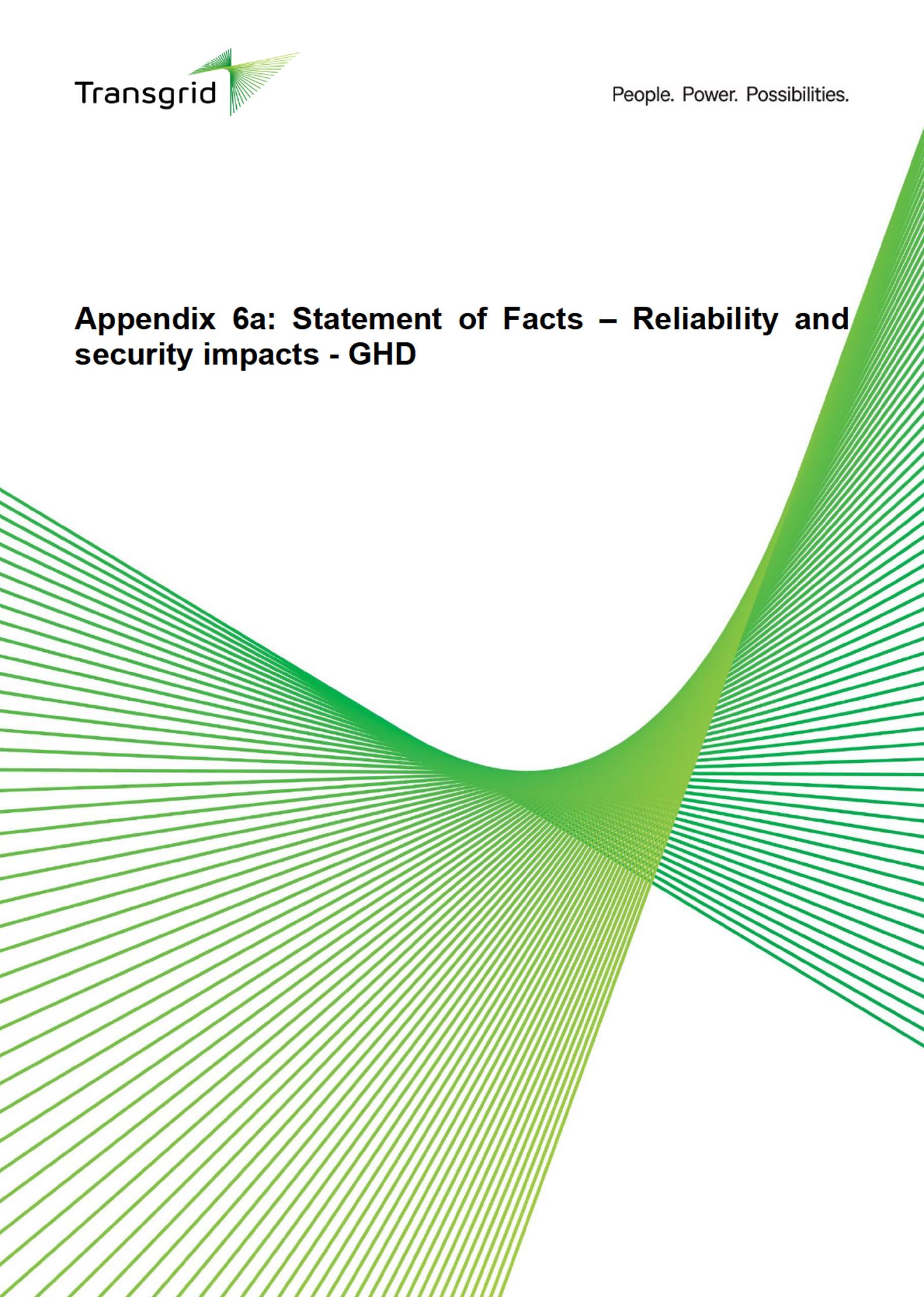


Appendix 6a: Statement of Facts – Reliability and security impacts - GHD

A decorative graphic consisting of numerous thin, parallel green lines that curve and sweep across the bottom half of the page, creating a sense of motion and energy.



Project EnergyConnect

**Statement of Facts: reliability and
security impacts**

Transgrid

12 December 2025



Project name		PEC statement of facts – reliability and security impacts					
Document title		Project EnergyConnect Statement of Facts: reliability and security impacts					
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S4	1.3	████████	████████		████████		30/6/2025
S4	1.4	████████	████████		████████		7/10/2025
S4	1.5	████████	████████		████████		12/12/2025

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Executive summary

GHD has reviewed public domain information to compile a statement of facts that documents the reliability and security benefits that are expected to be delivered by Project EnergyConnect (PEC) when fully operational. The statement of facts considered various sources of information including:

- Documents published as part of the original RIT-T
- Documents published as part of the AER's assessment of the RIT-T and subsequent contingent project assessments
- Document published as part of the AER's determination on Transgrid's revenue submission for the 2023-28 regulatory period
- Information published by AEMO in the Electricity Statement of Opportunities (ESOO) focussing on any reliability projections provided with and without PEC
- Relevant information published by AEMO in the Integrated System Plan (ISP) such as in the System Security Appendix
- Relevant information published by AEMO in various reports presenting system security outlooks for the National Electricity Market (NEM)
- Information published by Transgrid and ElectraNet in their respective Transmission Annual Planning Report.

The information gathered has been used to assess the extent of the reliability and security benefits that PEC is expected to deliver and consider whether failing to complete PEC stage 2 would materially adversely affect reliability and security of the NEM.

The review supports the following findings regarding reliability and security impacts on South Australia, New South Wales and Victoria attributable to the completion of PEC stage 2:

South Australia - Reliability

- Completing PEC stage 2 is expected to deliver material improvements to reliability for South Australia.¹
- The 2025 and 2024 ESOO demonstrate that completing PEC stage 2 provides a material reliability benefit in South Australia. The 2025 ESOO presents results that demonstrate PEC stage 2 can mitigate reliability risks that might otherwise arise through the retirement of Torrens Island B and Osbourne power stations.
- Failure to complete PEC stage 2 would inhibit the delivery of those reliability benefits and is likely to have materially adverse impacts on reliability.
- The 2025 ESOO update shows that reliability shortfalls predicted in the 2025 ESOO has been addressed through the delayed retirement of Torrens Island B.

South Australia - Security

- Completing PEC stage 2 and associated protection schemes significantly reduces the likelihood of South Australia being islanded from the rest of the NEM. This is a material system security benefit and allows the requirement to maintain a minimum of two synchronous generators online within South Australia to be relaxed. Completing stage 2 of PEC also allows constraints currently in place to limit RoCoF to 2 Hz/s following the loss of the Heywood Interconnector, to be revoked.
- Failure to complete PEC stage 2 would create adverse system security impacts by extending the requirement to run those aging generators in South Australia and extending the exposure of customers in South Australia to the risks associated with a power system that is less resilient to extreme weather events.
- Failure to complete PEC stage 2 would adversely impact power system security preventing the expected increase in system strength South Australia.
- AEMO has identified issues with addressing system security under minimum demand conditions which are heightened if South Australia is islanded under those conditions. Failure to complete PEC stage 2 would

¹ Refer to the various editions of the ESOO published by AEMO (**AEMO | NEM Electricity Statement of Opportunities (ESOO)**) and summarised in Table 1 and Table 4.

require the implementation of additional measures to enable system security to be maintained under minimum demand conditions in South Australia including additional emergency backstop support.²

New South Wales – Reliability

- PEC stage 2 enables the development of renewable generation in the SW REZ³. The geographic separation of the SW REZ from other REZs in New South Wales offers greater diversity between the output of wind farms in the SW REZ and other REZs such as the CWO and NE REZ. The enhanced diversity of renewable generation that may be enabled by PEC stage 2 is likely to produce improved reliability.
- The 2020 ESOO attributed a 0.00005% reduction in unserved energy (USE) in New South Wales to PEC, representing 7.7% of the Interim Reliability Measure (IRM).

New South Wales – Security

- Failure to complete PEC stage 2 would adversely impact power system security preventing the expected increase in system strength across Southwest New South Wales.
- PEC stage 2 will provide greater ability to export power from New South Wales and may therefore assist with meeting the threshold required to maintain system security in New South Wales particularly when the minimum demands in New South Wales and South Australia are not aligned.

Victoria – Reliability

- PEC Stage 2 incorporates a new transmission line between Dinawan and Wagga Wagga that will be leveraged to deliver VNI West. PEC stage 2 therefore enables the completion of VNI West which has been demonstrated in the 2024 ESOO as delivering significant reliability benefits to Victoria.
- The 2020 ESOO attributed a 0.0001% reduction in unserved energy (USE) in Victoria to PEC, representing 16.4% of the Interim Reliability Measure (IRM).

Victoria – Security

- Failure to complete PEC stage 2 would adversely impact power system security preventing the expected increase in system strength across Northwest Victoria.

The review supports the following conclusions regarding reliability and security impacts delivered by completing PEC stage 2:

1. PEC enhances interconnection between NSW and South Australia (SA), enabling better sharing of generation reserves across the National Electricity Market (NEM), including with Victoria. Failure to complete PEC stage 2 would inhibit the delivery of those reliability benefits and is likely have materially adverse impacts on reliability.
2. Completing PEC stage 2 delivers significant system security benefits. Those benefits primarily arise by reducing the likelihood of South Australia being islanded from the rest of the NEM. Failing to complete PEC stage 2 would create adverse system security impacts.

This report is subject to, and must be read in conjunction with, the limitations set out in section 1.2 and the assumptions and qualifications contained throughout the Report.

² **AEMO | Managing Minimum System Load (MSL)**

³ Access Rights announcement **What's being built in the South West Renewable Energy Zone | EnergyCo**

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Appendices

Appendix A	Reliability and Security Definitions
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1. Introduction

1.1 Purpose of this report

GHD has reviewed public domain information to compile a statement of facts that documents the reliability and power system security benefits expected to be delivered by PEC. This report may be used by Transgrid to support applications to the AER concerning PEC.

Appendix A extracts relevant definitions from the National Electricity Rules explaining the concepts of reliability and power system security.

1.2 Scope and limitations

This report: has been prepared by GHD for Transgrid and may only be used and relied on by Transgrid for the purpose agreed between GHD and Transgrid as set out in section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Transgrid arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

Accessibility of documents

If this report is required to be accessible in any other format, this can be provided by GHD upon request and at an additional cost if necessary.

1.3 Assumptions

We have assumed that the information in the referenced documents is accurate, GHD has not sought to independently verify the accuracy of that information.

2. Project summary

When complete PEC will establish a new HVAC interconnection linking the transmission systems in South Australia and New South Wales with additional capacity also provided to support the 220 kV transmission system in Northwest Victoria.

PEC was demonstrated by ElectraNet to satisfy the RIT-T in 2019 and subsequently the AER reviewed the project and found that it satisfied the RIT-T in 2020 and in 2021 approved capital expenditure of \$2.28bn for the project be allowed within the 2018-2023 regulatory control period in response to contingent project applications from ElectraNet and Transgrid. Further adjustment to the timing of capital expenditure on PEC was considered as part of the revenue determinations for the current regulatory control period for Transgrid. The key regulatory approvals for PEC as documented in Table 2.

PEC is being delivered in two stages. The scope of work for stage 1 is shown in Figure 1. This stage provides 150 MW of transfer capacity in each direction between South Australia and New South Wales under favourable conditions. Inter-network testing for stage 1 is complete⁴. The scope of work for stage 2 is shown in Figure 2. Under favourable conditions PEC stage 2 allows 800MW of transfer between South Australia and New South Wales in each direction.

PEC stage 1 effectively delivers an increase in the South Australian import and export capacity provided by the Heywood Interconnector (HIC). Most existing constraints remain in place following the delivery of PEC stage 1:

- A trip of HIC will also inter-trip PEC stage 1. As such PEC stage 1 does not permit any relaxation of the measures in place to manage RoCoF following the non-credible loss of the HIC as this contingency will still separate South Australia from the rest of the NEM. There is currently a constraint set in place to maintain South Australia RoCoF below 2 hertz per second (Hz/s) immediately following the non-credible loss of the Heywood interconnector, which was introduced to meet the requirements of regulation 88A of the Electricity (General) Regulations 2012 (South Australia).⁵
- PEC stage 1 does not remove the requirement to maintain a minimum number of synchronous generators online in South Australia to provide an adequate grid formation and assist to maintain adequate voltage control.
- Under favourable conditions PEC stage 1 provides an increase of 150 MW in the ability to import and export power from South Australia. The capability may be reduced at times of high power flows across Murraylink.
- PEC Stage 1 is expected to assist in managing the security risk associated with the loss of generation in South Australia because of destructive winds. Prior to PEC stage 1 this risk is managed through the reclassification process applied when destructive winds are forecast to impose a 250 MW South Australian import limit on HIC. PEC Stage 1 should allow the limit on the combined import across HIC and PEC to be increased to 400 MW under favourable conditions⁶.
- The combined transfer limit across PEC stage 1 and HIC is 700MW from South Australia to Victoria and 750 MW from Victoria to South Australia. This is a 150MW increase to the transfer limits with PEC stage 1 in service.
- All special protections schemes (SPSs) potentially impacted by PEC stage 1 have been reviewed.
- New constraints have been implemented to avoid overload of the Buronga Phase Shift Transformer (PST) following trip of Murraylink and revised limits implemented to reflect the improvements delivered by PEC stage 1.

⁴ [PEC system integration industry update April 2025 .pdf](#)

⁵ The processes in place to manage RoCoF risks associated with the loss of the HIC are discussed in section 5.3.2 of the 2024 general power system risk review, [2024-gpsrr.pdf](#)

⁶ High DPV in South Australia may require a further reduction in the limit.

Scope - PEC stage 1 (PEC-1)

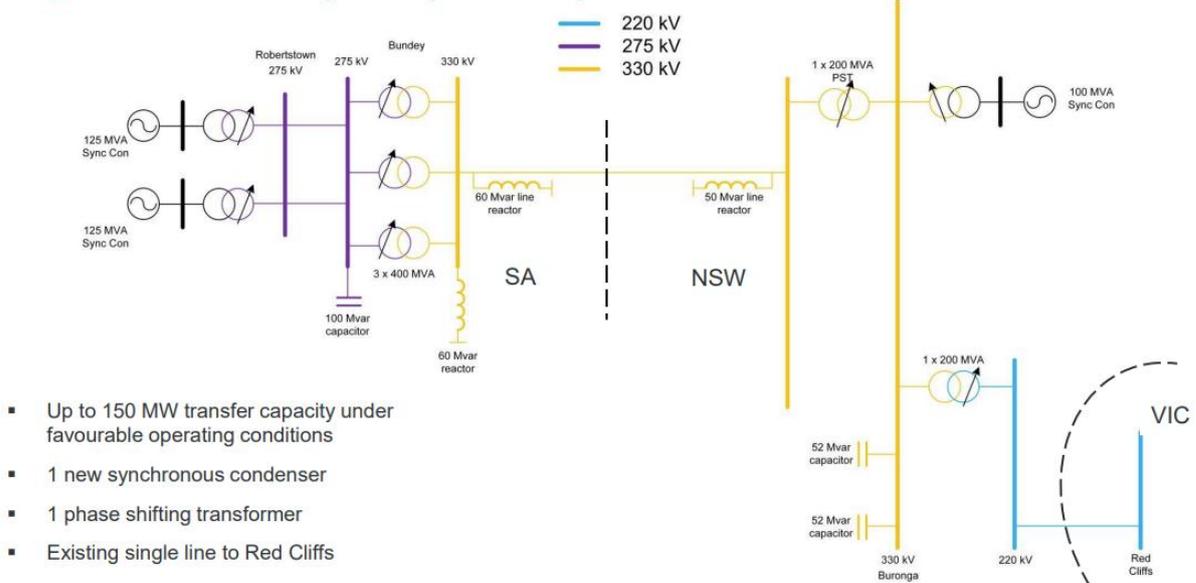


Figure 1 PEC stage 1 scope of works⁷

Scope - PEC stage 2 (PEC-2)

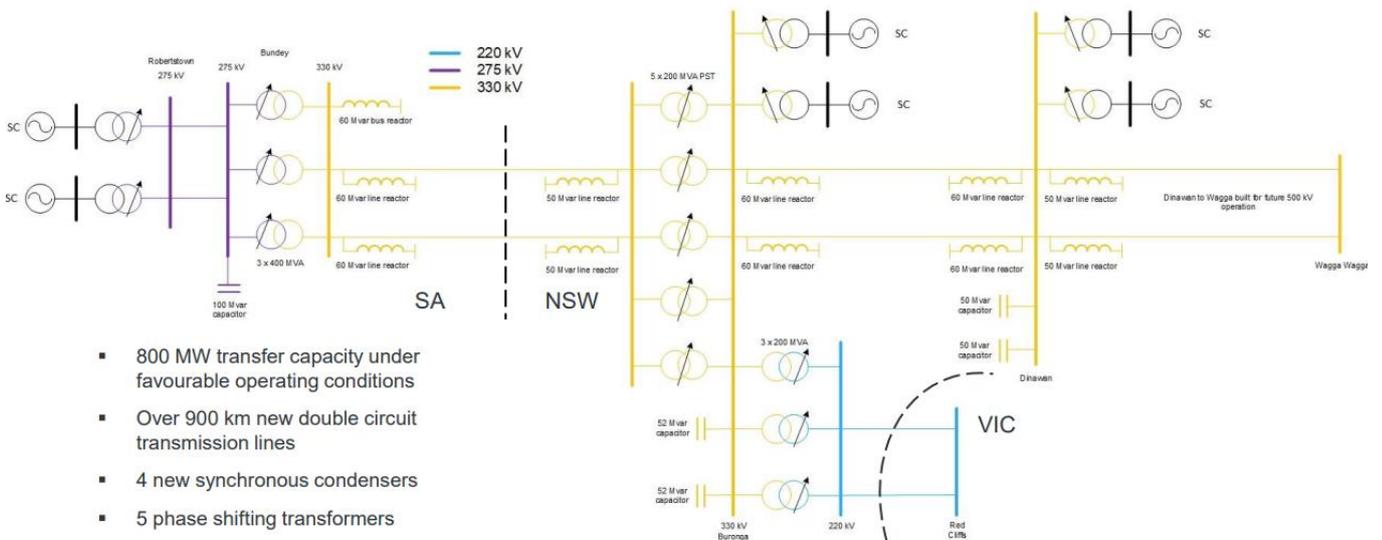


Figure 2 PEC stage 2 scope of works⁸

Under favourable conditions PEC stage 2 should provide a substantial increase in transfer capability⁹:

- 800 MW in each direction between New South Wales and South Australia
- Additional 100 MW in each direction across HIC
- A combined South Australia export limit across HIC and PEC of 1450 MW
- A combined South Australia import limit across HIC and PEC of 1300 MW
- Increase REZ network capacity for the V2, S2 and N5 REZ as defined in the AEMO ISP

⁷ Sourced from PEC industry update, April 2024, [20240418 PEC SI industry update \(5\).pdf](#)

⁸ Sourced from PEC industry update, April 2024, [20240418 PEC SI industry update \(5\).pdf](#)

⁹ [AEMO | Transmission augmentation information](#)

PEC stage 2 provides 5 PSTs at Buronga, by adjusting the tap on these transformers the distribution of power flow across HIC and PEC can be controlled. PEC stage 2 will be accompanied by new constraint equations to reflect the improved transfer capability provided.

A revised SPS is being implemented for PEC stage 2 to respond to the non-credible loss of either PEC or HIC. The scheme will ensure that loss of one interconnector does not result in trip of the other interconnector. PEC stage 2 therefore significantly reduces the likelihood of South Australia becoming disconnected from the rest of the NEM. When complete, PEC stage 2 is expected to allow removal of the requirement for a minimum number of synchronous generators in South Australia, and removal of interconnector constraints currently imposed to manage RoCoF and security risks associated with destructive winds.

In addition to the benefits mentioned above, Figure 3 shows that PEC underpins the development of transmission system supporting the NEM through the following:

- PEC provides a new double circuit line between Dinawan and Wagga Wagga which will be leveraged to deliver the VIN West project which increases transfer capability between NSW and Victoria
- PEC's proximity to the SW REZ in New South Wales facilitates the efficient connection of renewable energy projects within the REZ thereby diversifying the renewable generation available to the NEM.

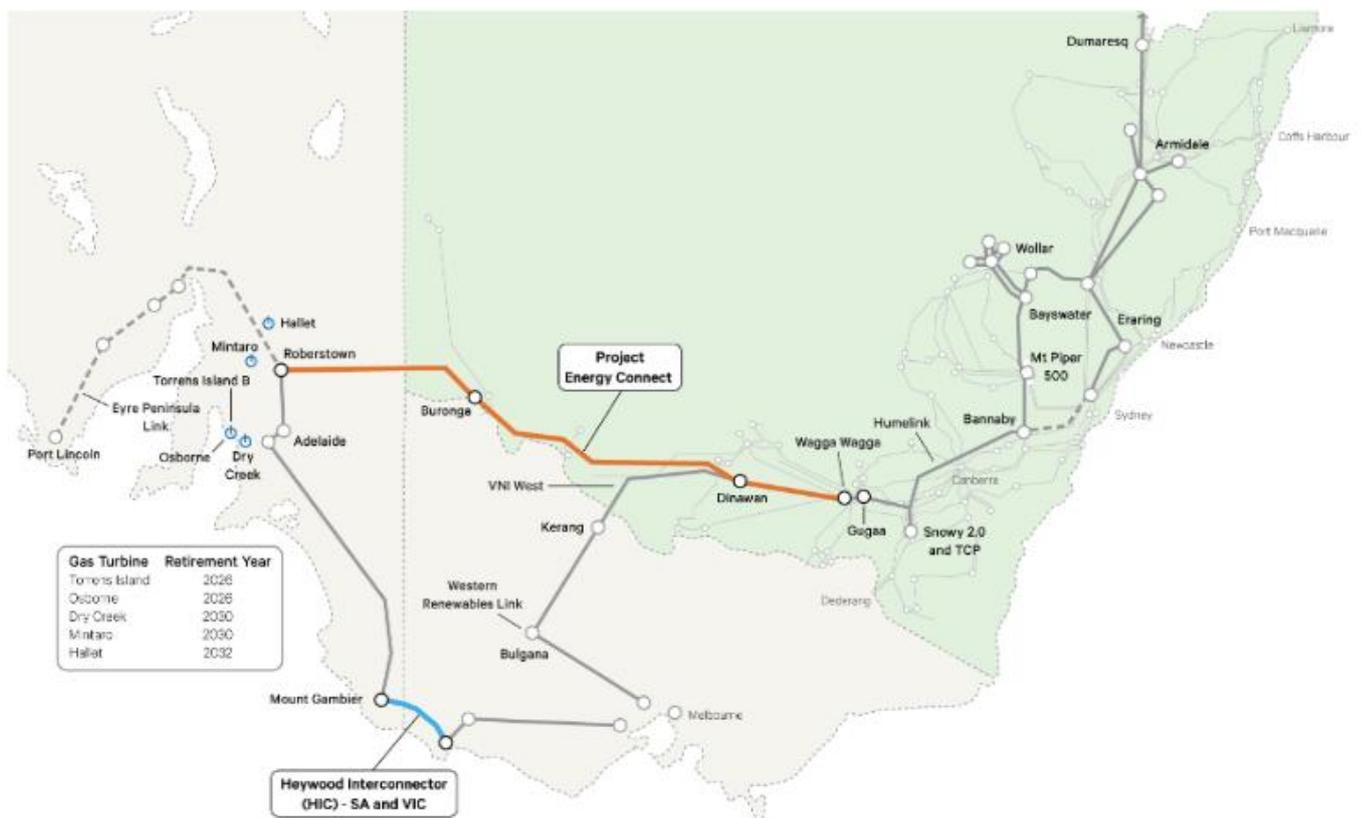


Figure 3 PEC supports supporting VIN West and Development of SW REZ

3. Impact of PEC on Reliability

The reliability impacts of PEC have been documented across various reports. The tables at the end of this report summarise our review of those documents noting which documents reported specific evidence of reliability impacts. As documented in those tables while many documents refer to the reliability benefits of PEC, the Electricity Statement of Opportunities (ESOO) provides the best quantification of those benefits.

The following sections summarise the information provided in the various documents on the reliability impacts of PEC.

3.1 RIT-T and associated regulatory submissions

The information presented on the reliability and security impacts of PEC in the various regulatory documents developed as part of the assessment of PEC against the RIT-T and associated expenditure reviews by the AER are summarised in Table 2. Table 3 summarises the information provided on reliability and security impacts presented in the documents published by AEMO as part of the PEC integration workstream.

Table 2 demonstrates that while the RIT-T and regulatory approvals all noted that PEC is expected to deliver reliability benefits, those benefits were not explicitly quantified in the market modelling undertaken to assess the market benefits delivered by PEC. The reliability benefits were instead captured through a mix of fuel cost savings, capex deferral etc. As discussed in Table 2 this arises from the market modelling approach adopted which seeks to optimise the generation investment to achieve the reliability standard in the counterfactual (base case) and all augmentation cases. This results in similar levels of reliability measured as unserved energy (USE) in all cases and impedes the ability to point to an explicit reliability metric as being improved by the introduction of PEC.

The RIT-T modelling captures as part of the market benefits of PEC the reduction in costs required to deliver reliability consistent with the reliability standard (0.002% USE).

As noted in Table 3 the market modelling undertaken to support the PEC integration workstream was focussed on the estimation of negative residues and did not explore PEC's impact on reliability.

3.2 ESOO

AEMO published the ESOO each year. It is a key document providing projections of reliability outcomes producing USE projections for each region of the NEM. The base case scenarios considered in the ESOO model existing and committed projects and interconnector augmentations that have been demonstrated as passing the RIT-T. As such from 2021 onward the ESOO has included PEC in the base case.

The base case USE projections provided in each ESOO from 2021 onwards all assess the reliability outcomes assuming release of full capacity across PEC. Figure 4 is extracted from the 2024 ESOO and indicates a significant reduction in the USE projection for South Australia following the assumed release of full capacity of PEC from 2027-28. PEC is identified as mitigating the impact of retirements of Osborne and Torrens Island B Power Stations.

Figure 4 shows the USE projections for the base case scenario which models existing, committed and anticipated projects. Figure 5 shows the USE projections for a sensitivity study included in the 2024 ESOO which modelled the additional capacity expected to be provided through various jurisdictional schemes in including the Capacity Investment Scheme South Australia – Victoria tender that sought to encourage 2400MWh of BESS across these regions by the end of 2027, actionable transmission projects, and growth of consumer energy resources (CER) consistent with the 2024 ISP. This figure includes the USE projections for the base case and the sensitivity. Comparing the USE projections in Figure 4 and Figure 5 shows that:

- A material improvement in reliability in South Australia appears in the base case in 2027-28 following release of full capacity across PEC.
- delivery of PEC mitigates the reliability risks associated with late delivery of the investments in the sensitivity study.
- PEC can provide a material improvement in reliability particularly in South Australia.

Figure 22 Reliability forecast, all NEM regions, first five years (2024-25 to 2028-29)



Figure 4 2024 ESOO Base Case USE projections showing improvement in South Australia aligned with PEC stage 2

Figure 30 Reliability impact of federal and state generation development schemes, 2024-25 to 2033-34 (%)

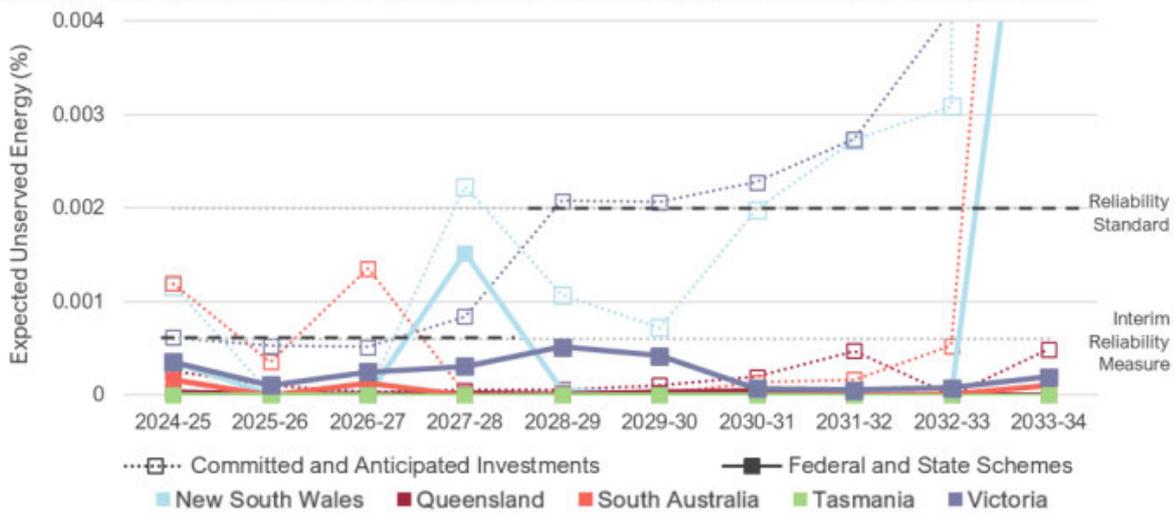


Figure 5 2024 ESOO - USE projections in the jurisdictional schemes sensitivity study

The 2025 ESOO results show a similar impact is expected from the delivery of PEC stage 2. The 2025 ESOO models two scenarios: the first assumes that only committed and anticipated developments proceed while the second assumes additional capacity is made available through government schemes and actionable developments. Figure 6 shows the USE results for the committed and anticipated developments scenario while Figure 7 shows the USE results for the scenario modelling government schemes and actionable developments. Both figures show a significant reduction in USE in SA following the delivery of PEC stage 2 which is assumed to be in service by 2027-28:

- In the committed and anticipated developments scenario, the delivery of PEC stage 2 helps reduce USE by 0.0023%, which is slightly more than the reliability standard
- In the government schemes and anticipated developments scenario, the delivery of PEC stage 2 helps reduce USE by 0.0007%, which is slightly more than the interim reliability measure (IRM).
- Figure 7 shows that from 2027-28, reliability risks decrease due PEC stage 2, mitigating the reliability risks from the retirements of Torrens Island B (800 MW on 30 June 2026) and Osbourne Power Station (180 MW on 31 December 2027)

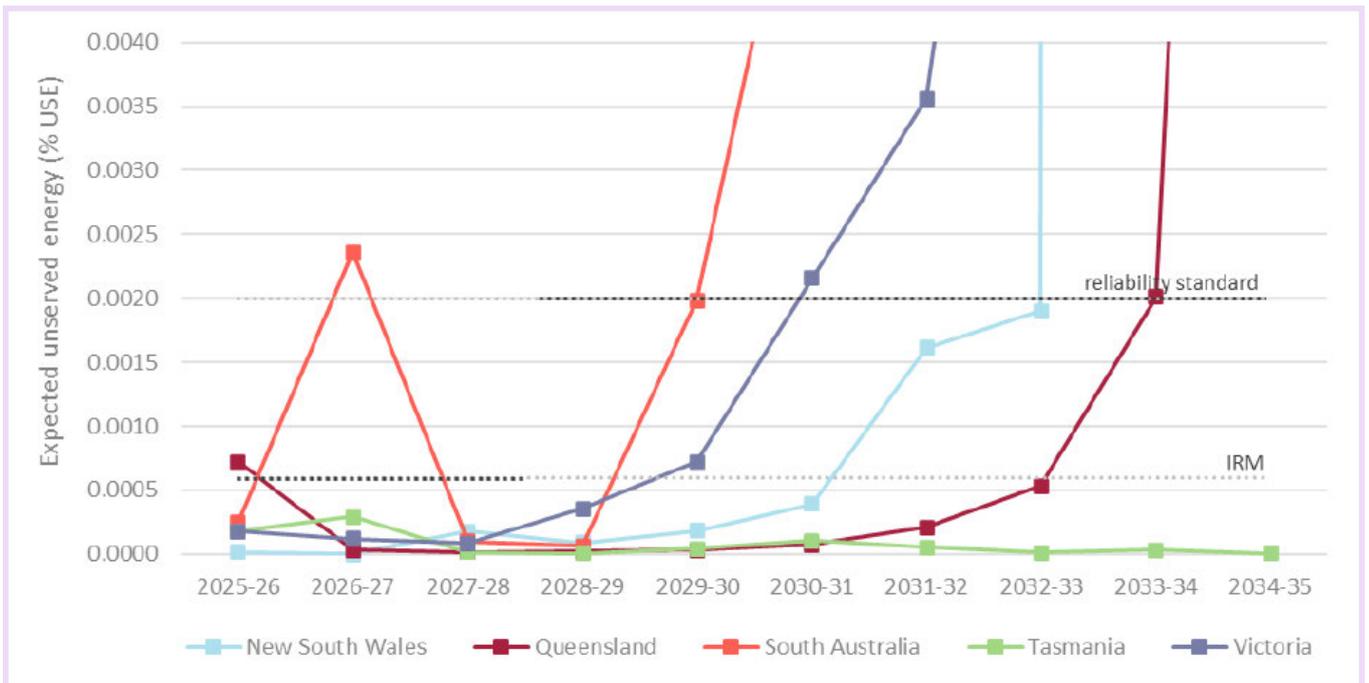


Figure 6 USE results from 2025 ESOO – committed and anticipated developments scenario

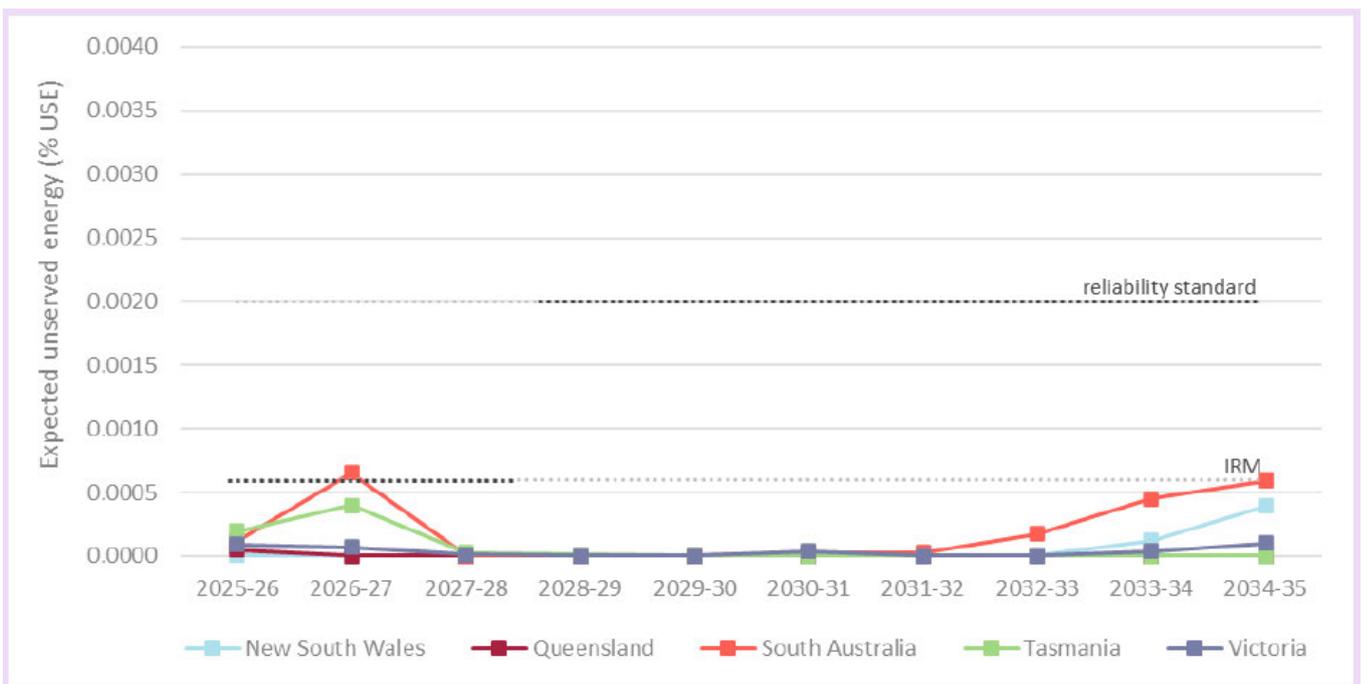


Figure 7 USE results from 2025 ESOO – government schemes and actionable developments scenario

The 2025 ESOO Update advised that the amended closure date for three units of the Torrens Island B Power Station (600 MW) in South Australia of 30 June 2028, which is later than the previously advised date of 30 June 2026, removed the reliability gap previously forecast for South Australia in the 2025 ESOO.

The magnitude of the change in USE aligned with the delivery of PEC does vary in each ESOO. There are a range of factors that contribute to the variation including the change in the assumed date for full release of PEC capacity and the assumed reserve situation at the time that PEC achieved full capacity driven by changes in the existing and committed generation capacity across the NEM.

The 2020 and 2018 ESOO included an ISP sensitivity that modelled the inclusion of PEC. In those documents the reliability benefits delivered by PEC can be appreciated by comparing the USE projections in the base case and those achieved in the ISP sensitivity study. Figure 8 compares the USE achieved in 2024-25 in the base case and

ISP sensitivity in the 2020 ESOO. The reduction in USE was attributed by AEMO as arising from the assumed release of full capacity across PEC from July 2024. The figure shows that while PEC has the biggest impact on the reliability in South Australia, beneficial impacts were also identified in New South Wales and Victoria. The following reliability improvements were attributed to PEC¹⁰:

- USE in New South Wales is forecast to reduce by 0.00005%, or 7.7% of the IRM
- USE in Victoria is forecast to reduce by 0.0001%, or 16.4% of the IRM
- USE in South Australia is forecast to reduce by 0.00041%, or 68.6% of the IRM

Figure 29 Reliability improvement forecast to be delivered by Project EnergyConnect, 2024-25

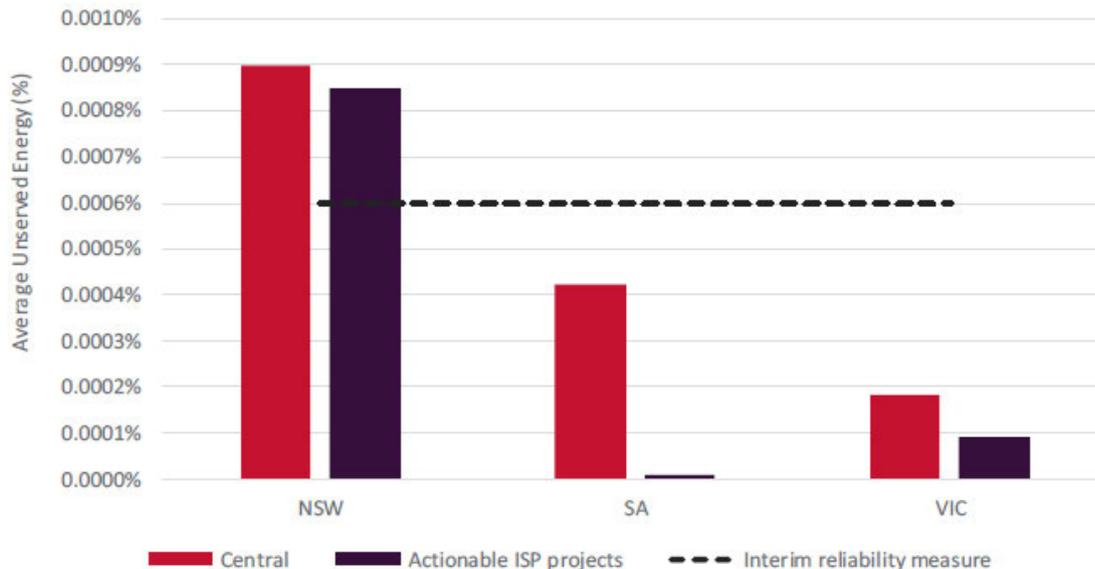


Figure 8 2020 ESOO - USE reduction in 2024-24 attributable to PEC

Table 1 presents the reliability impacts that are most likely attributable to PEC drawing on the results from the various editions of the ESOO summarised in Table 4. The reliability impacts for the versions of the ESOO in which PEC is included in the base case (i.e. 2021 to 2024) have been assessed by comparing the USE outcomes in the year prior to PEC with that achieved in the year where PEC is operating at full capacity. For 2020 and 2018 the reliability benefits have been assessed by comparing USE projections for the base case with those achieved in the ISP sensitivity study in the first year in which PEC is operating at full capacity.

Except for the result for 2020, it is uncertain whether the benefit reported is entirely due to PEC or a combination of PEC and other developments assumed to proceed at the same time. The reliability impacts vary from one version of the ESOO to the next which reflect differences in the reserve situation present in the ESOO modelling in the year in which PEC is commissioned.

The ESOO modelling includes an extensive set of constraints representing the secure transfer limits of the power system. While the ESOO modelling does not explicitly identify the reliability improvement delivered by PEC stage 1, it is expected to be less than the benefits delivered by PEC stage 2 as key system security constraints in South Australia are not relieved by PEC stage 1. For instance, PEC stage 1 does not alleviate the requirement to maintain a minimum of two synchronous generators online in South Australia to control RoCoF within acceptable levels should the HIC trip. The relaxing of these system security constraints with PEC stage 2 significantly increases the ability to share reserves between regions. It is therefore reasonable to expect that most of the reliability benefits identified in the ESOO as delivered by PEC arise from completion of PEC stage 2.

¹⁰ The quoted USE reductions represent the combined effect of augmentations in the ISP scenario assumed to be in service by 2024-25. This includes both VNI Minor (from December 2022) and PEC (from July 2024). Snowy 2.0 is modelled from 2025-26 in the base case so the reliability improvement in 2024-25 has been attributed to PEC.

Table 1 USE reduction aligned with release of full PEC capacity

ESOO publication	Reduction in South Australia USE	Comments
2025 Update	Not assessed	The delayed retirement of Torrens Island B removed the reliability gap forecast in the 2025 ESOO in 2027-28
2025	0.0023% in 2027-28	South Australia USE improvement following release of full PEC capacity in 2027-28. ¹¹
2024	0.0013% in 2027-28	South Australia USE improvement following release of full PEC capacity in 2027-28. South Australia reliability is better than standard across ten-year outlook. ¹²
2023	Not assessed	Reliability benefit is difficult to assess as with and without analysis was not undertaken and other changes in generation capacity aligned with PEC commissioning make the PEC reliability impact difficult to identify.
2022	0.001% reduction by 2026-27	South Australia USE reduced by 0.001% between 2023-24 and when full capacity is available across PEC. Early stages of PEC are modelled as available from 2024-25 ¹³
2021	Not assessed	Reliability benefit is difficult to assess as with and without analysis was not undertaken and base case USE is less than the IRM.
2020	0.0004% reduction in 2024-25	Reduction in USE in New South Wales (0.00005%) and Victoria (0.0009%) also observed through comparing the base case outcomes with ISP sensitivity results for 2024-25. This indicates PEC contributes reliability benefits beyond South Australia. ¹⁴
2019	Not assessed	ISP sensitivity studied did not include PEC, as such 2019 ESOO provides no insight into the reliability benefit delivered by PEC.
2018	0.001% (in 2024-25)	Reduction determined by comparing base case and ISP sensitivity which assumed RiverLink in service in 2024 and modelled addition renewable generation and storage in South Australia. Approximately 0.003% improvement in USE in Victoria driven by PEC allowing better access to New South Wales reserves and new generation assumed in the ISP to meet the VRET. ¹⁵

The 2018 ESOO included a comparison of the USE achieved in South Australia and Victoria in the base case and in two sensitivity studies that included the RiverLink interconnector between South Australia and New South Wales and modelled the power system with and without Snowy 2.0. The sensitivity studies differed with 416MW less utility scale storage and 745MW less renewable generation in South Australia in the scenario which included Snowy 2.0. Comparison of those two sensitivity studies shows that the modelled increase in interconnector capacity allows similar levels of reliability in South Australia with significantly less investment in local storage and renewable generation. This provides an indication of the material reliability benefits offered by the modelled RiverLink interconnector.

While the reliability benefits attributable to PEC stage 2 vary across the different editions of the ESOO, on the whole the ESOO results support the following findings regarding the reliability benefits delivered by PEC:

- PEC should deliver material reliability benefits
- The reliability benefits delivered through the completion of PEC stage 2 are likely to be greatest in South Australia, with some improvement in reliability also expected in Victoria and New South Wales
- The results of the 2024 ESOO demonstrate that releasing full capacity across PEC will provide a material improvement in reliability reducing USE by more than half of the reliability standard (0.0013%).

These results demonstrate that failure to complete PEC stage 2 will have a materially adverse impact on reliability.

¹¹ [AEMO | 2025 NEM Electricity Statement of Opportunities \(ESOO\)](#)

¹² [AEMO | 2024 NEM Electricity Statement of Opportunities \(ESOO\)](#)

¹³ [AEMO | 2022 NEM Electricity Statement of Opportunities](#)

¹⁴ [AEMO | 2020 NEM Electricity Statement of Opportunities](#)

¹⁵ [AEMO | 2018 NEM Electricity Statement of Opportunities](#)

The ISP modelling does not develop new generation capacity in the SW REZ in New South Wales. This result has been identified in submissions to the 2025 draft IASR as being inconsistent with the expectations of renewable energy developers.¹⁶

PEC stage 2 enables the development of renewable generation in the SW REZ¹⁷. The geographic separation of the SW REZ from other REZs in New South Wales offers greater diversity between the output of wind farms in the SW REZ and other REZs such as the CWO and NE REZ. The enhanced diversity of renewable generation that may be enabled by PEC stage 2 is likely to produce improved reliability.

Works delivered as part of PEC stage 2, namely the new transmission line between Dinawan and Wagga Wagga will be leveraged to deliver VNI West. As such a key component of PEC stage 2 supports the delivery of VNI West and the reliability benefits expected to flow from that project.

The 2024 ESOO included an assessment of the reliability benefits delivered by the combination of the assumed increase in coordinated Consumer Energy Resources (CER) and projects identified as actionable in the 2024 ISP. VNI West was modelled in that scenario as being in service in 2029-30 and was shown to deliver a significant improvement in reliability with the USE in 2029-30 reducing by 0.00137% compared to the base case which did not include VNI West of coordinate CER.

3.3 ISP

Every two years AEMO publishes an integrated system plan (ISP) which presents the result of studies undertaken by AEMO to identify the optimal development plan (ODP) for the NEM. The ISP tests whether major transmission augmentation projects such as new interconnectors are likely to deliver sufficient market benefits to justify their cost. Optimal development plans are assessed for different scenarios and the results used to assess the highest priority transmission network augmentations. The highest priority projects are identified as actionable projects which identifies the need for further work by the relevant TNSPs to undertake the necessary analysis to demonstrate that the project satisfies the RIT-T and can proceed.

The 2018 ISP first identified that a new interconnection between South Australia and New South Wales, referred to as RiverLink, should proceed. The ISP identified fuel cost savings as the key benefit delivered by RiverLink with other benefits including:

- Improving network capacity for this transmission route allows for potential new REZs that could be accessed along the RiverLink corridor, opening up the Riverland and Murray REZ (which was also identified by the New South Wales Government as a priority, the “Southwest” energy zone).
- The upgrade is projected to help use resources more efficiently across the NEM, with greater supply sharing between New South Wales, Victoria, and South Australia.

While not explicitly mentioning reliability, the enhanced supply sharing mentioned in the last dot point indicates that PEC will assist to maintain reliability.

The market modelling undertaken for the ISP adopts a similar approach to the RIT-T market modelling discussed in Section 3.1. The optimisation of generation in each of the ISP scenarios seeks to delivery reliability consistent with the reliability standard. The ISP therefore does not provide an explicit assessment of reliability impacts of interconnector augmentation proposals.

3.4 Transgrid TAPR

As noted in Table 6, the 2024 Transgrid TAPR provides information on the status of PEC and the scope of works encompassed by the project but does not quantify the reliability benefits PEC is expected to deliver.

¹⁶ Submissions from Windlab and Squadron Energy are available on the AEMO web site, [AEMO | Draft 2025 Inputs Assumptions and Scenarios Consultation](#)

¹⁷ Access Rights announcement [What's being built in the South West Renewable Energy Zone | EnergyCo](#)

3.5 ElectraNet TAPR

As noted in Table 6, the 2024 ElectraNet TAPR provides information on the status of PEC and the scope of works encompassed by the project but does not quantify the reliability benefits PEC is expected to deliver.

4. Impact of PEC on Security

The security impacts of PEC have been documented across various reports. The tables at the end of this report summarise our review of those documents noting which documents reported specific evidence of power system security impacts. The following sections summarise the most significant PEC security impacts.

4.1 RIT-T and associated regulatory submissions

The RIT-T quantified the various market benefits delivered by PEC. The benefit calculation assumed that PEC (and also the existing Heywood interconnector) would be operated in a way that ensures the South Australian system stays connected to the rest of the NEM for the non-credible loss of the other interconnector. This key security benefit of PEC is not explicitly valued in the calculated market benefits but is a key reason why PEC was found to deliver significant reduction in fuel costs as a result of less gas-powered generation (GPG) being dispatched. With PEC complete the requirement to maintain a minimum level of synchronous generator in South Australia is removed. This allows GPG to be replaced by variable renewable generation offering a substantial saving in fuel costs.

The PACR included additional information on the security benefits delivered by PEC:

- Identifying that the requirement for the minimum number of synchronous generators in South Australia is needed to address an inertia shortfall identified by AEMO in December 2018.
- Confirming that once PEC is completed the risk of South Australia being separated from the rest of the NEM is significantly reduced and therefore the inertia shortfall no longer exists
- PEC removes the requirement for a minimum number of synchronous generators in South Australia. Figure 9 is reproduced from the PACR and illustrates the impact of PEC in allowing accelerated retirement of gas fired generation in South Australia

Figure 5 – Timing of key SA gas-fired generator retirements under the PADR, ISP and PACR

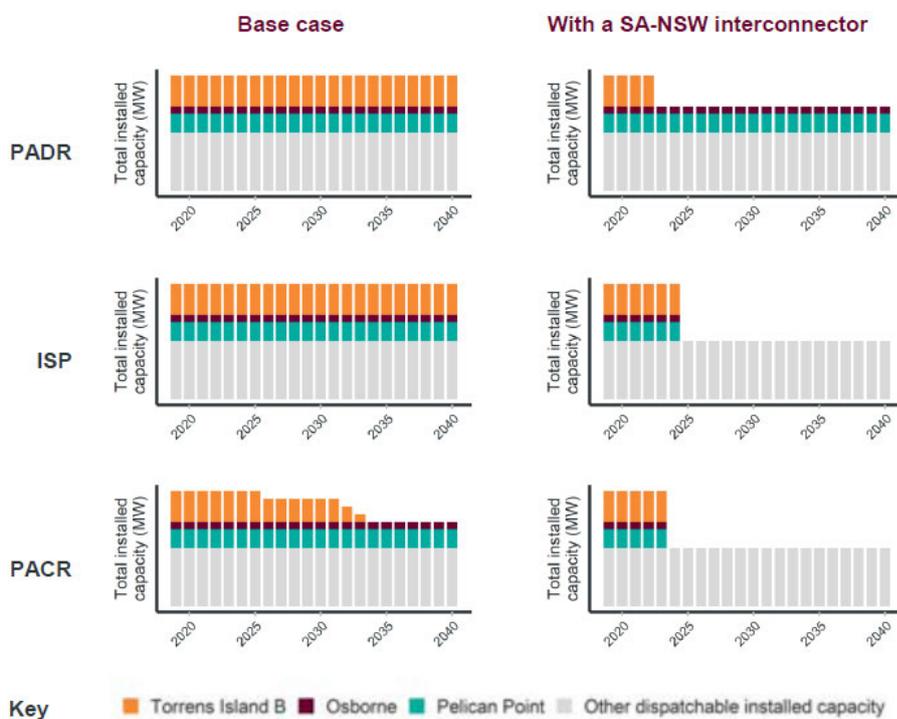


Figure 9 Retirement of GPG allowed by establishment of PEC

In 2020 the AER determine that PEC satisfied the RIT-T. The AER determination noted that PEC will enhance the security of supply in South Australia relying on advice from AEMO (summarised in Figure 10) that confirmed that

the requirement to maintain two synchronous generations online in South Australia will be removed following the completion of PEC.

Table 1 Planning assumptions for the 2018 ISP

Power System Requirement	Planning assumptions used in the 2018 ISP				
	At least 4 synchronous generating units	At least 3 synchronous generating units	At least 2 synchronous generating units	At least 1 synchronous generating unit	No synchronous generating units
SYSTEM NORMAL REQUIREMENT FOR POWER SYSTEM SECURITY					
System strength & fault current	NOW				SYNCONS ENERGY CONNECT
Operating reserves for ramping			NOW SYNCONS		ENERGY CONNECT
SYSTEM NORMAL REQUIREMENT TO SURVIVE 1-IN-3 YEAR SEPARATION EVENT [†]					
Grid formation				NOW SYNCONS	ENERGY CONNECT
Inertia and RoCoF				NOW*	SYNCONS ENERGY CONNECT
Primary frequency control				NOW SYNCONS	ENERGY CONNECT
Secondary frequency control			NOW SYNCONS		ENERGY CONNECT
Operating reserves for energy balance			NOW SYNCONS		ENERGY CONNECT
SYSTEM NORMAL MINIMUM REQUIREMENT					
Minimum requirement	NOW		SYNCONS		ENERGY CONNECT

[†] A "non-credible" separation event has occurred approximately once every three years since NEM start. With Energy Connect, the separation risk would be reduced.

* RoCoF risk is currently managed with a 3 Hz/s RoCoF constraint on the Heywood interconnector.

Figure 10 AEMO advice confirming PEC removes the requirement for synchronous generation in South Australia

The security benefits associated with PEC in the RIT-T and associated regulatory documents all stem from PEC establishing a new interconnection to South Australia which can operate in conjunction with HIC such that the loss of one interconnection does not island South Australia from the rest of the NEM. As noted in Section 2, PEC Stage 1 will be inter-tripped with HIC and therefore the key security benefits identified in the RIT-T and associated regulatory documents would not be realised until PEC stage 2 is complete.

4.2 ESOO

The primary focus of the ESOO is quantifying the expected reliability outcomes for the NEM, limited information is provided on system security. While more comprehensive discussion of security benefits delivered by PEC can be found in other documents various editions of the ESOO note the following security benefits delivered by PEC:

- The 2020 and 2021 ESOO noted that system security challenges associated with minimum demand conditions and managing voltage, system strength, inertia become increasingly difficult when South Australia is islanded, and PEC mitigates these risks by establishing a new interconnection and making islanding of South Australia much less likely.
- The 2016 ESOO provided an outlook for ancillary services in South Australia noting challenges in providing sufficient services to maintain a secure power system when South Australia is either disconnected from the rest of the NEM or at risk of doing so. PEC would have the ability to address each of the system security concerns identified by AEMO in the 2016 ESOO.

4.3 ISP

Across various editions of the ISP AEMO has consistently identified PEC as delivering the following security benefits:

- PEC is expected to increase system strength across Northwest Victoria, Southwest New South Wales and South Australia
- The likelihood of South Australia being islanded is greatly reduced once PEC stage 2 is complete

- PEC stage 2 and the associated protection schemes that manage the non-credible loss of either PEC or HIC will address inertia shortfalls in South Australia, which in turn allows relaxation of the requirement for a minimum of two synchronous generators in South Australia
- PEC stage 2 improves resilience to events causing a trip of the HIC by providing an alternative interconnection.

4.4 AEMO system security and minimum demand reports

Each year AEMO produces a number of reports providing a system security outlooks for the NEM. Those reports consider system strength, inertia, the need for NSCAS and the ability to operate securely under minimum demand conditions. Across various editions of those reports AEMO has identified PEC as delivering the following security benefits:

- PEC is expected to increase system strength across Northwest Victoria, Southwest New South Wales and South Australia:
 - Stage 1 offers increased system strength across all nodes in South Australia, Buronga and Red Cliffs
 - Stage 2 offers further improvements in system strength at those nodes and also Darlington Point
- PEC is expected to remove the requirement to dispatch a minimum number of synchronous generators in South Australia. The existing system strength limits advice published by AEMO states that a minimum of two large synchronous generators and four synchronous condensers must be dispatched to meet system strength requirements¹⁸.

AEMO and ElectraNet have undertaken various studies to explore whether it might be possible to reduce the number of synchronous generators in South Australia that need to be dispatched to maintain system security. While those studies have identified that it might be possible to reduce the minimum number of large synchronous generators in South Australia to one under favourable conditions, achieving those conditions is difficult and as a result the limit requiring a minimum of two large synchronous generators to be dispatched has not been relaxed. The reports documenting those studies identify that once PEC stage 2 is in services the requirement for a minimum number of synchronous generators in South Australia can be relaxed^{19,20}.

The reports published on managing minimum demand have identified a consistent emerging security challenge in operating the regions of the NEM securely under minimum demand conditions. In 2020 the focus was on South Australia where AEMO identified that the projected increase in distributed PV is leading to a reduction in minimum demand and creating a situation where there would be insufficient demand under islanded conditions to enable secure operation as the demand was not sufficient to allow the minimum number of synchronous generators to be dispatched.

The 2020 minimum demand report published by AEMO identified that establishing PEC was a crucial “no regrets” measure that would help address this issue providing the fundamental underpinning for power system operability. PEC addressed the issue by significantly reducing the likelihood of South Australia being islanded. At the time PEC was also viewed as allowing greater export of power to other regions effectively allowing the export of excess distributed generation from South Australia to other regions.

The 2024 minimum demand report published by AEMO identifies that similar concerns to those identified in the 2020 report are now appearing in most regions of the NEM. The report identifies that emergency backstop measures enabling the curtailment of distributed generation are required to maintain system security and identified gaps between the capability available through those measures and the capability required to maintain system security. The report identified that completion of PEC stage 2 will help address the identified issues in the following ways:

- PEC establishes a new interconnection with South Australia making it much less likely that South Australia will be separated from the NEM. This removes the requirement for synchronous generation in South Australia and thereby reduces the required amount of emergency backstop capability.

¹⁸ [transfer-limit-advice-system-strength.pdf](#)

¹⁹ [aemo-2024-transition-plan-for-system-security.pdf](#)

²⁰ [SA minimum synchronous generator requirements](#)

- PEC will increase the export capability from South Australia allowing export of excess generation when minimum demand periods in South Australia are not aligned with minimum demand periods in other regions. However, by the time PEC is fully commissioned, all NEM regions may on occasion simultaneously be experiencing low demand, which limits the ability to export excess generation from South Australia.
- The report also identified shortfalls in 2025 in New South Wales in providing the required emergency backstop capability necessary to hold minimum demand above the thresholds to enable the dispatch of the synchronous generation required to maintain system security. While not stated in the AEMO report GHD expects that PEC will provide greater ability to export power from New South Wales and may therefore assist with meeting the threshold required to maintain system security in New South Wales particularly when the minimum demands in New South Wales and South Australia are not aligned.

4.5 Transgrid TAPR

As noted in Table 6, the 2024 Transgrid TAPR provides information on the status of PEC and the scope of works encompassed by the project but does not quantify the security benefits PEC is expected to deliver.

4.6 ElectraNet TAPR

As noted in Table 6, the 2024 ElectraNet TAPR provides information on the status of PEC and the scope of works encompassed by the project. In addition, the TAPR identified the following security benefits provided by PEC:

- The current 250 MW import limit to the Heywood Interconnector for destructive wind conditions that could result in the loss of multiple transmission elements causing generation disconnection in SA (to reduce the risk of islanding) can be increased after the releasing of capacity for PEC Stage 1 (according to 2024 AEMO General Power System Risk Review).
- There is also currently a constraint set in place to maintain South Australia's rate of change of frequency (RoCoF) below 2 Hz/s immediately following the non-credible loss of the Heywood interconnector, which was introduced to meet the requirements of under regulation 88A of the Electricity (General) Regulations 2012 (SA). Given PEC Stage 1 will be inter-tripped for the non-credible loss of the Heywood interconnector AEMO recommends that these constraints will remain in place following commissioning of PEC Stage 1
- Several constraints on transmission system are expected to be alleviate with the commissioning of PEC stage 2 including:
 - Vic to SA Transient Stability limit for loss of the largest generation block in SA (Both South East Capacitor available).
 - Limit on Heywood interconnection flow to prevent RoCoF of exceeding 2Hz/s in SA immediately following loss of Heywood interconnector.
- The contracting of fast frequency response services to provide additional inertia will not be required following the commissioning of PEC. In December 2023, AEMO declared an inertia shortfall of 500 MWs from 1 July 2024 until PEC Stage 2 is operational and appropriate control schemes are in place. This shortfall could be met by an equivalent quantity of 30 MW of FFR contracts, or by further registrations in the 1-second FCAS market. On 12 June 2024, AEMO notified ElectraNet that sufficient registrations of 1-second FCAS had been registered and that ElectraNet would not be required to provide FFR from 1 July 2024. ElectraNet has subsequently cancelled all inertia shortfall agreements.

5. Findings and Recommendations

5.1 Reliability Impacts

While the reliability benefits attributable to PEC stage 2 vary across the different editions of the ESOO, on the whole the ESOO results support the following findings regarding the reliability benefits delivered by PEC:

- PEC should deliver material reliability benefits.
- The reliability benefits delivered through the completion of PEC are likely to be greatest in South Australia, with some improvement in reliability also expected in Victoria and New South Wales.
- The results of the 2024 and 2025 ESOO demonstrate that releasing full capacity across PEC will provide a material improvement in reliability. The 2025 ESOO presents results that demonstrate PEC stage 2 can mitigate reliability risks that might otherwise arise through the retirement of Torrens Island B and Osbourne power stations.

These results demonstrate that failure to complete PEC stage 2 is likely to have a materially adverse impact on reliability.

The ISP modelling does not develop new generation capacity in the SW REZ in New South Wales. This result has been identified in submissions to the 2025 draft IASR as being inconsistent with the expectations of renewable energy developers.²¹

PEC stage 2 enables the development of renewable generation in the SW REZ²². The geographic separation of the SW REZ from other REZs in New South Wales offers greater diversity between the output of wind farms in the SW REZ and other REZs such as the CWO and NE REZ. The enhanced diversity of renewable generation that may be enabled by PEC stage 2 is likely to produce improved reliability.

Works delivered as part of PEC stage 2, namely the new transmission line between Dinawan and Wagga Wagga will be leveraged to deliver VNI West. As such a key component of PEC stage 2 supports the delivery of VNI West and the reliability benefits expected to flow from that project.

The 2024 ESOO included an assessment of the reliability benefits delivered by the combination of the assumed increase in coordinated Consumer Energy Resources (CER) and projects identified as actionable in the 2024 ISP. VNI West was modelled in that scenario as being in service in 2029-30 and was shown to deliver a significant improvement in reliability with the USE in 2029-30 reducing by 0.00137% compared to the base case which did not include VNI West of coordinate CER.

5.2 Security Impacts

Various reports have consistently identified PEC as delivering significant power system security benefits. Those benefits primarily arise through reducing the likelihood of South Australia being islanded from the rest of the NEM. This is achieved once PEC stage 2 and the associated protection schemes are commissioned. The protection schemes manage the non-credible loss of either PEC or HIC ensuring that loss of one interconnector does not overload the remaining interconnector. This is a material system security benefit and allows the requirement to maintain a minimum of two synchronous generators online within South Australia to be relaxed and constraint equations maintaining RoCoF in South Australia below 2 Hz/s for the non-credible loss of Heywood interconnector to be revoked.

Failure to complete PEC stage 2 would create adverse system security impacts by extending the requirement to run those aging generators in South Australia and extending the exposure of customers in South Australia to the risks associated with a power system that is less resilient to extreme weather events.

AEMO has identified issues with addressing system security under minimum demand conditions which are heightened if South Australia is islanded under those conditions. Failure to complete PEC stage 2 would require

²¹ Submissions from Windlab and Squadron Energy are available on the AEMO web site, [AEMO | Draft 2025 Inputs Assumptions and Scenarios Consultation](#)

²² Access Rights announcement [What's being built in the South West Renewable Energy Zone | EnergyCo](#)

the implementation of additional measures to enable system security to be maintained under minimum demand conditions in South Australia.

PEC is expected to increase system strength across Northwest Victoria, Southwest New South Wales and South Australia:

- Stage 1 offers increased system strength across all nodes in South Australia, Buronga and Red Cliffs
- Stage 2 offers further improvements in system strength at those nodes and also Darlington Point

These results demonstrate that failure to complete PEC stage 2 is likely to have a materially adverse impact on power system security and risk exposing customers to a power system which is less resilient to contingencies. To avoid those adverse system security impacts additional costs would be incurred though:

- Maintaining existing requirements to keep synchronous generators online in South Australia. Those costs are substantial as indicated in the following figure extracted from the AEMO transition plan for system security.²³



Figure 11 Cost of security directions in South Australia

- Continued reliance on the aging synchronous generation may also give rise to adverse reliability impacts particularly if the failure rates of those generators increase with age.
- Continued difficulties in managing minimum load conditions requiring more frequent interruption of rooftop PV and procurement of additional minimum system load transitional services.²⁴

²³ [aemo-2024-transition-plan-for-system-security.pdf](#)

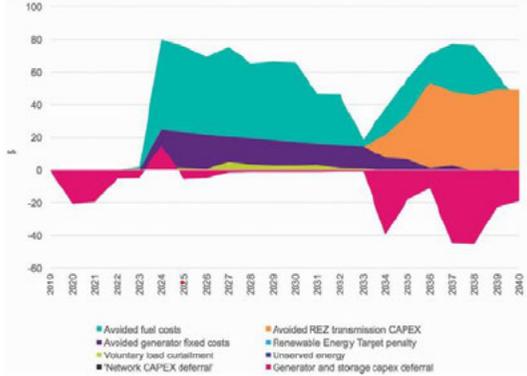
²⁴ [AEMO | Minimum System Load Transitional Services for Victoria and South Australia](#)

Table 2 PEC – Reliability & Security Impacts – Regulatory Approval Documents

Date	Entity	Document	Reliability Impacts	Security Impacts
Jun 2018	ElectraNet	Technical assumption report		The market modelling and technical assumptions report published alongside the PADR provided details on the assumed constraints on synchronous and non-synchronous generation, as well as how system strength and security have been modelled more generally.
Jun 2018	ElectraNet	PADR ²⁵	<p>The PADR reports the market benefits delivered by PEC derived through market modelling undertaken in PLEXOS:</p> <ul style="list-style-type: none"> – LT and ST model runs adopted different interconnector limits and constraints.²⁶ LT model used to determine entry of new generation and transmission capacity. It represented each region as a single node. Regions are connected by notional interconnectors with no loop flow constraint. – ST model modelled full network representation in mainland regions and includes the full network representation of all transmission reactance, impedance and ratings. GHD assumes this utilised the DC load flow option in PLEXOS. – The market modelling targeted achieving reliability outcomes consistent with the NEM reliability standard (i.e. 0.002%) in the base case and cases with transmission augmentations modelled. In each case the market modelling identifies the least cost generation path going forward consistent with meeting system security and reliability requirements <p>The market modelling results compared the USE (involuntary load shedding) in the base case and cases with augmentations proceeding. The value of the reduction in USE is expressed in monetary terms by multiplying by the assumed VCR of \$35,500/MWh. The benefit was found to be \$0 as the same USE outcome is targeted in the base case and augmentation cases.</p> <p>Weighted net market benefits of around \$1bn over 21 years. The preferred option in the PADR was option C3i. The NPV of the costs is approximately \$900M.</p>	Calculated market benefits presented in the PADR assume that any new interconnector (and the existing Heywood interconnector) would be operated in a way that ensures the South Australian system stays intact for the non-credible loss of the other interconnector. To achieve this interconnector transfer limits are implemented in the market modelling such that if the existing Heywood interconnector trips, the new interconnector would remain in service and vice versa. This involved implementing a limit on the combined transfer interconnectors supplying South Australia.

²⁵ SA Energy Transformation RIT-T, Project Assessment Draft Report, ElectraNet, 29 June 2018 available at [Reports & Publications | ElectraNet](#)

²⁶ SA Energy Transformation RIT-T, Market Modelling Report, ElectraNet, 29 June 2018

Date	Entity	Document	Reliability Impacts	Security Impacts
			<p>breakdown of gross market benefits across time for the central scenario are shown in following figure.</p> <p>Figure 7 – Breakdown of gross market benefits for Option C.3.i over time – central scenario</p>  <p>It is difficult to identify which benefits capture the economic value of the reserve capacity sharing that PEC enabled.</p> <p>Costs and benefits in AUD as of June 2018.</p>	
Feb 2019	ElectraNet	PACR ²⁷	<p>Modelling reported in the PACR continued the approach adopted in the PADR of constraining the generation investment in the base cases and augmentation cases to ensure that the NEM reliability standard is met. As such there is no explicit identification of reliability benefits delivered by PEC.</p> <p>Net market benefits of around \$900m over 21 years. Cost of interconnector estimated as \$1.53bn Costs and benefits in AUD as at Feb 2019</p>	<p>Section 4.1.3 of the PACR considered the security benefits delivered by PEC including the following information:</p> <ul style="list-style-type: none"> - In December 2018, AEMO declared an inertia shortfall (and confirmed a previously declared system strength gap) in South Australia as part of the 2018 NTNDP. In particular, AEMO commented that: <ul style="list-style-type: none"> • the fault level shortfall declared in South Australia will remain until new high-inertia synchronous condensers are installed by ElectraNet to address the system strength need; and • in terms of the inertia shortfall, it is recommended ElectraNet fit flywheels to the proposed synchronous condensers and consider opportunities for developments that provide fast frequency response (FFR). - Once a new interconnector is energised, the risk that South Australia will be separated is reduced and the inertia shortfall is no longer likely to be an issue.

²⁷ SA Energy Transformation RIT-T, Project Assessment Conclusions Report, ElectraNet, 13 February 2019 available at [Reports & Publications | ElectraNet](#)
GHD | Transgrid | 12667360 | Project EnergyConnect 19

Date	Entity	Document	Reliability Impacts	Security Impacts
				<p>The following further information on security benefits is provided in the response to submissions provided in Appendix C:</p> <ul style="list-style-type: none"> - The cap on non-synchronous generation has been modelled. Details of the non-synchronous cap can be found in the network technical assumptions report. - The RoCoF constraint will continue to constrain the Heywood interconnector based on the amount of inertia online for import conditions to limit the rate of change of frequency in a non-credible contingency scenario. - A new interconnector alleviates the RoCoF constraint on the operation of the existing Heywood interconnector and the cap on non-synchronous generation, thereby enabling the forced dispatch of gas generation in South Australia to be avoided. <p>As noted in section 4.1.1 in the PACR different assumptions were made in the PACR and PADR regarding the assumed retirement of gas fired generation and the minimum operating level for gas fired generation. The difference in retirement is illustrated in Figure 5 in the PACR which is reproduced below.</p> <p style="text-align: center;">Figure 5 – Timing of key SA gas-fired generator retirements under the PADR, ISP and PACR</p> <p style="text-align: center;">Key ■ Torrens Island B ■ Osborne ■ Pelican Point ■ Other dispatchable installed capacity</p>
Mar 2019	AER	RIT-T dispute	No mention of reliability	Dispute raised by SACOSS that RIT-T did not adequately consider security risks associated with generator closure in South Australia if PEC proceeds and the ability of the

Date	Entity	Document	Reliability Impacts	Security Impacts
				<p>proposed special protection Scheme (SPS) to manage risks associated with a trip of the Heywood interconnector.</p> <p>AER determined that there was no requirement to amend the RIT-T. The AER was satisfied that the SPS proposed as part of PEC was technically feasible.</p> <p>The AER noted that:</p> <ul style="list-style-type: none"> – in the market modelling, combined interconnector power transfer limits of 1,300 MW are assumed. However, this is on the basis that at that level of transfer, following the loss of either interconnector, the operation of a SPS will keep the remaining interconnector intact and allow the continued stable operation of the South Australian power system. – the proposed interconnector introduces system security risks in the event of non-credible loss of either the existing Heywood interconnector or the proposed interconnector. When imports into South Australia are high, the loss of one of the interconnectors may overload the remaining interconnector causing it to trip. This may lead to system instability, separation of South Australia from the NEM and a state-wide system black event. The inclusion of the SPS is designed to mitigate this risk.
Jan 2020	AER	Determine project satisfies RIT-T	<p>Focus was a review of the application of the RIT-T by ElectraNet and not independently calculating market benefits.</p> <p>AER determination confirms:</p> <ul style="list-style-type: none"> – The long-term model which models the effect of the credible options on long term investment decisions that are required to meet NEM reliability standards. <p>There is no addition mention of reliability in the AER determination. This is in keeping with the previous observations that the constraint built into the investment decision algorithm targets the USE standard for the base case and alternatives.</p> <p>The AER used Frontier Economics to review modelling undertaken by ElectraNet. Frontier Economics did not mention reliability impacts in their report.</p> <p>Frontier Economics did not identify any concerns with the modelling approach undertaken by ElectraNet.</p> <p>The AER determined that the project satisfied the RIT-T</p>	<p>AER determination notes that the identified need for PEC as expressed in the RIT-T includes enhancing security of supply in South Australia</p> <p>The AER requested advice from AEMO on the modelling assumptions regarding the dispatch of gas-powered generation in South Australia used in the 2018 ISP to allow comparison with the assumptions made by ElectraNet in the modelling undertaken for the PACR. AEMO's advice included the following table summarising how the requirement for the dispatch of GPG in South Australia was expected to change with the commissioning of new synchronous condensers and with the commissioning of PEC:</p>

Date	Entity	Document	Reliability Impacts	Security Impacts																																																																													
				<p>Table 1: Planning assumptions for the 2018 ISP</p> <table border="1"> <thead> <tr> <th rowspan="2">Power System Requirement</th> <th colspan="5">Planning assumptions used in the 2018 ISP</th> </tr> <tr> <th>At least 4 synchronous generating units</th> <th>At least 3 synchronous generating units</th> <th>At least 2 synchronous generating units</th> <th>At least 1 synchronous generating unit</th> <th>No synchronous generating units</th> </tr> </thead> <tbody> <tr> <td colspan="6">SYSTEM NORMAL REQUIREMENT FOR POWER SYSTEM SECURITY</td> </tr> <tr> <td>System strength & fault current</td> <td>NOW</td> <td></td> <td></td> <td></td> <td>SYNCHONS ENERGY CONNECT</td> </tr> <tr> <td>Operating reserves for ramping</td> <td></td> <td></td> <td>NOW SYNCHONS</td> <td></td> <td>ENERGY CONNECT</td> </tr> <tr> <td colspan="6">SYSTEM NORMAL REQUIREMENT TO SURVIVE 1-WIN-3 YEAR SEPARATION EVENT¹</td> </tr> <tr> <td>Grid formation</td> <td></td> <td></td> <td></td> <td>NOW SYNCHONS</td> <td>ENERGY CONNECT</td> </tr> <tr> <td>Inertia and RoCoF</td> <td></td> <td></td> <td></td> <td>NOW</td> <td>SYNCHONS ENERGY CONNECT</td> </tr> <tr> <td>Primary frequency control</td> <td></td> <td></td> <td></td> <td>NOW SYNCHONS</td> <td>ENERGY CONNECT</td> </tr> <tr> <td>Secondary frequency control</td> <td></td> <td></td> <td>NOW SYNCHONS</td> <td></td> <td>ENERGY CONNECT</td> </tr> <tr> <td>Operating reserves for energy balance</td> <td></td> <td></td> <td>NOW SYNCHONS</td> <td></td> <td>ENERGY CONNECT</td> </tr> <tr> <td colspan="6">SYSTEM NORMAL MINIMUM REQUIREMENT</td> </tr> <tr> <td>Minimum requirement</td> <td>NOW</td> <td></td> <td>SYNCHONS</td> <td></td> <td>ENERGY CONNECT</td> </tr> </tbody> </table> <p>¹ A "non-credible" separation event has occurred approximately once every three years since NEM start. With Energy Connect, the separation risk would be reduced.</p> <p>¹ RoCoF risk is currently managed with a 3 Hz/s RoCoF constraint on the Heywood interconnector.</p> <p>AEMO noted that the 2018 ISP found that a minimum local commitment of large synchronous generating units is needed in South Australia to provide essential power system services, including:</p> <ul style="list-style-type: none"> – System strength (and fault current) – Inertia (and Rate of Change of Frequency (RoCoF)) – Frequency control and operating reserves <p>The 2018 ISP identified that the most efficient development pathway for South Australia to address these requirements would include high-inertia synchronous condensers and a new interconnector to New South Wales.</p>	Power System Requirement	Planning assumptions used in the 2018 ISP					At least 4 synchronous generating units	At least 3 synchronous generating units	At least 2 synchronous generating units	At least 1 synchronous generating unit	No synchronous generating units	SYSTEM NORMAL REQUIREMENT FOR POWER SYSTEM SECURITY						System strength & fault current	NOW				SYNCHONS ENERGY CONNECT	Operating reserves for ramping			NOW SYNCHONS		ENERGY CONNECT	SYSTEM NORMAL REQUIREMENT TO SURVIVE 1-WIN-3 YEAR SEPARATION EVENT ¹						Grid formation				NOW SYNCHONS	ENERGY CONNECT	Inertia and RoCoF				NOW	SYNCHONS ENERGY CONNECT	Primary frequency control				NOW SYNCHONS	ENERGY CONNECT	Secondary frequency control			NOW SYNCHONS		ENERGY CONNECT	Operating reserves for energy balance			NOW SYNCHONS		ENERGY CONNECT	SYSTEM NORMAL MINIMUM REQUIREMENT						Minimum requirement	NOW		SYNCHONS		ENERGY CONNECT
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System strength & fault current	NOW				SYNCHONS ENERGY CONNECT																																																																												
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SYSTEM NORMAL REQUIREMENT TO SURVIVE 1-WIN-3 YEAR SEPARATION EVENT ¹																																																																																	
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Inertia and RoCoF				NOW	SYNCHONS ENERGY CONNECT																																																																												
Primary frequency control				NOW SYNCHONS	ENERGY CONNECT																																																																												
Secondary frequency control			NOW SYNCHONS		ENERGY CONNECT																																																																												
Operating reserves for energy balance			NOW SYNCHONS		ENERGY CONNECT																																																																												
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Minimum requirement	NOW		SYNCHONS		ENERGY CONNECT																																																																												
Sep 2020	ElectraNet	Material change of circumstance submission to the AER confirming that PEC remains the preferred option. Update modelling by ElectraNet align with the assumption in the 2020 ISP.	The market modelling and revised CBA submitted by ElectraNet is no longer available on the AER website as such GHD is unable to confirm the extent of any reliability benefits assessed in those revised models. It is reasonable to assume a similar approach to that adopted for the RIT-T market modelling which does not allow explicit quantification of the reliability impact as previously noted. Cost increase from \$1.53bn to \$2.43bn, gross benefits increased from \$1.25bn to \$1.86bn. Net benefit = \$148m	AER's letter ²⁸ responding to the ElectraNet submission raised the potential that the assumed requirement for GPG in the base case may be conservative as it might be possible for Batteries to reduce the amount of generation from GPG thereby reducing the fuel cost savings stemming from the system security benefits delivered by PEC. As the same GPG assumption were built into 2020 ISP the AER accepted the finding from ElectraNet is the preferred option.																																																																													
May 2021	AER ²⁹	CPA determination. \$2.28bn capex	FTI Consulting ("FTI") engaged by Transgrid to undertake independent analysis of the expected gross benefits of PEC. Assessed net benefit as 1.6bn:	FTI Consulting identified various documents citing security benefits delivered by PEC including:																																																																													

²⁸ [AER - Letter of response to ElectraNet - 28 September 2020_0.pdf](#)

²⁹ [TransGrid and ElectraNet – Project EnergyConnect contingent project | Australian Energy Regulator \(AER\)](#)

Date	Entity	Document	Reliability Impacts	Security Impacts
		<p>AER did not independently assess market benefits by relied on updated assessments by ElectraNet using AEMO ISP inputs</p> <p>The AER estimated gross benefits valued at \$1.2- \$1.3 billion in its Determination.³⁰</p>	<p>FIT³¹ cited the 2020 ISP as providing evidence of the importance of PEC in delivering reliability and security benefits, stating that PEC is classified as an Actionable ISP Project critical to address cost, security and reliability issues³²</p> <p>FTI³³ provided the following statement regarding reliability benefits of PEC:</p> <ul style="list-style-type: none"> - The increased interconnection provided by PEC is also likely to result in a reduction in unserved energy in the NEM, by allowing power to be redistributed from regions of high supply to regions of high demand. This is an additional benefit to NEM consumers, as it helps mitigate unnecessary situations of supply shortfalls. <p>However, no evidence in the form of USE projections with and without PEC were provided in the FTI report as such it does not quantify the reliability benefits.</p>	<ul style="list-style-type: none"> - AEMO’s reporting that completion of PEC under the proposed timelines “should be considered crucial for the ongoing security of South Australia’s power systems”³⁴ - The transition to a more intermittent based resource mix (and the coincidental decline in the share of generation from synchronous sources) has progressively led to a reduction in system strength and inertia (in particular in South Australia). PEC is expected to improve system stability and to remove the existing requirement for some synchronous generators, notably South Australia gas plant, to be online at all times. To capture this benefit, system security constraints are included in the counterfactual to assess how South Australia gas plant might need to continue to operate in the absence of PEC and a relevant subset of these constraints are relaxed (or removed) in our modelling of the system with PEC. - AEMO further concluded that these system security benefits are in addition to any cost savings delivered by PEC, that is, that they are “additional to any benefits related to energy transfer”. The report further outlined the urgency of the interconnector, and argued that, in its absence, “extreme measures such as an immediate moratorium on new distributed PV installations will likely be required”.³⁵ - AEMO highlighted that “the proposed EnergyConnect interconnector will substantially reduce the risk of South Australia separating from the rest of the NEM” and that “completion of the interconnector on the current proposed commissioning timelines should be considered crucial for the ongoing security of South Australia’s power system”³⁶

³⁰ [AER Decision](#)

³¹ [TransGrid - A.11A - FTI PEC - Wider Benefits Report - September 2020.pdf](#)<https://www.aer.gov.au/industry>

³² AEMO, Final 2020 Integrated System Plan, July 2020, page 14 and 84

³³ [TransGrid - A.11B - FTI Consulting, Benefits of Project EnergyConnect - June 2020.pdf](#)

³⁴ AEMO, Minimum operational demand thresholds in South Australia, May 2020 ([minimum-operational-demand-thresholds-in-south-australia-review.pdf](#)), page 55.

³⁵ AEMO, Minimum operational demand thresholds in South Australia, May 2020 ([minimum-operational-demand-thresholds-in-south-australia-review.pdf](#)), page 56.

³⁶ AEMO, Minimum operational demand thresholds in South Australia, May 2020 ([minimum-operational-demand-thresholds-in-south-australia-review.pdf](#)), page 55.

Date	Entity	Document	Reliability Impacts	Security Impacts
				<p>Four categories of benefits for PEC were quantified by FTI, each aligned with the RIT-methodology: avoided variable costs, avoided fixed costs, avoided Renewable Energy Zone transmission costs, and new-build generator capital costs.</p> <p>The analysis uses FTI's in-house power market model, running on PLEXOS, to simulate the NEM from 2020 to 2040, based on AEMO's Draft ISP 2020 central scenario assumptions. The counterfactual scenario models the NEM without PEC, including current topology, existing interconnectors, and committed investments (e.g., VNI and QNI upgrades). PEC's impact is assessed by comparing this baseline to a scenario where PEC is operational from July 2023.</p> <p>The ElectraNet CPA submission³⁷ highlighted the security benefits of PEC stating:</p> <ul style="list-style-type: none"> - For South Australian customers, the interconnector provides access to additional capacity when needed to replace expensive gas generation and improves power system resilience and security
Sep 2022	AER	Draft decision Transgrid determination 2023-28 ³⁸	<p>The AER identified in the draft decision that Transgrid sought to move some of the Capex associated with PEC and approved through the CPA submission into the 2023-28 regulatory period. The draft decision accepted this proposal noting that PEC has already been scrutinised through the CPA and is outside the scope of the determination for the 2023-28 period.</p> <p>The revenue submission and consideration by the AER did not specifically address the reliability benefits delivered by PEC.</p>	The revenue submission and consideration by the AER did not specifically address the security benefits delivered by PEC.

³⁷ [ElectraNet - PEC CPA application, September 2020](#)

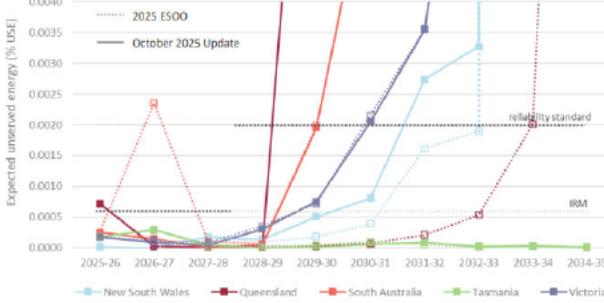
³⁸ https://www.aer.gov.au/system/files/AER%20-%20Transgrid%202023-28%20-%20Draft%20Decision%20-%20Overview%20-%20September%202022_1.pdf

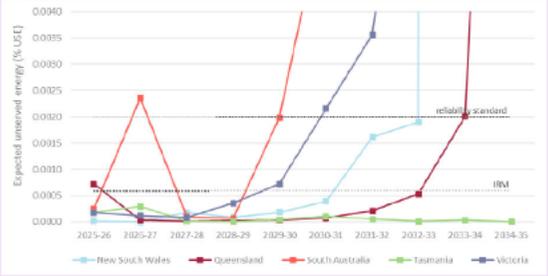
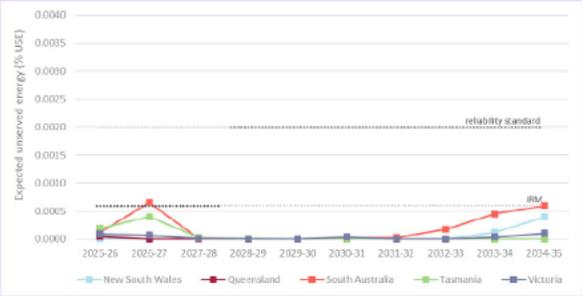
Table 3 PEC – Reliability & Security Impacts – (PEC Integration Workstream and benefits refresh)

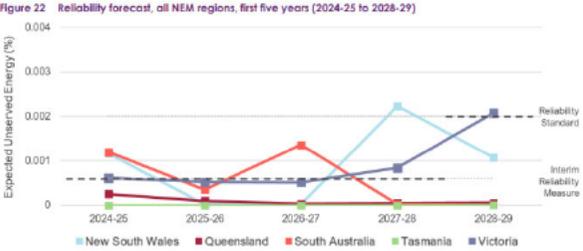
Date	Entity	Document	Reliability Impacts	Security Impacts
2022-2024	AEMO	Various reports supporting AEMO consultation on changes required to NEM to integrate PEC.	<p>AEMO Implementation paper³⁹ identified the need for a loop flow constraint in NEMDE. AEMO commissioned ACIL Allen to undertake market modelling to assess the need for a rule change to manage negative settlement residues accrued across interconnectors. The model implements the loop flow constraint developed by AEMO as documented in the May 2023 updated Implementation Paper</p> <p>The modelling undertaken by ACIL Allen does not provide any evidence to support reliability benefits delivered by PEC.</p>	The modelling undertaken by ACIL Allen does not provide any evidence to support security benefits delivered by PEC.
2024	Transgrid	Refreshed estimate of market benefits	<p>Modelling being undertaken by EY should provide revised estimates of the market benefits delivered by PEC. While GHD has not reviewed the modelling results we expect a similar approach has been adopted for determining the generation investment path as the original RIT-T assessment. That is each of the base case and augmentation options model a generation investment plan that is sufficient to meet the 0.002% USE target. This approach is likely impeding explicit quantification of the reliability benefits delivered by PEC.</p>	

³⁹ [pec-market-integration-paper.pdf](#)

Table 4 PEC – Reliability & Security Impacts – ESOO

Date	Entity	Document	Reliability Impacts	Security Impacts
2025 Update	AEMO	ESOO update	<p>The delay to the retirement of Torrens Island B power station has addressed the previously forecast reliability short fall. The 2025 ESOO update models two scenarios: the first assumes that only committed and anticipated developments proceed while the second assumes additional capacity is made available through government schemes and actionable developments. The figure below shows the USE results for the committed and anticipated developments.</p>  <p>The following figure shows the UES results for the scenario modelling government schemes and actionable developments.</p> 	This 2025 ESOO update did not address security challenges.
2025	AEMO	ESOO	The 2025 ESOO results show PEC stage 2 assists to improve reliability. The 2025 ESOO models two scenarios: the first assumes that only committed and anticipated developments proceed while the second assumes additional capacity is made available through	The 2025 ESOO provides a summary of emerging security challenges but did not provide analysis related to impact of PEC on system security.

Date	Entity	Document	Reliability Impacts	Security Impacts
			<p>government schemes and actionable developments. The figure below shows the USE results for the committed and anticipated developments.</p>  <p>The following figure shows the UES results for the scenario modelling government schemes and actionable developments.</p>  <p>Both figures show a significant reduction in USE in SA following the delivery of PEC stage 2 which is assumed to be in service by 2027-28:</p> <ul style="list-style-type: none"> - In the committed and anticipated developments scenario, the delivery of PEC stage 2 helps reduce USE by 0.0023%, which is slightly more than the reliability standard - In the government schemes and anticipated developments scenario, the delivery of PEC stage 2 helps reduce USE by 0.0007%, which is slightly more than the interim reliability measure (IRM). - From 2027-28, reliability risks decrease due to the assumed full commissioning of PEC Stage 2, enabling 800 MW transfer capacity between New South Wales and South Australia, mitigating the expected reliability risks from the retirements of Torrens Island B (800 MW on 30 June 2026) and 	

Date	Entity	Document	Reliability Impacts	Security Impacts
			Osbourne Power Station (180 MW on 31 December 2027).	
2024	AEMO	ESOO – base case assessment	<p>The 2024 ESOO modelled PEC in the base case with updated commissioning dates allowing the release of full capacity by July 2027.</p> <p>The 2024 ESOO identified reliability gaps in 2024-25 and 2026-27 against the Interim Reliability Measure (IRM) (p.64) due to alternative network configurations applied between the Latrobe Valley and Melbourne at times of high demand, which reduces total risks across Victoria, but results in reduced flows towards South Australia. In 2027-28, PEC stage 2 is forecast to release the full 800 MW transfer capacity, reducing reliability risks for South Australia below the IRM until 2032-33. PEC is identified as mitigating the impact of retirements of Osborne and Torrens Island B Power Stations.</p> <p>Figure 22 reproduced below illustrates the reduction in USE in South Australia achieved following the release of full capacity on PEC.</p>  <p>As PEC is modelled in all studies completed for the 2024 ESOO the reliability benefit delivered by PEC is not explicitly identified.</p>	This 2024 ESOO provides a summary of emerging security challenges but did not provide analysis related to impact of PEC on system security.
2024	AEMO	ESOO sensitivity study	<p>The 2024 ESOO contained a sensitivity study that considered the reliability improvements delivered by various jurisdictional schemes and other measures. This considered the Capacity Investment Scheme (CIS) South Australia-Victoria tender round:</p> <ul style="list-style-type: none"> – The Tender round sought to support the delivery of projects providing dispatchable capacity across Victoria and South Australia to address forecast reliability concerns. 	

Date	Entity	Document	Reliability Impacts	Security Impacts																																			
			<ul style="list-style-type: none"> – 2400MWh of capacity was sought with 800MWh in each of Victoria and South Australia and the remained able to be sourced from projects in either region. – Projects needed to be operational before the end of 2027 to support system reliability – Results of the tender round were published on 4 September 2024 with the following project being awarded a Capacity Investment Scheme Agreement⁴⁰ <table border="1"> <thead> <tr> <th>Company</th> <th>Project name</th> <th>Technology</th> <th>Capacity</th> <th>Location</th> </tr> </thead> <tbody> <tr> <td>EnergyAustralia</td> <td>Wooreen Battery Energy Storage System (BESS)</td> <td>350 MW (4 hour) lithium-ion battery</td> <td>1400 MWh</td> <td>VIC</td> </tr> <tr> <td>ZEN Energy</td> <td>Solar River Energy Storage System (ESS)</td> <td>170 MW (3.8 hour) lithium-ion battery alongside Solar River 230MW solar farm.</td> <td>653 MWh</td> <td>SA</td> </tr> <tr> <td>Pacific Green Technologies</td> <td>Limestone Coast West BESS</td> <td>250 MW (4 hour) lithium-ion battery</td> <td>1000 MWh</td> <td>SA</td> </tr> <tr> <td>Progress Power</td> <td>Springvale Energy Hub</td> <td>115 MW (2 hour) lithium-ion battery</td> <td>230 MWh</td> <td>VIC</td> </tr> <tr> <td>Pacific Blue</td> <td>Clements Gap BESS</td> <td>60 MW (2.4 hour) lithium-ion battery</td> <td>143 MWh</td> <td>SA</td> </tr> <tr> <td>EnergyAustralia</td> <td>Hallett BESS</td> <td>50 MW (4 hour) lithium-ion battery</td> <td>200 MWh</td> <td>SA</td> </tr> </tbody> </table> <p>The 2024 ESOO base case reliability projections only include projects that met AEMO’s criteria for existing, commissioning, committed or anticipated projects and therefore would not have considered the capacity incentivised by the CIS tender round. An additional sensitivity was included in the 2024 ESOO to capture the effects of CER forecasts, additional capacity incentivised through state and commonwealth schemes and the capacity provided by the delivery of actionable projects identified in the 2024 ISP. That sensitivity study considered the capacity expected to be delivered by the following:</p> <ul style="list-style-type: none"> – New South Wales: <ul style="list-style-type: none"> • The sensitivity study included all long duration storage projects awarded contracts through the 4 completed tenders identified in the Infrastructure Investment Objectives Report⁴¹, that were not already included in the base case reliability assessment. These refer to the 4, LTESA tender rounds completed by June 2024. Tender Round 5 projects were not included as 	Company	Project name	Technology	Capacity	Location	EnergyAustralia	Wooreen Battery Energy Storage System (BESS)	350 MW (4 hour) lithium-ion battery	1400 MWh	VIC	ZEN Energy	Solar River Energy Storage System (ESS)	170 MW (3.8 hour) lithium-ion battery alongside Solar River 230MW solar farm.	653 MWh	SA	Pacific Green Technologies	Limestone Coast West BESS	250 MW (4 hour) lithium-ion battery	1000 MWh	SA	Progress Power	Springvale Energy Hub	115 MW (2 hour) lithium-ion battery	230 MWh	VIC	Pacific Blue	Clements Gap BESS	60 MW (2.4 hour) lithium-ion battery	143 MWh	SA	EnergyAustralia	Hallett BESS	50 MW (4 hour) lithium-ion battery	200 MWh	SA	
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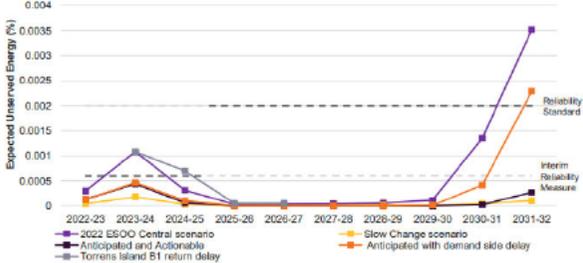
⁴⁰ Closed CIS tenders - DCCEEW

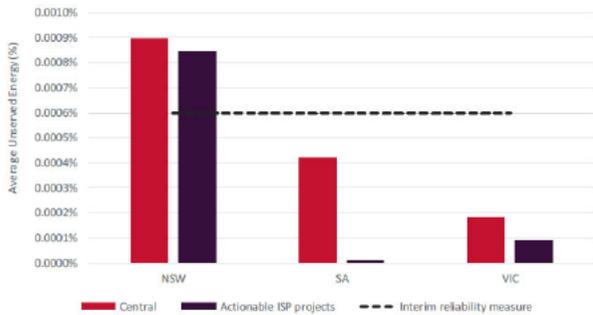
⁴¹ IIO Report

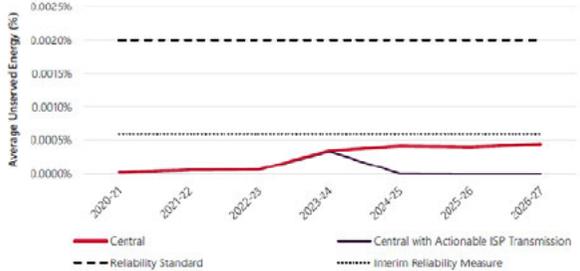
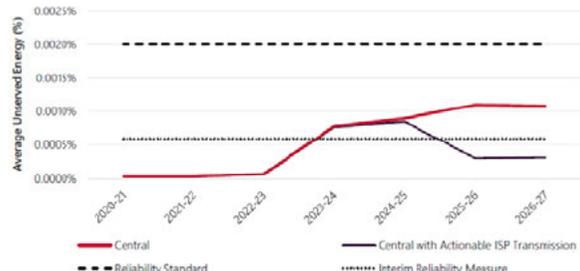
Date	Entity	Document	Reliability Impacts	Security Impacts
			<p>results for that round were announced in February 2025 which was after the publication of the 2024 ES00.</p> <ul style="list-style-type: none"> • The first 4 rounds provide 574MW of long duration storage projects • Actionable ISP projects: HCC REZ Network Infrastructure, Sydney Ring South, HTP 1.0, New England REZ Network Infrastructure Stage 1 and 2 <p>– Victorian:</p> <ul style="list-style-type: none"> • All projects that received funding through VRET Auction 2 that were not already included in the base case reliability assessment. • VRET Auction 2 funded six projects to bring forward 623MW of new renewable generation capacity and 365MW/600MWh of new BESS. While the projects have received funding, only some of the projects has achieved the progress required for inclusion in the 2024 ES00 base case. • Actionable ISP projects: VNI West, Marinius Link Stage 1 and 2. <p>– South Australia:</p> <ul style="list-style-type: none"> • The South Australian Hydrogen Jobs Plan seeks to fund a 200MW green hydrogen power station, to be operational by December 2025, alongside hydrogen electrolyser and hydrogen storage projects near Whyalla. This project was considered anticipated and therefore included in the base case reliability projections produced for the 2024 ES00. • Actionable ISP projects: Mid North SA REZ Expansion <p>The reliability projections from that sensitivity study are shown in the figure below, reproduced from the 2024 ES00. The figure demonstrates the various measures offer improvements in reliability compared to the base case with reliability projected to remain within the USE standard in all regions until 2033-34. In 2033-34 New South Wales retirement of coal fired generation is projected to result in reliability exceeding the USE standard.</p>	

Date	Entity	Document	Reliability Impacts	Security Impacts
			<p>The sensitivity study identifies that the combination of PEC with the capacity incentivised by federal and state scheme has a materially beneficial impact on reliability. The schemes offer to improve reliability in South Australia ahead of PEC being commissioned reducing the reliability improvement seen in 2027-28 once the full capacity of PEC is available.</p> <p>Figure 30 Reliability impact of federal and state generation development schemes, 2024-25 to 2033-34 (%)</p> <p>The results illustrate that the reliability improvement delivered by PEC depends on the timing of other investments. The figure demonstrates that PEC offers the ability to improve reliability outcomes particularly in any scenario in which the additional capacity assumed in the sensitivity study is delayed.</p> <p>Works delivered as part of PEC stage 2, namely the new transmission line between Dinawan and Wagga Wagga will be leveraged to deliver VNI West. As such a key component of PEC stage 2 supports the delivery of VNI West and the reliability benefits expected to flow from that project.</p> <p>The 2024 ES00 included an assessment of the reliability benefits delivered by the combination of the assumed increase in coordinated Consumer Energy Resources (CER) and projects identified as actionable in the 2024 ISP. VNI West was modelled in that scenario as being in service in 2029-30 and was shown to deliver a significant improvement in reliability with the USE in 2029-30 reducing by 0.00137% compared to the base case which did not include VNI West of coordinate CER.</p>	
2023	AEMO	ES00	<p>The 2023 ES00 modelled PEC in the base case with the same commissioning dates as the 2022 ES00. The</p>	<p>This 2023 ES00 did not provide a security analysis related to PEC.</p>

Date	Entity	Document	Reliability Impacts	Security Impacts
			<p>ESOO 2023 Central scenario shows expected USE above the IRM for both South Australia (2023-24) and Victoria (2023-25) in the first 5-year period 2023-28. With the commissioning of PEC, however, the expected USE in South Australia would be kept within the reliability standard despite the retirement of all Torrens Island B and Osborne Power Station.</p> <p>While not modelled in the ESOO AEMO stated that any delays to the commissioning of Project EnergyConnect are likely to lead to significantly higher reliability risks in 2026-27, due to the quantity of generation that has advised retirement at the time this transmission development is advised to complete commissioning.</p> <p>AEMO also stated that any delays to the commissioning of PEC are likely to lead to significant higher reliability risks in 2026-27 (p.69).</p> <p>As PEC is modelled in all studies completed for the 2023 ESOO the reliability benefit delivered by PEC is not explicitly identified.</p>	
2022	AEMO	ESOO	<p>PEC had been included in the base case reliability studies since 2021 ESOO. The 2022 ESOO, modelled the full capacity of PEC being available from July 2026 rather than June 2025 as modelled in the ESOO 2021. The early stages of PEC are assumed to be available from 2024-25. This one-year delay combined with delays in commissioning of committed generation, and load growth contributed to some forecast reliability gaps across South Australia, Victoria (IRM) and New South Wales (Reliability Standard).</p> <p>In South Australia, the retirement of Osborne Power Station which did not lead to a reliability gap in the 2021 ESOO, has produced a reliability gap in 2023-24 in the 2022 ESOO as demonstrated in figure 51 reproduced below.</p>	This 2022 ESOO did not provide a security analysis related to PEC.

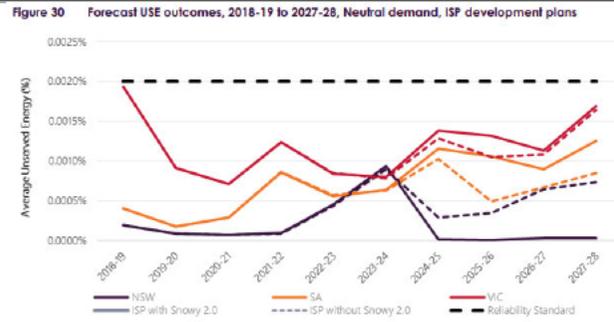
Date	Entity	Document	Reliability Impacts	Security Impacts
			<p data-bbox="846 220 1299 236">Figure 51 South Australia expected USE, scenarios and sensitivities, 2022-23-2031-32 (%)</p>  <p data-bbox="828 523 1388 574">From 2024-25, however, the commissioning of PEC significantly improves the outlook (p.55).</p>	
2021	AEMO	ESOO	<p data-bbox="828 596 1429 842">The 2021 ESOO included PEC in the base case studies as it had completed its regulatory approval process and received expenditure approval for the AER in May 2021. To allow for inter-network testing, PEC was modelled with its full capacity available from June 2025 (one year later than the ISP sensitivity considered in the 2020 ESOO). As PEC is modelled in all studies completed for the 2021 ESOO the reliability benefit delivered by PEC is not explicitly identified.</p> <p data-bbox="828 852 1429 903">The base case reliability studies identified the following USE outcomes which PEC helps to deliver:</p> <ul data-bbox="828 916 1429 1171" style="list-style-type: none"> - In South Australia USE levels remain below both the IRM and the Reliability Standard across the ten-year outlook period - In Victoria and New South Wales USE levels remain below both the IRM and the Reliability Standard across the first five years of the outlook period and increase beyond the standard in the second 5 years because of expected generation closures (Yallourn, Vales Point and Eraring). <p data-bbox="828 1181 1429 1289">AEMO identified that PEC is forecast to reduce supply scarcity risks by increasing transfer capacity between New South Wales and South Australia, allowing more resources to be shared across the NEM.</p>	<p data-bbox="1456 596 2060 842">The 2021 ESOO included an update on the challenges of maintaining power system security during periods of low operational demand included in the 2020 ESOO. Issues identified included managing voltage, system strength and inertia. AEMO identified that these security challenges become increasingly more difficult when South Australia is operated as an island, AEMO also cited situations where Victoria and South Australia could be at risk of separation from New South Wales.</p> <p data-bbox="1456 852 2060 1075">PEC is identified as a mitigation measure that is important in addressing these system security challenges. By creating a second synchronous connection South Australia to New South Wales, PEC reduces the likelihood of South Australia and Victoria becoming separated from the rest of the NEM, which significantly reduces the identified system security risks (p 104)</p>
2020	AEMO	ESOO	<p data-bbox="828 1311 1429 1394">The base case reliability assessment in the 2020 ESOO did not include PEC as it had not yet completed all necessary approvals.</p> <p data-bbox="828 1404 1429 1477">However, the ESOO explored the projected improvements in reliability outcomes if ISP actionable projects such as PEC are delivered in a timely manner.</p>	<p data-bbox="1456 1311 2060 1477">Section 7 of the 2020 ESOO reviewed the challenges of maintaining power system security during periods of low operational demand. Issues identified included managing voltage, system strength and inertia. AEMO identified that these security challenges become increasingly more difficult when South Australia is operated as an island.</p>

Date	Entity	Document	Reliability Impacts	Security Impacts																
			<p>PEC was considered an actionable project and modelled in this sensitivity study as in service from July 2024.</p> <p>The ISP sensitivity modelled the following actionable interconnector augmentation projects:</p> <ul style="list-style-type: none"> - VNI Minor included from December 2022 - PEC included from July 2024 - HumeLink included from July 2025 - CWO REZ Transmission Link included from July 2024, although the associated new generation developments were not modelled in the ISP sensitivity <p>Figure 29 in the ESOO considered the reliability benefits provided by PEC by comparing the USE in the base case and the ISP sensitivity for 2024-25.</p> <p>Figure 29 Reliability improvement forecast to be delivered by Project EnergyConnect, 2024-25</p>  <table border="1" data-bbox="831 703 1424 1018"> <caption>Data for Figure 29: Reliability improvement forecast</caption> <thead> <tr> <th>State</th> <th>Central (Average Unreserved Energy %)</th> <th>Actionable ISP projects (Average Unreserved Energy %)</th> <th>Interim reliability measure (Average Unreserved Energy %)</th> </tr> </thead> <tbody> <tr> <td>NSW</td> <td>~0.0009%</td> <td>~0.00085%</td> <td>0.0006%</td> </tr> <tr> <td>SA</td> <td>~0.0004%</td> <td>~0.00005%</td> <td>0.0006%</td> </tr> <tr> <td>VIC</td> <td>~0.0002%</td> <td>~0.0001%</td> <td>0.0006%</td> </tr> </tbody> </table> <p>The figure shows a noticeable reliability improvement in South Australia with less significant improvements also visible in New South Wales and Victoria. The improvements are attributed to PEC, increasing the South Australia import capability at times of high demand, more than offsetting the reliability impact of the retirement of Osborne (180MW in Jan 2024 in the base case). Analysis presented in Figure 68 compares the reliability outlook for South Australia in the base case and with the ISP actionable projects. It showed a sustained improvement in the reliability for South Australia following the commissioning of PEC, reducing USE outcomes by approximately 0.0004%.</p>	State	Central (Average Unreserved Energy %)	Actionable ISP projects (Average Unreserved Energy %)	Interim reliability measure (Average Unreserved Energy %)	NSW	~0.0009%	~0.00085%	0.0006%	SA	~0.0004%	~0.00005%	0.0006%	VIC	~0.0002%	~0.0001%	0.0006%	<p>PEC is identified as a mitigation measure that is important in addressing these system security challenges. By creating a second synchronous connection to the rest of the NEM, PEC significantly reduces the likelihood of South Australia becoming separated from the rest of the NEM, which significantly reduces the identified system security risks (p 72).</p>
State	Central (Average Unreserved Energy %)	Actionable ISP projects (Average Unreserved Energy %)	Interim reliability measure (Average Unreserved Energy %)																	
NSW	~0.0009%	~0.00085%	0.0006%																	
SA	~0.0004%	~0.00005%	0.0006%																	
VIC	~0.0002%	~0.0001%	0.0006%																	

Date	Entity	Document	Reliability Impacts	Security Impacts
			<p data-bbox="831 209 1279 225">Figure 68 Impact of actionable ISP transmission augmentations, South Australia</p>  <p data-bbox="831 568 1424 676">Expected USE in Victoria also reduces, although to a lesser extent, due to the increased capacity available on the interconnectors linking New South Wales and South Australia to Victoria.</p> <p data-bbox="831 687 1413 991">The impact of PEC on reliability in New South Wales is for more muted, with only a slight reduction in USE evident in 2024-25. This is because at times of high demand in New South Wales the transmission network between southern New South Wales and Sydney is already congested, and the new capacity provided by PEC is limited by this congested network, with is relieved by HumeLink (p.64). The commissioning of HumeLink in July 2025 delivers a more significant improvement in New South Wales reliability as demonstrated in Figure 65.</p> <p data-bbox="831 1002 1294 1018">Figure 65 Impact of actionable ISP transmission augmentations, New South Wales</p> 	
2019	AEMO	ESOO	As with the 2018 publication the 2019 ESOO considered sensitivity studies that examined the improvement in reliability that would arise if the power	The 2019 ESOO did not include any assessment of the ancillary service outlook.

Date	Entity	Document	Reliability Impacts	Security Impacts
			<p>system developed in accordance with projections developed through the ISP. The ISP scenarios in the 2019 ESOO consider scenario in which group 1 augmentations from the 2018 ISP proceed.</p> <p>As RiverLink was classified as a group 2 augmentation in the 2018 ISP it was not included in the ISP sensitivity published in the 2019 ESOO. The 2019 ESOO therefore does not provide any information on the reliability benefit delivered by PEC.</p>	
2018	AEMO	ESOO	<p>In 2018 the ESOO introduced an ISP sensitivity to allow assessment of how the projected reliability outcomes would change if the power system were to develop consistent with the scenarios modelled in the ISP.</p> <p>The sensitivity showed appreciable improvements in USE arising in the ISP scenario as illustrated in the following figures. The first (figure 22) shows the USE projects in the base case without ISP projects proceeding, the second (figure 30) shows the USE in the ISP sensitivity. The USE standard was projected to be exceeded in New South Wales, Victoria and South Australia in the base case whereas in the ISP sensitivity USE remains below the 0.002% standard indicating the benefit of reserve sharing provided by increased interconnection.</p> <p>Figure 22 Forecast USE outcomes, Neutral demand, committed projects only</p>  <p>The chart displays the forecast of Average Unused Energy (%) for three states: New South Wales (NSW), South Australia (SA), and Victoria (VIC) from the financial year 2018-19 to 2017-18. A horizontal dashed line represents the Reliability Standard at 0.0020%. The NSW line (dark blue) starts at approximately 0.0015% in 2018-19, dips to 0.0010% in 2019-20, then rises to 0.0020% by 2022-23 and continues to rise to about 0.0070% by 2017-18. The SA line (orange) remains consistently below the 0.0020% standard, starting at 0.0010% and ending at 0.0015%. The VIC line (red) starts at 0.0015%, dips to 0.0010% in 2019-20, then rises to 0.0020% by 2022-23 and continues to rise to about 0.0055% by 2017-18.</p>	The 2018 ESOO did not include any assessment of the ancillary service outlook.

Date	Entity	Document	Reliability Impacts	Security Impacts
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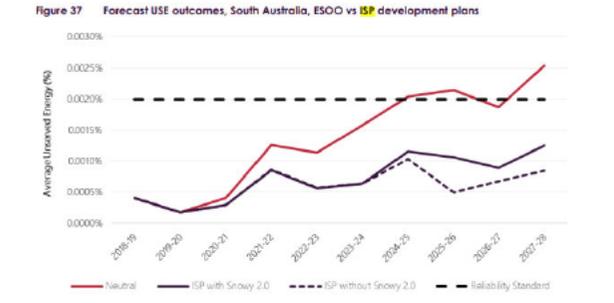
The pictures below show the reliability improvement projected for South Australia under the ISP development scenario.

Table 18 ISP developments in South Australia (over and above committed) by 2028

Source	Capacity (MW)	ISP Plan
Utility-scale storage	649	Without Snowy 2.0
	233	With Snowy 2.0
Additional wind and solar generation in South Australia	975	Without Snowy 2.0
	230	With Snowy 2.0
Additional interconnection with New South Wales	750	Both development plans
Additional interconnection with Victoria ^A	100	Both development plans

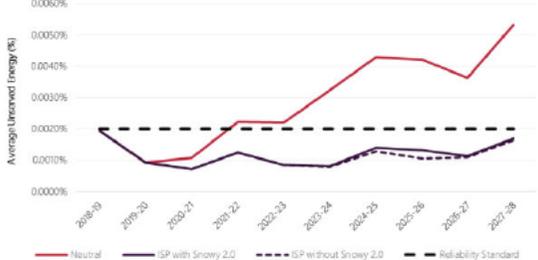
A. Due to the transmission works associated with the RiverLink augmentation

Despite the reduction in dispatchable capacity located in South Australia, both ISP development plans are projected to deliver improved reliability outcomes compared to the core ESOO Neutral scenario, resulting in USE below the reliability standard, as shown in Figure 37.



The red line shows the forecast assuming only committed and existing capacity. The other lines show the impact of addition capacity consistent with the two ISP sensitivities. The ISP sensitivities assume a new interconnector between New South Wales and South Australia in 2024 and an associate 100MW increase on the Heywood interconnect at the same time.

Date	Entity	Document	Reliability Impacts	Security Impacts
			<p>The scenarios also assume additional storage and renewable generation in South Australia with the amount of new capacity varying depending on whether Snowy 2.0 is assumed to proceed. The 2018 ISP indicates that the new storage capacity is commissioning in the same year as the interconnector and therefore the improvement in reliability prior to 2024-25 is due to the additional renewable generation capacity in South Australia.</p> <p>The two scenarios differ with 416MW less utility scale storage and 745MW less renewable generation in South Australia in the scenario which included Snowy 2.0. Comparison of those scenarios shows that the modelled interconnector capacity allows similar levels of reliability in South Australia with significantly less investment in local storage and renewable generation. This provides an indication of the reliability benefits offered by the modelled RiverLink interconnector.</p> <p>The calculated USE in South Australia in the ISP scenarios is approximately half of that in the base case ESOO scenario.</p> <p>A similar set of sensitivity studies were completed for Victoria which highlighted that the additional transmission capacity delivered by RiverLink allowed better reserve sharing with New South Wales and improved reliability. The improvement in reliability prior to 2024 is due to the additional generation capacity assumed in the ISP scenario.</p>	

Date	Entity	Document	Reliability Impacts	Security Impacts															
			<p>Table 21 ISP developments in Victoria (over and above committed) by 2028</p> <table border="1" data-bbox="846 252 1420 379"> <thead> <tr> <th>Source</th> <th>Capacity (MW)</th> <th>ISP plan</th> </tr> </thead> <tbody> <tr> <td>Gas-powered generation (GPG)</td> <td>0</td> <td>Without Snowy 2.0</td> </tr> <tr> <td></td> <td>90</td> <td>With Snowy 2.0</td> </tr> <tr> <td>Additional wind and solar generation in Victoria</td> <td>3,625</td> <td>Both development plans</td> </tr> <tr> <td>Additional interconnection with South Australia</td> <td>100</td> <td>Both development plans</td> </tr> </tbody> </table> <p>Despite the lack of any sizeable increase in dispatchable capacity, the level of USE in Victoria is forecast to fall to be within the reliability standard under both ISP development plans. This is due to the substantial volume of additional new intermittent generation developed in Victoria to meet the VRET, combined with the ability to import additional reserves from New South Wales via the RiverLink interconnector, in the ISP plan. The USE outcomes under the ISP sensitivities are shown in Figure 40.</p> <p>Figure 40 Forecast USE outcomes, Victoria, core ES00 vs ISP development plans</p> 	Source	Capacity (MW)	ISP plan	Gas-powered generation (GPG)	0	Without Snowy 2.0		90	With Snowy 2.0	Additional wind and solar generation in Victoria	3,625	Both development plans	Additional interconnection with South Australia	100	Both development plans	
Source	Capacity (MW)	ISP plan																	
Gas-powered generation (GPG)	0	Without Snowy 2.0																	
	90	With Snowy 2.0																	
Additional wind and solar generation in Victoria	3,625	Both development plans																	
Additional interconnection with South Australia	100	Both development plans																	
2017	AEMO	ES00	As was the case in 2016, PEC is not modelled in the 2017 ES00	The 2017 ES00 did not include any assessment of the ancillary service outlook.															
2016	AEMO	ES00	PEC Is not mentioned in the ES00 which is consistent with the AER not determined that the project passed the RIT-T until 2020. It appears the USE results in the 2016 ES00 did not model PEC.	<p>The ES00 provided an outlook of the requirement for ancillary services to maintain system security. Of relevance for PEC are the following emerging issues highlighted in the 2016 ES00:</p> <ul style="list-style-type: none"> - Regulation of frequency following the loss of the Heywood interconnector requires regulation sources within South Australia. AEMO procures a local (35MW) raise regulation requirement when there is an elevate likelihood of the Heywood interconnector tripping. This tends to occur 5~10% of time. In 2015 South Australia was considered at credible risk of synchronous separation from the rest of the NEM for 813 hours, or around 9.3% of the year. - There were only 3 supplies of regulation FCAS in South Australia at the time the 2016 ES00 was produces and AEMO raised concerns regarding the limited local supply capability and the potential need 															

Date	Entity	Document	Reliability Impacts	Security Impacts
				<p>to increase the requirement with further growth in large scale PV generation.</p> <ul style="list-style-type: none"> - A local requirement of contingency lower FCAS is also procured in South Australia during periods where the likelihood of the trip of the Heywood interconnector is elevated. The requirement is co-optimised with the flow on the interconnector. - Local contingency raise services are only procured during periods when South Australia is operating as an island. This is in keeping with the frequency standard applicable at the time of the 2016 ESOO. - AEMO raise concerns about the limited source of contingency FCAS citing an example from 1 November 2015 when local FCAS prices were set at the market price cap (\$13,800/MWh) following a separation event. - AEMO identified that rate of change of frequency for the non-credible loss of the Heywood Interconnector could become very high. Retirement of synchronous generation and operation of Heywood Interconnector at 650MW has the potential to lead to a RoCoF exceeding +/-4 Hz/s. If RoCoF exceed +/- 1Hz/s AEMO may not be able to maintain secure operation of the power system. <p>PEC would have the ability to address each of the system security concerns identified by AEMO in the 2016 ESOO.</p>

Table 5 PEC – Reliability & Security Impacts – ISP and associated system security reports

Date	Entity	Document	Reliability Impacts	Security Impacts
2024	AEMO	ISP	<p>PEC has its full capacity timing advised by the proponent as of:</p> <ul style="list-style-type: none"> + Stage 1: December 2024 + Stage 2: July 2027 <p>No explicit reliability analysis related to PEC was presented in the 2024 ISP.</p>	<p>The Appendices to the ISP identify the following security benefits delivered by PEC:</p> <ul style="list-style-type: none"> – Increase system strength at Red Cliffs in northwest Victoria – South Australia is not likely to island once PEC stage 2 is complete – Completion of PEC stage 2 with necessary protection schemes in place to manage the non-credible loss of either PEC or HIC will address inertia shortfalls in South Australia.
2024	AEMO	<p>System Strength Report</p> <p>In addition, AEMO also produced inertia and NSCAS reports in 2024.⁴²</p>	<p>No explicit reliability analysis related to PEC was presented in the 2024 reports.</p>	<p>PEC is expected to improve system strength in Southwest New South Wales, Northwest Victoria and South Australia:</p> <ul style="list-style-type: none"> – Stage 1 offers increased system strength across all nodes in South Australia, Buronga and Red Cliffs – Stage 2 offers further improvements in system strength at those nodes and also Darlington Point <p>PEC is expected to remove the requirement of two synchronous units being online in South Australia.⁴³</p> <p>While the system strength report did not identify any shortfall in South Australia this results from the modelling assuming a minimum number of synchronous generators being in service prior to the commissioning of PEC stage 2.</p> <p>Apart from revised timing for PEC the inertia and NSCAS reports identified consistent security benefits to the 2021 SSI report.</p> <p>The 2024 Inertia report identified that inertia shortfalls in South Australia identified in previous reports have been addressed through the procurement of capacity via the 1-second frequency control ancillary service market. The modelling to assess shortfalls assumed the continuation of the existing approach to maintaining a minimum number of synchronous generators online in South Australia until PEC stage 2.</p>

⁴² [AEMO | System Security Planning](#)

⁴³ [2024-system-strength-report.pdf](#)

2024	AEMO	Managing Minimum System Load ⁴⁴	Reports primarily address measured required to ensure system security with reducing minimum system loads.	<p>In 2024 AEMO published a report documenting challenges in maintaining security under minimum load conditions driven by high levels of distributed resources.⁴⁵ The report identified challenges in being able to dispatch the minimum amount of synchronous generation required to maintain system security when there are high levels of generation from distributed PV. The report identifies the need for Emergency Backstop mechanism that allows curtailment of distributed PV to maintain system security. The requirement is to enable mechanisms that can maintain 400MW of minimum demand in South Australia following an unplanned outage that disconnects South Australia from the rest of the NEM.</p> <p>The report identified that in 2024 the emergency backstop capability was 33MW below that required to maintain system security and the gap is forecast to increase over time. AEMO identified that improvement in compliance with backstop capabilities is an urgent priority and that delivering PEC is one of a number of measures that will help address the identified gap.</p> <p>The report identifies that without PEC from 2026 the 90% POE South Australia demand will be below the threshold that will require the Emergency Backstop mechanism to be enacted to maintain system security.</p> <p>When complete, PEC will help address these system security challenges:</p> <ul style="list-style-type: none"> – PEC establishes a new interconnection with South Australia making it much less likely that South Australia will be separated from the NEM. This removes the requirement for synchronous generation in South Australia and thereby reduces the required amount of emergency backstop capability – PEC will increase the export capability from South Australia allowing export of excess generation when minimum demand periods in South Australia are not aligned with minimum demand periods in other regions. However, by the time PEC is fully commissioned, all NEM regions may on occasion simultaneously be experiencing low demand, which limits the ability to export excess generation from South Australia.
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⁴⁴ [AEMO | Managing Minimum System Load \(MSL\)](#)

⁴⁵ [Supporting secure operation with high levels of distributed resources Q4 2024](#)

				<p>The report also identified shortfalls in 2025 in New South Wales in providing the required emergency backstop capability necessary to hold minimum demand above the thresholds to enable the dispatch of the synchronous generation required to maintain system security. While not stated in the AEMO report GHD expects that PEC will provide greater ability to export power from New South Wales and may therefore assist with meeting the threshold required to maintain system security in New South Wales. The benefit would not arise if minimum demands were experienced in New South Wales and South Australia at the same time.</p>
2024	AEMO	Transition plan for System security ⁴⁶	No explicit reliability analysis related to PEC was presented in this report.	<p>In December 2024 AEMO published a report presenting the transition plan for system security to meet new obligations arising for the Improving Security Frameworks rule change that commenced in March 2024.</p> <p>The report outlined a plan to maintain power system security for the NEM through the transition to a low-emissions power system and complements the ISP, system security reports and the engineering roadmap program. The plan presents the system security services required across three time horizons with Horizon 1 covering the near term (next two years).</p> <p>The report identifies that a key security cost that has arisen in Horizon 1 relates to the costs incurred by AEMO when it directs synchronous generation in South Australia to ensure the minimum number of units are online. The Figure below shows the substantial cost of directions to maintain 2 synchronous generators online.</p> <p>Figure 8 South Australian security directions: proportion of time by number of directed units, direction costs quarterly</p> <p>The plan identified that AEMO was exploring whether it could reduce the number of synchronous generators online from two to one and identified the possibility for</p>

⁴⁶ [aemo-2024-transition-plan-for-system-security.pdf](#)

				<p>that to occur in early 2025, but only under favourable conditions. Under other conditions a minimum of two large synchronous generators are required to be online. This aligns with the information provided in the August 2023 industry update summarised below, however the industry update concluded that as the favourable conditions were unlikely to arise, the current approach of requiring two synchronous generators to be online would continue.</p> <p>The implementation of revised transfer limit that can be implemented under favourable conditions and allow a reduction to one synchronous generator to be online does not appear to have occurred as the relevant transfer limit advice has not been revised, as noted below.</p> <p>The plan identifies that commissioning of PEC stage 2 is expected to have a significant system security benefit by allowing the minimum number of synchronous generators to be reduced to zero.</p>
2024	AEMO	Transfer limits advice – system strength in SA and Victoria ⁴⁷	No explicit reliability analysis related to PEC was presented in this report.	<p>In April 2024 AEMO published revised limits advice describing the constraint equations currently implemented in the NEM dispatch engine to ensure the power system remains in a secure operating state. The limits advice address constraints required to maintain sufficient system strength.</p> <p>Section 2.1 of the document presents a table defining the combinations of generation and synchronous condensers that need to be dispatched in South Australia to maintain the required level of system strength. That table demonstrates that currently AEMO requires a minimum of two large synchronous generators to be dispatched in South Australia together with four synchronous condensers to maintain sufficient system strength to ensure power system security.</p>
2023	AEMO	SA minimum synchronous generator requirements ⁴⁸	No explicit reliability analysis related to PEC was presented in this report.	<p>This industry update presented a summary of work being pursued by AEMO and ElectraNet to explore whether the minimum number of synchronous generators required in South Australia could be reduced while maintaining system security.</p> <p>The document identified the following potential requirements for synchronous generation:</p>

⁴⁷ [transfer-limit-advice-system-strength.pdf](#)

⁴⁸ [SA minimum synchronous generator requirements](#)

				<ul style="list-style-type: none"> – Provide grid reference voltage – Ensure correct operation of protection – Maintain adequate voltage control – Maintain adequate frequency control – Ensure sufficient ramping capability – Ensure sufficient system strength – Ensure sufficient inertia <p>The studies have identified that maintaining at least two on large synchronous generator online was required to maintain adequate voltage control. Which is consistent with the current system strength limit advice.</p> <p>The delivery of PEC stage 2 is expected to allow relaxation of these requirements.</p>
2022	AEMO	ISP	<p>In this ISP, PEC’s regulatory status was classified into “Anticipated” project with delivery date was moved to July 2026.</p> <p>No explicit reliability analysis related to PEC was presented in the ISP.</p>	<p>The Appendices to the ISP identify the following security benefits delivered by PEC:</p> <ul style="list-style-type: none"> – Improves the system strength outlook in South-West New South Wales and Northern Victoria – Address the issue with inertia and fault level shortfalls in South Australia. – Improves resilience to event causing a trip of the Heywood interconnection by providing an alternate interconnection.
2022	AEMO	<p>The following report were produced in 2022:</p> <ul style="list-style-type: none"> – Inertia report – NSCAS report – System Strength report⁴⁹ 	No explicit reliability analysis related to PEC was presented in those reports.	<p>Those reports identified consistent security benefits to the 2021 System Security Report.</p> <p>The inertia report noted that the identified inertia shortfall may be addressed through the provision of fast frequency response services.</p>
2021	AEMO	System Security Report ⁵⁰	No explicit reliability analysis related to PEC was presented in the system security report.	<p>The report claimed that the four new synchronous condensers installed in South Australia will meet the system strength requirements for the considered outlook period (2021-2026). In addition, PEC will help improve system strength in the longer term.</p> <p>AEMO declared an inertia shortfall from 1 July 2023 until the completion of inter-network testing of PEC (assumed by the end of July 2025), against the secure operating level of inertia in the South Australia region. With such</p>

⁴⁹ [AEMO | System Security Planning](#)

⁵⁰ [system-security-reports.pdf](#)

				<p>completion, AEMO expects that South Australia will no longer be considered likely to island and therefore a shortfall will not be expected after that date.</p> <p>Therefore, until the commissioning and testing of PEC is complete, at least two synchronous generating units must remain online for system security purposes.</p>																																								
2020	AEMO	ISP	<p>The RiverLink interconnected had its name changed to PEC and was considered as the low-regret actionable project which is already being progressed by TNSPs.</p> <p>No explicit reliability analysis related to PEC was presented in the 2020 ISP. However, reliability is discussed in the Appendix discussing power system operability. It identifies the following reliability impacts for PEC:</p> <ul style="list-style-type: none"> – Generation retirements in New South Wales (Liddell) and South Australia (Osborne) in 2023-24 may lead to USE in excess of the IRM in both regions, with the reliability risks in both regions reducing following the commissioning of PEC which is assumed to occur in 2024-25. <p>Figure 3 Central scenario reliability assessment, snapshot years</p> <table border="1"> <caption>Estimated data for Figure 3: USE as a share of regional demand (%)</caption> <thead> <tr> <th>Region</th> <th>2023-24</th> <th>2027-28</th> <th>2029-30</th> <th>2032-33</th> </tr> </thead> <tbody> <tr> <td>NSW</td> <td>0.0010%</td> <td>0.0002%</td> <td>0.0001%</td> <td>0.0001%</td> </tr> <tr> <td>QLD</td> <td>0.0008%</td> <td>0.0001%</td> <td>0.0001%</td> <td>0.0001%</td> </tr> <tr> <td>VIC</td> <td>0.0001%</td> <td>0.0001%</td> <td>0.0001%</td> <td>0.0001%</td> </tr> <tr> <td>SA</td> <td>0.0005%</td> <td>0.0001%</td> <td>0.0001%</td> <td>0.0005%</td> </tr> <tr> <td>TAS</td> <td>0.0000%</td> <td>0.0000%</td> <td>0.0000%</td> <td>0.0000%</td> </tr> <tr> <td>Reliability Standard</td> <td>0.0020%</td> <td>0.0020%</td> <td>0.0020%</td> <td>0.0020%</td> </tr> <tr> <td>IRM equivalent</td> <td>0.0005%</td> <td>0.0005%</td> <td>0.0005%</td> <td>0.0005%</td> </tr> </tbody> </table> <ul style="list-style-type: none"> – Without PEC, South Australia is forecast to continue relying on local synchronous generators for the foreseeable future. In this scenario retirement of existing GPG is a key concern for the security and reliability outlook of South Australia. Without further interconnection, investments in new synchronous generation capacity will be required in response to Osborne withdrawal as well as when Pelican Point retires in the mid-2030s. 	Region	2023-24	2027-28	2029-30	2032-33	NSW	0.0010%	0.0002%	0.0001%	0.0001%	QLD	0.0008%	0.0001%	0.0001%	0.0001%	VIC	0.0001%	0.0001%	0.0001%	0.0001%	SA	0.0005%	0.0001%	0.0001%	0.0005%	TAS	0.0000%	0.0000%	0.0000%	0.0000%	Reliability Standard	0.0020%	0.0020%	0.0020%	0.0020%	IRM equivalent	0.0005%	0.0005%	0.0005%	0.0005%	<p>The 2020 ISP classified PEC as an ‘actionable ISP project’ which will deliver net market benefits and support energy market transition through⁵¹:</p> <ul style="list-style-type: none"> – Lowering dispatch costs, initially in South Australia, through increasing access to supply options across regions; – Facilitating the transition to a lower carbon emissions future and the adoption of new technologies, through improving access to high quality renewable resources across regions; and – Enhancing security of electricity supply in South Australia. <p>AEMO finds that PEC is required immediately in all scenarios it has considered in the ISP.</p> <p>The ISP appendices provide additional information on the security benefits delivered by PEC:</p> <ul style="list-style-type: none"> – The 330 kV transmission lines, as well as the synchronous condensers associated with PEC will improve the system strength outlook around central South Australia, western Victoria, and south-west New South Wales – The commissioning of PEC will result in two double-circuit HVAC links and one HVDC link from South Australia to other NEM regions, meaning the risk of having to operate as an island will be significantly reduced. After PEC is commissioned, and no gas plant are required to be online in South Australia to manage RoCoF. – PEC will significantly reduce the likelihood of operating South Australia as an electrical island, and therefore mitigate the need to procure FFR to manage islanded operation – PEC will resolve the need to maintain headroom of the Heywood interconnector for credible contingencies in South Australia
Region	2023-24	2027-28	2029-30	2032-33																																								
NSW	0.0010%	0.0002%	0.0001%	0.0001%																																								
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Reliability Standard	0.0020%	0.0020%	0.0020%	0.0020%																																								
IRM equivalent	0.0005%	0.0005%	0.0005%	0.0005%																																								

⁵¹ AEMO, 2020 Integrated System Plan, July 2020, p.86.

				<ul style="list-style-type: none"> – PEC will reduce the likelihood of operating in conditions where a separation is credible and therefore reduce the impact of limits that manage those conditions – PEC improves the resilience of the power system by reducing the likelihood of islanding South Australia. <p>The removal of the requirement to run a minimum number of synchronous generators in South Australia once PEC is complete, allows that gas fired generation to be replaced by renewable generation and appears a substantial fuel cost savings in the market benefits reported for PEC in the ISP.</p>
2020	AEMO	Minimum Load thresholds in South Australia ⁵²	No reliability analysis related to PEC was presented in the report.	<p>The report considered the security and operability challenges under minimum demand conditions in South Australia. The report identified delivery of PEC as a crucial “no regrets” measure providing the fundamental underpinning for power system operability. The report identified a key power system security challenge is ensuring load is maintained above the minimum level required to keep synchronous generators online when South Australia is islanded.</p> <p>PEC was identified as reducing the likelihood of South Australia islanding, and alleviating the most challenging system security issues identified in the report.</p> <p>The report stated that if PEC does not proceed, extensive further measures (beyond those outlined in this report) will be required to address identified system security risks. Potential further measures could include commissioning significant utility-scale storage to provide FFR, retrofit of a large number of distributed PV systems to improve disturbance ride-through capabilities, resistor banks for managing excess distributed generation, and possibly a moratorium on new distributed PV connections.</p> <p>The report identified that the key benefits delivered by PEC include:</p> <ul style="list-style-type: none"> – Substantially reduces risk of islanding – Increases system strength – Increases import and export capabilities – Reduces risks associated with non-credible contingencies (such as loss of the Heywood interconnector)

⁵² [minimum-operational-demand-thresholds-in-south-australia-review.pdf](#)

				<ul style="list-style-type: none"> – Reduces need for local frequency and inertia services <p>The report identified one of the most important measures to mitigate security challenges is to ensure PEC is commissioned as rapidly as possible to remove the incidence of periods with a credible risk of separation.</p> <p>AEMO shared the report with the AER to emphasise the importance of PEC for ongoing security of the South Australia power system. The report identified the following key security benefits delivered by PEC:</p> <ul style="list-style-type: none"> – When AEMO must constrain Heywood flows in periods where the UFLS load is inadequate to manage the double circuit loss of the interconnector, PEC will act to alleviate this constraint, reducing impacts on market participants. – When AEMO must constrain Heywood flows in periods where distributed PV disconnection could cause inadvertent load shedding and possible separation from the rest of the NEM, PEC will act to alleviate this constraint, reducing impacts on market participants. – Operating South Australia as an island is expensive. For example, in the extended island operation, the cost of directions to scheduled participants in the South Australia region could be around \$9m, with FCAS costs to customers summing to \$36.5m. By reducing the likelihood of islanding, PEC would reduce the incidence of these costs. – It is becoming increasingly infeasible to operate South Australia as a secure island in periods with high levels of distributed PV generation. PEC considerably reduces the probability-weighted cost of a black system event, associated with a synchronous unit trip associated with a severe credible fault and disconnection of distributed PV, when South Australia is operating as an island.
2020	AEMO	System Strength and Inertia (SSI) Report	No reliability analysis related to PEC was presented in the 2020 SSI report.	<p>The report identifies that the following system security benefits will be delivered by PEC:</p> <ul style="list-style-type: none"> – The report emphasized that the previously declared shortfall of system strength at Red Cliffs will continue until the commissioning of the PEC. – The inertia shortfall in South Australia would be addressed by PEC. – PEC allows increased sharing of system strength between regions

				<ul style="list-style-type: none"> – PEC significantly reduces the likelihood of South Australia becoming islanded from the rest of the NEM – PEC removes the requirement to maintain a minimum of two synchronous generators in South Australia to meet system strength requirements⁵³
2019	AEMO	NSCAS Report	No reliability analysis related to PEC was presented in the 2019 NSCAS report.	<p>The report identified the following system security benefits delivered by PEC:</p> <ul style="list-style-type: none"> – Page 8 of the report identified that the synchronous condensers proposed as part of PEC would address emerging voltage control issues under minimum demand conditions in the Wagga Wagga area – Page 11 identifies that PEC will improve system strength in northwest Victoria and assist with voltage management – Page 14 identifies that PEC in combination with VNI and Western Renewables project all help to improve the limits on interconnector flows between Victoria and New South Wales: <ul style="list-style-type: none"> • transient stability limit for a fault and trip of a HWTS-SMTS 500 kV line and • the voltage collapse limit around Murray for loss of all APD potlines⁵⁴.
2018	AEMO	ISP	<p>In the Executive Summary, the ISP 2018 indicated that its analysis supports a new interconnector between South Australia and New South Wales, referred to as RiverLink (750 MW). It identified a range of further expected benefits from RiverLink, which as well as improving resilience for South Australia (the risk of islanding of the South Australian network will be greatly reduced with RiverLink in place, p.71), would enable connection of large amounts of renewable energy resources from the Riverland to Murray REZ, as well as improving inter-regional trade and competition, especially if linked to developments to support the Snowy 2.0 project in the 2020s and planned augmentation of the VNI interconnection. At that time, RiverLink was under assessment by ElectraNet as part of the South Australian Energy Transformation RIT-T.</p> <p>The ISP identified fuel cost savings as the key benefit delivered by RiverLink, other benefits included:</p>	<p>The ISP listed several benefits related to security impacts:</p> <ul style="list-style-type: none"> – With growing levels of DER in South Australia AEMO identified that maintaining system security under minimum demand conditions is becoming increasingly difficult. A joint report by AEMO and ENA called the Open Energy Network report included a case study for South Australia. It identified several emerging challenges that if not addressed would make it impossible to maintain system securing under minimum demand conditions. The ISP identified that the delivery of another interconnection is vital for system security. – With a second interconnection gas powered generation (GPG) would not be required to remain online in South Australia to maintain system security. AEMO projects that a new synchronous interconnector to South Australia, in combination with system strength remediation, will remove or

⁵³ [2020-system-strength-and-inertia-report.pdf](#)

⁵⁴ [2019 nscas report.pdf](#)

			<ul style="list-style-type: none"> – Improving network capacity for this transmission route allows for potential new REZs that could be accessed along the RiverLink corridor, opening up the Riverland and Murray REZ (which was also identified by the New South Wales Government as a priority, the “Southwest” energy zone). – The upgrade is projected to help use resources more efficiently across the NEM, with greater supply sharing between New South Wales, Victoria, and South Australia. <p>While not explicitly mentioning reliability, the enhanced supply sharing mentioned in the last dot point should assist to maintain reliability.</p> <p>The market modelling undertaken for the 2018 ISP adopted a similar approach to the RIT-T market modelling discussed in Table 2. That is the optimisation of generation in each of the ISP scenarios seeks to delivery reliability consistent with the reliability standard. The ISP therefore does not provide an explicit assessment of reliability impacts of interconnector augmentation proposals.</p>	<p>significantly alleviate the requirement to keep large synchronous generators online in South Australia. The simulation results obtained from the Neutral case with no interconnector augmentations pointed out that the RiverLink interconnector helps in reducing risks associated with power system security in South Australia, leading to lower overall utilization of GPG. Specifically, this Neutral case without the development of the RiverLink interconnector indicated that GPG utilization continues to be much higher than all other scenarios which develop that interconnector. That fact was demonstrated in Figure 23 (p.47) which shows a significant increase in the amount of GPG in the scenario without RiverLink.</p> <p>Figure 23 Projected installed capacity, no interconnector reference, relative to Neutral case</p> <p>The 'increased' CCCT capacity for this scenario is due to the continued operation of South Australian GPG in this scenario, relative to the Neutral case, which would allow GPG to mothball or retire due to the introduction of increased interconnection via the RiverLink interconnector.</p>
2022	AEMO	ISP Feedback Loop Notice (HomeLink early works) ⁵⁵	The notice issued by AEMO confirmed that HomeLink remained an actionable project and part of the optimal development plan despite revised project costs. The notice did not specifically address reliability or security impacts of PEC.	

⁵⁵ [isp-feedback-loop-notice-humelink-early-works.pdf](#)

Table 6 PEC – Reliability & Security Impacts – TAPR

Date	Entity	Document	Reliability Impacts	Security Impacts
2024	Transgrid	TAPR	The TAPR focuses on delivery and the scope of work for PEC and does not quantify expected reliability impacts.	The TAPR focuses on delivery and the scope of work for PEC and does not quantify expected security impacts.
2024	ElectraNet	TAPR	The TAPR focuses on delivery the scope of work for PEC and does not quantify expected reliability impacts.	<p>The TAPR 2024 pointed out that the current 250 MW import limit to the Heywood Interconnector for destructive wind conditions that could result in the loss of multiple transmission elements causing generation disconnection in SA (to reduce the risk of islanding) can be increased after the releasing of capacity for PEC Stage 1 (according to 2024 GPSRR).</p> <p>There is also currently a constraint set in place to maintain South Australia’s rate of change of frequency (RoCoF) below 2 Hz/s immediately following the non-credible loss of the Heywood interconnector, which was introduced to meet the requirements of under regulation 88A of the Electricity (General) Regulations 2012 (SA)⁵⁶. Given PEC Stage 1 will be inter-tripped for the non-credible loss of the Heywood interconnector AEMO recommends that these constraints will remain in place following commissioning of PEC Stage 1. The contracting of fast frequency response services to provide additional inertia will not be required following the commissioning of PEC. In December 2023, AEMO declared an inertia shortfall of 500 MWs from 1 July 2024 until PEC Stage 2 is operational and appropriate control schemes are in place. This shortfall could be met by an equivalent quantity of 30 MW of FFR contracts, or by further registrations in the 1-second FCAS market.¹³ On 12 June 2024, AEMO notified ElectraNet that sufficient registrations of 1-second FCAS had been registered and that ElectraNet would not be required to provide FFR from 1 July 2024. ElectraNet has subsequently cancelled all inertia shortfall agreements.</p> <p>Several constraints on transmission system are expected to be alleviate with the commissioning of PEC:</p> <ul style="list-style-type: none"> – Vic to SA Transient Stability limit for loss of the largest generation block in SA (Both South East Capacitor available).

⁵⁶ While regulation 88A refers to keeping RoCoF in South Australia above 3 Hz/s studies, concerns regarding the potential for subsequent trips of gas turbines if exposed to this level of RoCoF lead to the constraints implemented targeting 2 Hz/s.

Date	Entity	Document	Reliability Impacts	Security Impacts
				<ul style="list-style-type: none"> – Limit on Heywood interconnection flow to prevent RoCoF of exceeding 2Hz/s in SA immediately following loss of Heywood interconnector.

Appendices

Appendix A

Reliability and Security Definitions

This Appendix has been added to capture key definitions assumed in drafting the statement of facts. It is intended as a drafting aid and may be deleted from the final version of the document.

NER Clause 6A.7.1 (a)(6) identifies that a key condition for any re-opening of a revenue determination is that failure to do so would likely to materially adversely affect **reliability** and **security of** the relevant transmission system. This points to the need to consider the impact of PEC not proceeding on the reliability and security of the NEM.

Reliability

This is a defined term in the NER with the following definition provided in chapter 10

The probability of a system, device, *plant* or equipment performing its function adequately for the period of time intended, under the operating conditions encountered.

While the above definition is quite general the NER provides further clarity on reliability through the definition of a reliable operating state in clause 4.2.7. The NEM is in a reliable operating state if there is no involuntary load shedding occurring and AEMO expects that the reliability standard will be met.

The reliability standard for the NEM is defined in clause 3.9.3C(a) of the NER. The standard specifies a maximum acceptable level of unserved energy resulting from insufficient generation or transmission capacity to meet demand. The standard sets a USE limit of 0.002% of the total energy demanded in a region for the financial year. A lower threshold of 0.0006% USE is specified as an interim reliability measure. If the interim reliability measure is forecast to be exceeded this triggers provisions in the NER allowing contracting for additional reserve capacity.

For the purposes of this paper the reliability impact of PEC has been assessed by considering the impact on USE that is expected if PEC stage 2 is not delivered.

Some studies such as those performed by AEMO for the ESOO allow a direct measure of the expected USE impact which can then be turned into a monetary amount by multiplying the USE by the Value of Customer Reliability (VCR) approved by the AER.

Other assessments such as the market modelling undertaken for the ISP and the application of the RIT-T tend to build constraints into the generation expansion algorithm that select the least investment option that will deliver a level of reliability consistent with the reliability standard. As such the reliability benefit delivered by a new interconnector such as PEC may appear in part through generation capex and opex savings achieved by allowing sharing of reserve capacity between regions and may not be fully captured by changes in modelled USE outcomes.

Power System Security

Power system security is defined in the NER as the safe scheduling, operation and control of the *power system* on a continuous basis in accordance with the principles set out in clause 4.2.6. Those principles require:

- AEMO to operate the power system such that to the extent practicable it remains in a secure operating state
- That following a contingency event AEMO take steps to return the power system to a secure operating state as soon as practical and in any event within 30 minutes.
- Provision of sufficient emergency frequency control schemes to restore the power system to a satisfactory operating state following protected events and significantly reduce the risk of cascading outages and major supply disruptions due to multiple contingency events
- Sufficient system restart ancillary services
- Sufficient inertia available in each inertia sub-network
- Sufficient three phase fault level at each system strength node to meet system strength requirements
- Appropriate use of reclassification of contingencies to reduce the risk caused by multiple contingency events

NER clause 4.2.4 specifies that the following conditions need to be met for the power system to be in a secure operating state:

- The power system is in a satisfactory operating state (i.e. all plant operating within limits, frequency and voltage is being controlled within acceptable ranges for normal operation, fault currents will not exceed circuit breaker ratings, and the power system is stable) and
- The power system will return to a satisfactory operating state following any credible contingency event or protected event.

Power system security is a measure of the ability of the power system to ride through a credible contingency event or protected event landing in a satisfactory operating state and within 30 minutes return to a secure operating state in which it is again able to ride through another credible contingency or protected event.



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