Transgrid

Maintaining reliable supply to Broken Hill

RIT-T - Project Assessment Conclusions Report

Region: South Western New South Wales

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Summary

Broken Hill is located in the far west of New South Wales (NSW) and is part of our south-western transmission network. It is currently supplied by a single 220 kV transmission line, 'Line X2', from Buronga which spans approximately 260 km.

When Line X2 is out of service due to planned or unplanned outage, electricity supply to Broken Hill is supported by two diesel-fired turbines (currently owned by Essential Energy) to avoid involuntary load shedding. We rely on these turbines to meet the NSW Electricity Transmission Reliability and Performance Standards 2017 (the 'reliability standards') set by the NSW Energy Minister and regulated by the NSW Independent Pricing and Regulatory Tribunal (IPART).

Essential Energy notified us in late-2018 of its decision to divest the turbines located at Broken Hill. Without action, this would result in the required reliability of supply to Broken Hill not being maintained, and involuntary load shedding when Line X2 is on a planned or unplanned outage.

This Regulatory Investment Test for Transmission (RIT-T) process was initiated in November 2019 to assess options for continuing to provide reliable supply to Broken Hill. Publication of this PACR represents the final stage in the RIT-T process and follows the revised Project Assessment Draft Report (PADR) released on 6 October 2021.

Overview

The PACR finds that the continued operation of the existing diesel-fired turbines as an interim measure, followed by network support provided by the Hydrostor compressed air storage solution (Option 1A(4)) is the top-ranked option, followed closely followed by refurbishing and continuing the long-term use of the existing diesel-fired turbines (Option 2). Option 1A(4) is projected to deliver approximately $286 million in net benefits over the 27 year assessment period (on a weighted-basis), which is approximately 5.8 per cent greater than Option 2.

This finding marks a change from the conclusion in the PADR, which found Option 2 to be the top-ranked option (by a 9 to 12 per cent margin over Option 1A(2)), and reflects both an increase in the estimated wholesale market benefit from the energy storage solution (following alignment with the assumptions in the draft 2022 ISP released in December 2022) and that Hydrostor now expects to secure a significant external funding contribution from ARENA for Option 1A(4).

In addition to having a marginally greater expected net benefit, we consider Option 1A(4) to be preferred over Option 2 at this stage since it:

- uses a clean technology that is consistent with the general transition of the electricity sector to low emission technologies – Option 2 has an enduring reliance on fossil fuel technologies as part of the long term solution to meet reliability standards at Broken Hill, which we consider less preferable in the context of the general transition of the electricity sector to low emission technologies, and the Sustainability Strategy of Broken Hill City Council;
- supports the use of innovative solutions to meeting network needs, which may provide an example that can be adopted more widely – we have undertaken a holistic review and are confident that the compressed-air energy storage solution is technically feasible (this review has been supported by an independent technical assurance report from Aurecon);
- is able to efficiently accommodate additional mining load at Broken Hill, should it eventuate – Option 2 would require coupling with additional components to meet this additional load, which

would increase the future costs of this option and, potentially, compromise the level of reliability provided to customers in Broken Hill;

- has a lower level of unavailability due to outages (which reduces the risk of disruptions to customer supply in Broken Hill) – Option 2 requires significant refurbishment of the existing turbines that requires them to be out of service while this is undertaken; and
- is expected to have a further modest increase in net benefits if more available transmission capacity west of Wagga Wagga is assumed as a result of the anticipated investment under the separate RIT-T Transgrid is currently finalising to alleviate a voltage stability limit at Darlington Point – this development would not affect the net benefits of Option 2.

Notwithstanding the above, we consider that if either of the following two events occur, they would likely constitute a 'material change in circumstances' (i.e., under clause 5.16.4(z3) of the NER):

1. ARENA and Hydrostor not being able to finalise a funding agreement with a sufficient upfront external capital contribution; or
2. Transgrid and Hydrostor not being able to finalise a network support contract that is expected to be accepted as prudent and efficient by the AER.

Should either of these events occur, we would seek an exemption from the AER under clause 5.16.4(z3) of the NER to avoid having to reapply the RIT-T. Specifically, we consider that, should either of the above events occur, then the analysis in this PACR demonstrates that Option 2 should then be considered the preferred option under this RIT-T, unless Hydrostor were to decide to pursue a smaller-scale option (Option 1A(2)), which would then become the preferred option, even in the absence of external funding.

We consider this approach provides sufficient confidence that Transgrid will be able to progress an option to ensure the required reliability to consumers at Broken Hill at an efficient cost level without having to re-do the RIT-T. We note that re-doing the RIT-T would take significant time, which would compromise the reliability of supply to customers at Broken Hill and ultimately likely cost all NSW electricity customers more in the long-run.

We will be liaising closely with ARENA and Hydrostor to monitor how Option 1A(4) progresses through the various 'stage gates' ARENA has identified for its funding, in order to assess whether the above conditions are expected to be met within the timeframes outlined in this PACR.

In terms of the required external capital contribution, we consider a 'sufficient' amount to be an amount that results in Option 1A(4) being either within 5 per cent of, or outright preferred to, Option 2 on a weighted basis across the three scenarios assessed. While we note that this value depends on a range of factors, including the assumed cost of Option 1A(4) and the profile of the funding contribution, we currently consider this value to be at least $13.2 million if provided in full up-front, based on the PACR assessment.

We will update stakeholders when we consider either that both the external funding agreement and the network support agreement for Option 1A(4) are sufficiently certain, or at the point we determine there has been a material change in circumstances and that either Option 2 or Option 1A(2) should instead be progressed (i.e., when we would submit an exemption to the AER from having to reapply the RIT-T).

Assuming Option 1A(4) is progressed, the start-date for the network support contract would coincide with the expected commissioning date for the compressed-air solution in 2025/26.

Both Option 1A(4) and Option 2 are expected to generate sufficient benefits to recover their costs within ten years of commissioning their respective long-term solutions (under the weighted results).

Benefits from the options considered in this PACR

We consider this a 'reliability corrective action' under the RIT-T, as the identified need is to ensure that the externally-imposed IPART reliability standards for Broken Hill continue to be met. Without action, the required reliability of supply to Broken Hill would not be maintained, and there would likely be involuntary load shedding when Line X2 is on a planned or unplanned outage.

We are taking action under this RIT-T in order to avoid this outcome. All of the credible options assessed in this PACR provide back-up and reliable supply to Broken Hill for the future that is consistent with the NSW reliability standard and so avoid significant amounts of unserved energy to consumers in Broken Hill.

In addition, some of the credible options assessed also affect the wholesale electricity market. In particular:

- some options involve grid-connected storage that introduce new entities trading in the wholesale market, eg, dispatching into the National Electricity Market (NEM) outside of the allocation of storage needed to meet its Broken Hill network support commitments; and
- the impact on network capacity under some of the options facilitates greater uptake of renewables in surrounding Renewable Energy Zone (REZ) areas.

Both the benefits from the provision of reliable supply to Broken Hill and wider wholesale market benefits have been estimated as part of this PACR.

Key developments since the PADR have been reflected in the PACR

There have been a number of key developments since the revised PADR was released in October 2021 that have affected the analysis in this PACR. In particular:

- AEMO released its draft 2022 Integrated System Plan (ISP) in December 2021 – the wholesale market modelling in this RIT-T has been updated to reflect the assumptions underpinning the draft 2022 ISP, and the wholesale market benefits have also now been explicitly modelled for AEMO's step-change, progressive change and hydrogen superpower scenarios;
- the proponent of Option 1A(4) (Hydrostor) expects to secure funding from the Australian Renewable Energy Agency (ARENA) for its 200MW/1500MWh compressed-air energy storage solution, which has been included in the RIT-T analysis as 'external funding' for Option 1A(4); and
- the battery component of Option 1D has been progressed independently by the proponent (AGL) to a stage where we now consider a smaller-scale battery to be appropriately treated as an effectively 'committed' investment, and included in the base case for this RIT-T. As a consequence, only the incremental capital cost of increasing the size of this battery to provide network support is now reflected in the RIT-T assessment.

In addition, Transgrid agreed in January 2022 to purchase the existing turbines from Essential Energy to ensure supply reliability at Broken Hill is not compromised ahead of the optimal long-term solution being able to be implemented. The continued use of the existing diesel-fired turbines is the only way for us to meet our supply reliability obligations at Broken Hill in the immediate term and, based on the findings of the PADR, we consider this purchase to be a 'no regrets' decision as the continued use of the existing turbines, at least in the near-term, was found to be a common feature across all three of the top-ranked options in the PADR assessment. All options assessed in the PACR require continued use of the diesel-fired turbines in the short-term to continue to meet the reliability standards at Broken Hill, prior to the delivery and

commissioning of the main option components, with the exception of Option 1D and Option 2 (both of which require the on-going use of the existing diesel-fired turbines).

We also note that a number of options are no longer being assessed in this RIT-T:

- Hydrostor has withdrawn the different sizes of its compressed air energy storage solution that were included in the PADR, other than Option 1A(4), (i.e., Option 1A(1), Option 1A(2), Option 1A(3) and Option 1A(5) have all been withdrawn by the proponent);
- the proponent of Option 1C/5C, Option 5B and Option 1E/5E from the PADR has withdrawn these options,[1] and so they are no longer included in the RIT-T assessment; and
- Options 5A(1)-(5), which involved Transgrid ownership of a compressed-air-energy storage facility built by Hydrostor are no longer considered credible options as Hydrostor has now indicated its preference to proceed with Option 1A(4) only as a non-network solution.

In addition, we received submissions from four parties in response to the PADR. While submissions covered a range of topics, there were six broad topics that were most commented on:

- support for the use of a compressed-air energy storage solution;
- concern with the reliability of options involving diesel turbines over the long-term, and inconsistency with clean energy goals;
- interaction with potential new mining loads at Broken Hill; and
- the need for consistency with the latest ISP.

The key matters raised in submissions relevant to the RIT-T assessment are summarised in this PACR, together with our responses and how the matters raised have been reflected in the assessment.

The PACR assessment covers five different types of credible options

Stakeholder consultation over the course of this RIT-T has assisted greatly with developing and refining the credible options considered. Specifically, consultation with third parties has enabled this PACR to assess the following five types of credible options:

- Option 1: three different non-network opex solutions, predominantly provided by third parties:
  - Option 1A(4): a 200MW/1500MWh compressed-air energy storage solution provided by Hydrostor;
  - Option 1D: use of the existing 50 MW diesel-fired turbines acquired by the proponent, AGL (and provided to Transgrid as a service), 50MW/75MWh battery and 10 MW demand management; and
  - Option 1F: 100MW/800MWh liquid-air energy storage.
- Option 2: Transgrid acquiring the existing turbines from Essential Energy and refurbishing them as required over the long-term.
  - The costs of this option have been updated since the PADR, based on more accurate information on both the acquisition price and subsequent refurbishment costs;
- Option 3: establishing new diesel-fired turbines at Broken Hill;
- Option 4: building a second single circuit 220 kV transmission line from Buronga to Broken Hill; and
- Option 5G: 50MW/275MWh thermal energy storage, to be wholly or partially owned by Transgrid.

[1] Option 1C/5C involved a 73MW/292MWh battery, Option 5B involved a 62.5MW/250MWh battery and Option 1E/5E involved a 222MW/444MWh battery.

All options reduce expected unserved energy (EUE) at Broken Hill to the amount required under the IPART reliability standard. Option 4 provides an additional level of reliability due to the second transmission line and is assessed to reduce EUE to effectively zero.

Aside from Option 1D and Option 2, which require the on-going use of the existing diesel-fired turbines, all options require continued use of the diesel-fired turbines in the short-term to continue to meet the reliability standards at Broken Hill, prior to the delivery and commissioning of the main option components. It is assumed that Transgrid would own and operate the existing turbines for this interim period.

In order to maintain confidentiality of commercial-in-confidence information in submissions, proponent costs, and cost structures, have not been presented in this PACR.

Three scenarios have been assessed

The RIT-T is focused on identifying the top-ranked credible option in terms of expected net benefits. However, uncertainty exists in terms of estimating future inputs and variables (termed future 'states of the world').

To deal with this uncertainty, the NER requires that costs and market benefits for each credible option are estimated under reasonable scenarios and then weighted based on the likelihood of each scenario to determine a weighted ('expected') net benefit. It is this 'expected' net benefit that is used to rank credible options and identify the preferred option.

The credible options have been assessed under three scenarios as part of this PACR assessment, which differ in terms of the key drivers of the estimated net market benefits.

The three alternative scenarios are characterised as follows:

- a 'low net economic benefits' scenario, involving a number of assumptions that gives a lower bound and conservative estimate of net present value of net economic benefits;
- a 'central' scenario which consists of assumptions that reflect our central set of variable estimates that provides the most likely scenario; and
- a 'high net economic benefits' scenario that reflects a set of assumptions which have been selected to investigate an upper bound of net economic benefits.

The table below summarises the specific key variables that influence the net benefits of the options under each of the scenarios considered.

Table E-1: Summary of scenarios

Variable	Central	Low net economic benefits	High net economic benefits
Network capital costs	Base estimate	Base estimate + 25%	Base estimate - 25%
Non-network costs	Base estimate	Base estimate + 25%	Base estimate - 25%
Broken Hill demand	Based on POE50 demand forecast	Based on POE90 demand forecast	Based on POE10 demand forecast
Wholesale market benefits estimated	EY estimated based on the step-change 2022 ISP scenario	EY estimated based on the progressive change 2022 ISP scenario	EY estimated based on the hydrogen superpower 2022 ISP scenario
VCR	$37.78/kWh	$26.45/kWh	$49.12/kWh
Discount rate	5.50%	7.50%	1.96%

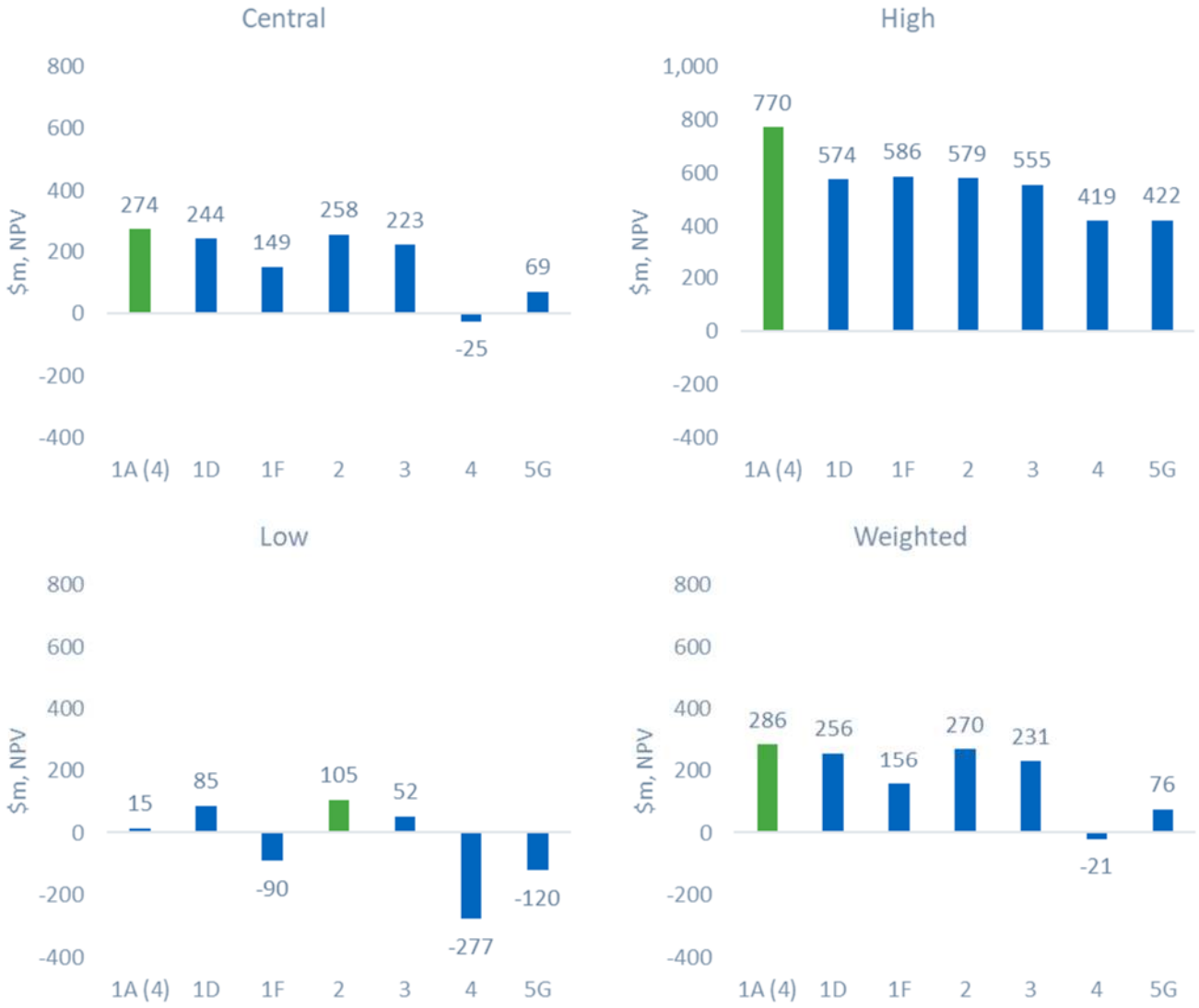
The wholesale market modelling has been updated since the PADR and we now model the market benefits of the options (where relevant) across the three key 2022 ISP scenarios. We have also weighted each of the scenarios for this RIT-T based on the draft 2022 ISP weightings for the underlying ISP scenarios, i.e.:

- 52 per cent to central scenario (based on the step-change scenario in the ISP);
- 30 per cent to the low benefits scenario (based on the progressive change scenario in the ISP); and
- 18 per cent to the high benefits scenario (based on the hydrogen superpower scenario in the ISP).

The Hydrostor network support option is the preferred option

The PACR assessment finds that network support delivered by Option 1A(4) is the preferred option under the RIT-T, closely followed by Option 2. Option 1A(4) is expected to deliver $286 million in net benefits over the 27 year assessment period (on a weighted-basis), which is 5.8 per cent greater than the net benefits expected from Option 2.

Figure E-1.1: Estimated net benefits for each scenario



This finding marks a change from the conclusion in the PADR, which found Option 2 to be the top-ranked option (by between 9 to 12 per cent over a smaller-sized Hydrostor solution (i.e., Option 1A(2)[2])), and reflects both the increase in the market benefits now expected from the Hydrostor option under the updated market modelling and that Hydrostor now expects to secure a significant external funding contribution from ARENA for Option 1A(4). Specifically, the RIT-T assessment of Option 1A(4) in this PACR reflects $45 million of external funding from ARENA, which reduces the cost of this option in the assessment.

The vast majority of the estimated wholesale market benefits for the Option 1A(4) in each scenario comes from its ability to defer, or avoid, significant costs associated with the construction of new, more expensive generation and/or storage capacity in the NEM. In contrast, Option 2 does not allow for any wider wholesale market benefits as the turbines are currently configured to operate only in islanded mode (and

[2] Specifically, the net benefits of Option 1A/5A(2) were found in the revised PADR to be within 9 to 12 per cent of the net benefits of Option 2, on a weighted basis, across base case I and base case II, respectively. As noted above, Option 1A(2) is considered as a sensitivity in section 7.5.7 in this PACR, given that Hydrostor is now focussing on Option 1A(4). See section 6.1 of the revised PADR for why two base cases were modelled at that stage of the RIT-T and section 2.2.4 of this PACR for why only one base case is now considered relevant.

sensitivity testing found that retrofitting them to enable them to dispatch in the wholesale market is not net beneficial).

We have tested the robustness of the conclusion to a number of other sensitivity tests as part of this PACR – namely:

- an increase in the capacity of the 330 kV transmission system west of Wagga Wagga, consistent with the outcome of the concurrent 'improving stability in south-western NSW' RIT-T;
- the existing turbines in Option 2 being retro-fitted to be able to dispatch to the NEM and generate wholesale market benefits;
- assuming new mining spot load development in the Broken Hill area;
- alternate commercial discount rate assumptions;
- different scenario weightings (i.e., those adopted in the PADR);
- the assumed profile of the external ARENA funding; and
- a decision by Hydrostor to revert to a smaller-sized solution (i.e., Option 1A(2) from the PADR), with no ARENA funding.

These sensitivities confirm that Option 1A(4) is the preferred option, closely followed by Option 2,[3] and that Option 1A(4) has potential additional benefits from being able to meet any additional future mining load without needing to incur additional option costs, and if there is an increase in the capacity of the 330 kV transmission system west of Wagga Wagga.

The last sensitivity above finds that, if Hydrostor and ARENA were not able to conclude an external funding agreement to progress Option 1A(4), and Hydrostor reverted to providing the network support via the smaller sized Option 1A(2) without any external funding, this option would then become the preferred option under the RIT-T (albeit ranked equally with Option 2).

Non-network support provided by Hydrostor using its compressed-air energy storage solution is the preferred option

The assessment in this PACR finds that network support provided by the Hydrostor compressed air storage solution (Option 1A(4)) is the top-ranked option, followed closely followed by refurbishing and continuing the long-term use of the existing diesel-fired turbines (Option 2). Option 1A(4) is projected to deliver approximately $286 million in net benefits, which is approximately 5.8 per cent greater than Option 2.[4]

Option 1A(4) involves Transgrid acquiring the existing diesel turbines at Broken Hill from Essential Energy and temporarily using them to provide network support at Broken Hill ahead of Hydrostor installing a 200MW/1500MWh compressed-air energy storage solution that will create a mini-grid at Broken Hill (at which point the turbines will be de-commissioned), and entering into a network support agreement with Transgrid. It involves 50MW and 250MWh dedicated in reserve at all times for reliability support services at Broken Hill and, when not called upon to provide the required reliability, the compressed-air energy storage components would participate in, and add liquidity to, the NEM wholesale market.

[3] The one exception to this is the high discount rate sensitivity (7.50 per cent), which finds that Option 2 becomes the highest ranked option, delivering benefits 12 per cent greater than Option 1A(4).

[4] If the external ARENA funding is removed from the assessment, Option 2 becomes the preferred option (unless Hydrostor were to decide to pursue the smaller Option 1A(2) – see section 7.5.7).

In addition to having a marginally greater expected net benefit, we consider Option 1A(4) to be preferred over Option 2 at this stage since it:

- uses a clean technology that is consistent with the general transition of the electricity sector to low emission technologies – Option 2 has an enduring reliance on fossil fuel technologies as part of the long term solution to meet reliability standards at Broken Hill, which we consider less preferable in the context of the general transition of the electricity sector to low emission technologies, and the Sustainability Strategy of Broken Hill City Council;[5]
- supports the use of innovative solutions to meeting network needs, which may provide an example that can be adopted more widely – we have undertaken a holistic review and are confident that the compressed-air energy storage solution is technically feasible (this review has been supported by an independent technical assurance report from Aurecon);
- is able to efficiently accommodate additional mining load at Broken Hill, should it eventuate – Option 2 would require coupling with additional components to meet this additional load, which would increase the future costs of this option and, potentially, compromise the level of reliability provided to customers in Broken Hill;
- has a lower level of unavailability due to outages (which reduces the risk of disruptions to customer supply in Broken Hill) – Option 2 requires significant refurbishment of the existing turbines that requires them to be out of service while this is undertaken; and
- is expected to have a further modest increase in net benefits if more available transmission capacity west of Wagga Wagga is assumed as a result of the anticipated investment under the separate RIT-T Transgrid is currently finalising to alleviate a voltage stability limit at Darlington Point – this development would not affect the net benefits of Option 2.

Notwithstanding the above, we consider that if either of the following two events occur, they would likely constitute a 'material change in circumstances' (i.e., under clause 5.16.4(z3) of the NER):

1. ARENA and Hydrostor not being able to finalise a funding agreement with a sufficient upfront external capital contribution; or

2. Transgrid and Hydrostor not being able to finalise a network support contract that is expected to be accepted as prudent and efficient by the AER.

However, should either of these events occur, we would seek an exemption from the AER under clause 5.16.4(z3) of the NER to avoid having to reapply the RIT-T. Specifically, we consider that, should either of the above events occur, then the analysis in this PADR demonstrates that Option 2 should be considered the preferred option under this RIT-T (unless Hydrostor were to decide to provide the network support solution via a smaller scale option (i.e., Option 1A(2)), in which case this would then be considered to be the preferred option, as outlined in section 7.5.7).

We consider this approach provides sufficient confidence that Transgrid will be able to progress an option to ensure the required reliability to consumers at Broken Hill at an efficient cost level without having to re-do the RIT-T. We note that re-doing the RIT-T would take significant time, which would compromise the reliability of supply to customers at Broken Hill and ultimately likely cost all NSW electricity customers more in the long-run.

[5] Broken Hill City Council, *Sustainability Strategy 2018-2023*.

We note that the application of the 'material change in circumstances' provision in the Rules (and the ability to include a 'decision rule' in a PACR), are currently being considered by Australian Energy Market Commission.[6] In the event that the NER changes following this PACR, we would consider the two events above to constitute two elements of a decision rule for ultimately determining the preferred option for this RIT-T if circumstances change.

We will be liaising closely with ARENA and Hydrostor to monitor how Option 1A(4) progresses through the various 'stage gates' ARENA has identified for its funding, in order to assess whether the above conditions are expected to be met within the timeframes outlined in this PACR.

We note that the assumptions around external funding reflected in this PACR are consistent with information provided by ARENA to Transgrid, but that the agreement remains subject to negotiation between ARENA and Hydrostor.

In terms of the upfront capital contribution, we consider a 'sufficient' amount to be an amount that results in Option 1A(4) being either within 5 per cent of, or outright preferred to, Option 2 on a weighted basis across the three scenarios assessed. While we note that this value depends on a range of factors, including the assumed cost of Option 1A(4) and the assumed profile of the external funding, we currently consider this value to be at least $13.2 million based on the PACR assessment.[7]

Assuming Option 1A(4) remains preferred, the start-date for the network support contract would coincide with the expected commissioning date for the compressed-air solution in 2025/26.

Further information and next steps

This PACR represents the final formal stage in the RIT-T process.

We will update stakeholders when we consider either that both the external funding agreement and the network support agreement for Option 1A(4) are sufficiently certain, or at the point we determine there has been a material change in circumstances and that either Option 2 or Option 1A(2) should instead be progressed (i.e., when we would submit an exemption to the AER from having to reapply the RIT-T).

Assuming Option 1A(4) is progressed, the start-date for the network support contract would coincide with the expected commissioning date for the compressed-air solution in 2025/26.

Further details in relation to this project can be obtained from regulatory.consultation@transgrid.com.au.

[6] AEMC, *Transmission Planning and Investment Review*, Consultation Paper, 19 August 2021, p. 54.

[7] We consider net benefit outcomes within 5 per cent of each other to be effectively equal. In the context of the external funding, we find that it would need to be at least $13.2 million in order for Option 1A(4) to be within 5 per cent of Option 2 (whereas, in order for Option 1A(4) to have exactly the same net benefit as Option 2, $27.9 million in external funding would be required).