Figure 5 and in the Draft Network Authorisation Guidelines.⁵

Plan phase

The **Plan** phase includes the declaration of a REZ by the Minister, as well as the NSW-wide system planning process - including the NIS. The declaration of a REZ is the first step in formalising a REZ under the EII Act.⁶ This declaration sets out the intended minimum network capacity, geographical area and network infrastructure that will make up the REZ. Declarations inform the design of conceptual network infrastructure options as part of the NIS (see Chapter 3).

Develop phase

The **Develop** phase occurs when the five-step process moves from conceptual network options to assessing specific network infrastructure projects. This phase includes undertaking rigorous stakeholder consultation and on-the-ground community engagement. In preparing RNIP recommendations for the Consumer Trustee, the Infrastructure Planner may have regard to the REZ Declaration, NIS, and Development Pathway (amongst other things) but is not bound by them.

Where appointed as Infrastructure Planner for a REZ, EnergyCo has a range of responsibilities during the Develop phase.⁷ These responsibilities include leading community engagement, developing the environmental impact statement for the REZ, coordinating generation and storage projects including to support the Consumer Trustee auction processes and IIO timing objectives, minimising local impacts, expediting and de-risking generation connections and facilitating effective coordination of generation and network investments. It also initiates the land acquisition process and will run competitive tenders or non-contestable processes to recommend a Network Operator or other service providers to deliver the RNIP.⁸ In addition to these functions, EnergyCo is also responsible for coordinating with generation and storage projects to ensure that the cumulative impacts of the network infrastructure and associated projects is appropriately managed and minimised to the greatest practicable extent.

When preparing recommendations as Infrastructure Planner, EnergyCo intends to adopt the guiding principles outlined in the <u>Draft Network Authorisation</u> <u>Guidelines.</u> In particular, a flexible, or 'option-rich', approach to developing these projects is intended to maximise future optionality and ensure that the NSW electricity system is robust enough to withstand future uncertainties and deliver affordable, clean and reliable electricity to NSW consumers.

Following recommendations from the Infrastructure Planner about a proposed RNIP, the Consumer Trustee will consider whether the RNIP is consistent with the Development Pathway⁹ and in the long-term interests of NSW electricity consumers. The Consumer Trustee may then:

- recommend the Minister give a direction to the recommended network operator for the RNIP
- authorise the recommended network operator to carry out the RNIP.¹⁰

EnergyCo and the Consumer Trustee will maintain their respective independence throughout the process but will operate collaboratively. If the RNIP is authorised by the Consumer Trustee, the Regulator will calculate the TET to determine the prudent, efficient, and reasonable capital costs¹¹ and make a revenue determination for costs of carrying out the network infrastructure project that may be recovered from NSW electricity consumers.¹² The revenue determination framework has a pathway for project costs that are determined through contestable and non-contestable processes.¹³

- 12. See section 38 of the Ell Act.
- 13. See part 9 of the EII Regulation.

^{5.} Draft NIS Report is separate to, and will not supersede, recent detailed consultation undertaken with stakeholders on the recommendation, authorisation and determination processes for RNIPs.

^{6.} See section 19 of the Ell Act.

^{7.} The Minister has appointed EnergyCo as infrastructure planner for the Central-West Orana, Illawarra, New England, South West and Hunter Central Coast REZs under section 23(5) of the EII Act.

^{8.} See section 30 of the EII Act and sections 43-45 of the Electricity Infrastructure Investment Regulation 2021.

^{9.} See section 31(5) of the EII Act.

^{10.} See section 31(1) of the EII Act.

^{11.} See section 38(4) of the EII Act.

Deliver phase

The **Deliver** phase commences once the regulator has made the revenue determination. During this phase, EnergyCo will conclude the necessary land acquisitions and seek planning approval for the network infrastructure project from the NSW Government. The authorised Network Operator is then responsible for carrying out the network infrastructure project in accordance with the authorisation, including construction, service and ongoing operation and maintenance.

Priority transmission infrastructure projects

A network infrastructure project located in NSW can be declared by the Minister as a PTIP under the EII Act if two main conditions are fulfilled. Firstly, the project is identified in the most recent ISP or the project is part of an identified ISP project. Secondly, the project can help address an identified breach in the <u>NSW</u> <u>Energy Security Target</u>. It is important to note that a PTIP declaration in itself does not remove the project from the NEM regulatory approval process. The Minister may appoint an infrastructure planner for a PTIP.¹⁴ The appointed infrastructure planner may make assessments and recommendations about a PTIP. This may include recommending network operators and whether or not to carry out competitive procurement processes for the project.¹⁵ Following a recommendation by the Infrastructure Planner, the Minister can authorise or direct a network operator to carry out a PTIP.¹⁶ The Minister may only issue a direction to a network operator if the PTIP is an appropriate response to an identified future breach of the <u>NSW Energy Security</u> <u>Target</u> and if it is in the public interest.¹⁷



Image courtesy of Getty. Young woman on a farm.

- 14. See section 63(2) of the EII Act.
- 15. See section 43 of the EII Regulation.
- 16. See section 32(1)(b) and section 36(2) of the EII Act.
- 17. See section 34(3) of the EII Act.



Plan	1. NSW-wide system planning	 Consumer Trustee publishes the Infrastructure Investment Objectives Report, including the 20-year Development Pathway and 10-Year Plan for competitive tenders for electricity infrastructure EnergyCo publishes the Network Infrastructure Strategy Minister declares a REZ(s), including appointment of the Infrastructure Planner
Develop	2. Develop network options for REZ	 Infrastructure Planner assesses network options, including relevant stakeholder and community engagement Infrastructure Planner nominates a Network Operator(s) (potentially through a contestable process) Infrastructure Planner submits recommendation to the Consumer Trustee
	3. Authorise REZ network project	 Consumer Trustee considers recommendation from Infrastructure Planner Consumer Trustee provides authorisation (or recommends Ministerial direction) Consumer Trustee sets maximum capital cost and informs Regulator
Deliver	4. Make revenue determination	 Regulator runs the Transmission Efficiency Test to calculate the prudent, efficient and reasonable capital costs Regulator determines the revenue for the Network Operator for project
	5. Carry out project	 Authorised Network Operator carries out the project, including construction, operation and maintenance Regulator remakes or adjusts revenue determinations

The Network Infrastructure Strategy

Image courtesy of iStock. Woman leaning against a gate on a farm.

The Network Infrastructure Strategy lays out transmission options to support the timely and effective delivery of the Consumer Trustee's Development Pathway for generation, long-duration storage, and transmission infrastructure in the best interests of NSW electricity.

Introducing the Network Infrastructure Strategy

The primary purpose of the NIS is to provide guidance to the Consumer Trustee on potential network infrastructure projects that may be required to deliver the legislated infrastructure investment objectives in NSW. This is provided as a set of potential Network Infrastructure Options for both REZs and downstream augmentations within the existing shared network needed to transfer REZ generation to households, businesses, and industry. The NSW Government recognises that NSW sits within the broader NEM. For this reason, EnergyCo will prepare the NIS with input from the Consumer Trustee, AEMO, as National Transmission Planner), Transgrid (as the NSW Jurisdictional Planning Body), and the NSW DNSPs.

As a product of collaboration, EnergyCo hopes the NIS will build understanding and confidence amongst stakeholders regarding the future of REZ infrastructure in NSW. While the first edition of the NIS will focus on the network infrastructure required to meet the EII act objectives, future editions may consider in more depth wider considerations, such as the emerging hydrogen industry and other opportunities.



Image courtesy of iStock. Sunrise over solar farm.

Objectives

The NIS is based on three key objectives:

1. Coordinated NSW-wide electricity infrastructure development

Plan the network infrastructure required for practical coordination of generation, storage and new load in the long-term financial interests of NSW electricity consumers and provide the network infrastructure options as inputs to the Consumer Trustee's Infrastructure Investment Objectives Report. 2. Investor guidance

Provide greater certainty and visibility to investors, developers, and electricity infrastructure supply chains, to materially drive down the cost of capital and achieve cheap, reliable and clean electricity for NSW consumers.

3. Meaningful engagement

Work with all stakeholders to improve network infrastructure planning so that it not only delivers benefits for NSW electricity consumers, but maximises benefits for, and minimises impacts on, regional communities.



Image courtesy of iStock. Wind turbines.

Coordinated electricity infrastructure development

The NIS provides a set of potential Network Infrastructure Options that could unlock hosting capacity in areas with high quality renewable energy resources, enable transfer of power to major load centres and anticipate future system needs. By doing so, it helps to secure affordable, clean, and reliable electricity for consumers.

In developing these Network Infrastructure Options, EnergyCo is adopting a detailed approach to network planning by adjusting the scale, cost, and timing assumptions to reflect real-world considerations, such as community sentiment, land-use planning, workforce availability and supply chain constraints. Importantly, a new standard methodology is being proposed by EnergyCo regarding how costs and schedules are estimated for options in NSW to ensure they are more realistic (see Chapter 3).

By integrating these into the Network Infrastructure Options, the Consumer Trustee gains visibility of comprehensive information that may assist in its decision making. Regulations require that the Consumer Trustee's IIO Report must contain information on the transmission network required for REZs.¹⁸ The 2021 <u>IIO Report</u> used assumptions regarding transmission infrastructure projects from AEMO's 2020 ISP and the 2021 Inputs, Assumptions and Scenarios Report, as well as additional inputs regarding NSW REZs specifically developed for the report. The high level and static consideration of these assumptions was acknowledged as a limitation of the inaugural IIO Report. The Options develop by EnergyCo will help to overcome this limitation.

Once assessed, the Consumer Trustee can advise EnergyCo on the selection and sequencing of Network Infrastructure Options that are in the best long-term financial interests of consumers. With this advice, EnergyCo can select a sequence of network infrastructure projects that balance practicality, long term financial interest of consumers and energy security. Future requests for authorisation of specific RNI may be informed by the NIS; however, the Infrastructure Planner must make recommendations and the Consumer Trustee must make authorisations with regard to all possible options at a given point in time. In exercising these functions, the Infrastructure Planner and the Consumer Trustee are not bound by the IIO or NIS reports.

While the inaugural NIS will focus on the transmission network, future editions may look to wider considerations. For instance, with increasing electrification across the NSW economy and the potential emergence of a local hydrogen supply sector, EnergyCo is considering whether demand-side factors, including non-network solutions, should be prioritised in the transmission planning process. Three significant emerging market considerations and their treatment in the forthcoming and future network infrastructure strategies are discussed in the 'Emerging market considerations.



Image courtesy of iStock. Woman picking strawberries in greenhouse.

18. Section 24(b)(ii) of the Electricity Infrastructure Investment Regulations.

Investor guidance

Given the number of network projects required across the state in the coming decades, and the scale of investments involved, it is important that EnergyCo and the wider NSW planning process provide sufficient and valuable information to prospective investors. By openly communicating the potential options being considered for RNIPs and other transmission projects in NSW, the NIS will provide early insights and the long-term direction for network development for interested investors.

While the NIS will not determine the final nature or timing of network projects, it will provide greater and earlier visibility of the options being considered. This visibility is intended to provide guidance for prospective investors who may be considering electricity infrastructure investments in NSW.

The NSW Framework allows for introducing a contestable approach for the provision of network infrastructure (including the design, finance, construction, ownership, asset management and maintenance of new network infrastructure). This differs from the National Electricity Rules (National Framework), under which all projects would be delivered by incumbent Network Service Providers.

As stated in the Draft Network Authorisation Guidelines, when considering if a contestable process for transmission services is feasible, the Infrastructure Planner intends to adopt the following principles:

- Whether the required network infrastructure is readily separable from the existing transmission system, distribution systems or other REZ network infrastructure projects.
- Whether there is a sufficient market of appropriately qualified and resourced potential providers, for example, to create the competitive tension required to drive efficient bids.
- Whether the incumbent Network Service Provider can deliver the REZ network infrastructure project within the required timeframe and within reasonable cost estimates.

- The cost of the network infrastructure project relative to the cost of running a contestable procurement process (particularly in the case of relatively low value projects).
- Any timing constraints that a contestable process may place on project delivery timeframes.

Consultation on the Draft Network Authorisation Guidelines closed on 1 June 2022 and the final document is expected to be released by early 2023. For more information on the contestable process also see the <u>Policy Paper on Regulatory framework</u> for the Transmission Efficiency Test and Regulator's <u>determinations</u> for network infrastructure projects.

The Central-West Orana (CWO) REZ is the first NSW REZ using the new contestable approach. The experience gained from running a contestable process for this first pilot REZ will serve to inform the process undertaken for subsequent REZs. In early 2022, the NSW Government launched an Expression of Interest for Network Operators to deliver the CWO REZ transmission project. In May 2022, a shortlist of three parties was announced. These shortlisted parties have been invited to submit a Request for Proposal, with the contract to be awarded in 2023.



Image courtesy of iStock. Learning in the sun.

Meaningful engagement

The scale of transformation required in the NSW electricity system is unprecedented and will necessitate detailed and ongoing engagement with communities around NSW. EnergyCo is committed to taking a socially, culturally, and environmentally respectful approach to the transformation of NSW's energy system and will undertake meaningful engagement activities to ensure the Final NIS is informed by the views and experiences of a wide range of stakeholders.

EnergyCo also recognises the need to balance the competing views of different stakeholder groups and manage the compatibility of land uses throughout this process. These approaches reflect the EII Act's recognition of the importance of maintaining social licence to build and operate transmission infrastructure in NSW and will seek to ensure that social matters and benefit sharing opportunities are appropriately considered as part of overall project delivery costs.

As stated in the Draft Network Authorisation Guidelines (NAG), the Infrastructure Planner intends to implement the following core engagement requirements when assessing and making recommendations about RNIPs:

• Establish an engagement approach and communications framework that is tailored to the needs and values of local communities and stakeholders.

- Provide opportunities for local communities and stakeholders to meaningfully participate in the transmission route planning process.
- Provide clear, transparent, and publicly accessible information that outlines how the outcomes of community and stakeholder engagement have informed decision-making about transmission route planning.
- Inform communities and stakeholders about how and when they will be engaged and how the Infrastructure Planner will take feedback into account.

To supplement the NAG and provide greater information and guidance to communities, the NSW Government is preparing the Draft NSW Transmission Guidelines for release by the end of 2022. This document will introduce an approach to maximising regional benefits and minimising local impacts throughout the development process. Ongoing engagement with local communities about specific RNIPs authorised by the Consumer Trustee will also take place throughout the NSW planning assessment process.



Image courtesy of iStock. Aboriginal grandmother holding baby.

Alignment with National Framework

Under the National Framework, AEMO prepares the ISP at least every two years as a whole-of-system plan for the efficient development of the NEM over the next 20 years and beyond. The ISP has carriage of guiding the development pathway for the interconnected electricity system across the NEM. Similarly, the TNSP/DNSPs are required to prepare the TAPR/DAPRs for NSW each year to identify over the next 10 years any emerging constraints within their existing network and consider maintenance and operational needs of their existing asset base. The TNSP/DNSPs prepare options to address these needs and provides information through their respective planning documents for parties interested in delivering solutions to meet them.

The NIS is distinct from AEMO's ISP and the TAPR/DAPRs with respect to key parameters:

- Coverage that focuses on REZs in NSW.
- Granularity that is concerned with the design of REZs and associated downstream augmentations.
- Time horizon of 20 years in line with the Consumer Trustee's IIO Report.

The IIO Report, which may be informed by the NIS, serves a similar purpose for NSW as AEMO's ISP does for the wider NEM, while also ensuring that NSW will meet the Roadmap's objectives. For avoidance of doubt, neither the IIO nor the NIS supersede AEMO's responsibility for planning of power system security requirements in the NEM under the National Framework nor Transgrid's responsibility, either as the NSW jurisdictional planning body or system operator, for implementing solutions to deliver power system security in line with that planning. The preparation of transmission options for the NIS represents new expansions to support REZs, rather than detailed planning to modify and maintain the existing transmission network. In certain instances, there may be an overlap between AEMO, Transgrid and EnergyCo in the planning and delivery of particular network services (for example, system strength). EnergyCo may include scope for certain network services within, and explicitly for, a given RNIP, however, consistency will be maintained with any network services plans that Transgrid would develop through joint planning.

Through collaboration with AEMO and the TNSP/DNSPs, the NIS and the IIO Report will together build on, and maintain consistency with, the ISP and the TAPR/DAPRs, respectively. It is envisaged that future editions of all of these documents will need to reference work being carried out by each organisation and their respective legislative frameworks. EnergyCo will work closely with Transgrid and AEMO in delivering the REZs and downstream augmentation to ensure compatibility with the existing network; both on a project specific level as well as more broadly across a portfolio of projects.

Neither the IIO nor the NIS create any obligation for either the Consumer Trustee or the Infrastructure Planner to develop any network infrastructure projects. Instead, they both serve as guidance for the requirements that need to be achieved.

The NIS is proposed to be released every two years and accompany the Consumer Trustee's IIO Report, with the option to publish an update annually if there have been significant developments in the market.

Question for stakeholders

1. In what ways can the NIS further complement, align or improve the National Transmission Planning and Investment framework under the National Electricity Rules?



2. Do you agree that the NIS should in future accompany the IIO Report?

Figure 6. The NIS and the ISP and TAPR/DAPRs



Emerging market considerations

The transformation of the energy sector, both nationally and in NSW, includes high levels of uncertainty from emerging trends that could fundamentally reshape the market. EnergyCo is conscious that these trends need to be carefully considered and accommodated through optionality in the network design process. For this reason, a principle of making NSW future-ready for emerging market and technology trends will be adopted as part of the network option design process (see Chapter 3). Key emerging market trends are raised here and their potential implications for analysis are outlined.

Question for stakeholders

3. What additional emerging trends that could influence the development of NSW's electricity system, beyond the three outlined, should be considered in the NIS?





Image courtesy of iStock. Farmer using a mobile phone on a tractor

Unprecedented scale of a future Hydrogen economy

The NSW Government is working towards establishing the state as a global market leader in hydrogen, using green hydrogen to not only decarbonise its own emissions and support diverse domestic applications, but to also export its renewable energy to international markets. NSW has the resources, infrastructure, and ambition to build an integrated green hydrogen economy.¹⁹

In October 2021, the NSW Government released the NSW Hydrogen Strategy which sets out a bold vision and plan to develop a commercial green hydrogen industry in NSW. The Strategy provides around \$3 billion in financial incentives that are expected to directly reduce the cost of green hydrogen to below \$2.80 per kg and unlock new demand for green hydrogen. It has also set an initial target of 700 MW of electrolyser capacity and 110,000 tonnes per annum of green hydrogen production by 2030. Achieving the Strategy's 2030 targets would create an estimated additional 10,000 jobs and increase gross state product by over \$600 million each year from 2030 onwards.

This is only the first step in the NSW Government's broader effort to establish a new green hydrogen economy. Green hydrogen will not only play a critical role in achieving the NSW Government's net zero emissions objective by 2050 and support domestic industrial growth, but also position the state to capture a new globally competitive export industry at a scale, rivalling NSW's coal export industry.

Estimates for the potential demand for green hydrogen²⁰ are unprecedented. The IEA estimates global green hydrogen demand of around 75 million tonnes per annum (Mtpa) by 2030 and 220 Mtpa by 2040²¹ in its net zero scenario. The Green Scenario in BloombergNEF's New Energy Outlook 2021 is even more ambitious. It projects global green hydrogen demand of around 170 Mtpa by 2030 and 820 Mtpa by 2040. To illustrate the potential scale of such a demand, if NSW captured only 3% of global green hydrogen demand across both scenarios, it would result in a NSW export opportunity of 2-5 Mtpa by 2030 and 7-25 Mtpa by 2040. The scale of solar and wind resources needed to produce this amount of hydrogen is unprecedented. NSW would require an additional 40-90 GW installed generation by 2030 alone to service this demand. This would obviously far exceed the current Roadmap targets. NSW is therefore considering the scale of export industry to which we should aspire and plan the NSW energy system, and how we could meet these unprecedented levels of demand while capturing the full economic potential for the State.

Green hydrogen

Green hydrogen is produced using electrolysers powered by renewable energy, using electricity to split water molecules and separate out the hydrogen. Hydrogen has the potential to replace fossil fuels in many applications. It is a fuel that can be stored for long periods, transported, combusted, used in fuel cells and as an industrial chemical feedstock. Depending on how the technology matures, it may offer an additional long-duration storage option for energy produced from renewables.

Growing hydrogen hubs

Leading hydrogen development locations are typically characterised by proximity to excellent renewable energy resources, access to water and hydrogen demand or distribution infrastructure. These hubs are intended to be a central point of hydrogen production, which is supplied to 'spokes' that extend out from the hub. Research and development projects, and facilities, can also be attached to hubs to deliver technology innovation, efficiency improvements and cost reductions.

The NSW Government's hydrogen hub initiative is providing up to \$150 million in funding to support the establishment of hydrogen hubs in NSW. The 10 projects shortlisted for grant funding propose a total of 4.5 GW of electrolyser capacity by 2030. Eight of these projects are in the Hunter and Illawarra regions.



Image courtesy of iStock. Port Kembla, Wollongong, NSW.

21. IEA, May 2021, Net Zero by 2050-A Roadmap for the Global Energy Sector.

^{19.} The phrase 'green hydrogen' includes green hydrogen produced in its various carrier forms

⁽that is, gas, ammonia, liquid hydrogen, and liquid organic hydrogen carriers). 20. For the purpose of the NIS, EnergyCo has focused green hydrogen due to its close linkage with the electricity sector.

Future hydrogen and the Network Infrastructure Strategy

Both domestically and internationally, the market for hydrogen is expected to grow significantly as large energy consumers around the world progress towards their own decarbonisation goals. NSW is well placed to serve a significant portion of this demand for the following reasons:

- NSW possesses vast renewable generation resources.
- The State is already undergoing a national-leading transformation in its power system under the Roadmap.
- We have a skilled workforce, infrastructure, and a proven track record as a major energy exporter.

We are considering how to leverage these advantages and position NSW as a global hydrogen market leader for large-scale projects.

If hydrogen grows to be as large as some currently anticipate, significant network investment will be necessary to enable the required scale of electricity generation. Properly planned for and, where applicable, integrated into the existing grid, hydrogen presents an opportunity to better plan and manage the electricity network. For example, hydrogen can be stored and transported with relative ease compared to other energy storage solutions. It therefore can become another domestic low-carbon energy storage option that enhances energy system resilience and stability.

Electrolysers themselves present an opportunity to introduce additional demand into parts of the network which would otherwise be too generation heavy. This can help to stabilise the network and reduce curtailment and thus create more 'headroom' for new generators to connect and to reduce overall consumer prices. Hydrogen may also provide an opportunity for additional demand-side management. Finally, it can be an important source of flexible, dispatchable capacity to help the NSW power system during renewable energy 'droughts'.

There may be opportunities to co-optimise corridors for electricity transmission and hydrogen pipelines. Opportunities for alternative energy storage and transportation aside from traditionally understood transmission infrastructure enables greater flexibility in finding efficient and cost-effective solutions to delivering the clean energy that NSW will need, either for domestic consumption or international export. Forward planning of both hydrogen hubs/pipelines and the NSW electricity network may create system benefits and reduce cumulative community impact from otherwise separate developments.

Increasing renewable energy supply for hydrogen export

Depending on the scale of operation, it may be more practical and/or preferable for hydrogen generation to sit semi or completely independently of the existing network, as it is likely that a large amount of generation would need to be dedicated just to hydrogen production. This could conceptually be a REZ partially or fully dedicated to hydrogen production.

Alternatively, existing REZs could be expanded to supply greater energy to the grid, with the flexible hydrogen production loads used to balance the grid in lieu of energy storage. At times of high electricity prices, hydrogen producers could switch off, returning capacity to the market and putting downward pressure on prices for other consumers. EnergyCo could provide industry with estimates of the anticipated greater supply to support investment and planning decisions in hydrogen export projects.

The location of hydrogen electrolysers would need to take into account the uses of that hydrogen; for example, it can be cheaper to locate electrolysers close to renewable generation and construct the necessary infrastructure (for example, pipelines) to transport the hydrogen to its end-users (including to ports for shipping hydrogen to international destinations), rather than locate electrolysers close to ports or end-users and then connect the necessary electricity transmission infrastructure. Answers to the 'pipes vs. wires?' question requires whole-of-energysystem planning which EnergyCo could undertake through the NIS as an input to development of the State's Hydrogen Infrastructure Masterplan.

EnergyCo acknowledges the unique opportunity that NSW has and views the NIS as one possible conduit for exploring these opportunities. As the energy landscape in NSW rapidly evolves in the coming years, EnergyCo will continue to closely monitor changes in the domestic and global hydrogen industries and consider opportunities to support the growth of hydrogen through the augmentations proposed in the NIS.

Question for stakeholders

4. Has the NIS appropriately assessed the impact of a potential domestic and export hydrogen economy on transmission infrastructure? If not, what additional factors should EnergyCo consider?



- 5. What is the most effective way for EnergyCo to support the delivery of renewable energy capacity for hydrogen export projects by 2030 and 2040? For example, should we expand existing REZs or develop new dedicated REZs?
- 6. What is the hydrogen export potential that future NIS should aim to facilitate through its network developments by 2030, 2040 and 2050?



Image courtesy of Bimi. Solar farm in Autumn.

Offshore wind

Interest in developing offshore wind (OSW) in the NEM, including in NSW, is rapidly gaining pace. This is consistent with international experience, with OSW developments increasing in number and scale across Europe and Asia.

While onshore wind in comparison remains a lower cost and faster-to-develop solution in Australia, there are advantages to OSW. In particular, OSW projects may:

- leverage high-capacity offshore wind resources with some time diversity from onshore wind resources
- provide economies of scale with the potential for very large project developments
- deliver consumer price benefits due to greater resource diversity
- be developed in proximity to existing electricity demand (which is typically along the east coast) and reduce the need for major transmission expansions further inland.

In 2021, the Australian Government passed the Offshore Electricity Infrastructure Act 2021

(Offshore Electricity Infrastructure Act), which included a National Framework for licensing offshore generation and transmission infrastructure in Commonwealth waters. The Offshore Electricity Infrastructure Act empowers the Federal Minister to 'declare' areas of the coastline as suitable for offshore wind development and may use declarations to impose conditions on offshore developments and licensees. The National Framework for regulating OSW is an important step for developing an OSW industry in NSW and Australia.

OSW zones are also considered in the ISP. Candidate offshore wind zones in the 2022 ISP include locations in both the Hunter Central Coast and Illawarra regions, adjacent to onshore REZs in NSW. The registration of interest process conducted for the HCC REZ in early 2022 identified significant commercial interest in developing several OSW projects in this region. Developers have also proposed projects for the Illawarra coastline and further south. Importantly, while there is growing interest in OSW and benefits it could deliver, there remain barriers to its uptake in Australia. The Framework is still in initial stages and requires further development to provide guidance for potential OSW projects. In addition, the long lead times, and requirement for significant supporting infrastructure such as undersea interconnectors and flotation technology, act as barriers for near-term industry development.

Offshore wind and the Network Infrastructure Strategy

While the market has demonstrated growing interest in developing OSW in NSW, the technology is currently developing and is not expected to be commercially operable in the short term. However, there is immense potential for OSW to gather pace in NSW and policy work in this area would unlock more possibilities, and as such OSW has been considered as a technology that could be selected.

EnergyCo will maintain flexibility in network planning to allow for prospective OSW developments in the future, such as in the Hunter Central Coast and Illawarra regions. This approach will allow EnergyCo to keep pace with the development of the local OSW market and respond accordingly. As required, EnergyCo will engage in joint planning and coordinate the preparation of OSW. This will involve consultation and collaboration with AEMO, the Consumer Trustee, Transgrid and the wider industry.

Question for stakeholders

7. How and at what point should generation from OSW be considered in network planning for the future editions of the NIS? What other considerations are important when it comes to OSW?



Long-duration storage

The variability of renewable energy resources necessitates the need for complementary investment in storage in line with increasing penetration of renewables. Long-duration storage of electricity is essential for firming of variable generation by storing surplus renewable generation and releasing it into the grid when demand exceeds supply. In accordance with the EII Act, a minimum objective to construct 2 GW of long-duration storage (in excess of 8 hours duration) by 2030 is in place. The Consumer Trustee which manages competitive tenders for long-duration storage LTES Agreements, will play a crucial role in achieving the objective. Currently, pumped hydro is the primary form of longduration storage. The NSW Government administers a dedicated Pumped Hydro Recoverable Grants Program to assist developers with the cost of any eligible activity leading to the development of an eligible pumped hydro project which thereby supports commercialisation. In addition, WaterNSW is seeking private sector investment via a competitive tender process for leveraging NSW's existing dams.

Over time, other maturing technologies may provide long-duration storage alongside pumped hydro projects in the NSW energy market. Technology options may include but are not limited to thermal storage, compressed air storage and gravity storage. For instance, Transgrid recently identified an advanced compressed air energy storage solution as the preferred option to support electricity supply in Broken Hill (see Box 2).

Box 2: Broken Hill compressed air energy storage project

An advanced compressed air energy storage (A-CAES) project has been selected as the preferred option to provide long-duration storage and ensure reliable electricity supply in Broken Hill. The compressed-air facility would store excess energy, collected at times of low demand, in repurposed former mine shafts deep underground, and then draw on that supply during periods of high demand to supplement the grid and ensure continuity of power to consumers in the region.

This project will be able to store up to 200 MW of energy which can subsequently provide 8 hours of electricity at full capacity. Overall, it is expected to deliver a broad range of economic benefits to the community which has been calculated at \$286 million over a 27-year forecast period with construction commencing in 2023. This analysis takes into consideration that the project uses clean technology, is innovative in the solution being implemented, and has a higher level of reliability relative to other credible options.

This project is currently the only large-scale A-CAES project in Australia. EnergyCo will monitor the learnings from this project, as these are likely to inform energy participants of the robustness and scalability of this type of long-duration storage technology.

Long-duration storage and the NIS

Long-duration storage plays a crucial role in optimising an energy system with a high penetration of renewable energy sources. With respect to REZs, EnergyCo has investigated the potential for pumped hydro projects to connect to the existing shared network and to the future network within the Network Infrastructure Options. In future editions of the NIS, EnergyCo will seek to clarify potential barriers for pumped hydro to connect to the network. Importantly, EnergyCo will be technology-neutral in assessing options for long-duration storage. Like other emerging market considerations in hydrogen and OSW, EnergyCo will seek to maintain flexibility in network planning to be able to accommodate long-duration storage technology in the most attractive locations. This approach will allow EnergyCo to keep pace with any technological or project advancements occurring in the storage industry and respond accordingly.

Question for stakeholders

8. How can EnergyCo best work with industry to incorporate long-duration storage projects into transmission planning for REZs in NSW?



Preparing the Network Infrastructure Options

Image courtesy of Getty. Girl touching a solar panel
EnergyCo is adopting a comprehensive and practical approach to network planning for renewable energy zones and critical enabling augmentations, that accounts for realistic issues to assure the timely and cost-effective delivery of electricity infrastructure.

Preparing the Network Infrastructure Options

EnergyCo has undertaken a rigorous development process to prepare a set of potential Network Infrastructure Options that expand the transmission network and drive the energy transformation in NSW. To effectively plan this transformation, economic, social, and technical considerations need to be considered to ensure the options can be delivered and consumers as well as communities benefit.

Overview

A key output of the NIS is the Network Infrastructure Options that will provide guidance to investors and the Consumer Trustee. This chapter sets out and seeks feedback on the process for developing the Network Infrastructure Options. The resulting Options are presented in Chapter 4. The Options are at a conceptual design stage. They consider initial feedback provided by communities and other stakeholders through the 'Declaration' process for the REZs and by proponents of generator and storage projects through registration of interest processes. However, they have not yet been subject to detailed land-use planning, deep community engagement, economic appraisal nor in-depth power system analysis.

Guiding principles

The preparation of the Network Infrastructure Options is based on a set of guiding principles, designed to be in the long-term financial interests of consumers and aligned with the multi-criteria factors outlined in the <u>Draft Network Authorisation Guidelines</u> that the Infrastructure Planner may account for when making a recommendation for an RNIP, as detailed in Table 2 below.

Limitations

The Network Infrastructure Options are conceptual in nature and are informed by preliminary power system analysis only. They represent a potential future network configuration based on theoretical maximum generation in the identified REZs. Detailed design, planning and further technical analysis will be required to determine not only the feasibility of each option, but also the detailed solution at the Infrastructure Planner (IP) recommendation stage. All options are subject to change, and neither EnergyCo nor the Consumer Trustee are bound to any particular option presented.

These Options have not yet been subject to any detailed land use planning, environmental or community impact considerations. Before proceeding to development, each of these augmentation options would need to be subject to detailed community engagement and consultation processes to inform future design options.

The secure operation of the grid is critical to maintaining reliable electricity supply for NSW consumers and businesses. The technical validity of the network options will be assured through a joint planning process between AEMO, relevant TNSPs/ DNSPs and EnergyCo.

Table 2. Guiding principles from the Draft Network Authorisation Guidelines

Guiding principle	The development process seeks Network Infrastructure Options that
Affordability	 minimise long-term system costs, i.e., network cost per MW of generation capacity including downstream augmentations maximise inter-REZ and intra-REZ competition for LTES Agreements enhance network utilisation enable emissions reductions of 50 per cent by 2030 and achieve net zero emissions by 2050 at the lowest cost to consumers in line with NSW's Net Zero Plan
Network benefits and reliability	 create hosting capacity in high quality resource areas reduce the risks of shortfalls of system strength and other system services ensure system reliability and security and thus reduce unserved energy risk
Timeliness	 allow for timely delivery of projects minimise risk of delays due to land use, environmental or planning constraints
Social license	 ensure perspectives of local communities, landholders and other regional stakeholders are considered minimise impacts on and maximise benefits for local communities, including the likelihood of repeated disruption of host communities over the short to medium term
Flexibility	 provide low-cost and quick expansion options to enable adjustment to changing electricity needs, e.g., faster levels of electrification such as hydrogen electrolysers provide reasonably priced insurance against delay of other infrastructure projects or early retirement of existing generators
Innovation	 reduce or avoid the need for conventional 'poles and wires' allow more efficient or less impactful delivery make NSW future-ready for a dynamic and innovative energy market.

Question for stakeholders

9. Has EnergyCo identified the right principles to guide the development of the Network Infrastructure Options? How could they be improved?



- 10. What are stakeholder views on taking an 'option-rich' approach to manage the inherent uncertainty in the future evolution of the energy system? Are there better approaches to manage this uncertainty?
- 11. Do stakeholders agree that the development of network options should be designed at sufficient scale to avoid multiple projects being built in the same locality over time?

Development steps

Driven by the guiding principles outlined above, EnergyCo has developed a process for identifying opportunities for REZ development and, at a high level, scoping a potential option to support. An overview of how the Options are developed and used to inform the Consumer Trustee's Development Pathway is provided in Figure 7.

By identifying the size and shape of the REZs, a series of potential augmentations have been identified that will expand the amount of generation that could connect. This includes any augmentations to the existing network that would be required to support this new generation reaching the load centres.

Real world scope adjustments are then made to the options based on their risk profile to better reflect the current energy market. These can be adjustments with respect to changes in global supply chains and workforce availability, the changing supply of energy in NSW (such as the potential closure of Eraring power station in 2025), community sentiment considerations, or contingency planning.

Once the scope of each augmentation has been identified, a high-level cost and schedule estimate is carried out to assess the ability for each option to be delivered. This estimation is based on a combination of the AEMO Transmission Cost Database (TCD) and EnergyCo's experience to date in the development of CWO REZ.

Step 0: REZ Declaration

The Minister for Energy determines the geographical area and the specified network infrastructure that forms part of the REZ. These priority NSW regions were identified by the EII Act for REZs because they have good energy resources (such as wind and solar), have strong investor interest, are close to existing grid infrastructure and industry, and minimise both environmental and land-use constraints. Under the EII Act, the Minister has formally declared two REZs: the Central-West Orana and New England REZs. The Minister is yet to formally declare the remaining three REZs in the EII act: South West, Illawarra, and Hunter Central Coast.

Each REZ has a draft geographical area that roughly outlines the REZ boundary. A Registration of Interest (RoI) is performed to better understand the market interest in and around these REZ areas and is used to help refine the boundary. In addition, heritage, environmental and land use planning considerations are factored into this evaluation, shaping the final REZ geographical boundary to capture desirable generation that is in the best long-term interest of consumers.

Step 1: Engineering analysis

Once the REZ has been declared by the Minister, EnergyCo can proceed to undertake engineering analysis to design the Network Infrastructure Options needed to deliver the intended network capacity and provide future optionality. This process is completed by:

- assessing the potential generation potential of the geographic area
- preparing within-REZ network options to deliver that generation within the REZ
- determining downstream augmentation needed to bring that REZ generation to load centres, such as major cities.

Figure 7. Informing the Development pathway with the Network Infrastructure Options

 O. REZ declaration process Refine geographical area (location) Determine intended network capacity (size) Specify REZ network infrastructure Appoint Infrastructure Planner 	eted In ps Progress	Future steps
NSW-wide system planning		
Design steps	Inputs	
 1. Engineering analysis Prepare a long list of network options to meet the maximum cap the REZ in the geographic area Prepare a short list of network options that is refined based on: a. Generation potential identification b. Within-REZ network options c. Downstream augmentations 	acity of AEMO AEMO Transg REZ D	ISP IASR grid TAPR eclaration
 2. Real-world adjustments Incorporate stakeholder feedback on suitability of real-world adjustion Identify future delivery constraints (supply chain factors, work for availability, contingency planning) Ensure accommodation of coal-fired power station requirements 	stments brce	holder ack
 3. Cost and Schedule Estimation Each augmentation undergoes a standardise, high level cost and schedule estimation The inputs and assumptions behind these estimations are based EnergyCo's current understanding of market considerations 	AEMO Currer sound	TCD nt market ings
 4. Transmission and generation optimisation Consumer Trustee models the transmission expansion required to fachieving the generation and storage targets under the Roadmap 	facilitate Optior	ork tructure ns
 5. Network Infrastructure Strategy Determine a <i>non-binding</i>, sequenced and timed 20-year developm for transmission, generation and storage Publish the Final Network Infrastructure Strategy 	ent plan	olanning EMO and grid
Network authorisation process		
 Infrastructure Planner assesses network options, undertakes rigoro engagement, and nominates a Network Operator Infrastructure Planning recommends a specific network option to the 	us stakeholder and com ne Consumer Trustee	nmunity

Consumer Trustee considers recommendation from Infrastructure Planner, provides authorisation, and sets
 maximum capital cost and informs Regulator

Step 1a: Generation potential identification

AEMO's ISP identified the maximum potential renewable resource (solar and wind) available in each of the given REZs,²² and was used as the theoretical ceiling for total generation that could plant within each REZ geographical area. The Step Change scenario in the <u>Final ISP 2022</u> was chosen for this analysis, as it represents a likely future of the NEM given the broad uptake of renewables by the private sector and strong governmental policy supporting this growth.

Based on the registration of interest data gathered for CWO, NE, HCC and SW REZs, a least-distance optimised set of hub locations was identified for each REZ. This was achieved by selecting hub locations that maximised the amount of renewable generation collected within a 10 km radius of a given point, with preference given to locationally specific generation technologies (for example, wind and pumped hydro). The 10 km radius was used as an initial guide for locating potential hubs with the identified ROI information as it represents, on average, the distance between a generator and its connection to the shared network that would not require substantial reactive power requirements to connect. Note that only projects within the geographical boundary defined in each respective REZ declaration were considered when identifying the hub locations.

Step 1b: Within-REZ network options

A comprehensive list of network options was developed to connect identified potential hub locations together in a practical and scale efficient arrangement. Based on the amount of generation potentially connecting at each hub location, a connection arrangement – including operating voltage and number of circuits – has been proposed to ensure sufficient transfer capacity is available for the aggregated generation being transferred through a given hub location. This long-list represents a 'maximum potential network capacity' for the REZ, and subsequently, an indication of the potential maximum renewable generation capacity for a given REZ.

The initial list of options was then refined to a shorter list, aggregating different augmentations and hub locations together where additional benefit could be gained. The potential aggregation benefits could be economies of scale, minimisation of community or environmental impacts, or based on other technical requirements. This short list forms the *maximum theoretical transfer capacity* identified for each REZ below. This refinement formed the Network Infrastructure Options presented in Chapter 4 and Appendix D.

Step 1c: Downstream augmentations

Based on the refined list of REZ augmentations, a series of downstream augmentations was then identified to alleviate future constraints on the shared network as a result of REZ expansions. These downstream augmentations have been linked to the increase in generation capacity from given within-REZ augmentations, as they are aimed at minimising potential constraints on renewable generation reaching the load centres. In developing the downstream augmentations, the known transmission projects identified in both AEMO's ISP and Transgrid's TAPR have been considered.

Step 2: Real-world scope adjustments

EnergyCo is in a unique position as it is already the Infrastructure Planner for two of the first five NSW REZs. It is therefore able to combine the first-hand knowledge and experience of developing network augmentations with existing NSW planning processes, close stakeholder engagement and other Roadmap initiatives with a REZ-focused lens. As part of the NIS, EnergyCo is proposing to bring real-world issues within the scope, cost, and delivery timeframes of options, to ensure the Network Infrastructure Options are realistic and can be practically achieved.

In Step 2, the scope of the options is adjusted in line with their risk profile based on supply chain constraints and workforce availability, potential early retirements of coal-fired power stations, community feedback considerations, and contingency planning. Considerations regarding the importance of delivery timeframes and project scope are reframed based on the combined level of urgency and difficulties of practical delivery under forecast market conditions. Adjustments are then made to a given option's scope and timing accordingly.

If required, EnergyCo will work with the Consumer Trustee to develop adjustments to the costs and timing of transmission development as a result of the following factors, and develop realistic assumptions.

22. Refer to Appendix 3 - Renewable Energy Zones of AEMO's Draft ISP 2022.

Supply chain constraints and workforce availability

The realities of delivering electricity infrastructure under current market conditions in Australia cannot be ignored. As global economies decarbonise, there is growing competition for capital, materials, plant, labour, and skills to deliver infrastructure for a cleaner future. At the same time, the global COVID-19 pandemic has increased pressure on global supply chains, further increasing costs for electricity infrastructure delivered to and installed in Australia. Infrastructure Australia has highlighted that the construction of electricity infrastructure will create pressures on the market's capacity to deliver, as there are known and growing constraints on the skilled labour, materials and equipment needed at all stages of project development, construction, and operation.²³

EnergyCo is cognisant of these industry trends and recognises that supply chain considerations and workforce availability must be factored into long term planning for REZ delivery. This is achieved by reflecting these adjustments in the cost and estimated delivery time frames of each option, which may change the relative sequencing of options during the economic modelling.

Coal-fired power station retirements

The backbone of the current electricity system was largely built to link coal-fired power stations to major cities on the East Coast. Four out of five baseload coal power stations in the State are expected to retire by the mid-2030s, and consequently new renewable generation must replace this lost capacity. However, given the potential closure of Eraring in 2025, failures of plants with long lead times to repair and recent thermal coal supply constraints, there is a possibility that power stations may retire earlier than anticipated This potential future has been considered in the options development in the form of the Early Transmission Network Augmentations scenario, which aims to bring online as much generation as possible through utilising existing capacity or proposing minor augmentations to create additional capacity on the existing network.

Social licence

EnergyCo's goal is to ensure that the community's views are proactively integrated into its infrastructure strategy alongside technical and economic factors. This process starts with meaningful engagement during the initial REZ declaration process, by way of feedback sought from local communities on the design the REZ. Following the declaration of a REZ, EnergyCo will continue this commitment to understanding community views through a range of engagement and feedback activities. EnergyCo is committed to working with local communities to help inform and refine network options during the consultation and development phases for each REZ.

Contingency planning

From a reliability and safety perspective, it is important that the identified options ensure that the network can withstand outages on single assets without causing widespread losses in electricity supply. Incorporated into the design of the Options is consideration for such contingency events. Factors such as redundancy or route diversity (at a conceptual level) were included where appropriate in the scope of certain augmentations, to best ensure operational reliability.



Image courtesy of Getty. Garden workers planting saplings.

23. Briggs C., Rutovitz J., Jazbec M., Langdon R., Nagrath K., University of Technology Sydney with Infrastructure Australia. 2021, Market Capacity for Electricity Generation and Transmission Projects, A report from Infrastructure Australia's Market Capacity Program, available at: www.infrastructureaustralia.gov.au/sites/default/files/2021-10/Market%20Capacity%20for%20Electricity%20 Infrastructure%20211013.pdf

Step 3: Cost and schedule estimation

Once the scopes for the possible augmentations have been identified, in Step 3, an indicative schedule and cost estimate is developed for each option based on EnergyCo's best understanding of current market conditions. These schedule and cost estimates give context around the practicality of each option and will be used as inputs into the for the modelling exercise performed by the Consumer Trustee.

Better estimating infrastructure delivery costs

In preparing the Network Infrastructure Options, EnergyCo has developed a standard methodology for estimating the cost of delivery of each option under the Roadmap. This allows the costs and benefits of each option to be compared on equal ground, as the same cost building blocks, risk factors and approach to assessing both these elements are consistent.

This methodology is based on AEMO's Transmission Cost Database (TCD) tool with a set of REZ-specific parameters to ensure the cost estimates are as realistic as possible. A standardised set of Project Factors, Known Risks and Unknown Risks was developed to best reflect the realistic technical, social, and economic constraints that a REZ project would likely face in the current market context. These project factors and risks apply to individual line items, adjusting the cost appropriately. The specific project factors and risks used can be found in Appendix C.

Building on the initial estimates produced by the TCD, additional costs were incorporated into the total delivery cost for each augmentation to reflect costs incurred when delivering real-world projects. These reflect the greater upfront consideration of community-related costs, such as social procurement or additional biodiversity offsets, or Roadmapspecific mechanisms, such as the establishment of a Special Purpose Vehicle for cost recovery. These parameters were derived by drawing on the experience of developing the CWO REZ project and represent the costs likely to be incurred during the future development of any other project.

Lastly, financing costs are estimated based on the total calculated capital cost of the augmentation – with experience being drawn from the development of the CWO REZ.

Whilst aiming to determine the most realistic cost estimate possible, it should be noted that the estimation produced is an early view of the potential delivery cost of a given augmentation. The cost produced in this process is in-line with a Class 5b estimate (±50%) level of accuracy, as there are certain scope and timing parameters of each project that are impossible to determine until the time of detailed design.

Given that the application of these estimations is for conceptual comparison of augmentations, this cost estimation process is sufficiently robust for these purposes. Once each augmentation starts to have a specific solution development, more detailed cost estimation will be conducted.

Better estimating infrastructure delivery times

The delivery timing of each augmentation plays a crucial role in planning the power system. Key pieces of network infrastructure can help unlock new renewable generation capacity and alleviate network constraints if delivered at the right time. A better understanding of the realistic constraints on the ability to deliver will help to identify where additional resources may be needed to ensure critical augmentations are delivered when they are needed. This is particularly challenging in the current market environment, where there is a local and global shortage of materials and labour as well as an ever-growing demand for these resources as nations around the world continue to drive their own clean energy transformations.

The proposed approach to better understanding the constraints around delivery of the augmentations is that EnergyCo derived three possible delivery timeframes for each option:

- 1. Central case which assumes business-as-usual delivery expectations from current market conditions.
- 2. Accelerated case which assumes acceleration of development and early works activities to compress delivery time frames, generally resulting in approximately a 3-month schedule acceleration when compared to the Central case.
- **3. Delayed case** which assumes delays to development and construction activities, resulting in approximately a 12-month delay when compared to the Central Case.

The delivery timeframes are aligned with three modelling scenarios to be used by the Consumer Trustee in preparing the Development Pathway, discussed in Step 4.

As many of the augmentations listed in the Network Infrastructure Options are not yet developed to have delivery schedules, an estimate based on the scale of the augmentation has been proposed.

To estimate these delivery dates, knowledge and experience will be drawn from the market sounding activities that were carried out during the development of the CWO REZ. A Central case schedule has been put together for CWO, overlaid with the current market sentiment on resource and material constraints and the intended reference scope, covering planning approvals, tender activities, property acquisition and construction activities. The Accelerated case was derived by identifying possible areas where the delivery program could be compressed where possible, which was primarily during the construction phase (for example, early works package, additional resources for construction). Conversely, the Delayed case was derived by identifying where major program delays could occur, which was primarily construction activities but also included possible delays to earlier development activities.

The Central case for all augmentations was estimated using the base schedule put together for CWO, with adjustments made based on the scope of each augmentation. It is proposed that the relative schedule differences between the Central, Accelerated and Delayed case schedules of the CWO REZ can then subsequently be applied to every augmentation within the options.

Question for stakeholders

12. Is the process for estimating cost and delivery schedule for these potential augmentations considering enough factors to be robust enough for a high-level comparison of options? If not, how could it be improved?





Image courtesy of iStock. Girl is running the way to wind energy.

Step 4: Network optimisation modelling

In its current form, the Options present the indicative scope, cost, and earliest operational date of the range of augmentations, however the benefit that each of these augmentations provides is heavily dependent on their actual delivery timing. To avoid energy shortfalls and costly electricity price spikes for consumers, these proposed augmentations need to be appropriately sequenced to enable generation to come online ahead of actual generator retirements and in the right places.

The approach to determining this sequence is to undertake a network optimisation modelling exercise to determine when these augmentations will provide the most benefit to NSW. This assessment will be carried out by the Consumer Trustee and will forecast generation build out across the state with the IIO's 2030 generation targets, and subsequently identify when a given transmission augmentation would be required to enable this new generation build.

The Consumer Trustee will undertake network optimisation modelling to prepare a build trajectory over a 20-year period in respect of generation and long-duration storage infrastructure to meet infrastructure investment objectives including the minimum objectives. This development pathway will then be adopted in its Infrastructure Investment Objectives reports.

The Consumer Trustee will concurrently develop an optimised sequence and timing for network infrastructure by selecting from the Network Infrastructure Options developed.

Modelling co-optimisation

Three distinct scenarios have been selected to test the benefits of the augmentations under a range of possible futures. This will help to identify augmentations that are 'no-regret' (that is, provide tangible benefits under all scenarios), but also to test the robustness of the proposed options put forward. The three modelling scenarios that have been selected are:

- 1. Central Case in line with the inputs and assumptions for AEMO's 'Step Change' scenario in the ISP 2022. The Central Case assumption for delivery schedule is applied to this scenario, as it represents the current expected timing of projects.
- 2. Early Closure assumes all coal-fired power stations in NSW are retired earlier than currently anticipated and an accelerated schedule for proposed transmission augmentations is required. This scenario is expected to highlight the benefit of implementing REZ at an earlier stage if capacity withdrawals occur earlier. The Accelerated Case assumption for delivery schedule is applied here, as it represents potential acceleration of project delivery to ensure sufficient energy is available.
- 3. Transmission Delay assumes a delay in delivery of all major transmission projects in the NEM (with a capital cost above \$1 billion) later than currently anticipated. This scenario is expected to highlight the benefit of the proposed downstream augmentations. The Delayed Case assumption for delivery schedule is applied here, as it represents potential project delays from both development and delivery activities.

Better estimating renewable build trajectory

In line with developing realistic estimates for cost and schedule, EnergyCo is aiming to forecast the build trajectory of renewable generation as realistically as possible. The value of a transmission augmentation is in its ability to unlock additional renewable generation. Currently, the model being implemented maintains the same build limits as in the ISP Step Change, however from recent market engagement it was identified that the prospective interest in generation development differs in size and mix to the initial assumption. To better ensure that the benefits unlocked by a given option are as accurate as possible, further investigation was carried out to determine a more reasonable generation build limit.

With regard to generation that could connect to the existing transmission system in NSW, EnergyCo undertook an analysis of known generation projects across NSW to gain an understanding of the potential generation build out over the next three to five years. These dates align with the potential retirement of Eraring Power Station in 2025 and the indicated delivery timeframes of HumeLink, Hunter Transmission Project, Project EnergyConnect, and the New England REZ Transmission Link. Data from the NSW Planning Portal, discussions with developers and the REZ Registration of Interest (Rol) process for CWO, NE, HCC and SW were collated together to form a comprehensive list of generation projects. With the aim of identifying projects that could be commissioned up until 2027 given their current progression, the following criteria was used to refine the list:

- 1. Greater than or equal to 30 MW in capacity.
- 2. For projects with commissioning dates before the end of 2025, EnergyCo included projects with a planning status of seeking approvals, approved or under construction.²⁴
- 3. For projects with commissioning dates before the end of 2027, EnergyCo included projects with a planning status of in planning, seeking approvals, approved or under construction.²⁵
- Not committed prior to 14 August 2019 AEMO Gen Info Sheet²⁶ and not committed or in service in February 2022 AEMO Gen Info Sheet.

- 5. From both the 2025 and 2027 analysis, the following filters were also used to screen out projects:
 - A project with a connection distance greater than 10 km from an existing transmission line was not considered in this analysis, as these projects are likely to encounter difficulties in meeting their Generator Performance Standards.
 - b. The scale of the project not being appropriate for the nearest existing connection asset.
 - c. No battery or pumped hydro projects were included in this list (as they are considered separately).
 - d. Not identified as a committed project in AEMO's latest Generator Information Sheet (June 2022).

Beyond 2027, these additional restrictions to generation build out are not imposed, as there would be sufficient time for new entrants into the market to develop a generation project. The existing limitations to generation build out across NSW apply, and are in line with the assumptions used in the ISP.

Going forward, EnergyCo will further refine this methodology to improve the accuracy of projections and to better understand generation infrastructure build trajectories into the future.

Question for stakeholders

13. Are the scenarios used to test the benefits of the augmentations adequate? If not, how could they improved?



14. Is the methodology to estimate the projects commissionable by 2025 and 2027 adequate? If not, how could it be improved? How could EnergyCo estimate the generation projects that may be connected to the existing shared NSW network post 2027?

24. EnergyCo assumed that projects with one of these planning statuses, that did not provide a competition date, could feasibly connect by 2025. 25. EnergyCo assumed that projects with one of these planning statuses, that did not provide a competition date, could feasibly connect by 2027.

26. As per the requirements in the EII Act for eligibility of an LTESA or Access Right.

Step 5: The Network Infrastructure Strategy

From the insights gained in the network optimisation modelling, EnergyCo will sequence select projects over a 20-year development timeframe that enable NSW to reach the infrastructure investment objectives out to 2040, whilst delivering benefits to NSW electricity consumers and maintaining electricity reliability and affordability. This sequence will be detailed in the Final NIS. Subject to its own independent assessment at the time, the Consumer Trustee may adopt the sequence in the Final NIS as its Development Pathway for its 2023 IIO Report.

Question for stakeholders

15. What are stakeholder views on the processes used to develop the REZ network options? How could the option development process be improved to reduce electricity prices for NSW consumers, support reliability and security, and maximise benefits for regional communities?



16. What factors additional to consumer price impacts, community feedback, land-use planning, workforce availability and supply chain considerations, should the NIS consider in designing, developing, and delivering REZ transmission network options?



Image courtesy of iStock. Farmer watching over cattle on farm.

The Network Infrastructure Options

Image courtesy of iStock. Female wind farm engineer.

A range of network augmentations within REZs and the shared network has been developed to identify configurations for the clean energy transformation of the NSW energy system. The status of the REZ augmentations is classified using the 'plan, develop, deliver' framework outlined in Chapter 1. A detailed look at the potential augmentations and the technical scope requirements are available in Appendix D.

Renewable Energy Zones

The declared REZs in the CWO, NE, HCC and SW regions are the most advanced in terms of planning and development. Together, the four REZs would have a network transfer capacity of approximately 15 GW upon completion of their initial network options. If the four REZ's are developed to their ultimate capabilities, they would have a potential network capacity of approximately 50 GW in total. The ILW REZ is in an earlier stage of planning and has not yet been fully scoped.

Note that the transfer capacity is being referred to in this instance. The installed renewable capacity for each REZ will be dependent on the Access Scheme applied to each RNIP. Refer to Box 3 for an explanation of the difference between transfer capacity and installed renewable capacity.

Box 3: Transfer Capacity versus Installed Renewable Capacity

Transfer Capacity and Installed Renewable Capacity are two different metrics used to describe separate aspects of a given Network Infrastructure Option. They are not interchangeable.

Transfer Capacity

The Transfer Capacity of a given network configuration refers to the maximum amount of power that can be sent from one point of the network to another without exceeding operating constraints at any point in time. In a REZ, it refers to the maximum amount of power that can be transferred from REZ generators to the REZ connection point(s) with the shared network at any point in time. The exact power transfer at any time is determined by a number of different operating parameters, including generator dispatch configuration, ambient temperature, network configuration etc.

Installed Renewable Capacity

The Installed Renewable Capacity refers to the total amount of nameplate renewable generation that is (or can be) connected to a given section of the network, for example, the sum total of

renewable generation capacity connected to a given REZ Network Infrastructure Project (RNIP). The maximum possible Installed Renewable Capacity of a given network depends on key design and operational parameters. As the power output of renewables typically varies over time, for example, with changes to sunlight and wind speeds, most renewable generators typically dispatch less than their nameplate capacity at any point in time. Networks can be utilised more efficiently by installing nameplate generation capacity in excess of the Transfer Capacity of the network asset. In other words, the Installed Renewable Capacity of a REZ can be higher than its Transfer Capacity. In that case, renewable generators will have to be curtailed when the combined output of the renewable generators at a point in time exceeds the Transfer Capacity of the network. The acceptable level of transmission curtailment within a REZ will be set specific to each Access Scheme. This Target Transmission Curtailment Level will be set at a level that supports the efficient utilisation of the access rights network and considers the long term financial interest of consumers. Access rights may be granted to generators up to a level of aggregate maximum capacity for a REZ, without causing the forecast curtailment on the REZ network infrastructure to exceed this Target Transmission Curtailment Level.

Table 3. Summary of potential transmission capacities of each REZ

REZ	Central-West Orana	New England	South West	Hunter Central Coast	Illawarra
Status	Develop	Develop	Plan	Plan	Plan
Option 1 (MW)	3,000	8,000	2,500	1,000	Undeclared
Maximal theoretical transmission capacity (MW)	13,600	17,000	16,400	2,950	ТВС
Description	CWO REZ is currently being developed. An initial development larger than the minimum 3 GW in the REZ declaration is being considered by EnergyCo to enhance consumer benefits and minimise community impacts of this project.	EnergyCo is considering whether the NE REZ can be developed in Stages, with option 1 being developed in conjunction with the Hunter Transmission Project and Waratah Super Battery.	Option 1 of the SW REZ is currently in the process of finalising its declaration, expected in Q3 2022.	It is expected that the HCC REZ will be formally declared in Q3 2022.	The design of the ILW REZ is expected to commence soon, with an expression of interest process having recently closed.

Downstream augmentations

As each REZ grows in hosting capacity, additional downstream network augmentations are required to enable the flow of power to the major load centres. These augmentations will be upgrades to existing transmission infrastructure to maximise the utility of these assets, as well as new infrastructure to create the required additional capacity. These augmentations have been categorised based on the regions within NSW that they connect. In line with the region classification used by AEMO in the ISP. These regions and flow paths are expressed in Figure 8.





CNSW-SNW

This flow path connects the central section of NSW (for example, Wollar, Wellington, Dubbo and Bannaby etc) to the major load centre (that is, Newcastle/Sydney/ Wollongong). Augmentation to this flow path will help unlock additional renewable resources in the central part of NSW, including within the CWO REZ.

NNSW-CNSW

This flow path connects the north-eastern section of central NSW (for example, Liddell/Bayswater) to the further northern part of NSW (for example, Tamworth/Armidale and beyond). Augmentations to this flow path will alleviate constraints to delivering power to the load centres along the existing 500 kV and 330 kV transmission system. The augmentations that will increase the network capacity on this flow path are encompassed with the NE REZ options, rather than as separate downstream augmentations.

SNSW-CNSW

This flow path connects the south west section of NSW (for example, Wagga Wagga and Dinawan) to the southern part of Central NSW (for example, Dapto). This will help unlock generation in the southern part of NSW, including the SW REZ. These augmentations will facilitate the growth of generation primarily in the SW REZ.

A summary of the range of capacity increases along each flow path is summarised in Table 4. It should be noted that all the identified potential downstream augmentations are in the conceptual stage. The scope and timing of each option are subject to change depending on the rate of expansion of the REZs, both individually and combined.

Table 4. Potential added network capacity between regions

Augmentation	CNSW – SNW	CNSW – NNSW	SNSW – CNSW
Status	Concept	Concept	Concept
Additional Network Capacity (MW)	11,600	10,000	15,200
Description	Improve power flow from regional NSW to the load centre.	Improve power flow from an expanded NE REZ.	Improve power flow from an expanded SW REZ to Central NSW.



Image courtesy of iStock. Aerial view of powerlines at sunset.

Other transmission infrastructure projects of high importance in NSW

Delivering affordable and reliable supply is essential for NSW electricity consumers and the NSW economy. So, in addition to expanding the network to deliver REZs, there are also several priority transmission projects that may be accelerated through the NSW-specific transmission planning framework.

Waratah Super Battery

To ensure NSW continues to have reliable energy supply following the potential closure of the Eraring Power Station, the NSW Government is procuring the services of a 700 MW standby network battery, 'the Waratah Super Battery'. This battery will help to ensure sufficient supply by alleviating constraints on the existing network during periods of high demand.

The Waratah Super Battery will be the largest standby network battery in the Southern Hemisphere and together with other minor transmission upgrades, will allow Sydney, Newcastle, and Wollongong consumers to access more energy from existing electricity generation in regional NSW. It will achieve this by enabling an increase in the transfer capacity of the existing transmission lines via a System Integrity Protection Scheme and minor transmission augmentations.

The Waratah Super Battery has been identified as a PTIP in the ISP 2022 and will be delivered under the NSW Framework. EnergyCo has launched a competitive procurement process to identify suitable developers and appropriate site(s), and it is anticipated that the project will be delivered by 2025.



Image courtesy of iStock. Storage basin of pumped storage plan.

Hunter Transmission Project Overview

The Hunter Transmission Project (HTP) is critical for energy security in NSW and the delivery of the Roadmap. Its critical role has been recognised by the HTP's status as a NSW actionable ISP project in the 2022 ISP, where it forms part of the group of actionable ISP projects referred to as 'Sydney Ring (Reinforcing Sydney, Newcastle and Wollongong Supply)'. Due to its central role in the NSW Roadmap, the Consumer Trustee's 2021 IIO report has also identified HTP as a REZ-critical project.

Consequently, the NSW Minister for Energy has now declared the HTP to be a PTIP under the EII Act and appointed EnergyCo as the Infrastructure Planner for project.

The HTP will include up to two 500 kV double circuit transmission lines that connect to the existing 500 kV network at the Bayswater and Eraring power stations. It will provide the vital missing link between the two 500 kV transmission pathways from Northern and Western NSW into the Sydney, Newcastle and Wollongong (SNW) area. HTP will provide the essential transfer capacity required to support the delivery of the CWO, NE HCC REZs, and support the transformation of the NSW electricity network to supply affordable, clean and reliable energy to homes, businesses and industry in the Sydney, Hunter and Central Coast regions and beyond, see Figure 9 for an overview of the project.

Objectives

HTP has been proposed to cost-effectively enable key REZs and improve reliability as an integral part of the Roadmap. Specifically, its objectives are to:

- Strengthen the transmission grid and increase energy security in NSW.
- Unlock renewable energy export of the CWO, NE and HCC REZs by significantly expanding the current downstream network capacity from around 3GW to at least 11GW, to facilitate the delivery of the legislated combined transfer capacity of the CWO and NE REZs under the EII Act. Without the HTP the development of both REZs would be significantly curtailed and NSW would fail to deliver the Roadmap.
- Address energy shortfalls during peak demand periods following the successive closure of existing coal fired power stations in NSW, commencing with Liddell in 2023, followed by Eraring as early as 2025 and the expected closure of Vales Point and Bayswater by the mid 2030s. The HTP will enable generation from outside the SNW region to reach NSW's biggest and most populated demand centre during these periods. In the interim, the WSB will provide an innovative non-network solution ahead of Eraring's scheduled closure to ensure NSW electricity supply remains reliable.

Timing

Given the critical role it will play in the NSW transmission network, the first stage of the HTP needs to be delivered by 2027-28. This is consistent with the timing identified in the 2022 ISP, as this aligns with the scheduled delivery of energy from the CWO and NE REZ's under the Roadmap, and the need to protect NSW's energy security against any further accelerated closure of existing coal-fired power stations.

To expedite the delivery of the project, the HTP is one of the first projects that can draw on the \$1.2 billion Transmission Acceleration Fund, which was announced by the NSW Government in February 2022.

Size, design and community engagement

HTP will require a transfer capacity of at least 8 GW to lift the system wide transfer capacity from Northern and Western NSW to at least 11 GW.²⁸ This transfer capacity is required to allow generators in the CWO and NE REZs to export their energy up to their legislated combined transfer capacity of 11 GW without significant curtailment. HTP would require even more transfer capacity if there is significant generation development in the upper part of the HCC or an accelerated rate of electrification including hydrogen industry development. The design of HTP has commenced and EnergyCo will consult with a broad range of stakeholders during the route design studies. At this early stage, EnergyCo expects to use up to two 500 kV double circuit lines to achieve the necessary transfer capacity while minimising local community impacts. Multiple 330 kV lines would be required to achieve the same transfer capacity, which would have a greater local community impact.

EnergyCo is committed to minimising its impacts on the local community and environment, and will work closely with the local community and key stakeholders during the development of the HTP (see Chapter 2 on Meaningful Engagement), and intends to start detailed consultation on the project later this year.

Delivery mechanism

The NSW Minister for Energy has declared the HTP to be a PTIP under the EII Act and appointed EnergyCo as the Infrastructure Planner for project.

As the Infrastructure Planner, EnergyCo is now responsible for carrying out the detailed planning and design of the HTP, selecting a network operator for the project, consulting with the local community and key stakeholders, and securing the necessary approvals for the project under the EII Act and EP&A Act.

EnergyCo will determine whether this project will be delivered as a contestable project in line with the principles provided in the Draft Network Authorisation Guidelines, or otherwise.



Figure 9. HTP essential to enable legislated transfer capacity of CWO, NE and HCC REZ



28. As long as Bayswater remains in service.

HumeLink

To enable greater access to low-cost renewable generation and meet demand in the Sydney, Newcastle and Wollongong areas, a 500 kV transmission upgrade connecting renewable and peaking generation in southern NSW and Victoria via the HumeLink project will increase the transfer capacity and stability limits required. This project is being delivered by Transgrid under the actionable ISP framework.

Southern Sydney Ring

The scope of the southern Sydney Ring is currently at an earlier development stage compared to the Hunter Transmission Project (its northern counterpart). Future options will consider growth in generation in the southern regions of NSW.



Image courtesy of iStock. Australian Alpine road.

Renewable Energy Zone augmentations

Central-West Orana Renewable Energy Zone



Background

EnergyCo is advanced in the development phase for Option 1 of the Central-West Orana REZ, located around Dubbo and Wellington on the land of the Wiradjuri, Wailwan and Kamilaroi people.

The Central-West Orana (CWO) REZ has been selected as a REZ primarily due to the region's strong mix of energy resources and the significant level of investor interest. In 2020, the NSW Government received 113 registrations of interest for the CWO REZ, representing 27,000 MW of new energy generation and storage projects, which dwarfed initial capacity projections of 3,000 MW.

Option 1 of the project was formally declared by the Minister for Energy and Environment in 2021 with an intended network transfer capacity of 3,000 MW. According to the <u>CWO REZ Access Rights and Scheme</u> <u>Design Position Paper</u> this network infrastructure could host up to 5,840 MW of renewable generation with a target transmission curtailment of 4.37%. For an overview of the difference between network transfer capacity and renewable generation hosting capacity, see Box 3.

The CWO REZ will deliver over \$5 billion of new investment in the region and over 3,900 jobs during construction. Once established, the CWO REZ is intended to power more than 1.4 million homes each year.²⁹

Project development

A competitive tender to deliver the network infrastructure for the REZ was launched in early 2022 with an expression of interest to the market. At the beginning of May, three shortlisted tenderers were selected from a large group of highly competitive offers. EnergyCo will continue at pace with the procurement process with the CWO delivery contract expected to be awarded in 2023.

EnergyCo is considering whether there is benefit from expanding the network transfer capacity of CWO REZ. An initially larger size is being investigated because it provides several significant benefits for consumers, communities, and investors:

- It enables greater competition between generation projects, which leads to lower consumer prices.
- It avoids repeated impacts on, and disruption of, local communities by building the necessary infrastructure at one time.
- It provides insurance to NSW consumers should other REZ projects experience delays or the pace of the transformation accelerate, for example, because of faster than currently anticipated coal exits or increased electrification, which may be driven by faster development of a hydrogen economy.

A transfer capacity above 3,000 MW of generation to the major demand centres in Sydney, Newcastle, and Wollongong, could be enabled by downstream augmentations of the shared network. These augmentations, such as the Hunter Transmission Project and Waratah Super Battery, are also being progressed.

As part of CWO's development, EnergyCo has published Access Standards that will apply to generators in CWO REZ, which were developed in collaboration with Transgrid and AEMO. EnergyCo will continue to work closely with industry, communities, market bodies and other stakeholders to finalise the design and development of the CWO REZ.

29. www.energyco.nsw.gov.au/renewable-energy-zones/centralwest-orana-renewable-energy-zone#:~:text=The%20Central%2DWest%20 Orana,investment%20across%20the%20regional%20economy

Figure 10. CWO REZ and possible network options



 —
 Existing 330 kV Network
 IIIIII Option 2

 —
 Existing 500 kV Network
 IIIIIII Option 3

Outlined above are broad possible options for the CWO REZ. This information is provided as guidance only. As a result of the ongoing refinement of this REZ the details of the network infrastructure arrangement may differ slightly from the options listed in the Draft NIS. However these options are still indicative of the potential expansion that CWO REZ could incorporate. The Infrastructure Planner may determine to recommend to the Consumer Trustee a different REZ network infrastructure project, or different elements of a REZ network infrastructure project, such as location, development requirements, staging, sequencing, and design.

Solar farm

M Hydro projects

Table 5. Summary of the CWO REZ

Key information	
Intended Network Capacity (MW)	3,000 MW
Option 1 proposed generation hosting capacity (MW)	5,840
Option 1 scope	The CWO REZ will include two new energy hubs at Merotherie and Elong Elong.
	Transmission lines operating at 500 kV and/or 330 kV will connect the energy hubs to the shared network.
	The REZ design will be limited to 3 GW until further downstream augmentations such as the Hunter Transmission Project are in place. These projects are being developed concurrently.
	EnergyCo is currently investigating the feasibility of building optionality into the current CWO REZ design to utilise the additional capacity brought in by the Hunter Transmission Project.
Necessary augmentations of the existing network	Delivering the reference scope will require cutting into the existing Wollar substation at Line 5A3 between Mt Piper and Bayswater and adding 330 kV lines between both Bayswater to Liddell and Mt Piper to Wallerawang.
Maximum theoretical transfer capacity (MW)	13,600
ISP status	Anticipated



Image courtesy of iStock. A group of farmers discussing in the field.

New England Renewable Energy Zone



Background

The NSW Government is in the development phase for the New England REZ around Armidale on the lands of the Biripi, Dainggatti, Nganyaywana, Ngarabal, and Gumbainggir people.

The New England region is an outstanding location that is host to several large-scale wind and solar projects and is also close to the existing high voltage power lines that connect the NSW east coast and Queensland. This provides ample opportunities to both increase NSW's own energy resilience and share renewable energy with Queensland, leveraging geographical diversity. As a result, the New England (NE) REZ will be able to power 3.5 million homes and will promote NSW as the preferred destination across Australia for renewable energy investment.

In 2021, the NSW Government received 80 registrations of interest for the NE REZ, representing 34,000 MW of new energy generation and storage projects. Option 1 of the project was formally declared by the Minister for Energy and Environment in 2021 with intended network capacity of 8,000 MW.

Project development

The NE REZ was formally declared on 17 December 2021, establishing the geographical boundary, REZ network infrastructure and the intended network transfer capacity (8,000 MW as legislated). The design of the REZ infrastructure is currently underway. EnergyCo will consider whether it can be delivered in stages from south to north in the REZ geographical area, with an expected commissioning date in the late 2020's. EnergyCo has commenced development on Option 1 of the NE REZ design.



Image courtesy of NSW Department of Planning and Environment. New England, NSW.

Figure 11. NE REZ and possible network options



Note: The generation and network arrangements shown are indicative and in ongoing development, and subject to change.



Outlined below is a possible network option for the New England REZ. This information is provided as guidance only. The Infrastructure Planner may determine to recommend to the Consumer Trustee a different REZ network infrastructure project, or different elements of a REZ network infrastructure project, such as location, development requirements, staging, sequencing, and design).

Table 6. Summary of the New England REZ

Key information	
Intended Network Capacity (MW)	8,000 MW
Option 1 scope	500 kV transmission options were identified to access renewable generation in New England REZ to the major load centre. 8,000 MW New England REZ will be developed in multiple stages.
Necessary augmentations of the existing network	N/A
Maximum theoretical transfer capacity (MW) ³²	9,400
ISP status	Actionable NSW project



Image courtesy of EnergyCo. Truck on highway.

South West Renewable Energy Zone



Background

The NSW Government is currently in the planning phase for the South West REZ around Hay on the lands of the Wiradjuri, Yorta Yorta, Baraba Baraba, Wemba Wemba, Wadi Wadi, Madi Madi, Nari Nari, Dadi Dadi, Kureinji and Yitha Yitha people.

The South West (SW) REZ was chosen due to an abundance of high-quality wind and solar resources, proximity to Project EnergyConnect, relative land-use compatibility, as well as a strong pipeline of proposed renewable energy projects.

Transgrid is building the NSW portion of Project EnergyConnect, the interconnector between NSW and South Australia that will support the development of the SW REZ. It includes a section of transmission line between Wagga Wagga and Dinawan that will be constructed at 500 kV and link to the eastern edge of the REZ. Initially, this transmission line will be operated at 330 kV, enabling 1,200 MW of transfer capacity, and in future the line can be operated at 500 kV with minor upgrades at each end. This, in conjunction with HumeLink, would enable the full 2,500 MW of transfer capacity.

An initial Registration of Interest (RoI) process was conducted for the SW REZ in late 2021. EnergyCo received 49 registrations of interest totalling 34,000 MW from potential generation and storage projects. This highlights the potential economic and community value, as this is around 13 times the intended network capacity for the SW REZ.

Project planning

The SW REZ is expected to be formally declared by the Minister for Energy in Q3 2022 with an intended network capacity of 2,500 MW and appointment of EnergyCo as the Infrastructure Planner. The SW REZ is expected to receive up to \$2.8 billion in private investment by 2030 and to support over 2000 construction jobs in the region at its peak.

Subject to the declaration of the SW REZ, it may be appropriate to expand the existing network infrastructure at Dinawan and Wagga Wagga to 500 kV operation in order to convert Dinawan into a REZ energy hub. A map of the REZ geographical area is shown in Figure 12.

Figure 12. SW REZ and possible transmission network options





Outlined below is a possible network option for the South West REZ. This information is provided as guidance only. The Infrastructure Planner may determine to recommend to the Consumer Trustee a different REZ network infrastructure project, or different elements of a REZ network infrastructure project, such as location, development requirements, staging, sequencing, and design).

Table 7. Summary of the SW REZ

Key information	
Draft Intended Network Capacity (MW)	2,500 MW
Option 1 scope	The South West REZ will expand existing infrastructure at Dinawan and Wagga Wagga to 500kV operation to convert Dinawan into a REZ energy hubs.
Necessary augmentations of the existing network	Delivering the Option 1 scope will require completion of Project EnergyConnect and HumeLink.
Maximum theoretical transfer capacity (MW)	12,500
ISP status	N/A

Draft Network Infrastructure Strategy

Hunter Central Coast Renewable Energy Zone



Background

EnergyCo is in the early stages of planning a REZ in the Hunter and Central Coast regions on the lands of the Awabakal, Bahtabah, Biraban, Darkinjung, Mindaribba, Wanaruah and Worimi people.

The Hunter and Central Coast regions have unique features which make them ideal locations for a REZ. Notably, the zone contains four of NSW's five coal-fired power stations, and so these regions can leverage and utilise the infrastructure, land and resources associated with the existing power stations, including rehabilitated mining land, electricity network infrastructure, port and transport infrastructure, and a skilled workforce.

These regions also have strong renewable energy resources and an existing pipeline of renewable energy projects. As of April 2022, there are 16 distinct largescale renewable energy and battery storage projects in the Hunter and Central Coast regions that are either approved or progressing through the NSW planning system. These projects have a combined generation capacity of around 2,750 MW and represent about \$2.9 billion in investment.

In addition to the potential to tap into traditional onshore renewable energy resources, there has been demonstrated interest in developing offshore wind projects off the Central Coast region, as an extension of this REZ.

The Hunter Central Coast (HCC) REZ will ensure these regions have a key role in a renewable energy future. It will provide an opportunity to power existing industries with cleaner electricity as well as supporting economic growth, including emerging technology in green hydrogen, ammonia and metal production, electric vehicle fleet operators and electrification of industrial processes.

Project planning

An initial Registration of Interest (RoI) process has been undertaken for the HCC REZ, to sound out commercial interest in developing generation and storage projects in the region. This was the first step in engaging with industry on the design of the HCC REZ. EnergyCo will be using the expressions of commercial interest to inform and fine-tune the timing, capacity, and boundaries of the zone.

The response to this Rol process found commercial interest in renewable generation and storage projects representing almost 40,000 MW and more than \$100 billion of potential investment. It was through this process that significant interest in offshore wind development was put forward, reflecting commercial interest in a broader scope of technologies than just the traditional onshore generators.

Like all REZs, planning, designing, and building the HCC REZ will be complex. EnergyCo will continue to engage closely with the local community, industry, local government and other stakeholders as the design and delivery of the REZ progresses. In addition, there are several related developments including a burgeoning hydrogen hub industry, critical transmission infrastructure upgrades, an innovative battery project and significant potential for co-ordination of distributed energy resources.

It is expected that the HCC REZ will be formally declared in Q3 2022.

Figure 13. HCC REZ and possible network options. Note the grey indicatively refers to the Hunter Transmission Project



Note: The generation and network arrangements shown are indicative and in ongoing development, and subject to change.



Outlined below is a possible network option for the Hunter Central Coast REZ. This information is provided as guidance only. The Infrastructure Planner may determine to recommend to the Consumer Trustee a different REZ network infrastructure project, or different elements of a REZ network infrastructure project, such as location, development requirements, staging, sequencing, and design).

Table 8. Summary of the HCC REZ

Key information	
Options 1 transfer capacity (MW)	1,000 MW
Option 1 scope	The Hunter Central Coast REZ will enable generation to connect to existing infrastructure in the upper Hunter region, utilising the existing capacity between Muswellbrook and Newcastle.
Necessary augmentations of the existing network	Modifications to Muswellbrook substation to accommodate new transmission lines.
Maximum theoretical transfer capacity (MW)	2,950
Offshore wind project interest	>20 GW from the HCC ROI
ISP status	N/A



Image courtesy of Destination NSW. Father and children on a walk in Yarriabini National Park.

Illawarra Renewable Energy Zone



Background

EnergyCo is in the early stages of planning a REZ in the Illawarra region on the lands of the Dharawal people.

The Illawarra (ILW) REZ has unique features which make it an ideal location for enhanced renewable energy development. The Illawarra region has good renewable energy resources, including wind and solar, and there are opportunities for the REZ to use existing power stations, electricity network infrastructure, port and transport infrastructure and a skilled workforce.

Project planning

The ILW REZ will ensure this region has a key role in a renewable energy future, powering existing industries and supporting economic growth. It has the potential to support growth of emerging industries and technologies including green hydrogen, ammonia and metal production, electric vehicle fleet operators and electrification of industrial processes. The development of the ILW REZ will unlock a significant pipeline of large-scale renewable energy and storage projects.

The NSW Government is exploring these opportunities in the design of the ILW REZ. Like all REZs, designing and building the electricity network infrastructure will be complex and take some years to achieve. The NSW Government will engage extensively with local community and regional stakeholders on the design and delivery of the ILW REZ.

The ILW REZ is in an earlier stage of planning than the CWO, NE, SW, and HCC REZs. As such, this Draft NIS and the Final NIS will unlikely include specific project options for the REZ. A Rol for the ILW REZ was carried out and closed in late July 2022. EnergyCo received interest from renewable generators, energy storage and network developers, and existing and proposed energy loads. The submissions are to be analysed over the coming months, with the findings used to inform the ILW REZ declaration.



Image courtesy of NSW Department of Planning and Environment. Illawarra region, NSW.

Downstream augmentations

Background

To support the expansion of the REZs across the state, significant network augmentation is required to transfer power from the REZ generators to the load centres. Whilst some augmentations lie outside the geographical boundary of any REZ, they are integral to the effective and timely delivery of each REZ and thus their ability to deliver real benefits to NSW consumers. As such, these augmentations are being equally considered in the Network Infrastructure Options alongside their within-REZ counterparts. The timing and scale of these projects will need to be closely synchronised with development of the REZs to be most beneficial for NSW electricity consumers. These options will be considered for future development if and when the REZs grow.

It is important to note that the NIS does not assign transmission infrastructure projects to a particular regulatory pathway. Downstream augmentations may be developed under the NSW or National Framework depending on their urgency, scope, and circumstances. A discussion of regulatory pathways can be found in Chapter 2.

Central NSW to Sydney, Newcastle and Wollongong



Background

The proposed augmentations on the CNSW – SNW flow path are aimed at alleviating the transfer limits from both CWO, NE and SW REZs as they expand. The northern augmentations are tied to CWO and NE REZ expansions, and the southern augmentations to SW REZ. Both will unlock new transmission capacity to bring this additional power to the load centres over time.

Project planning

There are a range of operating voltages and circuit arrangements being considered along the northern and southern sides of this flow path that will be needed in stages. Consideration for scale efficient 500 kV lines has been accounted for where appropriate from a cost and social licence perspective.

Southern NSW to Sydney, Newcastle and Wollongong



Background

The proposed augmentations on the SNSW – SNW flow path are aimed at alleviating the transfer limits from SW REZ as it expands and Snowy 2.0 as it enters service. This will unlock additional generation in the South West region and more opportunities for load balancing through enabling the full potential of the Snowy 2.0 pumped hydro scheme.

Project planning

The expansions in this region factor in the proposed Dinawan to Wagga Wagga 500 kV uprate and HumeLink expansions into potential augmentations. These expansions are currently in development, and when established, will support generation to connect. Future expansions have been proposed to support the SW REZ if it grows sufficiently to exceed this in development capacity.

Central NSW to Northern NSW



Background

The proposed augmentations on the CNSW – NNSW flow path are to improve power transfer from the NE REZ as it expands.

Project planning

These augmentations are primarily driven by the need for additional volume of transmission capacity from NE REZ to the shared network. Key hub locations within the NE REZ were identified as ideal to increase the connection capacity from NE REZ to the shared network, based on physical proximity to the existing shared network. These augmentations are encapsulated within the possible augmentations in the NE REZ.

Figure 14. Downstream network augmentation options



Note: The generation and network arrangements shown are indicative and in ongoing development, and subject to change.



Next steps

Image courtesy of iStock. Aboriginal family enjoying the day in the garder

Final Network Infrastructure Strategy

The Final NIS, anticipated in Q1 2023, will respond to feedback received on this Draft NIS and provide important updates, including:

- further details and refinements based on feedback regarding Network Infrastructure Options to be provided as guidance to the Consumer Trustee when preparing the optimal 20-year Development Pathway for electricity infrastructure in NSW
- the maximum generation and storage capacities which can be built over time in REZs, reflecting EnergyCo's assessment of realistic limitations, such as supply chain constraints, which the Consumer Trustee may use as assumptions in the next IIO Report developed by the Consumer Trustee
- a potential sequence of network infrastructure projects that support the Consumer Trustee in determining their Development Pathway for NSW
- further information about the NSW Government's plans to support, and enable through the electricity sector, emerging industries such as offshore wind and hydrogen production.

Ideally, the Final NIS would have been published in conjunction with an updated optimal 20-year Development Pathway in the most current IIO. However due to timing constraints, the Final NIS and the next IIO will be published separately. Future Final NIS reports are intended to be released concurrently with each IIO Report to ensure strategic alignment between EnergyCo and the Consumer Trustee while both organisations retain their independence and specific functions. This will ensure an optimal recommendation and authorisation process for future REZ Network Infrastructure.

How to get involved

The NIS outlines EnergyCo's vision for the schedule of works needed to deliver the transformational change to the NSW energy system in line with the legislated Roadmap. Whilst equipped with the best information at the time of NSW's future energy needs, real world market constraints and the status of evolving technologies, this transformation is happening within a dynamic environment, where change can be both sudden and substantial.

As such, EnergyCo wishes to continue engaging with stakeholders on the evolving technical, social, and economic factors that shape the clean energy transformation. EnergyCo welcomes questions or feedback on the approach to the development of the NIS via <u>contact@energyco.nsw.gov.au.</u>

Additionally, EnergyCo will be hosting a webinar on 13th October aimed at introducing the development work on the NIS to date and offer an opportunity to discuss any questions.



Image courtesy of iStock. Aboriginal couple using a digital tablet in the garden.

Consultation questions

To shape the 2022 NIS, EnergyCo is seeking feedback on the following questions via <u>contact@energyco.nsw.gov.au</u> by 28 October 2022. Stakeholders are not required to answer all questions but are encouraged to choose to answer those questions most relevant to them:

1	In what ways can the NIS further complement, align or improve the National Transmission Planning and Investment framework under the National Electricity Rules?
2	Do you agree that the NIS should in future accompany the IIO Report?
3	What additional emerging trends that could influence the development of NSW's electricity system, beyond the three outlined, should be considered in the NIS?
4	Has the NIS appropriately assessed the impact of a potential domestic and export hydrogen economy on transmission infrastructure? If not, what additional factors should EnergyCo consider?
5	What is the most effective way for EnergyCo to support the delivery of renewable energy capacity for hydrogen export projects by 2030 and 2040? For example, should we expand existing REZs or develop new dedicated REZs?
6	What is the hydrogen export potential that future NIS should aim to facilitate through its network developments by 2030, 2040 and 2050?
7	How and at what point should generation from OSW be considered in network planning for the future editions of the NIS? What other considerations are important when it comes to OSW?
8	How can EnergyCo best work with industry to incorporate long-duration storage projects into transmission planning for REZs in NSW?
9	Has EnergyCo identified the right principles to guide the development of the Network Infrastructure Options? How could they be improved?
10	What are stakeholder views on taking an 'option-rich' approach to manage the inherent uncertainty in the future evolution of the energy system? Are there better approaches to manage this uncertainty?
Do stakeholders agree that the development of network options should be designed at sufficient scale to avoid multiple projects being built in the same locality over time? Is the process for estimating cost and delivery schedule for these potential augmentations 12 considering enough factors to be robust enough for a high-level comparison of options? If not, how could it be improved? Are the scenarios used to test the benefits of the augmentations adequate? If not, how could they improved? Is the methodology to estimate the projects commissionable by 2025 and 2027 adequate? If not, how could it be improved? How could EnergyCo estimate the generation projects that may be connected to the existing shared NSW network post 2027? What are stakeholder views on the processes used to develop the REZ network options? How could the option development process be improved to reduce electricity prices for NSW consumers, support reliability and security, and maximise benefits for regional communities? What factors additional to consumer price impacts, community feedback, land-use planning, 16 workforce availability and supply chain considerations, should the NIS consider in designing, developing, and delivering REZ transmission network options?

Image courtesy of Getty. Modern farming.

EnergyCo

