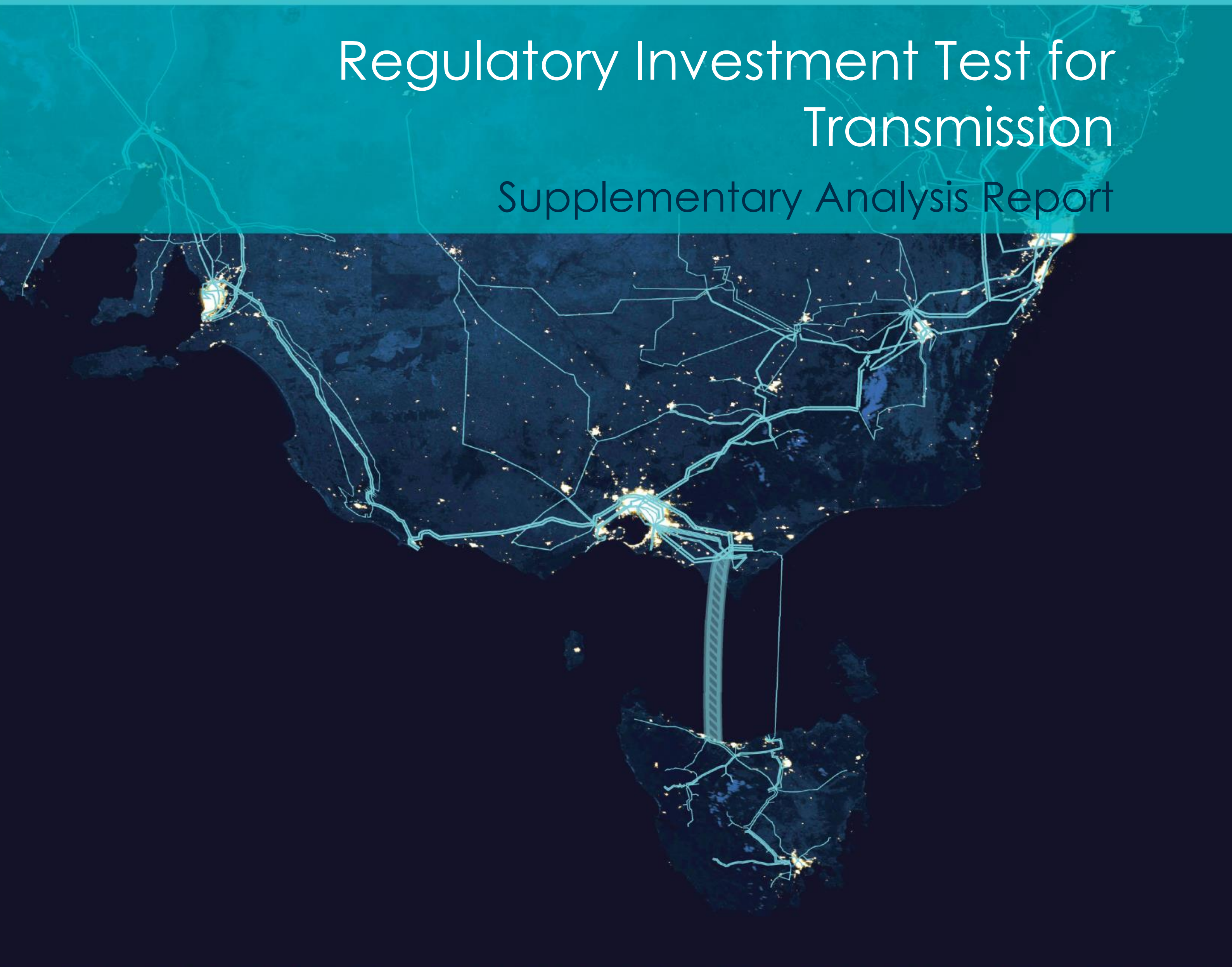
Regulatory Investment Test for Transmission

Supplementary Analysis Report



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Responsibilities

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Executive summary

The National Electricity Market (**NEM**) is transitioning from a centralised thermal generation based system to a diversified power system with significant contributions from behind the meter and utility scale renewable generators. This transition requires strategic investments in transmission and cost-effective dispatchable energy infrastructure to meet customers' energy needs at the lowest cost.

This Supplementary Analysis Report explains to stakeholders and interested parties the pivotal role Marinus Link can play in the ongoing transition of the NEM. This report includes an updated cost benefit assessment of Marinus Link as part of the regulatory process that commenced in July 2018.[1]

In December 2019, we published the Project Assessment Draft Report (**PADR**) for Marinus Link. The PADR is a key step in the Regulatory Investment Test for Transmission (**RIT-T**) process, as it presents detailed cost-benefit analysis to identify the project option that maximises net market benefits, having regard to alternate investment options including non-network solutions.

In response to the PADR, a key theme raised in stakeholder submissions was that our scenarios, inputs and assumptions should be aligned with AEMO's 2020 Integrated System Plan (**ISP**) which, at that time, had not yet been finalised. Given this feedback, we decided to pause our RIT-T process to take account of the 2020 ISP.

Now that the 2020 ISP has been published, we want to report back to stakeholders and present some further modelling results. In addition to reporting these results, this report also explains the next steps in the regulatory process, as new National Electricity Rules (**Rules**) have been introduced since the publication of our PADR, which are relevant to Marinus Link.

Batteries and other solutions

Our PADR modelling demonstrated that Marinus Link has an important national role to play in delivering the lowest cost solution for electricity customers as the economy transitions from a

[1] Our analysis, consistent with the Marinus Link PADR and ISP, defines Marinus Link as the two 750 MW HVDC interconnectors between Burnie area in Tasmania and Latrobe Valley in Victoria and the supporting North West Transmission Developments in Tasmania. The North West Transmission Developments are outlined in detail in Appendix 3 of our PADR and in the Final 2020 ISP Transmission outlook, although the order of the transmission developments is expected to change.

centralised coal-fired thermal generation system to a highly diverse portfolio dominated by distributed energy resources (**DER**) and variable renewable energy (**VRE**), supported by dispatchable resources to ensure the power system can reliably meet demand at all times.

In particular, Tasmania's existing hydro capacity is a significant source of value to mainland Australia's electricity customers, given the forecast coal plant closures and the projected growth in variable renewable generation. Stakeholders in their submission to our PADR highlighted the potential role that batteries could play in the future. A number of submissions asked us to consider whether battery capacity could be a cost-effective alternative to Marinus Link by providing the increased storage capability required by the NEM.

In this report, we have explored this question in detail, focusing specifically on the latest projections for the growth in battery capacity and the potential for lower cost batteries in the future. Our analysis shows that Marinus Link unlocks longer duration pumped storage in Tasmania that provides seasonal energy shifting capability.[2] Shorter duration storage solutions are effective in shifting energy across hours or a day, but cannot provide a cost effective alternative to deeper storage capability that is accessed by Marinus Link. Our findings are further substantiated by sensitivity analysis that considers a further 30% reduction in battery costs, as compared to 2020 ISP Central scenario projections. This analysis shows that Marinus Link still provides net benefits in a future with very low battery costs, with net market benefits only negatively impacted by $40 million.

Our modelling approach treats all technologies, investment options and demand side measures on an equal footing, including non-network options, to identify the lowest cost solution for meeting customers' future energy needs. This report confirms that batteries and Marinus Link both have important roles to play as we transition to a lower carbon economy.

2020 Integrated System Plan

AEMO published its 2020 ISP in July 2020. The purpose of the ISP is to coordinate transmission and generation planning to provide for the efficient development of the power system over a planning horizon of at least 20 years. In relation to Marinus Link, AEMO explains that:[3]

> "Marinus Link is a multi-staged actionable ISP project to be completed from 2028-29, with early works recommended to start as soon as possible, and with further stages to proceed if their respective decision rules are satisfied."

[2] Seasonal shifting of energy typically implies storing excess renewable energy during periods of high renewable generation (e.g. spring, autumn) and utilising it during low production periods (e.g. winter).

[3] AEMO, 2020 Integrated System Plan, July 2020, page 82.

The 2020 ISP aligns with the broad findings that we reached in our PADR. In particular, both the PADR and the 2020 ISP concluded that a staged 1500 MW interconnector delivers the greatest net benefit compared to the alternative of not proceeding with Marinus Link.

Recent project developments

Since the publication of our PADR, we have continued to undertake preliminary works to ensure that Marinus Link is able to proceed in accordance with the timeframes envisaged in the PADR which have also been adopted in 2020 ISP. In particular:

- Marinus Link is now in the Design and Approval phase of the project, with work underway to enable an investment decision to be made by 2024.
- Announcement of Marinus Link as a priority project for economic recovery from the ongoing COVID-19 transition, with the Australian Government facilitating enhanced environmental approvals assessment resourcing. This ‘fast track’ decision allows the timeframes for the environmental approvals process to be reduced, supporting Marinus Link to be commissioned by 2027.
- The Australian Government, in its October 2020 Budget, announcing that further funding will be made available to support Marinus Link’s activities to achieve a final investment decision by 2024. This is in addition to the $56 million in grant funding that the Australian Government has already provided to the Tasmanian Government to progress early Design and Approvals phase activities.
- A preferred route for the Staverton to Hampshire Hills section of the North West Transmission Developments has been identified and the planning and environmental approvals processes commenced. This project is part of the North West Tasmanian transmission developments that support Marinus Link, should it proceed, and also support efficient delivery of energy from new generators locating in the North West Tasmania and Central Tasmania Renewable Energy Zones.

The modelling for this report recognises the ‘fast tracked’ feasible delivery date of 2027, which is earlier than the estimated earliest in-service date we provided to AEMO in developing the 2020 ISP.

Further modelling of costs and benefits[4]

As requested by stakeholders in their submission to our PADR, the intention of this supplementary analysis is to seek broad alignment of Marinus Link RIT-T with the scenarios, inputs and assumptions of the 2020 ISP. Therefore even though the PADR modelling suggested commissioning the two stages of Marinus Link no more than two years apart in scenarios with higher decarbonisation ambitions, TasNetworks settled on a consistent three year spacing between stages, which is broadly aligned to the ISP analysis. As noted in the 2020 ISP, the actual timing of Stage 2 will depend on decision rules which will be developed in the 2022 ISP.

Our supplementary cost benefit analysis shows that the optimal timing of Marinus Link is consistent with the 2020 ISP. In particular:

- Early works for both stages should be completed by 2023-24;
- The timing of Stage 1 would be needed at the earliest possible timing (estimated to be 2027) if the Step Change scenario eventuates;
- Stage 1 of the project should be in-service by no later than 2031, as TRET is expected to be legislated; and
- Stage 2 should be in-service shortly after Stage 1 if the Step Change scenario eventuates.

The results presented in the table below shows that delivering Marinus Link in two stages by the earliest feasible timing would deliver a net market benefit of approximately $1,600 million, if the Step Change scenario eventuates. The table also shows that Marinus Link would deliver a substantial net market benefit if the Central scenario eventuates, with a maximum net market benefit of $871 million if the project is delivered in 2031 and 2034.[5]

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[4] All values presented in this report are 1 July 2019 real dollars unless stated otherwise. Net Present Value (NPV) outcomes are also discounted back to 1 July 2019 based on the WACC of 5.9% for all scenarios, except Slow Change (WACC of 7.9%).

[5] All dates in this report are on a financial year basis. The year represents the start of the financial year. For instance, 2032 represents the financial year commencing from 1 July 2032 to 30 June 2033. Unless otherwise stated, all interconnector and capacity expansion occurs at the beginning of the financial year whereas unit retirements occurs at the end of the financial year.

Table 1: Net market benefits of Marinus Link in Central and Step Change Scenarios (NPV, $ million)

	Commissioning Years			
Scenario	2027 & 2030	2028 & 2031	2031 & 2034	2034 & 2037
Central	$639	$731	$871	$776
Step Change	$1,599	$1,615	$1,582	$1,309

In relation to the Step Change scenario, the difference in net market benefit is only $16 million between the commissioning years 2027 and 2028. This difference represents only around 0.5% of the estimated total project costs. We also note that the earlier timing is likely to provide 'insurance benefits' arising from the additional availability of interconnector capacity, which have not been factored into the modelling. In these circumstances, it is reasonable to regard both options as equivalent to one another. On this basis, the remainder of the report will suggest the optimal timing of Marinus Link as 2027 & 2030 (earliest feasible timing).

It is also important to recognise that the least cost modelling is based on principles of perfect foresight[6] that assume an orderly transition with retiring generators providing up to five years of mandated notice. In reality, it is possible that some of these generators might retire sooner than expected or provide a much shorter notice of closure, or both, than outlined in the Rules. The operational and financial constraints on the ageing thermal generation fleet, which we discuss in this report, are likely to increase the prospect of earlier than expected closures.

At this stage, it is not possible to say with certainty which of the Step Change or Central scenarios will eventuate. One approach to managing this uncertainty is to lock-in a particular timing now, based on a weighted average between the two scenarios. The 2020 ISP indicates that the appropriate weighting would be 67/33, with Central being the more likely outcome.[7]

An alternative approach is to proceed with the early works, and delay making a timing decision until we have more information. This approach captures 'real option value' by preserving our ability to deliver the project by 2027 if the Step Change scenario eventuates. By ensuring that

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[6] One of the principal tenets of economic equilibrium theory, the basis for majority of long-term economic modelling, is the assumption that all persons concerned correctly foresee the relevant events in the future, and this foresight includes not only the change in objective data but also the behaviour of all other persons.

[7] AEMO, 2020 Integrated System Plan, July 2020, Table 12, page 87.

the project is ready to proceed by 2027, customers retain the option of a maximum net market benefit of almost $1,600 million.

Even if the Step Change scenario does not eventuate exactly as described by the 2020 ISP, commissioning Marinus Link at its earliest feasible timing ensures that the transitioning power system has sufficient interconnection in place to manage unplanned coal retirement. Support for timely interconnection investment is further demonstrated by the $250 million in interconnector project funding the Australian Government provided collectively to Marinus Link, Project Energy Connect and VNI West.

By contrast, if we decided to lock-in later in-service dates now, based on the present assessment of the balance of probabilities, customers would be unable to secure the maximum possible benefit from Marinus Link in a rapidly transforming NEM.

Getting ready for early delivery

The case for capturing the option value is further strengthened if there is good reason to expect the Step Change scenario may occur. Our assessment is that there is mounting evidence that the NEM's current trajectory is consistent with the Step change scenario. In particular, we note that:

- The pace of renewable penetration in NEM continues to trend closer to the Step Change development trajectory, rather than Central scenario;
- The views expressed by chair of the Energy Security Board that the power system is likely to be heading towards a Step Change scenario[8];
- Increased generation from renewables is likely to exert commercial pressure on coal fired generators as operational inefficiencies arise as output is continually varied to accommodate lower cost renewable generation in the supply stack; and
- Sustained pressure from institutional investors and customers on the owners of coal-fired generators to align their business plans with the goals of the Paris Agreement could also lead to early retirement of assets due to environmental considerations.[9]

In most instances, the lead time associated with withdrawing dispatchable capacity from the NEM is much shorter than commissioning large transmission projects. Therefore, noting the important role that Marinus Link can play in ensuring an orderly transition of ageing generators,

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[8] "We are headed for step change:" ESB's Kerry Schott on new market design, Renew Economy, 30 September 2020

[9] The inputs and assumptions in the Step Change scenarios best capture the electricity market outcomes required to achieve the targets of the Paris climate change agreement.

especially noting the minimal difference in the net market benefits over the modelling horizon, the earliest commissioning date of the project should be retained.

Moreover, Marinus Link will play an important role in reducing emissions in accordance with the Technology Investment Roadmap released by the Australian Government. Whilst this contribution to achieving the cumulative emission reduction target or enabling Australia to deliver the stretch target for energy storage has not been factored directly into our cost benefit modelling, it is a matter that reinforces the prudence of preserving the early delivery of Marinus Link.

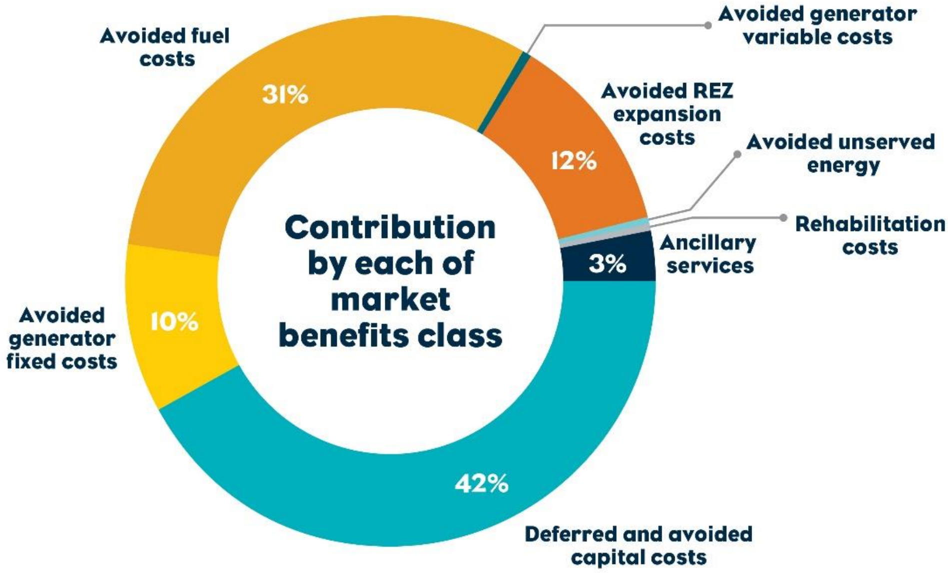
Source of benefits for Marinus Link

In a transitioning power system with the potential for an ageing generation fleet to retire prematurely, the first stage of Marinus Link provides the opportunity to access hydro capacity in the existing Tasmanian hydro system while the second stage of Marinus Link enables development of long duration pumped hydro facilities and further access to one of the best wind resources in the NEM.

The overall benefits of Marinus Link are further demonstrated through our modelling that suggests the largest source of savings are derived from deferred and avoided capital costs (42%) by utilising the existing and repurposed Tasmanian hydro capacity along with the development of longer duration cost-effective pumped hydro in Tasmania. Since the storage duration of pumped hydro in Tasmania is typically 2-4 times longer than comparable mainland Australia facilities, this reduces the need for developing and maintaining additional gas-fired peaking generation on the mainland that may only operate occasionally. This reduced need for gas-fired generation manifests itself as avoided fuel costs in our modelling and provides the second largest contribution (31%) to the overall gross market benefits of Marinus Link.

The figure below shows the different sources of market benefits from Marinus Link as identified by the RIT-T guidelines, under the Step Change scenario.

Figure 1: Contribution by each of market benefits class as identified by RIT-T guidelines (Marinus Link, Step Change scenario, 2027 & 2030)[10]



New ISP Rules and feedback loop

In July 2020, new Rules were introduced that established the ISP in the planning and regulatory framework and made consequential changes to the RIT-T arrangements for actionable ISP projects, being projects that need to commence development within two years of the ISP. For Marinus Link, as the RIT-T process has already commenced, we have the option of either adopting the new Rules or continuing to apply the previous Rules.

As Marinus Link is a staged actionable ISP project, the new Rules will require each stage of the project to go through a 'feedback loop' with AEMO, which verifies that the proposed works and costs for each stage are consistent with the optimal development path used to develop the ISP. Each stage of the project must obtain AEMO approval before the AER is able to determine the revenue allowance for that stage.

[10] For ease of reading, data labels for market benefit classes with minimal contribution have not been displayed but included in the analysis. The legend mentions the remaining benefit classes.

Given the assurance that the feedback loop will provide to stakeholders regarding the prudency and efficiency of each stage of the project, we have decided to adopt the new ISP Rules in relation to Marinus Link, following the release of the PACR.

Next steps

In accordance with the RIT-T process, we propose to publish the PACR for Marinus Link in the first half of 2021. In the meantime, we invite stakeholder feedback on the analysis presented in this report. Details of the consultation process are provided in section 1.3.

Following the completion of the PACR, we expect to seek a contingent project determination (or determinations[11]) from the AER in relation to the early works component of the project, in accordance with the new ISP Rules. The first step in this process will be to seek AEMO's confirmation regarding the scope and cost of this work. The 2020 ISP defined early works for Marinus Link Stage 1 and Stage 2 as an actionable project without any decision rules. Consistent with views shared previously, the cost recovery for the project would only commence once the interconnector pricing is satisfactorily resolved.

The Stage 1 of the project (commissioning of the first 750 MW link and the accompanying transmission developments) will be subject to a contingent project application once the decision rules specified in the 2020 ISP have been satisfied.

[11] It may be that revenue determinations are sought for a share of total early works costs by TasNetworks (for the North West Transmission Developments component of the overall Marinus Link project) and by a new transmission network service provider (which would own the High Voltage Direct Current and Converter Stations component of the overall Marinus Link project).

1 Introduction and Overview

1.1 Purpose of this document

The regulatory investment test for transmission (**RIT-T**) is a cost benefit analysis overseen by the Australian Energy Regulator (**AER**). It assesses the economic and technical impact of, and preferred timing for, all major network investments in the National Electricity Market (**NEM**). The RIT-T process ensures regulated transmission investment decisions are in the long-term interests of customers.

Project Marinus was established in December 2017 to undertake a detailed Feasibility and Business Case Assessment of a second Bass Strait electricity interconnector, known as Marinus Link. We commenced the RIT-T process for Marinus Link in July 2018 and published an Initial Feasibility Report in February 2019. In December 2019, we published the cost benefit assessment for Marinus Link in our Project Assessment Draft Report (**PADR**), which is a key stage of the RIT-T process.

We have consulted extensively with stakeholders and the broader community from the commencement of Project Marinus. In addition to formal consultation processes mandated by the National Electricity Rules (**Rules**), we have established a dedicated website[12] to encourage on-going engagement on a broad range of project issues.

Since the project commencement in December 2017, the transformational changes taking place in the electricity sector have continued to gather pace as the economy transitions to a lower carbon future. In response to these changes and in anticipation of the future challenges they present, there have been important changes to AEMO's role as the National Transmission Planner, which have implications for Marinus Link.

In particular, AEMO has responsibility for publishing an Integrated System Plan (**ISP**) every two years. The purpose of the ISP is to establish a whole of system plan for the efficient development of the power system that meets the needs of electricity customers over a planning horizon of at least 20 years. AEMO published its inaugural ISP in 2018.

Shortly after the publication of our PADR, AEMO published its draft 2020 ISP with a view to publishing the final version in July 2020. In response to our PADR, a number of stakeholders highlighted the importance of aligning our scenarios, inputs and assumptions with the 2020 ISP.

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[12] https://www.marinuslink.com.au

In light of stakeholder feedback, we decided to pause our RIT-T process to take account of the assumptions in the 2020 ISP. In addition, new Rules governing 'actionable ISP projects' were introduced on 1 July 2020 and the AER published accompanying guidelines in August 2020. By delaying the next stage of the RIT-T, we have been able to consider these changes in addition to findings in the 2020 ISP.

The purpose of this report is to explain the implications of the 2020 ISP for Marinus Link and how we propose to complete the RIT-T process.

1.2 Structure of this report

The remainder of this Supplementary Analysis Report is structured as follows:

- Section 2 recaps on our cost benefits analysis undertaken to date.
- Section 3 summarises the stakeholder feedback we received on our PADR.
- Section 4 discusses the 2020 ISP and its implications for Marinus Link.
- Section 5 highlights the market and regulatory developments since our PADR was published in December 2019.
- Section 6 explains our additional cost-benefit modelling we have undertaken in light of the 2020 ISP, recent developments and stakeholder feedback.
- Section 7 reports our modelling results and our preferred option.
- Section 8 explains Marinus Link's role in the NEM and the value it is able to unlock.
- Section 9 outlines the other project considerations relating to Marinus Link.
- Section 10 sets out the next steps and timelines for completing the RIT-T.

The appendix to this paper summarises the feedback from stakeholders to our PADR and our response to the issues raised. This report is further supported by an accompanying Ernst & Young report outlining the technical details of market modelling undertaken for this analysis.

1.3 Consultation and next steps

Project Marinus welcomes submissions from stakeholders on this report by 7 December 2020. Submissions should be made to:

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Email: team@marinuslink.com.au

All enquiries relating to this document or requests for information should also be directed to the person named above.

The next formal stage of this RIT-T involves publication of the Project Assessment Conclusions Report (PACR). We currently anticipate that the PACR will be published in the first half of 2021.

2 Recap on our cost benefit analysis

This chapter recaps on the RIT-T process for Marinus Link and the findings in our PADR.

Key Messages

- Our RIT-T process for Marinus Link has been undertaken in accordance with the Rules requirements, with an extended timeframe to allow for additional stakeholder input.
- We listened carefully to stakeholders' feedback in the early stages of the RIT-T process, which highlighted the importance of a robust and transparent modelling approach.
- Ernst & Young and GHD were engaged to undertake modelling in accordance with the RIT-T requirements. Our view is that the engagement of these respected consulting firms should provide stakeholders with confidence that the modelling is soundly based and complies with the Rules requirements.
- The RIT-T modelling in our PADR examined the case for Marinus Link across four scenarios. The analysis showed that the optimal capacity and timing is a staged 1500 MW interconnector, with 750 MW stages in 2028 and 2032.
- Our PADR explained that the optimal timing would vary depending on which scenario eventuated. For all scenarios, however, a two staged 1500 MW interconnector was shown to be superior.
- Our PADR included sensitivity analysis to test various 'what ifs' in relation to the net market benefit from the preferred option.

2.1 RIT-T process to date

Our RIT-T process commenced with the publication of the Project Specification Consultation Report (**PSCR**) in July 2018. The purpose of the PSCR is to describe the 'identified need' that further interconnection between Tasmania and Victoria would address. It also provides details of the assumptions underpinning this need, credible options that would address this need, how we intend to evaluate the benefits of these options, the likely implementation timetable, and indicative costs.

We received 15 submissions to the PSCR, which covered a wide range of topics, including:

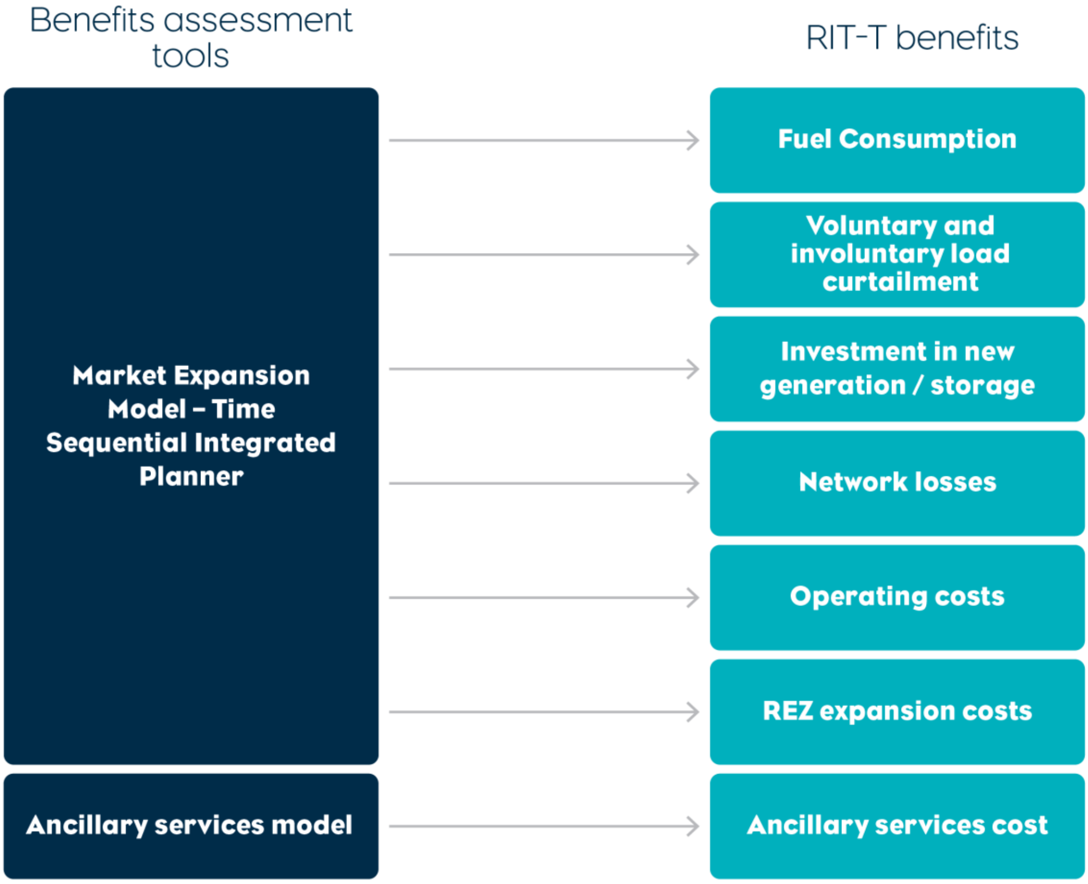
- the ISP;
- Basslink's performance;
- Potential benefits of Marinus Link;
- Project costs;
- Investment assessment and modelling; and
- Project funding and cost recovery.

In relation to investment assessment and modelling, the key message was that our cost benefit analysis for Marinus Link should:

- Be transparent;
- Adopt reasonable input assumptions;
- Recognise regional differences in wind generation performance;
- Avoid an overly narrow approach; and
- Test outcomes through suitably wide sensitivity analysis.

In preparing our PADR, which was published in December 2019, we ensured that we addressed the feedback from stakeholders, including the comments in relation to our investment assessment and modelling. In particular, to ensure that the cost benefit analysis was robust and independent, we engaged Ernst & Young and GHD to undertake the modelling on our behalf. The figure below shows how this modelling relates to the RIT-T benefits.

Figure 2: Our assessment tools for estimating the RIT-T benefits



Our PADR explained that Ernst & Young's market expansion model takes the projected NEM demand over the study period as an input to determine the optimal generation and transmission interconnector investments to supply this demand, such that the overall cost of supply to the NEM is minimised. The optimal generation mix may consist of both existing generation and assumed new generation, along with potential network and non-network solutions.

Voluntary load reduction (i.e. demand-side participation) is also included in the model and adopted when it results in a lower cost of supply. In addition to ensuring customer load is supplied, the model also applies simplified operational constraints to ensure there are sufficient reserves of dispatchable generation during high demand periods, and to ensure NEM inertia requirements are met.

Taking all these factors into account, the model determines the most appropriate timing of new generation and energy storage investments, and the retirement of existing generation that reaches end-of-life or is uneconomic, across all NEM regions, to yield the overall least cost outcome over the study period. The model expresses the total cost of supply in present value terms.

GHD was engaged to estimate the ancillary service benefits that would arise from Marinus Link. Ancillary services perform an essential role of ensuring stable power system operation on a minute-to-minute basis, especially when subjected to unforeseen contingency events. Our PADR explained that while generators and other network devices directly provide ancillary services, interconnectors offer the ability to transfer some types of ancillary services between regions, thereby lowering the overall cost of ancillary services within the NEM.

We extended the consultation period for our PADR to 6 April 2020, to provide stakeholders with additional time to review the extensive published material. We received 15 submissions to the PADR, which are discussed in further detail in Chapter 3 of this report.

In terms of process, the Rules require us to publish our Project Assessment Conclusions Report (PACR) as soon as practicable after the conclusion of after the end of the consultation period for the PADR. In light of stakeholder feedback, however, we considered it appropriate to wait until the publication of the 2020 ISP before deciding how the RIT-T process should proceed.

2.2 Project Assessment Draft Report

Our economic cost-benefit analysis in the PADR considered four scenarios, which were described as follows:

- Global slowdown;
- Status quo/current policy;
- Sustained renewables uptake; and
- Accelerated Transition to a Low Emissions Future.

We examined four credible options for Marinus Link, with interconnector capacities ranging from 600 MW to 1500 MW plus supporting AC network augmentations. For each option, we evaluated the net market benefits of Marinus Link and supporting transmission compared to a base case 'without Marinus Link and supporting transmission', across each of the four scenarios.

The PADR modelling indicated that each credible Marinus Link and supporting transmission option would deliver a net market benefit compared to the 'without Marinus Link and supporting transmission' base case, under each of the four scenarios. The cost-benefit analysis in the PADR therefore showed unequivocally that Marinus Link and supporting transmission should proceed. The principal modelling challenge related to identifying the optimal capacity and timing for Marinus Link, including whether the project should be staged.

Our PADR explained that the modelling revealed that there are significant economies of scale in constructing 750 MW increments of interconnector capacity compared to 600 MW. Furthermore, the cost-benefit analysis showed that there is significant additional value if Marinus Link is 1500 MW, staged in two 750 MW increments. As a consequence, the PADR concluded that a staged 1500 MW interconnector is the preferred RIT-T option.

The PADR modelling showed that Tasmania's existing hydro capacity is a significant source of value to mainland Australia electricity customers, given the forecast coal plant closures and the projected growth in renewable generation. Our modelling showed that Marinus Link and supporting transmission unlocks this benefit by:

- Displacing expensive gas-fired peaking generation on the mainland that would otherwise be required to meet electricity demand;
- Providing the NEM with access to lower cost, higher capacity, energy storage to provide 'firm' capacity for variable renewable generation; and
- Enabling Tasmania to exploit its natural advantages in terms of topography and wind resources to provide further savings for lower cost pumped hydro storage capacity and wind generation compared to the available options on mainland Australia.

Our detailed analysis indicated that the optimal capacity and timing for Marinus Link is:

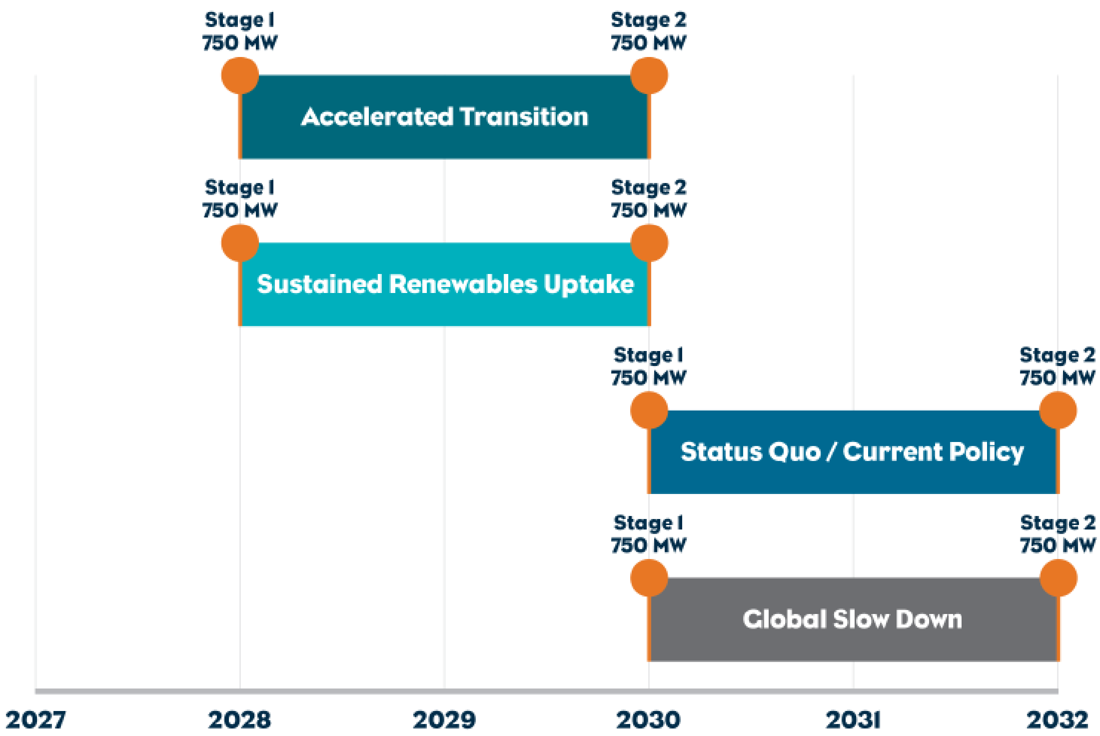
- Stage 1: An initial 750 MW DC link between Burnie area in Tasmania and Hazelwood area in Victoria, together with supporting network augmentations in Tasmania, should be commissioned in 2028; and
- Stage 2: The commissioning of a further 750 MW DC link in 2032.

We explained that Stage 1 would enable customers in mainland Australia to benefit from the spare capacity that already exists in Tasmania's hydro system. Stage 2 would be delayed until 2032, at which time the mainland NEM would require peaking gas fired generation and mainland storage in the absence of additional interconnector capacity.

By staging additional interconnector capacity in 2032, we explained that investment in lower cost storage capacity and wind generation in Tasmania will provide further savings to the mainland NEM by displacing more expensive alternatives. In aggregate, the combination of Stage 1 and Stage 2 investments in Marinus Link maximises the net market benefit across a range of scenarios.

In terms of timing, the four scenarios revealed different drivers for earlier or later commissioning, as shown in the figure below.

Figure 3: Our assessment tools for estimating the RIT-T benefits



While the PADR modelling revealed that the optimal timing would vary depending on which of the scenarios eventuated, the PADR applied the RIT-T Guidelines which required the scenarios to be weighted equally as there was no clear evidence to support a different weighting. The net market benefit of the optimal timing of 2028 and 2032 was estimated to be $1.67 billion, assuming a total project cost of $2.76 billion.

To augment our cost-benefit analysis, we undertook a range of sensitivity studies to understand the impact of key variables on the market modelling results. This sensitivity analysis essentially provides a 'what if' analysis, which stress-tests the conclusions from the cost-benefit analysis.

The sensitivity analysis identified a number of instances where the preferred timing as identified by the RIT-T would be brought forward. In relation to numerous other sensitivities, the timing of the preferred option remained unchanged. Overall, the sensitivity analysis did not undermine the selection of the preferred option or the timing indicated by the cost-benefit analysis.

The PADR also commented that whilst our economic cost-benefit analysis identified that Marinus Link should proceed in two 750 MW increments commissioned in 2028 and 2032, a case could be made for delivering Marinus Link and supporting transmission earlier. For example, the PADR explained that delivering the first stage in 2027 and the second stage in 2028 would have the following advantages compared to the optimal timing:

- Marinus Link and supporting transmission would provide additional protection against unexpected events, such as earlier coal project plant closures or a prolonged Basslink outage; and
- Earlier construction will bring forward the jobs and investment stimulus that are expected to be provided to the Victorian and Tasmanian economies.

The PADR explained, however, that an earlier timing for Marinus Link would require external funding (e.g. from Government) if it were to be brought forward as a regulated transmission project. We noted that the funding would need to be sufficient to defray network charges so that customers would be indifferent between the earlier project timing and the optimal timing.

3 Stakeholder feedback

This chapter summarises the feedback from stakeholders in response to our PADR.

Key messages

- We welcome the feedback from stakeholders on our PADR.
- Stakeholders have raised a wide range of issues, which principally cover 6 themes. The principal areas of concern relate to ‘who pays’; project uncertainty; cost-benefit modelling; and alignment with the 2020 ISP.
- A number of the issues raised by stakeholders are addressed through the further modelling presented in this Update Report, which is discussed in Chapter 6.
- The appendix to this paper provides further information on how we have addressed the issues raised by stakeholders.

3.1 Feedback on PADR

TasNetworks received 15 submissions on the PADR, including two confidential submissions. A full summary of each non-confidential submission is provided in Appendix 1.

We welcome the significant level of engagement from stakeholders and the positive feedback received in relation to the PADR. A wide range of issues were raised in stakeholders’ submissions, with a number of submissions providing detailed observations regarding input assumptions and forecasts that may affect the relative costs and benefits of Marinus Link compared to other options. For example, ACIL Allen on behalf of Basslink Pty Ltd commented on the forecast investment in CCGTs projected by Ernst & Young in its market modelling.

In addition to the detailed forecasting issues raised by stakeholders, the following themes have emerged from submissions:

- Support for Marinus Link from some stakeholders, but challenged by others;
- ‘Who pays?’ remains a key issue for stakeholders;
- Further consideration needs to be given to uncertainty, including COVID-19;
- Some stakeholders support a staged approach to Marinus Link;
- Cost-benefit analysis in the PADR queried by some stakeholders; and
- Stakeholders expect the RIT-T to align with the 2020 ISP.

In the remainder of this section, we discuss of these themes in turn.

3.1.1 Support for Marinus Link from some stakeholders, challenged by others

The submissions provided a range of views on whether Marinus Link should proceed. Four submissions supported Marinus Link (Clean Energy Council, Hydro Tasmania, Tasmanian Minerals, Manufacturing & Energy Council, UPC Renewables), whilst three submissions strongly challenged the case for Marinus Link (Basslink, Energy Australia, Tasmanian Small Business Council). Other submitters either provided qualified support or made no specific comments in favour or against Marinus Link, but appeared broadly supportive.

TasNetworks welcomes the feedback received and notes the range of views expressed. TasNetworks' view is that the case for Marinus Link should be settled through the application of the RIT-T in accordance with the Rules and the AER's guidelines. We also note that the 2020 ISP has assessed the economic case for Marinus Link, which we discuss in the next chapter.

3.1.2 'Who pays?' remains a key issue

The majority of the submissions we received highlighted the 'who pays' issue as a key concern in relation to Marinus Link. This issue is discussed in detail in section 9.1 of this report.

3.1.3 Further consideration needs to be given to uncertainty, including COVID-19

A number of submissions raised the issue of uncertainty, with some stakeholders specifically commenting on the potential impact of COVID-19. Stakeholders highlighted uncertainty both in relation to the costs of Marinus Link and the benefits that it is expected to provide over its asset life.

Four stakeholders suggested that uncertainty was such a significant issue that Marinus Link should not proceed within the timeframes envisaged by the PADR (Energy Australia, ENGIE, Origin Energy, and Tasmanian Small Business Council). In addition, EUAA highlighted concerns with the accuracy of project cost estimates, given ElectraNet's recent experience with its Energy Connect project.

TasNetworks agrees with stakeholders that uncertainty is an important factor to consider in the RIT-T analysis. This point is highlighted by the AER's RIT-T guidelines, which includes the following commentary on uncertainty and risk:[13]

> "The future will be uncertain when RIT–T proponents apply the RIT–T. Therefore, the expected costs and market benefits of a credible option (and therefore the net economic benefit) should also be uncertain. This uncertainty may have a material impact on the selection of the preferred option."

TasNetworks agrees with the AER's observation that the future will always be uncertain. Whilst deferring an investment decision may be appropriate in some cases, uncertainty will be inherent in most investment decisions. Furthermore, it is incorrect to regard a decision to defer an investment as necessarily being a lower cost or lower risk option.

TasNetworks' view is that the optimal project identified through the RIT-T process should be adopted as the preferred option, as this option is most likely to deliver least cost outcomes for customers, notwithstanding the uncertainties and risks highlighted by stakeholders. As discussed in section 5.4, we propose to adopt the new ISP Rules for the remainder of the RIT-T process, which provides for a feedback loop with AEMO to ensure that the preferred project scope and forecast costs are consistent with the ISP's optimal development path.

In response to the stakeholder feedback regarding the impact of COVID-19, this report has adopted the energy consumption forecasts from the 2020 Electricity Statement of Opportunities (ESOO). These forecasts reflect the continued uptake of behind-the-meter photovoltaic capacity, combined with the installation of battery storage systems and energy efficiency improvements, along with the impacts of the COVID-19 pandemic, which are expected to dampen peak demand growth in both the short and medium term. Additionally, peak demand is expected to remain relatively flat over the remainder of the outlook period.

3.1.4 Some stakeholders support a staged approach to Marinus Link

A number of stakeholders commented on the proposed staging of Marinus Link in the PADR, highlighting that staging assists in managing uncertainty (Energy Users Association of Australia, Hydro Tasmania, Tasmanian Minerals, and Manufacturing & Energy Council).

As highlighted by submitters, staging the project is a potentially useful means of addressing the issues of risk and uncertainty, including construction risk. It is also closely related to the issue

13 AER, Application guidelines, Regulatory investment test for transmission, August 2020, page 49.

of option value, where additional value can be obtained by taking action to preserve opportunities to take different courses of action in light of new information.

TasNetworks supports the concept of staging Marinus Link, as reflected in the preferred option in the PADR. As discussed in the next chapter, the 2020 ISP has reached the same conclusion in relation to Marinus Link.[14]

3.1.5 Cost-benefit analysis in the PADR queried by some stakeholders

A number of submissions questioned the PADR's approach to estimating the costs and benefits of Marinus Link.

Basslink Pty Ltd and the Tasmanian Small Business Council each made submissions in response to Marinus Link's PADR, raising concerns regarding the modelling approach. For example, the submissions commented that the project's net market benefits were calculated over a shorter period than the expected life of Marinus Link's assets

Whilst Basslink and TSBC are correct that our analysis is based on only part of the project costs, this is because the study period has been limited to 30 years from 2020/21 to 2049/50, while the HVDC and AC assets have lives of 40 and 60 years respectively. The shortening of the study period is a standard approach, which has been adopted in other recent RIT-Ts.

As explained in the PADR[15], there are good reasons to expect that the project will continue to provide benefits beyond the end of the study period that exceed the residual costs of the assets. On this basis, if the study period were extended, the conclusions in the PADR would be unchanged. The benefit of limiting the study period is that we substantially reduce the modelling requirements without affecting our conclusions.

Earlier this year, to explain the modelling issues in further detail, we published a short paper that describes the approach taken and examines how it compares with other RIT-Ts. TasNetworks expects that this further explanation and accompanying spreadsheet will address any concerns regarding the modelling approach.

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[14] Explanatory note on computation of benefits and costs for Marinus Link (www.marinuslink.com.au/rit-t-process/)

[15] Refer section 6.4 of the PADR that demonstrates the gross market benefits exceeding annualised costs towards the end of the modelling period.

3.1.6 Stakeholders expect the RIT-T to align with the Integrated System Plan

Five submissions highlighted the importance of aligning the PADR with the information and analysis presented and used in developing the ISP.

TasNetworks agrees with submitters that the RIT-T for Marinus Link should take account of the 2020 ISP. The purpose of this report is to explain to stakeholders the implications of the 2020 ISP for our assessment of Marinus Link in accordance with the RIT-T.

4 Insights from the 2020 ISP

This chapter discusses the 2020 ISP and its key findings in relation to Marinus Link.

Key messages

- The 2020 ISP identifies an optimal development path, drawing on extensive stakeholder engagement, as well as internal and external industry and power system expertise.
- By adopting the 2020 ISP's input assumptions and scenarios, this report has assumed a greater role for batteries in meeting customers' future energy needs, by adopting higher levels of battery capacity and lower battery costs compared to our PADR.
- The 2020 ISP concludes that Marinus Link is a multi-staged actionable ISP project with decision rules.
- The optimal timing of Stage 1 will depend on which scenario eventuates, with the earliest date confirmed as 2028, which aligns with our PADR. Furthermore, the ISP expressed the need for first stage of Marinus Link to be available as soon as feasible, in case the Step Change scenario eventuates.
- The ISP concludes that early works for both stages of Marinus Link should commence as soon as possible in readiness for the construction of Stage 1.

4.1 Australia's complex energy transition

The purpose of the ISP is to coordinate transmission and generation planning to provide for the efficient development of the power system over a planning horizon of at least 20 years. By 2040, the 2020 ISP concludes that the NEM would reflect the following changes:

- **Distributed Energy Resources (DER)**: expected to double or triple, providing 13 to 22 per cent of total underlying annual energy consumption.
- **New grid scale renewables**: more than 26 GW is needed to replace coal-fired generation, with 63 per cent of coal-fired generation set to retire.
- **Dispatchable resources**: 6-19 GW of new dispatchable resources are needed to back up renewables, in the form of utility-scale pumped hydro, fast responding gas-fired

generation, battery storage, demand response and aggregated DER participating as virtual power plants.

- **Power system services**: the growing need to actively manage power system services (voltage control, system strength, frequency control, inertia, ramping and dispatchability).
- **Transmission**: strategically placed interconnectors and REZs, coupled with firming resources, to add capacity and balance variable resources across the NEM.

AEMO notes that the ISP serves the regulatory purpose of identifying actionable and future ISP projects, as well as the broader purposes of informing market participants, investors, policy decision makers and consumers. AEMO makes the following observations regarding the comprehensive nature of its modelling approach:[16]

> "As a rigorous whole-of-system plan, the ISP is a far more comprehensive and richer analysis than other comparable modelling exercises for Australia's energy future. It takes into account not only the capital and fuel costs of generation but also future network developments and deployment of DER. It includes a degree of sector coupling with the transport and gas sectors. It also takes the first steps towards including insights on the role of hydrogen. It incorporates innovations in consumer-owned DER, virtual power plants (VPPs), large-scale generation, energy storage, and power-system services. Finally, it ensures the physical limitations and constraints of Australia's energy system are accurately represented."

In relation to its modelling approach, AEMO explains that it uses scenario modelling and cost-benefit analysis to determine the most efficient ways to meet power system needs, in the long-term interests of consumers. The key elements in AEMO's approach for the 2020 ISP are:

- **Consultation on ISP assumptions, scenarios and sensitivities**. AEMO consulted extensively with industry, academia, government, developers and consumer representatives, culminating in its Forecasting and Planning Scenarios, Inputs and Assumptions Report in August 2019. AEMO subsequently updated its inputs and assumptions, drawing on feedback received on the Draft 2020 ISP.
- **Five scenarios to trace different speeds of transition**:
    - **Central scenario**, which reflects current federal and state government policies

[16] AEMO, 2020 Integrated System Plan, July 2020, page 10.

- **Slow Change scenario** with slower economic growth and emission reductions;
- **High DER scenario** with more rapid consumer adoption of DER;
- **Fast Change scenario** with greater investment in grid-scale technology; and
- **Step Change scenario** where both consumer-led and technology-led transitions occur in the midst of aggressive global decarbonisation.

- **Two new sensitivities to test changes in inputs that could materially alter the optimal development path**: being the legislation of the Tasmanian Renewable Energy Target of 200% by 2040, and updated demand forecasts including the potential impacts of COVID-19 and recent trends in PV sales.

In our view, 2020 ISP provides a comprehensive analysis of how best to meet customers' energy needs over a 20 year planning horizon. The objective of the ISP, which is to identify an optimal development path having regard to all credible options without any preference for technology, is fully aligned with the purpose of the RIT-T. Given this background, the findings of the 2020 ISP in relation to Marinus Link are of significant importance.

4.2 ISP findings for Marinus Link

The 2020 ISP identifies the following transmission projects as being most urgently needed (termed 'actionable ISP projects'):

- **VNI Minor**: a minor upgrade to the existing Victoria-NSW Interconnector (VNI), which is close to completing its regulatory approval process, with project completion expected in 2022-23.
- **Project EnergyConnect**: a new 330kV double-circuit interconnector between South Australia and New South Wales, which is close to completing its regulatory approval process. The project completion is expected by 2024-25.
- **HumeLink**: a 500kV transmission upgrade to reinforce the NSW southern shared network and increase transfer capacity between the Snowy Mountains hydroelectric scheme and the region's demand centres. This project commenced its regulatory approval process earlier this year, with project completion due by 2025-26.
- **NSW Central-West Orana REZ Transmission Link**: network augmentations to support the development of the Central-West Orana REZ in NSW. The project completion is due in 2024-25.

In addition to these 'actionable ISP projects', the 2020 ISP also identified a category of projects as 'actionable ISP projects with decision rules', which AEMO explains as follows:[17]

> "These projects are also critical to address cost, security and reliability issues. The decision rules for these projects can be assessed during the RIT-T process and will be confirmed by AEMO during an ISP feedback loop process with the TNSP once the decision rules eventuate."

Two interconnector projects have been identified as 'actionable ISP projects with decision rules':

- VNI West, a new high voltage alternating current (HVAC) interconnector between Victoria and New South Wales; and
- Marinus Link, which AEMO defines as two new high voltage direct current (HVDC) cables connecting Victoria and Tasmania and the supporting staged Tasmanian AC transmission investment between the Burnie area and Palmerston Substation.[18]

In relation to Marinus Link, AEMO explains that:[19]

> "Marinus Link is a multi-staged actionable ISP project to be completed from 2028-29, with early works recommended to start as soon as possible, and with further stages to proceed if their respective decision rules are satisfied."

AEMO explains that its analysis recognises 'option value' by recommending that early works commence as soon as possible in anticipation of the first cable being operational by 2028-29. AEMO notes that even if a scenario eventuates that warrants a later date of 2031-32, the timeframes would only allow a three-year contingency for potential delays in the planning approvals or construction works.[20]

Table 2 shows the optimal timing of Marinus Link across the 2020 ISP's optimal development path for each of the scenarios, which is designed to deliver the greatest net market benefits to

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[17] AEMO, 2020 Integrated System Plan, July 2020, page 14.

[18] The Final 2020 ISP Transmission outlook spreadsheet outlines the complete project description and required network augmentation.

[19] AEMO, 2020 Integrated System Plan, July 2020, page 82.

[20] AEMO, 2020 Integrated System Plan, July 2020, page 83.

meeting customers' future electricity needs. The findings of the 2020 ISP modelling provided guidance in determining the various commissioning timelines tested in this report.

Table 2: Optimal timing of Marinus Link under various ISP scenarios[21]

Stage (750 MW each)	Step Change	Fast Change	High DER	Central
Link 1	2028	2031	2031	2031
Link 2	Between 2031 and 2035			

The ISP concludes by defining Marinus Link as follows:[22]

> "Marinus Link is therefore specified as a multi-staged actionable ISP project with a single RIT-T process as follows:
>
> - Complete early works on both cables by no later than 2023-24
> - Stage 1 of the project, as described by TasNetworks in its PADR, is to construct the first cable from 2028-29 should the Step Change scenario eventuate, and by no later than 2031-32, if decision rules are satisfied. The decision rules for Marinus Link to proceed from early works to construct the first cable include:
>   - there is successful resolution as to how the costs of the project will be recovered (from consumers or other sources), and
>   - either TRET is legislated, or, either the Step Change or Fast Change scenario unfolds.
> - Stage 2 of the project, as described by TasNetworks in its PADR, is to construct the second cable if further decision rules are satisfied. The decision rules for Marinus Link to proceed to construct the second cable will be specified in the 2022 ISP, with the intent that this stage continues to be assessed to deliver value at that time."

[21] The Fast Change scenario had a regret cost of $14 million but did not include the legislation of TRET. The Central scenario outcomes are based on the TRET sensitivity (Appendix 2 of the 2020 ISP, section A2.5.5).

[22] AEMO, 2020 Integrated System Plan, July 2020, page 83.

4.3 Comparison with the PADR

As explained in Chapter 2, our PADR concluded that the optimal capacity and timing for Marinus Link is:

- **Stage 1**: An initial 750 MW DC link between Burnie area in Tasmania and Hazelwood area in Victoria, together with supporting network augmentations in Tasmania, should be commissioned in 2028; and
- **Stage 2**: The commissioning of a further 750 MW DC link and supporting network augmentations in 2032.

The conclusions in our PADR are broadly aligned with the 2020 ISP, which concludes that Stage 1 should be completed by 2028 if the Step Change scenario eventuates and by no later than 2031, if decision rules are satisfied. As already noted, Stage 2 will be subject to further assessment regarding its timing in the 2022 ISP.

According to AEMO, therefore, our PADR is aligned with the ISP if Step Change occurs, whilst no later than 2031 may be optimal in other circumstances (i.e. TRET is legislated or the Fast Change scenario eventuates). As already noted, in readiness for Stage 1, the ISP proposes that early works commence as soon as possible.

In broad terms, therefore, the 2020 ISP confirms the findings that we reached in our PADR, despite the difference in input assumptions and scenarios, demonstrating the robustness of these conclusions. In both cases, a staged 1500 MW interconnector is found to provide the greatest net market benefits to the customers, as compared to the alternative of not proceeding with Marinus Link. Given the passage of time since our PADR was published, a number of changes have occurred in relation to the scenarios adopted in the ISP and the forecast input data. Evidently, however, these changes have not had a material impact on the preferred option as described in the PADR.

5 Recent Developments

The purpose of this Chapter is to highlight a number of important market and regulatory developments since the publication of our PADR in December 2019.

Key messages

- Marinus Link is now in the Design and Approval phase of the project, which will enable an investment decision to be made in mid 2020s.
- A preferred route for the Staverton to Hampshire Hills section of the North West Transmission Development has been identified. This project will support Marinus Link and new generators locating in this Renewable Energy Zone.
- Key input assumptions that affect the future development of the NEM continue to change, as highlighted by the 2020 ISP, not least the impact of COVID-19. Whilst this creates uncertainty for all NEM participants, the RIT-T facilitates efficient investment decisions in these circumstances through the use of scenario analysis.
- New Rules and AER guidelines have been introduced to give effect to the ISP and integrate it in the transmission planning and regulatory arrangements. TasNetworks proposes to adopt these new Rules in completing the RIT-T process for Marinus Link.

5.1 Design and approvals stage

Following the successful completion of the PADR, we have progressed the early phases of the project to ensure that the timetable envisaged in the PADR is capable of being met, subject to satisfying the remaining regulatory and commercial requirements. As a result, Marinus Link has now entered the Design and Approvals phase of the project, which comprises various activities required to achieve an investment decision for Marinus Link and the North West Transmission Developments. The project is targeting an investment decision in the mid-2020s.

In reaching the Design and Approval phase, it is important to note the following key developments that indicate Federal and State Government support for the project:

- Our shareholder Ministers have confirmed that Project Marinus is a high priority for Tasmania, setting a target of doubling the State's renewable energy production, backed by Marinus Link; and

- The Prime Minister has announced that the Commonwealth will fast track the environmental approvals process for Marinus Link, with the project recognised as priority infrastructure to support Australia's COVID-19 recovery. Funding has also been announced by the Australian Government, as part of a $250 million interconnector fund, to support the project achieving FID by 2024.

It is important to note that the progress to the Design and Approval phase enables Marinus Link to proceed in accordance with the timeframes envisaged in the 2020 ISP, and as early as 2027. Whilst it is prudent to progress the project in this way, it does not pre-judge the outcome of the outstanding regulatory and commercial processes.

5.2 North West Transmission Developments

The capacity of the transmission network in North West Tasmania will need to ensure the power system can accommodate the future renewable energy and storage developments proposed for the region, including Marinus Link. These changes include a new transmission route between Staverton and Hampshire Hills in Tasmania.

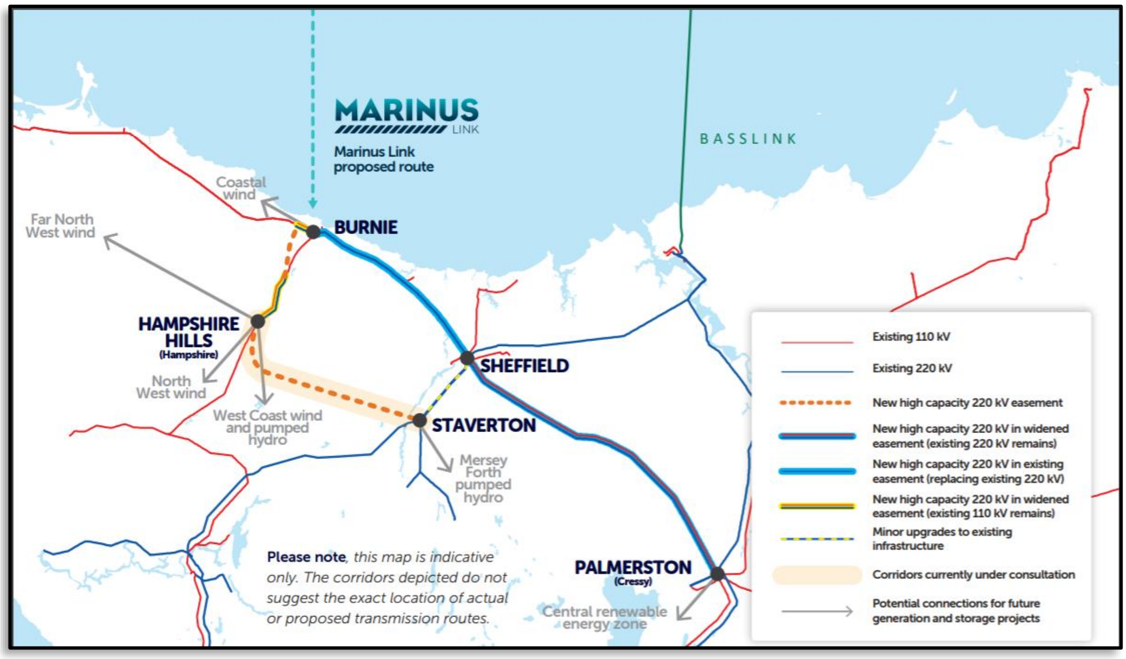
The Staverton to Hampshire Hills transmission route is proposed to connect Marinus Link, pumped hydro and other future renewable energy projects, including the Robbins Island and Jim's Plain Renewable Energy Parks, currently being planned by a private energy developer, UPC Renewables. The UPC Renewables connection has prompted TasNetworks to bring forward the timing of development between Staverton and Hampshire Hills.

TasNetworks' goal is to work with UPC Renewables and other generation and storage developers to achieve a coordinated and optimised transmission network that efficiently unlocks the renewable energy zone. The proposed transmission line between Staverton and Hampshire Hills is to be built, owned and operated by TasNetworks. Under this arrangement, UPC Renewables will pay for the right to use the line.

TasNetworks' has followed a rigorous route selection process to identify the preferred Staverton to Hampshire Hills route. Over an 18 months period, we have considered a range of factors and constraints relevant to the development of transmission infrastructure. The preferred route will support the progress of the environmental and social impact assessment, detailed transmission line design, environmental and planning approvals, and land access negotiations.

The map below shows the existing transmission network and the proposed transmission upgrades. These developments form the proposed 220 kV 'rectangle' that connects Burnie, Sheffield, Staverton and Hampshire Hills.

Figure 4: North West Transmission Developments



5.3 COVID-19 and other impacts

The 2020 ISP highlighted that a number of changes occurred during its second round of consultation:

- **Demand projections**. COVID-19 affected near-term demand, supply and risks in the energy sector, whilst record PV sales in 2019 have affected longer-term trends.
- **Changes in regional policies**. Tasmania announced the TRET, proposing to legislate this later in 2020, which will support 200% renewable energy generation in Tasmania by 2040. New South Wales firmed up its commitment to develop the transmission needed to accommodate 3 GW of large-scale variable renewable energy (VRE) in the Central West REZ. Victoria is procuring a 250 MW battery to enable up to 250 MW of increased imports from New South Wales to Victoria. In September 2020, as part of Victoria's COVID-19 recovery plan, the Victorian government announced potentially conducting a second round of procurement under the Victorian Renewable Energy Target program.
- **Changes in input costs**. The 2020 ISP highlighted a number of significant changes to its cost assumptions, including:
  - An increase of 30% in transmission projects;

- Reductions in the costs of grid-scale batteries by 30-40%;
- Increases in new gas-powered generators of 30-60%; and
- Increased costs for new pumped hydro energy storage by 50%.

AEMO noted that some of these changes were embedded in its ISP modelling, whilst others were used to test whether the ISP outcomes are sensitive to the change. AEMO concluded that despite these changes, the key findings of its Draft 2020 ISP were largely unaffected, which highlighted the robustness of the scenarios and approach used in developing the ISP.[23]

In relation to the impact of COVID and the growth in DER on the case for Marinus Link, AEMO made the following observations:[24]

> "While COVID-19 will have a noticeable impact in the next three to five years, the revised growth in DER has a more lasting impact, leading to much lower minimum demands and operational consumption in Victoria. This variability in operational demand, coupled with the increase in VRE to meet VRET, would increase the need for flexibility (storage and/or interconnection) to help balance demand and supply. This increases the value of early VNI West delivery (DP8[25]), and also favours candidates with earlier Marinus Link development (DP3 and DP5)."

It is evident from the 2020 ISP that input assumptions will continue to change as new information becomes available. Importantly, however, the key conclusions of the draft 2020 ISP are unaffected by the recent changes, which provides confidence that the use of scenarios and sensitivity analysis in the planning process is effective in making decisions even though the future is uncertain.

In relation to the RIT-T process for Marinus Link, it is important to get the balance right between bringing the process to a conclusion and updating the analysis in light of further information. As already noted, the AER's RIT-T guidelines recognises that uncertainty will be an inherent feature of any RIT-T process:[26]

> "The future will be uncertain when RIT–T proponents apply the RIT–T."

The Rules provide clear guidance on when changes in circumstances require the reapplication of the RIT-T, following the publication of the Project Assessment Conclusions Report. At this

[23] AEMO, 2020 Integrated System Plan, July 2020, page 31.

[24] AEMO, 2020 Integrated System Plan, July 2020, page 74.

[25] Development path.

[26] AER, Application guidelines, Regulatory investment test for transmission, August 2020, page 49.

stage of the RIT-T process, however, there is no reason to restart the RIT-T analysis for Marinus Link.

5.4 ISP Rule change and Guidelines

On 1 July 2020, new Rules were introduced that establish the ISP in the planning and regulatory framework by:

- defining the roles and responsibilities of AEMO, the TNSPs and the AER;
- explaining how the cost-benefit analysis will work, given the work undertaken in the ISP to identify actionable ISP projects and the requirement for TNSPs to undertake the RIT-T; and,
- ensuring that TNSPs can obtain cost recovery for actionable ISP projects through streamlined contingent project provisions.

For the purpose of this report, it is useful to highlight the following aspects of the new ISP Rules:

- A simplified set of contingent project triggers apply to actionable ISP projects so that the TNSP is able to obtain cost recovery. As part of this process, there is a requirement for TNSPs to obtain confirmation from AEMO that the project, or a particular stage of the project, meets the identified need in the ISP and the project costs are aligned with the costs modelled in AEMO's optimal development path (used in developing the ISP).
- Transitional arrangements apply so that TNSPs can choose whether to apply the new RIT-T arrangements for actionable ISP projects or continue with the previous Rules, if the RIT-T has already commenced or the project was identified as a contingent project in the TNSP's revenue determination.

In accordance with the ISP Rules, the AER published its final ISP guidelines on 25 August 2020. The AER explained that in its view Marinus Link's RIT-T is 'substantially complete' and should not be updated to apply the new RIT-T guidelines, even if TasNetworks elects to adopt the new Rules.[27] The AER's table below confirms this approach[28].

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[27] AER, Fact Sheet, Final Guidelines for Integrated System Plan, August 2020, page 2.

[28] AER, Final Decision, Guidelines to make the Integrated System Plan actionable, page 19.

Figure 5: Transitional arrangements for ISP Projects, AER

Regulatory Process	New ISP rules apply?	Final AER guidelines apply?*
2020 ISP	No – deemed compliant	No
2022 ISP (and all later ISPs)	Yes	Yes
VNI Minor RIT–T	Yes – at election of TNSP	No – RIT–T already finalised
Project EnergyConnect RIT–T	Yes – at election of TNSP	No – RIT–T already finalised
HumeLink RIT–T	Yes – at election of TNSP	No – RIT–T past draft report** stage
MarinusLink RIT–T	Yes – at election of TNSP	No – RIT–T past draft report stage
VNI West RIT–T	Yes – at election of TNSP	Yes
Central West REZ RIT–T	Yes	Yes

Source: AER analysis; AEMO, *2020 ISP*, July 2020; NER. Notes: *See section 4.2; **Project assessment draft report.

In explaining the above approach, the AER emphasises the importance of not restarting the RIT-T analysis if the PADR has already been published:[29]

> "It is not appropriate for the guidelines to apply to RIT–T applications where a draft report has been published. Such RIT–T applications are substantively underway and may require re-starting the draft report. For these RIT-T applications, the previous RIT–T instrument and application guidelines continue to apply."

For Marinus Link, our approach is to apply the new ISP Rules so that AEMO has the opportunity to review our proposed project scope and costs at each of the stages (early works, stage 1 and stage 2) to verify that both are consistent with the optimal development path in the 2020 ISP and subsequent ISPs. In addition, we do not propose to restart the RIT-T process or to apply the AER's new RIT-T guidelines.

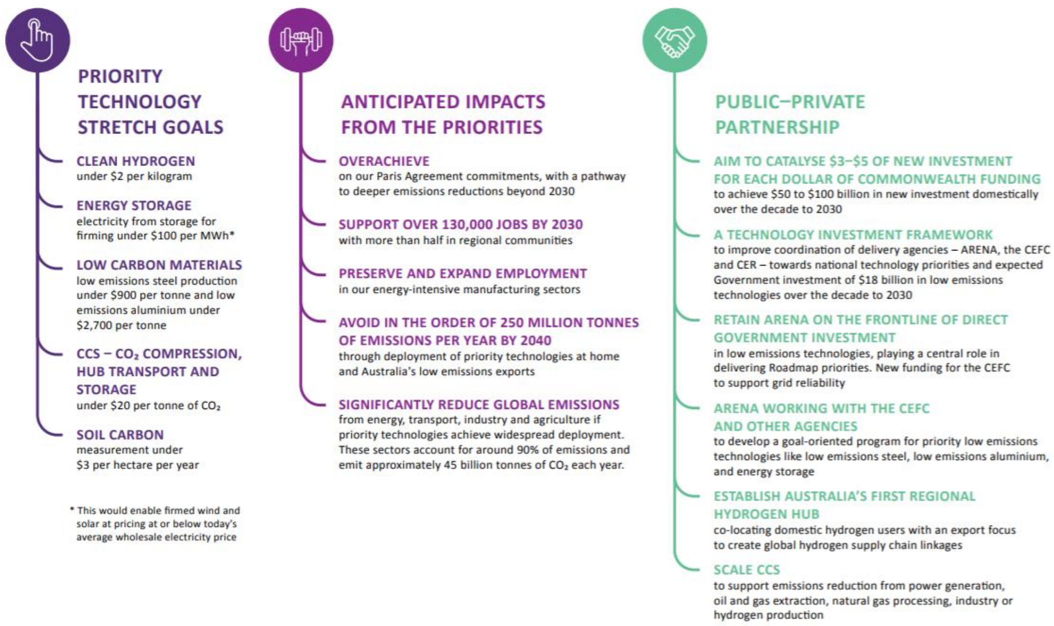
Our proposed approach is consistent with the feedback we received from stakeholders, which emphasised the importance of aligning our RIT-T analysis with the 2020 ISP. As explained above, our approach is also consistent with the views expressed by the AER.

[29] AER, Final Decision, Guidelines to make the Integrated System Plan actionable, page 19.

5.5 Technology Investment Roadmap

In September 2020, the Australian Government released the Technology Investment Roadmap (Roadmap). The Roadmap is an enduring strategy to accelerate the development and commercialisation of new and emerging low emissions technologies. The major milestones of the Roadmap process are annual Low Emissions Technology Statements that will prioritise low emissions technologies with the potential to deliver the strongest economic and emissions reduction outcomes for Australia. Highlights from the first low emissions technology statement are shown in Figure 6.

Figure 6: Highlights of the Technology Investment Roadmap[30]



The priority target of grid-scale electricity storage states electricity from storage for firming under $100/MWh and also includes a stretch goal of achieving an average wholesale electricity price below $70/MWh with low emission dispatchable firming sources with eight or more hours of storage. The Statement notes that achieving the priority target presents the potential to reduce Australia's cumulative emissions by over 700 Mt CO_2-e to 2040.[31] Based on emission

[30] Australian Government, First Low Emissions Technology Statement – 2020, Page 6.

[31] Australian Government, First Low Emissions Technology Statement – 2020, Page 19.

projections for the current financial year[32], this target represents an opportunity to further reduce NEM emissions by up to 7% from the projected levels in the Central scenario of the 2020 ISP.[33]

As explained later in this report, Marinus Link has an important role to play in reducing emissions in accordance with the Roadmap. Whilst this contribution to the Roadmap has not been factored directly into our cost benefit modelling, it is a matter that may be relevant to a decision to bring forward the project commissioning date.

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32 Australian emissions projections 2019, Figure 7.

33 Central ISP scenario budget from FY 2021 to 2040 is 2,102 Mt. Targeted reduction of 700 Mt represents a value of 1,960 Mt, based on current financial year estimate of 133 Mt.

6 Supplementary modelling

This Chapter explains our approach to supplementing our modelling in the PADR in light of recent developments, the 2020 ISP and stakeholder feedback. In supplementing our modelling, we are conscious that whilst our PADR has been published, alignment with the ISP was a key theme from stakeholders' submissions.

Key messages

- The modelling approach adopted in the PADR for Marinus Link is closely aligned with the 2020 ISP, as both approaches seek to meet customers' future energy needs in the most efficient manner, having regard to network and non-network options.
- This report builds on the analysis presented in the 2020 ISP by examining the 1500 MW option, and adopting the scenarios, inputs and assumptions from the ISP.
- Some stakeholders raised concerns regarding our assessment of battery capacity as an alternative to Marinus Link. To address these concerns, we confirm that our supplementary modelling adopts the assumptions and forecasts in the 2020 ISP.
- The input assumptions in the 2020 ISP have been updated to reflect AEMO's latest forecasts as presented in its Electricity Statement of Opportunities 2020, published in August, which considers the impact of pandemic on electricity consumption.
- The modelling presented in this report covers the period to 2042, consistent with the available dataset in the 2020 ESOO. In contrast, our PADR modelling examined the net market benefits to 2050.
- For the purpose of this report we have adopted the 2020 ISP total project costs of $3.15 billion ($2019) for Marinus Link.
- To address matters raised by stakeholders, we have included additional sensitivities in this paper to consider the impact of significant hydrogen load growth in Tasmania of up to 1,000 MW; sustained lower gas prices; increased pumped hydro storage capacity in Tasmania; variation in battery cost projections; and 'upper bound' estimate of 2020 ISP costs for Marinus Link.

6.1 Modelling approach

Our PADR for Marinus Link explained that Ernst & Young's market modelling examined the total integrated system costs of meeting customers' future electricity needs. We explained that the model selects the lowest cost combination of generation, storage, non-network options, and demand-side response, in addition to considering the optimal timing and capacity of other interconnector options apart from Marinus Link. As a consequence, therefore, each option for Marinus Link and supporting transmission was accompanied by different investments across the NEM.

In broad terms, the modelling approach in the PADR for Marinus Link is therefore aligned with the ISP's objective, which is to identify the combination of investments that will address customers' needs in the most efficient manner. Given the passage of time, input assumptions and scenarios in the 2020 ISP differed from those employed in our PADR for Marinus Link. As explained in section 4.3, however, AEMO's conclusions regarding the optimal capacity and timing for Marinus Link were closely aligned with the preferred option identified in the PADR.

A number of stakeholder submissions to our PADR commented on the importance of ensuring that our modelling is aligned with the inputs and assumptions of the 2020 ISP. We are also mindful, however, that it is important to build on the work undertaken in the 2020 ISP rather than revisiting earlier analysis. In making this observation, we note that the AER has described the RIT-T process for Marinus Link as being 'substantially complete'.[34] The 2020 ISP also explains that the PADR is 'complete'[35], noting that 'it is prudent to maintain momentum on the current Marinus Link RIT-T and continue progressing early works for both cables through to Final Investment Decision in 2023-24.'[36]

To build on AEMO's analysis and respond to stakeholders' feedback that we should align our modelling with the 2020 ISP, we considered it appropriate to undertake further modelling focusing on:

- a 1500 MW Marinus Link option, undertaken in two 750 MW stages; and
- the impact of ISP's scenario weightings on the case for Marinus Link.

The adoption of scenarios are discussed in further detail in section 6.3.

[34] AER, Fact Sheet, Final Guidelines for Integrated System Plan, August 2020, page 2.

[35] AEMO, 2020 Integrated System Plan, July 2020, page 90.

[36] AEMO, 2020 Integrated System Plan, July 2020, page 83.

6.2 Updated assumptions and input data

For the 2020 ISP, AEMO consulted extensively with industry, academia, government, developers and consumer representatives through two rounds, one before and one after the publication of the draft 2020 ISP in December 2019. The first round culminated in the Forecasting and Planning Scenarios, Inputs and Assumptions Report, August 2019. The second round consultation led to the following material changes to input assumptions:[37]

- A minimum increase of approximately 30% in transmission capital costs, applied to all projects;
- An increase of approximately 50% in future uncommitted pumped hydro energy storage capital costs;
- A decrease in large-scale battery costs (depending on storage depth) of 30-40% and an extension of utility battery life; and
- a decrease in the size of future gas-powered generation, resulting in an increase in capital costs of 30-60%.

For the purpose of this report, we have adopted the same inputs and assumptions as AEMO in the 2020 ISP; any deviations from these are outlined in Section 6.6. This approach addresses the feedback we received from stakeholders that our inputs and assumptions should be aligned with the ISP. In addition, by adopting AEMO's assumptions, we are effectively leveraging off AEMO's extensive industry consultation, which considered feedback from 54 stakeholders.[38] In our view, this approach ensures that stakeholders' competing views are assessed objectively and reflected fairly in the adopted assumptions, thereby avoiding any risk that the selected inputs are biased positively or negatively towards Marinus Link.

6.3 Scenarios and weighting

In our PADR, we adopted the following four scenarios which were closely aligned with AEMO's scenarios in 2019, as explained below:

- **Global slowdown**. This scenario essentially represented a future in which there is a sustained global economic slowdown, resulting in reduced demand for both commodities and energy. This scenario included reduced national energy demand,

[37] AEMO, 2020 Integrated System Plan Consultation Summary Report, August 2020, page 4.

[38] AEMO, 2020 Integrated System Plan Consultation Summary Report, August 2020, page 10.

including the loss of all mainland Australia aluminium smelters; a 25 per cent reduction in gas prices; and termination of all emissions reduction schemes. This scenario was closely aligned with AEMO's 2019 'Slow Change' scenario.

- **Status quo/current policy**. This scenario represented the median-projection NEM demand profile and a continuation of existing policies. Under this scenario, the Mandatory Renewable Energy Target was included in its current form and state-based renewable energy targets were assumed to be implemented. This scenario was closely aligned with AEMO's 2019 'Central' scenario.
- **Sustained renewables uptake**. This scenario assumed that the recent momentum in renewable investment would be sustained and, consequently, a number of coal-fired generators retire three to five years earlier than the nominated closure dates. This scenario was closely aligned with AEMO's 2019 'Fast Change' scenario.
- **Accelerated Transition to a Low Emissions Future**. This scenario represented a future in which there is a concerted international effort to meet the objectives of the Paris Climate Accord. Under this scenario, load was assumed to increase due predominantly to the accelerated transition to electrification of the transport sector to support a lower emissions trajectory. This scenario was aligned with AEMO's 2019 'Step Change' scenario.

We explained that AEMO subsequently developed a fifth scenario, 'High DER', for which we had no direct equivalent. This scenario essentially involved a more rapid consumer-led transformation of the energy sector, leading to increased adoption of DER and accelerated change in the generation sector. In our PADR, we applied an equal weighted to each of the four scenarios, but did not include the 'High DER' scenario as it had not been developed at that time.

The 2020 ISP has continued to adopt five scenarios, although the policy assumptions and input parameters have changed in light of the latest available information, as indicated in the table below.

Table 3: Policies incorporated in each scenario

Policy	Slow Change	Central	Fast change	High DER	Step Change
VRET – 40% by 2025; 50% by 2030	✓	✓	✓	✓	✓✓
TRET - 100% by 2022	✓	✓	✓	✓	✓
TRET - 200% by 2040	×	×	×	✓	✓
QRET – 50% by 2030	×	✓	×	✓	✓✓
Central-West Orana REZ Transmission Link	✓	✓	✓	✓	✓
Snowy 2.0	✓	✓	✓	✓	✓
Current DER and EE policies	✓	✓	✓	✓✓	✓✓
26% reduction in emissions by 2030 (NEM)	✓	✓	✓	✓	✓✓
NEM carbon budget to achieve 2050 emissions levels	×	×	✓	×	✓✓

Note:

✓ - indicates that this setting will be included in the scenario

× - indicates that this setting will be excluded from the Scenario

✓✓ - indicates that the existing policy is included at a minimum, but volume likely to be exceeded

For the purpose of this report, we have adopted AEMO's five scenarios and accompanying input data, with the exception of the adjustments described in section 6.6. By adopting AEMO's scenarios and inputs, we are responding directly to those stakeholders that asked us to align our analysis with the 2020 ISP.

Importantly, however, the supplementary modelling in this report does not imply that we resile from the analysis and preferred option presented in the PADR. As previously noted, our PADR was conducted at a point in time, having regard to the best available information and the application of RIT-T guidelines. We recognise, however, that it is appropriate to test our earlier findings in light of the new information, particularly given the feedback received from stakeholders.

In terms of scenario weightings, we consider it helpful to present the supplementary analysis by applying an equal weighting to AEMO's five scenarios, as this analysis will provide a useful comparison with our analysis in the PADR. In addition, the report depicts outcomes for the Central and Step Change scenario, as outlined in the recommendation for the RIT-T proponent in the 2020 ISP.

Table 4: 2020 ISP's 'Least Regrets' Scenario Weighting for Marinus Link[39]

Project	Responsible TNSP(s)	Identified need	ISP candidate option†	Scenarios of relevance for TNSP under ISP Framework
Marinus Link **(with decision rules) ‡** **PADR completed in December 2019**	TasNetworks and AEMO Victorian Planning	The characteristics of customer demand, generation and storage resources vary significantly between Tasmania and the rest of the NEM. Increased interconnection capacity between Tasmania the other NEM regions has the potential to realise a net economic benefit by capitalising on this diversity.	Marinus Link is a second, and potentially third, HVDC cable interconnection between Tasmania and Victoria. It is proposed with a transfer capability of 750 MW (one cable) or 1,500 MW (two cables).	Central with TRET (67%), and Step Change (33%)

† Indicative outline of the recommended option for project delivery
‡ These requirements can be assessed during the RIT-T process and will be confirmed by AEMO during an ISP feedback loop process with the TNSP once the decision rules eventuate. These projects are also critical to address cost, security and reliability issues.

As explained in section 5.4, we are adopting the new ISP Rules for the final stage of the RIT-T process for Marinus Link. Given this approach, it is appropriate to consider AEMO's focus on the Central and Step Change scenarios and its likelihood weightings, in addition to presenting the updated modelling results using an equal weighting across all five scenarios.

6.4 Battery costs and installed capacity trajectory

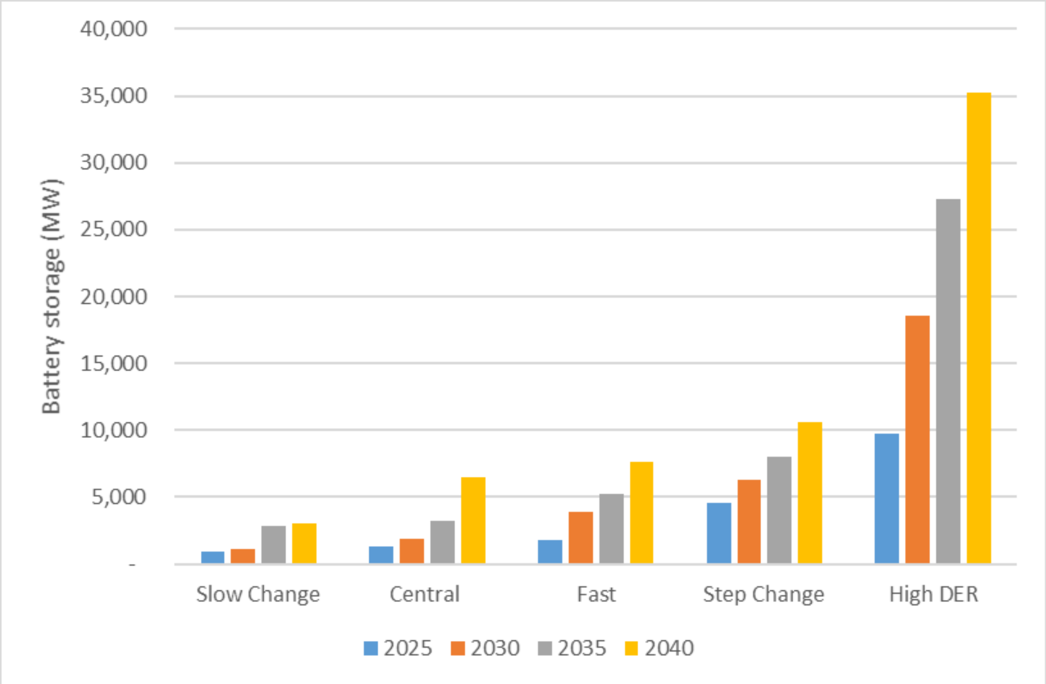
Stakeholders in their submissions to our PADR suggested that our modelling was understating the role of Battery Energy Storage Systems (**BESS**) in the ongoing NEM transition. As this report is based on the scenarios and accompanying inputs and assumptions of the ISP, this section provides an insight into the amount of battery capacity installed and battery cost trajectory in each of the scenarios.

To reflect the different potential evolutions of the NEM, varying quantities of dispatchable battery storage are assumed in each of the scenarios, with up to 35,000 MW committed in the High DER scenario. It is worth noting that this battery storage is exogenously[40] committed in each of the scenarios and therefore does not rely on least cost economics of the modelling.

[39] AEMO, 2020 Integrated System Plan, July 2020, Table 12, page 87.

[40] In economic modelling, when the value of the input is determined outside the model and is imposed on the model. In contrast, an endogenous variable value is determined by the model based on the modelling parameters.

Figure 7: Total battery storage installed in each of the ISP scenarios



Whilst we have adopted the 2020 ISP scenarios and input assumptions regarding battery capacity and costs, there are good reasons to believe that these are likely to overstate the future role played by batteries in meeting customers' future energy needs, as explained below.

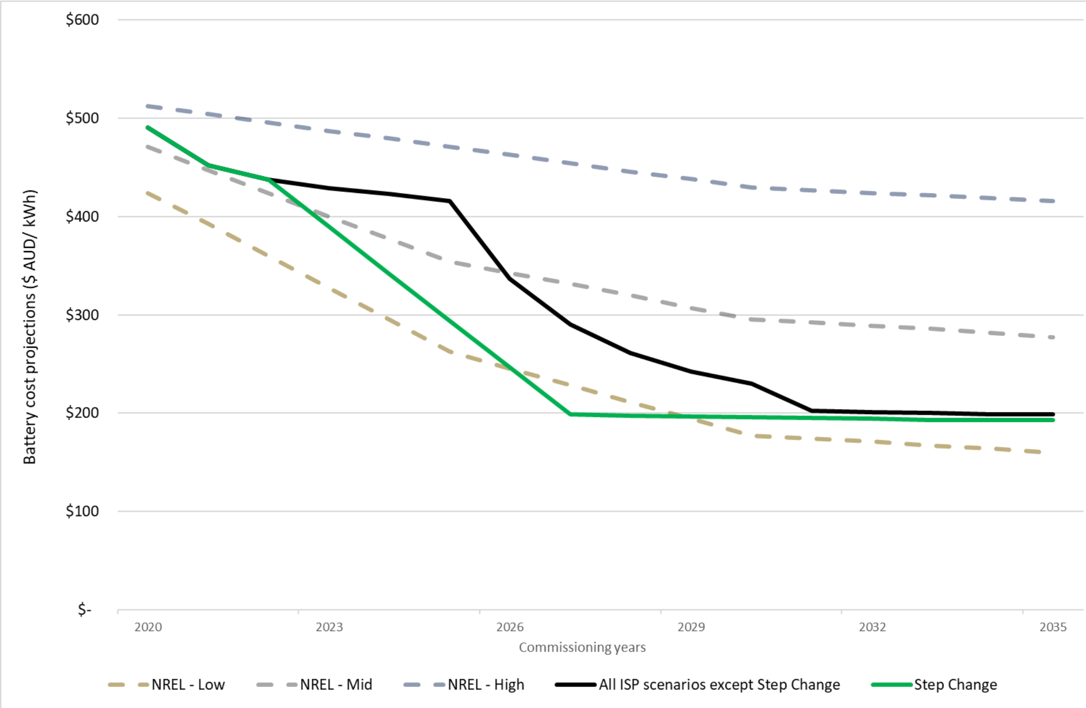
In addition to increasing the amount of battery committed in each of the scenarios, the 2020 ISP's inputs and assumptions also reduced the cost of battery technology by 30-40%. As shown in Figure 8, the ISP battery cost projection for all scenarios is lower than mid-price forecast for National Renewable Energy Laboratory (**NREL**) projection for utility scale battery storage costs.[41]

The NREL publication adopts cost projections for utility-scale battery storage based on their analysis and synthesises findings from 25 other technical publications. Similar to the ISP's cost projections, the NREL study found that battery costs could reduce by up to 70% in the next 10 years. However, it also noted that the cost reductions could be smaller if there are constraints in sourcing of raw materials; issues regarding the environmental impacts of lithium-ion batteries; or concerns regarding the recycling of used batteries. The NREL study also recommends a 2.5% Fixed Operations and Maintenance (**FOM**) cost of total installed capital costs and a battery life of 15 years. In comparison, the ISP studies do not assume any FOM costs and

[41] Cost Projections for Utility-Scale Battery Storage (2019). National Renewable Energy Laboratory, Golden, Colorado.

adopts a longer battery life of 20 years, which will reduce the annualised costs of battery capacity.

Figure 8: Battery cost projection comparison for 4 hour storage – 2020 ISP & NREL ($AUD/kWh)



For the reasons set out above, the 2020 ISP inputs and assumptions, including significant amounts of exogenously committed BESS, may prove to overstate the role of batteries in addressing customers' future energy needs. Nevertheless, in this report we have adopted the 2020 ISP's assumptions, which should provide stakeholders with assurance that the cost benefit assessment of Marinus Link is undertaken on a technology neutral basis.

6.5 Updated project costs

Our PADR explained that the central estimate of the capital costs for the preferred option as identified by the RIT-T, including transmission network augmentations, was $2.76 billion at that time. The estimated costs include supporting network augmentation in Tasmania to ensure that the planned transfer capacity can be delivered. We explained that $2.76 billion was the expected capital expenditure excluding allowances for accuracy and contingencies, expressed in 2019 dollars.

As already noted, the 2020 ISP commented that each major transmission project identified in the ISP that had gone through the RIT-T process had at least a 30% increase in cost from initial estimates, due to a range of factors. As a consequence, AEMO increased the capital cost estimates by approximately 30% and adjusted for the specific project circumstances for each ISP projects.[42] In Marinus Link's case and its supporting transmission investments, AEMO adopted modelled costs of $3.15 billion ($2019). For the purpose of this report, we have adopted modelled cost estimate from the ISP. The table below shows a breakdown of revised cost estimates.

Table 5: Cost breakdown of Marinus Link in $2019 ($ million)

Cost breakdown	Cost ($2019, million)
Capital cost (DC)	$2,671
Capital cost (AC)	$484
Total cost (DC + AC)	$3,155
Annual operating cost	$24
Annualised cost (WACC - 5.9%)[43]	$217
Annualised cost (WACC – 7.9%)	$265

We will continue to reassess the total project costs as we complete the RIT-T process and progress the 'early works' in accordance with the 2020 ISP. For the purpose of this report, we consider it appropriate to adopt AEMO's view on infrastructure cost given AEMO's detailed interaction with other TNSPs and suppliers on the cost of developing transmission infrastructure.

6.6 Input and assumptions deviations from 2020 ISP

As noted in previous chapters, a key purpose of this report is to consider the implications of the 2020 ISP, including AEMO's inputs and assumptions. However, in order to provide the most comprehensive update for stakeholders, it is appropriate to vary some inputs and assumptions

[42] AEMO, 2020 Integrated System Plan, July 2020, page 31.

[43] Consistent with 2020 ISP, the WACC of 5.9% is used for all scenarios, except Slow Change. Slow Change uses a WACC of 7.9%.

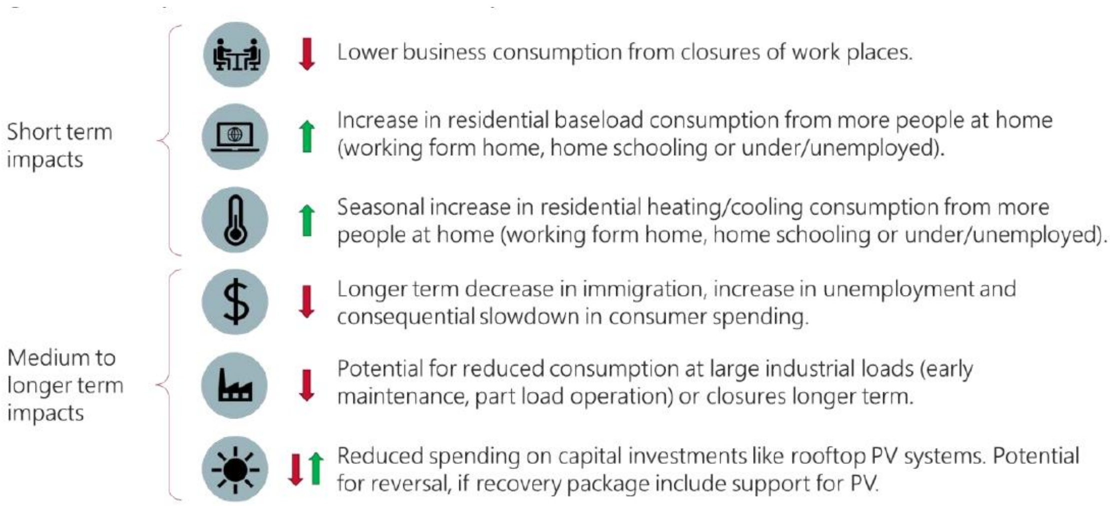
from those adopted in the 2020 ISP. This section outlines and provides justification for inputs and assumptions that diverge from the 2020 ISP.

6.6.1 2020 ESOO

The 2020 ISP was based on the Electricity Statement of Opportunities (**ESOO**) for 2019, but included a sensitivity to highlight the impact of reduced energy consumption from the COVID-19 pandemic. AEMO has now published the 2020 ESOO, which provides an updated view on the impact of the pandemic. Given the availability of better information in the 2020 ESOO, we consider it appropriate to adopt this data, rather than continuing to rely on the 2019 ESOO as reflected in the 2020 ISP.

The figure below provides an overview of the impact of COVID-19 on AEMO's latest energy forecasts, noting the different short term and medium impacts.

Figure 9: Impact of COVID on energy consumption forecasts[44]



An overarching observation is that there is considerable uncertainty regarding future demand and the increase in the capacity of distributed PVs in both the residential and business sectors. However, the best estimate is that operating demand will remain largely stagnant until the 2040s, as the increase in underlying demand is offset by behind the meter energy resources.

The 2020 ESOO also outlines the trend of sustained reduction in minimum operational demand, particularly in South Australia and Victoria. The inertia constraint included in our modelling

[44] AEMO, 2020 Electricity Statement of Opportunities, August 2020, Figure 6, page 28.

ensures sufficient synchronous capacity is online to meet the minimum inertia levels of the system.

An important difference in the modelling presented here is that the study period ends in 2042, consistent with the available dataset in the 2020 ESOO. In contrast, our PADR modelling examined the net market benefits to 2050.

6.6.2 Tasmanian Renewable Energy Target (TRET)

The Tasmanian Renewable Energy Target (**TRET**) was announced by Premier Peter Gutwein in his State of the State address in March 2020. The Premier announced that Tasmania expects to reach 100 per cent self-sufficiency in renewables before 2022 with the full commissioning of Granville Harbour and Cattle Hill wind farms – using 10,500 GWh as an annual average demand baseline assumption. The TRET is to achieve a doubling, or 200 per cent, from the baseline of 2022 generation levels by 2040.

The TRET legislation was tabled in the Tasmanian Parliament on 15 October 2020. The tabled legislation proposes a total renewable energy generation target of 21,000 GWh by 2040. In addition, the tabled legislation also includes an interim renewable energy generation target of 15,750 GWh by 2030. The supplementary modelling presented in this report assumes that the proposed TRET is achieved in all five scenarios. This assumption differs from the 2020 ISP, which included TRET at 200% in the 'High DER' and 'Step Change' scenarios, but only 100% in the other three scenarios as the legislation was yet to be put before Parliament.

6.6.3 Economic retirements and interconnector timing

The generation outlook spreadsheets[45] for the 2020 ISP suggest that economic generator retirements[46] do not occur in the Central and High DER scenario. The modelling for this report

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[45] AEMO, 2020 Integrated System Plan Generation Outlook, September 2020

[46] Economic retirement refers to the model choosing to retire a generating unit prior to its scheduled closure date because it would be a lower cost option to retire the unit early than to continue its operation until the scheduled retirement date.

allows economic retirements to occur in all scenarios[47], except the Slow Change scenario. Economic retirements are permitted from 2024 onwards, on the basis of the three year notice of closure Rule.[48] Sensitivity analysis is conducted to demonstrate the impact on the net market of benefits of Marinus Link in the case where economic retirements are not allowed in the Central scenario.

The 2020 ISP provided guidance to TasNetworks to include the accelerated delivery date of 2027 for VNI West[49], although the economic optimal timing for the project is 2035, on the basis that it is expected to provide protection against scarcity risks and support for Victorian Renewable Energy Target among other factors.

The modelling for this report assumes the accelerated delivery date for VNI West, and includes the commissioning of QNI 'medium' and 'large' in 2032 and 2035 respectively, which are identified as future ISP projects in the 2020 ISP.

6.6.4 Modelling refinements

The modelling for this report leverages the proprietary modelling resources of Ernst & Young for renewable energy traces, inertia and reserve constraints, and latest generator information as published by AEMO.

The Tasmanian hydro system continues to be represented as a 10-pond system in the modelling for this report in contrast to the 2020 ISP modelling, which is based on a 7-pond system. In addition, the reserve and inertia constraints detailed in the Ernst & Young attachment released with our PADR continue to be used. The 2020 ISP's market modelling paper indicates that a more iterative process was followed wherein market modelling results are investigated through power system analysis to ensure that the reliability and system security needs of the power system will be met.[50] In contrast, Ernst & Young's time sequential resource planning for capacity expansion ensures the power system needs are met on an hourly basis.

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[47] Coal and gas-powered generators are allowed to retire in Central and High DER case, whereas only coal fired generators are permitted to retire in scenarios with decarbonisation targets – Fast Change and Step Change scenario.

[48] AEMC, Generator three year notice of closure, Rule determination, 8 November 2018

[49] AEMO, 2020 Integrated System Plan, July 2020, Guidance for RIT-T proponents, page 83

[50] AEMO, ISP, Appendix 9

The modelling for this report also uses Ernst & Young's proprietary renewable energy resource traces for each of the 35 Renewable Energy Zones and the latest information from AEMO's July 2020 generator information paper[51]. This data has been updated from that adopted in the 2020 ISP, and therefore it is appropriate to adopt it in this report.

Please refer to the accompanying Ernst & Young's report for additional information regarding these modelling refinements and other technical details related to the modelling undertaken for this report.

6.7 Sensitivity analysis

This section explains the various sensitivity analysis undertaken, based on the issues raised by stakeholders in their submissions to our PADR, and on recent market trends.

6.7.1 Hydrogen Load Growth

Hydrogen is increasingly being discussed as a promising fuel that could reduce the amount of fossil fuels burned in several sectors, such as transportation and heavy industry, and help achieve net-zero carbon emissions target by 2050, a target set by the majority of state governments and territories in Australia, and by a number of countries.

Our PADR contained a hydrogen sensitivity that assumed Tasmanian system load would increase by 100 MW. Since the release of our PADR, however, ARENA and the Tasmanian State Government have announced significant seed funding for hydrogen projects.

The Global Gas Report 2020[52] predicts hydrogen industry will emerge strongly in the 2030s and reach a mature status in the following decade, if the OECD countries commit to achieve their decarbonisation objectives. Therefore, for this report we have expanded the size of hydrogen load growth in Tasmania to 500 MW by 2035 and 1,000 MW by 2040. This load growth is assumed under the Step Change scenario, since it aligns with the decarbonisation objectives needed for the growth of the hydrogen industry.

It is assumed that hydrogen load will have a capacity factor of 80%[53], with consumption reduced during periods of high electricity demand. This assumption aligns with material reviewed that

[51] NEM Generator Information July 2020 V2, https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-planning-data/generation-information

[52] International Gas Union, Global Gas Report 2020, https://igu.org/resources/global-gas-report-2020

[53] Based on industry journals, a capacity factor of at least 70-80% is needed to justify the capital cost investment associated with hydrogen production.

suggests hydrogen production will primarily absorb excess renewable energy, and therefore will not increase the firming requirement on the system.

6.7.2 Sustained Low Gas Price

The gas price projections in the 2020 ESOO are marginally lower than the 2020 ISP assumptions, but on average the gas price for a new entrant CCGT in Victoria is approximately $11/GJ (June 2019 dollars for a period of 2025 to 2050)[54].

As a means of economic recovery from the COVID-19 pandemic, several business experts are calling on the government to provide financial underwriting to ensure a sustained reduction in gas price. This sensitivity assumes that the underwriting support is for up to $3/GJ thereby lowering the gas price to $8/GJ. The 2020 Gas Statement of Opportunities (GSOO) estimates the demand for eastern and south-eastern Australia to be approximately 600 PJ (excluding LNG exports). This level of underwriting therefore provides for a potential annual financial assistance of up to $1.8 billion.

The sensitivity is conducted with inputs and assumptions associated with the Central scenario, with Marinus Link committed in its optimal commissioning timeframe for this scenario.

6.7.3 750 MW of committed pumped hydro in Tasmania

Hydro Tasmania in its submission to our PADR indicated lower capital costs for Tasmanian pumped hydro projects as compared to those in mainland Australia. The estimate provided suggested a reduction of 20-25% below the 2020 ISP costs. This sensitivity assumes 750 MW of pumped hydro is committed in Tasmania with the second stage of Marinus Link.

As noted in our PADR, pumped hydro development typically occurs in conjunction with the retirement of dispatchable thermal generation capacity. We have therefore incorporated this sensitivity in the Step Change scenario and optimal commissioning timeframe of Marinus Link for this scenario.

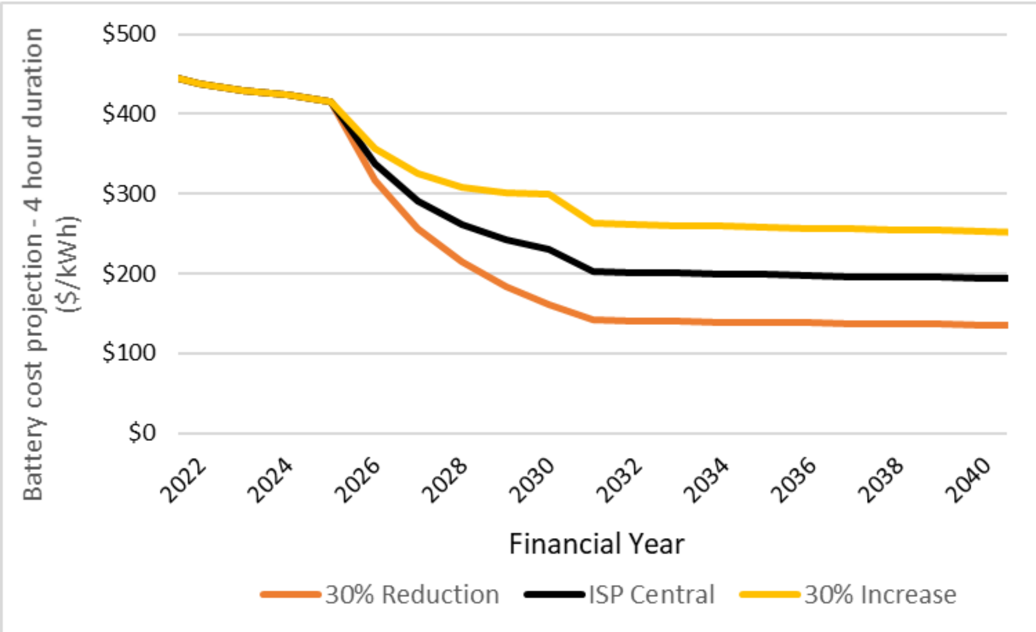
6.7.4 Variation in battery cost (+/- 30%)

In recognition of the narrative discussed in section 6.4 regarding potential for variation in battery costs, this sensitivity examines the impact if the battery costs are 30% higher or lower than 2020 ISP costs for a battery storage with 4 hour storage duration by 2030. The below figure

[54] 2020 forecasting and planning inputs, assumptions and scenarios report, August 2020.

provides the battery cost trajectory. The sensitivity is conducted with inputs and assumptions associated with Central scenario with Marinus Link committed in its optimal commissioning timeframe for this scenario.

Figure 10: Battery cost sensitivity – 4 hour storage ($2019/kWh)



6.7.5 ISP 'upper bound' sensitivity

The 2020 ISP mentions an upper bound cost range of $4.1 billion ($2019) for Marinus Link. This sensitivity tests the robustness of optimal timing of the project to this upper bound project cost estimate.

6.7.6 Economic retirements not permitted in Central scenario

As discussed in section 6.6.3, this is a sensitivity wherein economic retirement of generators is not permitted in Central scenario.

7 Market Benefit Results

This chapter presents the results of the cost-benefit analysis for a 1500 MW Marinus Link and the accompanying North West Transmission Development, constructed in two stages, which is consistent with the definition of Marinus Link in the 2020 ISP[55]. The cost benefit analysis employs the updated input assumptions and forecasts described in the previous chapter.

Key messages

- We have undertaken additional modelling to examine the impact on the economic case for Marinus Link if the 2020 ISP scenarios, inputs and assumptions are adopted. Where appropriate, we have also incorporated recently published data in our modelling.
- Our modelling confirms the findings in the 2020 ISP that Marinus Link is justified, assuming equal weighting is applied across the scenarios. The optimal timing for stage 1 is 2031 in our modelling, which is consistent with the ISP.
- If the Step Change scenario eventuates, our modelling shows that the optimal timing for stage 1 would be brought forward to the earliest feasible timing. Furthermore, there is a compelling case to undertake the early works necessary to deliver stage 1 by 2027 and Stage 2 by 2030, even if this scenario does not eventuate. This finding is consistent with the 2020 ISP, which requires early works for both stages of the project to be completed by 2023-24.
- Our modelling indicates that Marinus Link plays a key role in meeting customers' future energy needs. Importantly, Marinus Link is part of an integrated solution in which other transmission, generation and storage solutions, including a significant growth in battery capacity, and demand-side measures all play their role according to their capabilities and costs.
- Our sensitivity analysis does not raise any issues in relation to the adoption of the preferred option. In particular, the optimal timing for the project is insensitive to assumptions regarding higher than expected project costs.

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[55] The detailed staging of the North West Transmission Developments is under review, and is expected to change from that assumed in the PADR and 2020 ISP, however does not affect the RIT-T analysis or conclusions.

- Our analysis of recent changes in the NEM suggests that the current trajectory is consistent with the Step Change scenario. The rapid rate of change and Marinus Link's potential value in smoothing the transition as coal plant retires, provides the backdrop for pursuing the earliest commissioning of the project.

7.1 Net market benefits

As explained in section 4.2, we have examined various timings of Marinus Link ranging from earliest feasible time of 2027, to 2034 for Stage 1 of the project, and assumed in each case that Stage 2 proceeds three years later. As noted in the 2020 ISP, the timing of Stage 2 will depend on decision rules which will be developed in the 2022 ISP. Table 6 identifies the commissioning years with the optimal timing, shaded in green, for each scenario, and also shows the optimal timing when weighted equally:

- across all scenarios; and
- across all scenarios, apart from the slow change scenario.

The rationale for the latter approach is that the 2020 ISP in its decision signposts suggests that actionable projects with decision rules would be reconsidered if the slow case eventuated.[56]

[56] This approach is set out in the 2020 Integrated System Plan, July 2020, page 93.

Table 6: Net market benefits of Marinus Link by scenario (NPV, $ million)

	Commissioning Years			
Scenarios	2027 & 2030	2028 & 2031	2031 & 2034	2034 & 2037
Central	$639	$731	$871	$776
Fast Change	$789	$838	$906	$828
High DER	$612	$701	$857	$758
Slow Change	-$214	-$109	$107	$204[57]
Step Change	$1,599	$1,615	$1,582	$1,309
Average (All Scenarios)	$685	$756	$864	$775
Average (no Slow Change)	$910	$972	$1,054	$918

In the above table, we have highlighted both 2027 and 2028 as optimal timing for the Step Change scenario. In practical terms, the $16 million difference between these two outcomes is immaterial, being less than 0.5% of the estimated project costs. In addition, our modelling does not capture some of the 'insurance' benefits of delivering the project sooner, which would further reduce (if not eliminate) the apparent difference in net market benefits between the two years.

Our analysis shows that the commissioning timing with the highest net market benefits for Marinus Link is broadly consistent with the 2020 ISP. In particular, the 2020 ISP stated that:

a. If the Step Change scenario eventuates, Stage 1 of the project should be completed by 2028 (earliest feasible timeline prior to Prime Minister's announcement regarding fast tracking environmental approvals for Marinus Link); or

b. If TRET is legislated, Stage 1 of the project should be completed by no later than 2031; or

c. If the Fast Change scenario unfolds, Stage 1 of the project should be completed by no later than 2031.

[57] While this commissioning year provides the highest modelled net market benefits, further modelling would be needed to determine optimal timing in this scenario.

As explained in section 6.6.2, our modelling reflects TRET being legislated. Therefore, the average across all scenarios is consistent with the element (b) set out above, which describes the optimal timing if TRET is legislated. Our analysis shows that net market benefits are maximised if stage 1 is commissioned in 2031. This modelling therefore confirms the conclusion in the 2020 ISP regarding the optimal timing of Marinus Link, if TRET is legislated.

Our modelling also shows that if the Step Change scenario eventuates, the optimal timing is the earliest feasible timing, which indicates a slightly earlier timing than the 2020 ISP (see element (a) above). Our modelling confirms the 2020 ISP's conclusion that Stage 1 should proceed in 2031, if the Fast Change scenario eventuates (see element (c) above).

As outlined in section 5.3, TasNetworks will be adopting the new ISP Rules to deliver the project in a staged manner, thereby retaining optionality as the NEM continues to transition to a low emission future, and technology costs evolve. In this regard, it is useful to report the results (in the table below) for the Central and Step Change scenarios, which the 2020 ISP suggests are the scenarios of relevance to consider, and weight.[58]

Table 7: Net market benefits of Marinus Link in Central and Step Change Scenarios (NPV, $ million)

	Commissioning Years			
Scenarios	2027 & 2030	2028 & 2031	2031 & 2034	2034 & 2037
Central	$639	$731	$871	$776
Step Change	$1,599	$1,615	$1,582	$1,309

The results presented in the above table shows that delivering Marinus Link in Stage 1 as early as feasibly possible would deliver a net market benefit of approximately $1,600 million, if the Step Change scenario eventuates. The table also shows that Marinus Link would deliver a substantial net market benefit if the Central scenario eventuates, with a maximum net market benefit of $871 million. A weighted average using AEMO's proposed weighting of 67% for Central Scenario and 33% for Step Change indicates that the highest expected net market benefit would be $1,108 million if the project were committed to be delivered in 2031 and 2034.

[58] AEMO, 2020 Integrated System Plan, July 2020, Table 12, page 87.

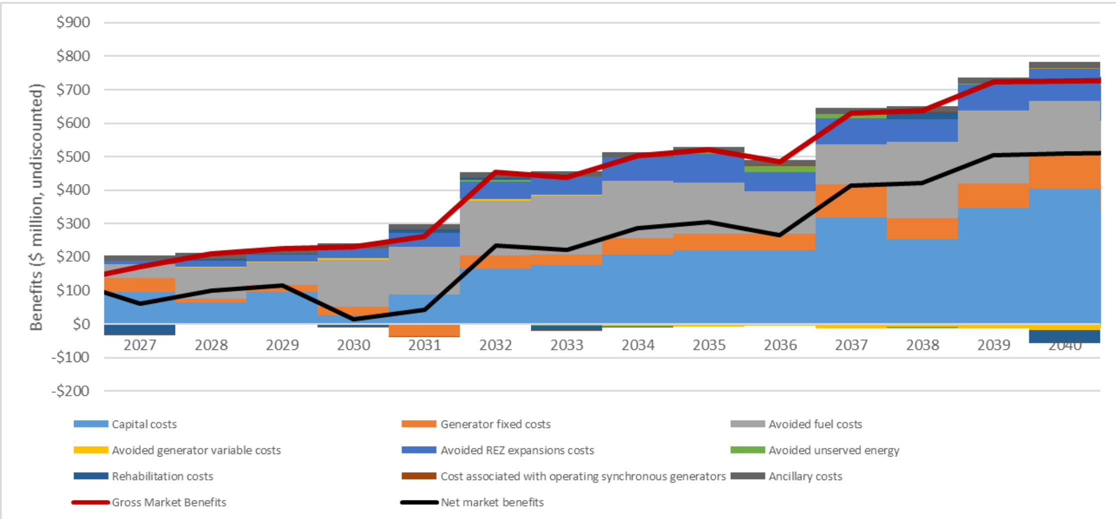
Our view, however, is that customers' best interests are served by capturing the real option value associated with enabling early delivery if a Step Change scenario eventuates. This approach delays a decision regarding the optimal timing of the project until better information becomes available regarding the likelihood of particular scenarios eventuating. This approach is consistent with the staging of Marinus Link 'with decision Rules' in the ISP, which allows for different timings depending on which scenario unfolds.

By taking a real options value approach, we avoid the loss of value that would arise by locking in a later project timing now. This approach also captures the potential value of the Prime Minister's announcement that the environmental approvals process will be fast-tracked, which brings forward the earliest feasible project timing from 2028 (as assumed in the 2020 ISP) to 2027.

7.2 Benefits from Marinus Link

The annualised gross and net market benefits obtained throughout the NEM if Marinus Link were commissioned in 2027 & 2030 are shown in Figure 11 below, assuming that the Step Change scenario eventuates.

Figure 11: Annualised gross and net market benefits from Marinus Link commissioned in 2027 & 2030 under the Step Change scenario ($ million, undiscounted)



The composition of the market benefits, by benefit class, is shown in the pie chart in Figure 12. As outlined in our PADR, our modelling shows that the first stage of Marinus Link provides the opportunity to access available and repurposed hydro capacity in the existing Tasmanian hydro system. The prospect of utilising existing Tasmanian hydro capacity allows the NEM to defer the need for investment in shorter duration dispatchable storage options on mainland Australia that would still require system redundancies in the form of gas-powered generation.

The first stage of Marinus Link also accompanies up to 900 MW of additional wind development in Tasmania, depending upon the scenario. The second 750 MW of Marinus Link sees further wind development and complements the development of cost effective and long duration pumped hydro energy storage (PHES) in Tasmania.

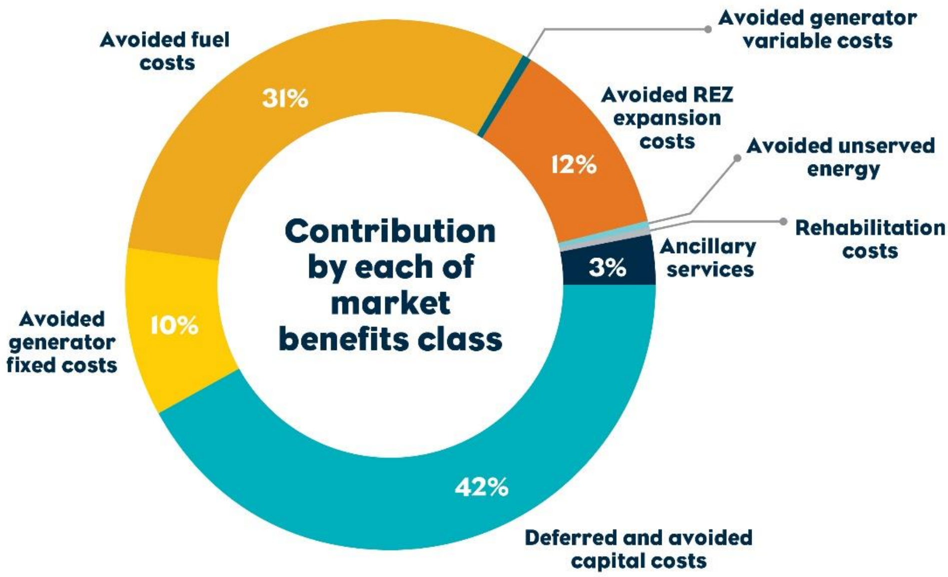
In addition to low emission dispatchable hydro and pumped hydro energy, Tasmania has some of the best land-based wind resources in the country. This results in higher capacity factors (i.e. higher average energy output), which means that the cost of generating a unit of energy could be up to 25% lower in Tasmania compared to elsewhere in Australia.

Marinus Link unlocks this wind generation potential and enables delivery of higher value generation to the broader NEM. A 1500 MW Marinus Link unlocks the potential for up to 2,500 MW of additional wind development in Tasmania. The modelling for this report also confirms that, in addition to further developing on-island energy intensive industries, Marinus Link plays an integral role in achieving the TRET by 2040.

The largest source of the savings for Marinus Link are derived from deferred and avoided capital costs (42%) by utilising the existing and repurposed Tasmanian hydro capacity along with the development of longer duration cost-effective pumped hydro in Tasmania. Since the storage duration of pumped hydro in Tasmania is typically 2-4 times longer than comparable mainland Australia facilities, this reduces the need for developing and maintaining additional gas-fired peaking generation on the mainland that may only operate occasionally. This reduced need for gas-fired generation manifests itself as avoided fuel costs (31%) in our modelling and provides the second largest contribution to the overall gross market benefits of Marinus Link. Use of the lower cost pumped hydro instead of gas-fired generation also contributes to emissions reduction, which is not explicitly valued under the RIT-T.

The figure below shows the different sources of market benefits from Marinus Link as identified by the RIT-T guidelines, under the Step Change scenario.

Figure 12: Contribution by each of market benefits class as identified by RIT-T guidelines (Marinus Link, Step Change scenario, 2027 & 2030)[59]



Chapter 8 provides further information on the economics of Marinus Link, with particular reference to the benefits of long duration energy storage.

7.3 Comparison with PADR results

Table 8 compares the updated net market benefit modelling with our earlier results in the PADR. An important difference in the modelling presented here is that the study period ends in 2042, consistent with the available dataset in the 2020 ESOO. In contrast, our PADR modelling examined the net market benefits to 2050. Therefore, it is necessary to shorten the PADR modelling period (to 2042) to provide an 'apples with apples' comparison.

Table 8: Comparison of the net market benefits between PADR and this report (NPV, $ million)

	Abridged PADR modelling period (2028 & 2032)	Supplementary Analysis Report (2028 & 2031)
Average (No Slow Change)	$1,027	$972

[59] For ease of reading, data values for market benefit classes with minimal contribution have not been displayed but included in the analysis.

The table shows that the equivalent net market benefits in the PADR for a 2028 and 2032 timing were $1,027 million. Whilst our supplementary modelling does not include the net market benefits for this particular combination of years, the closest combination is 2028 and 2031, which provides a net market benefit of $972 million.

Despite the increase in project costs and the changes in scenarios, inputs and assumptions since the PADR was published, the net market benefits provided by Marinus Link remain largely unchanged. This further demonstrates the robustness of Marinus Link's value proposition to the NEM, despite the continued evolution of information.

7.4 Preferred option

The modelling in this report confirms the findings from the 2020 ISP that Marinus Link is an integral part of the optimal development pathway in the ongoing evolution of the NEM. Our modelling confirms that the first stage of Marinus Link is needed as soon as possible in case of a Step Change scenario, and by no later than 2031 for all other scenarios except for Slow Change.

The average weighted outcomes across all scenarios indicate that the optimal commissioning date for the first stage is 2031, with the second stage being commissioned in 2034. As outlined in section 5.3, TasNetworks will adopt the new ISP Rules to deliver the project in a staged manner, thereby retaining optionality as the NEM transitions, and technology costs evolve. By taking this staged approach, customers can be confident that the project will be delivered in accordance with their long-term interests.

At this stage, our preferred option is to undertake a staged 1500 MW Marinus Link, as follows:

- Early works for both stages should be completed by 2023-24;
- The timing of Stage 1 would be the earliest feasible timing if the Step Change scenario eventuates; and
- Stage 1 of the project should proceed by no later than 2031, as the TRET is expected to be legislated.

The timing of Stage 2 will be subject to decision rules to be specified in the 2022 ISP. Our current modelling assumes that Stage 2 will be commissioned three years after Stage 1 is completed, noting that actual timing will depend on the pace of market transition.

7.5 Sensitivity Analysis

Our sensitivity analysis indicates that the market benefits of Marinus Link are robust against a range of different sensitivity outcomes. The outcomes of the sensitivities mentioned in Section 6.7 are outlined in Table 9. The sensitivity analysis is undertaken in the optimal commissioning timing of the scenario under which the sensitivity is assessed.

Table 9: Summary of sensitivity analysis (NPV, $ million)

Sensitivity	Net market impact of sensitivity	Revised net market benefit with sensitivity	Relevant scenario (Timing)
Hydrogen Load Growth	-$554	$1,045	Step Change (2027 & 2030)
750 MW committed pumped hydro in Tasmania	$573	$2,136	
Sustained Low Gas Price	-$163	$654	Central (2031 & 2034)
Battery costs higher by 30%	$51	$835	
Battery costs lower by 30%	-$40	$796	
Economic retirements not permitted in Central scenario	-$59	$812	

In relation to total capital costs of the project, whilst the optimal timing of Marinus Link is slightly delayed in some of the scenarios, Table 10 demonstrates that the overall scenario weighted average optimal timing of Marinus Link remains unchanged even at the higher capital costs of $4.1 billion ($2019).

Table 10: Net market benefits of Marinus Link for 2020 ISP upper bound cost estimate (NPV, $ million)

Scenario	2027 & 2030	2028 & 2031	2031 & 2034	2034 & 2037
Central	$308	$434	$666	$648
Fast Change	$458	$541	$700	$700
High DER	$281	$404	$651	$629
Step Change	$1,268	$1,318	$1,376	$1,180
Average (No Slow Change)	$579	$675	$848	$789

This above analysis provides comfort that the case for Marinus Link is unlikely to be affected by the project costs inclusive of potential increases for level of accuracy and contingencies. Having said that, arrangements are in place to ensure that project costs are closely controlled and monitored, with risk mitigation measures being developed with prospective suppliers and contractors.

7.6 Is a Step Change Scenario likely?

The modelling results presented in this chapter confirm the 2020 ISP's findings that Marinus Link will need to be ready as soon as possible if the Step Change scenario eventuates. In this section, we consider the likelihood of a Step Change scenario, given the recent developments in the NEM. As explained below, there are good reasons to believe that the NEM is already on a trajectory to a Step Change scenario. More broadly, in this rapidly changing environment transmission investments need to anticipate change rather than respond to it, if we are to achieve an orderly transition of our power system.

TRET is expected to be legislated shortly and the interconnector cost allocation matter is currently under consideration by the Energy National Cabinet Reform Committee (discussed further in section 9.1). A key matter that needs to be resolved for the first stage of Marinus Link before the project can proceed to the contingent project application phase is to determine the NEM signposts that most closely align with the scenarios outlined in the 2020 ISP.[60]

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[60] Marinus Link would be needed in 2027 in case of a Step Change scenario whereas commissioning could be delayed to 2031 in case of any of the other scenarios, except slow change.

The sustained renewable uptake scenario in our PADR described a situation where the rate of installation of utility scale renewables and DER witnessed since 2015 continues for the next decade. Since the publication of our PADR, however, the actual trend in the development of DER and utility scale projects has gained further strength. Most notably, the Clean Energy Regulator in its second-quarter 2020 update noted that the small-scale rooftop PV installation is expected to reach 2.9 GW for the year, representing an almost 50% increase from projections only a year ago. In addition, the total renewable energy capacity expected to be installed this year is 6.3 GW, matching the record set in financial year 2019-20.[61]

This rate of growth is noteworthy particularly given the challenges associated with delivering projects during the pandemic and the delays in grid connections and significant reductions in marginal loss factors faced by large-scale renewables. This additional capacity represents almost 13 TWh of additional renewable supply to the NEM, or alternatively, that an additional 6.5% of the NEM demand can be met from renewable sources installed in financial year 2019-20.

The trend for the next financial year suggests committed and anticipated generation from utility scale projects to be close to 3.0 GW[62], without including the recently announced potential second round of the Victorian Renewable Energy auction scheme.[63]

As noted by various industry publications and suggested in our modelling for this report, the NEM will continue its significant transformation to world-leading levels of renewable generation.[64] As shown in the Figure 13, the projected growth trend of renewables in the NEM is closer to Step Change rather than Central scenario.

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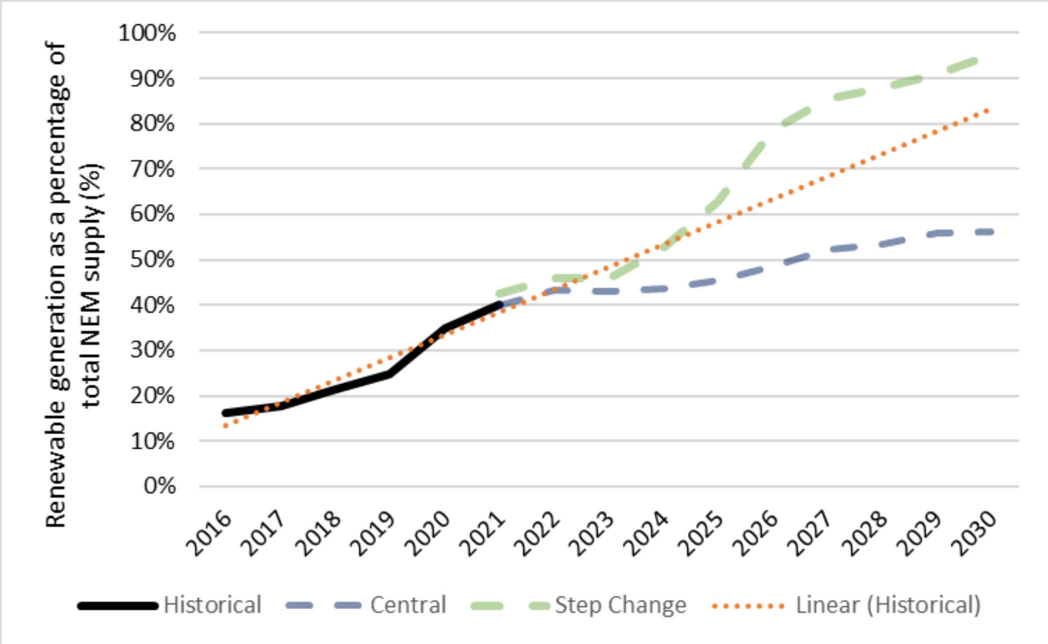
[61] Clean Energy Regulator, Quarterly Carbon Market Report, June Quarter 2020

[62] 2020 ISP assumptions workbook, maximum capacity.

[63] Department of Energy, Land, Water and Planning, VRET2 market sounding.

[64] AEMO, Renewable Integration Study, April 2020.

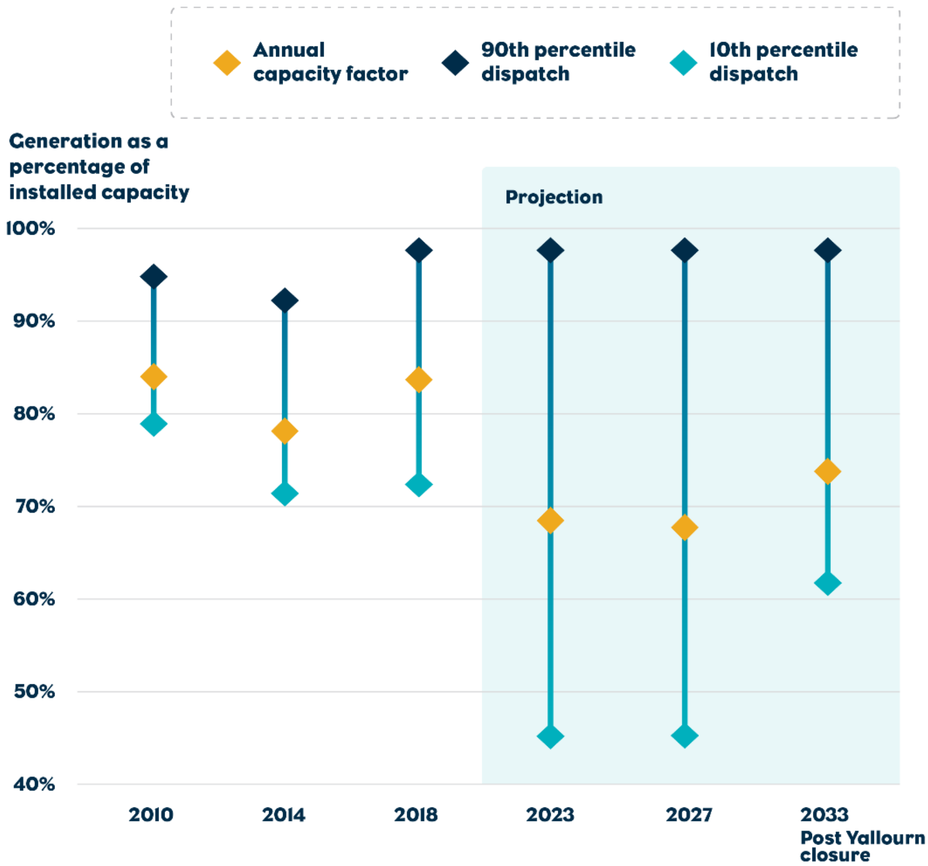
Figure 13: Renewable generation as a percentage of total NEM supply



This continual increase in renewable penetration is likely to exert commercial pressures on coal fired generators, as operational inefficiencies arise as output is continually varied to accommodate lower cost renewable generation in the supply stack.

Figure 14 depicts the historical and projected top and bottom percentiles of brown coal generation for selected years between 2010 and 2033. The figure indicates that the generators have historically operated in a tight band (less than 25% variation in dispatch), implying that the generators have not had to significantly vary their output despite changes in demand and availability of supply from other generators. In contrast, the projected operation profile suggests that the generators will have to vary their output in response to continued increase in supply from variable renewable generators. The projected operation band (difference between the top and the bottom 10 percentile) increases to almost 60% in this decade before reducing marginally once the Yallourn power station retires in 2032.

Figure 14: Annual top and bottom 10 percentile of generation for brown coal (Historical and projected in the Central scenario)[65]



While the previous figure demonstrates the effect of variation on an annual basis, Figure 15 depicts the projected daily ramping requirements on Victorian brown coal generators in October 2023. In that month, the average daily difference between the maximum and minimum output is over 1,900 MW.

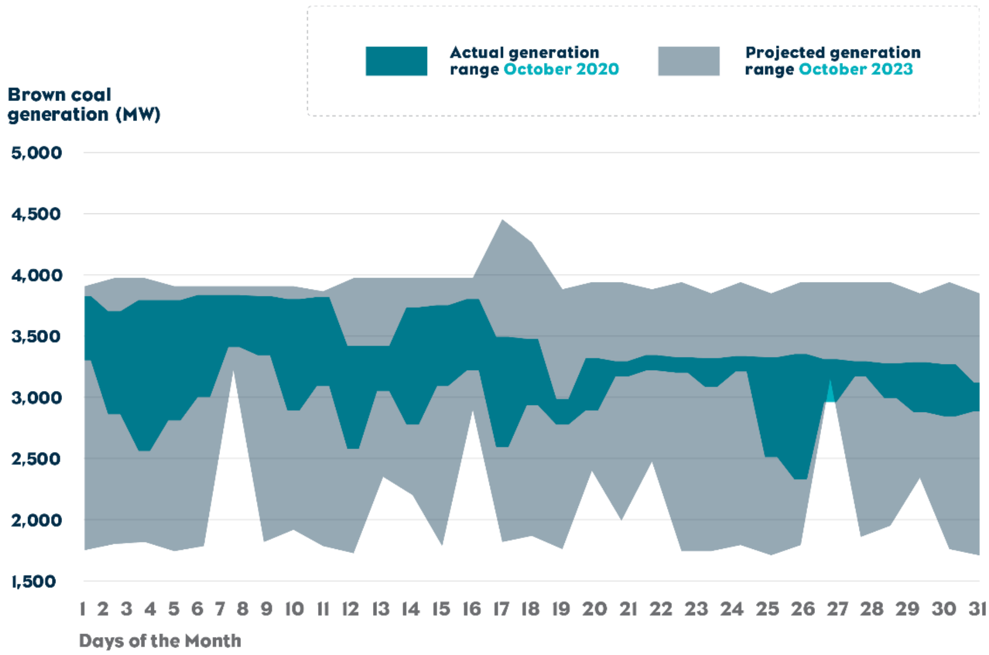
The reason for showcasing results projected for 2023 is to demonstrate the forecast near-term impact on the power system once the currently proposed renewable energy projects are commissioned across the NEM. The average daily ramping progressively increases for black and brown coal generators once renewables are endogenously committed by the model to meet various state based renewable energy targets. The chart also provides the October 2020 variation in output undertaken by the same generators for reference. The current difference

[65] Note the chart does not start at 0%. Since the chart includes actual historical data and modelled projections, it could include some effects of modelling not precisely reflecting reality.

between the maximum and minimum generation is slightly less 560 MW. This implies that the ramping requirements between current operations and projection is forecasted to increase by almost four-fold. The ramping requirement on thermal coal fired generators are the highest in the spring and autumn season, with high VRE output coupled with lower system demand due to mild weather conditions.

While mothballing or taking an extended outage on a small number of units may be seen as a means of reducing the ramping constraints on generators in order to extend their life, the resulting unavailability of dispatchable capacity during the morning and evening demand peaks would have to be alternatively sourced from more expensive gas-powered generators.

Figure 15: Maximum and minimum daily generation range for October (Actuals for 2020 and modelled for October 2023 under Central scenario)



The continued increase in renewable penetration is likely to exert economic and mechanical strain on the ageing thermal generators that may lead to some of the coal-fired generators retiring earlier than their technical life. This mechanical strain on the generators is likely to require either investing significant capital to safely allow some of the assets to ramp efficiently or reassessing the life of the asset.[66]

[66] Cheap renewables put coal plants to the test, Weekend Australian, 15 June 2019

Sustained pressure from environmentally conscious customers and institutional investors on the owners of coal-fired generators to align their business plans with the goals of the Paris Agreement on climate change[67] could also lead to early retirement of assets due to environmental considerations.[68]

Our view, which was also recently expressed by the chair of the Energy Security Board, is that the NEM is already on a trajectory that is consistent with the Step Change scenario. [69] In the context of the RIT-T assessment, this analysis may warrant a higher weighting to be placed on this scenario than adopted in this chapter. More broadly, however, it is important to recognise that the lead time associated with withdrawing dispatchable capacity from the NEM is much shorter than commissioning large infrastructure projects. Given the important role that Marinus Link can play in ensuring an orderly retirement of ageing generators, the relative flatness in the net market benefits over the modelling horizon, with positive net benefits from the 2020s, lend weight to the proposition that the earliest commissioning date of the project should be pursued.

[67] UN Climate Change, COP 21, Paris, December 2015

[68] Rest Super fund commits to net-zero emission investments after Brisbane man sues, ABC News, 3 November 2020.

[69] “We are headed for step change:” ESB’s Kerry Schott on new market design, Renew Economy, 30 September 2020

8 Marinus Link's role in the NEM

The purpose of this chapter is to provide further information on value that Marinus Link is able to unlock for the benefit of the NEM, with a particular focus on the benefits of long duration storage.

Key messages

- Over the next two decades, there is expected to be further significant increases in the amount of energy provided by VRE sources, with a corresponding increase in the use of energy storage facilities in the NEM.
- The complementary role played by short term and long duration dispatchable storage in managing Variable Renewable Energy droughts and shifting energy on an hourly and daily basis.
- Marinus Link will provide the NEM with increased access to Tasmania's hydro and pumped hydro resources.
- Pumped hydro is a cost-effective source of long duration energy storage which can provide the dispatchable capacity needed to maintain the security and reliability of the NEM as ageing coal plant is retired, and the contribution of VRE continues to increase.

8.1 Scale of NEM transition

The scale of transition that the NEM is projected to witness over the next two decades is unprecedented. In addition to sourcing up to three times more energy from DER, the installed capacity of the NEM is expected to more than double by 2040 (Figure 16). This fundamental transition of the NEM, based on least cost economics, is expected to lead to sourcing significant amounts of generation from VRE sources and storing excess energy in dispatchable sources like batteries and pumped hydro facilities for energy shifting purposes.

Figure 16: Installed capacity in NEM 2021 & 2040 (Step Change scenario)

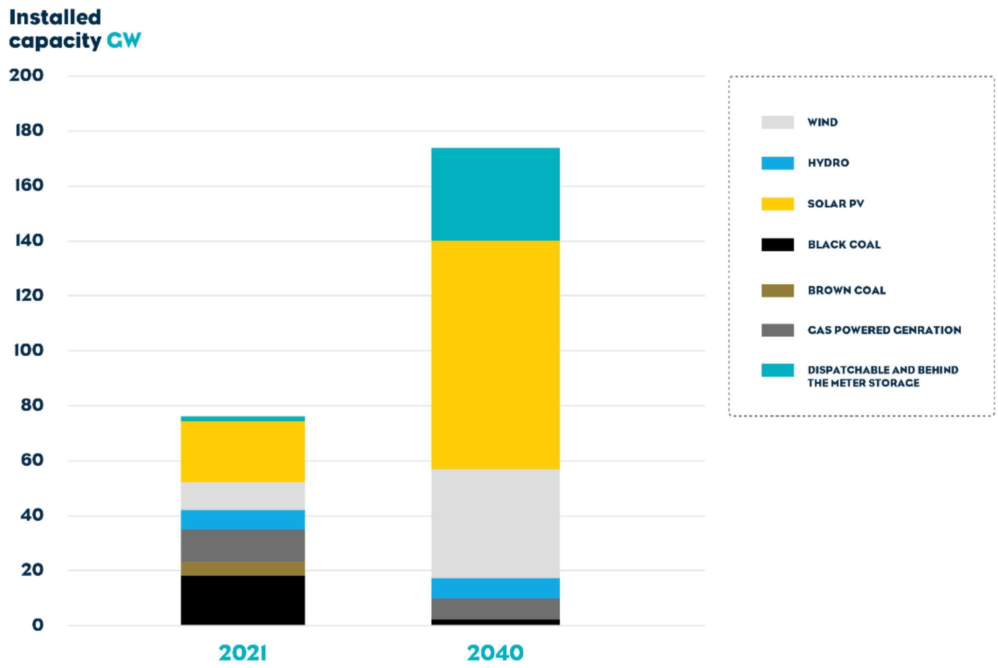
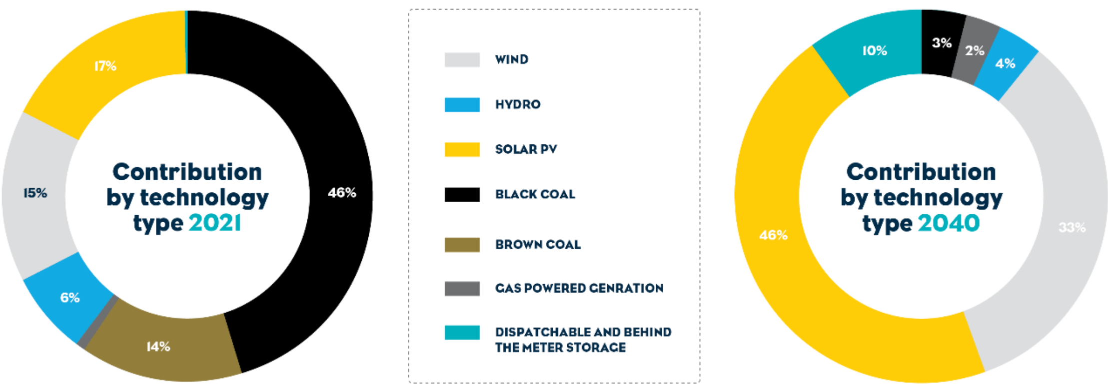


Figure 17 depicts the potential change in the contribution of each of the technology types between 2021 & 2040 in a Step Change scenario. The contribution from VRE is expected to increase from 33% to almost 80% whereas the contribution from thermal generation reduces from 60% to almost 5%.

Figure 17: Energy contribution by technology type (2021 and 2040, Step Change scenario)



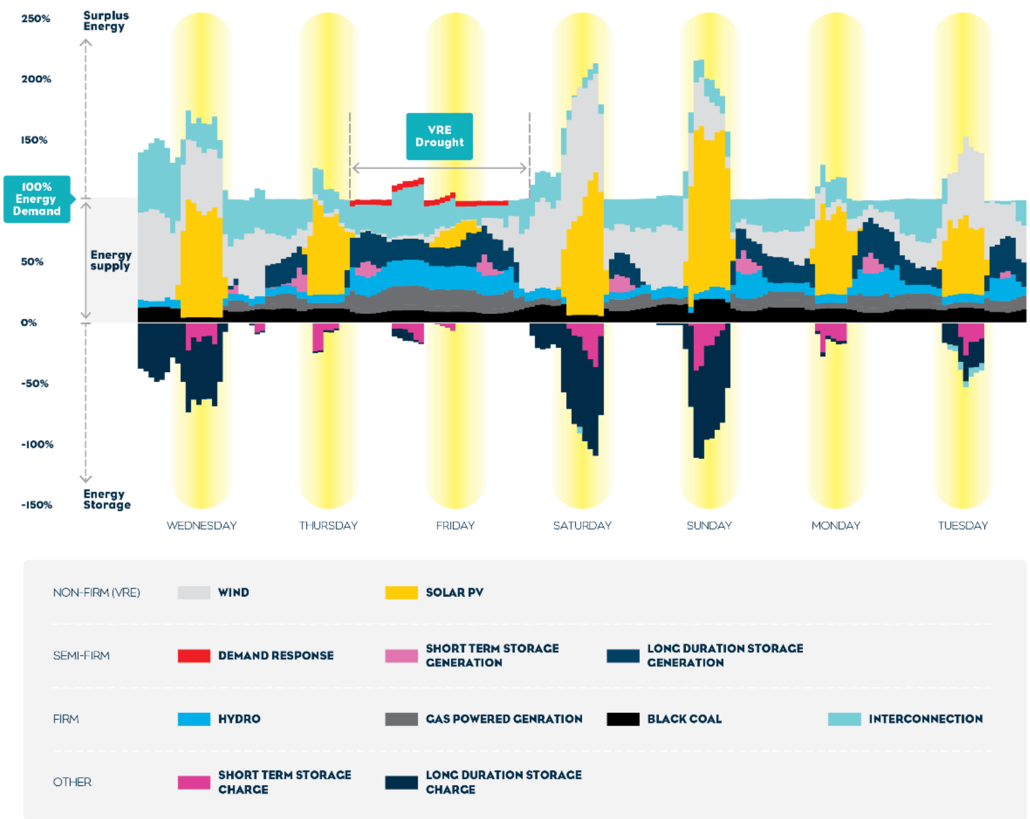
Whilst these results are for the Step Change scenario which includes the retirement of coal generators prior to the end of their technical life, this transition is present in other scenarios too, albeit over a slightly longer time horizon.

8.2 Navigating a VRE drought

As the contribution from VRE sources progressively increases, the role played by dispatchable capacity becomes critical in this NEM transition. As noted in submissions made by Energy Australia and Hydro Tasmania, the least cost modelling approach adopted for this report and the ISP assumes perfect foresight, thereby providing the best opportunity for shorter duration storages, typically lasting less than 6 hours, to charge and discharge at the most opportune time. In reality, forecasting accuracy is unlikely to be 100% and storages are likely to be dispatched sub-optimally. This lack of perfect foresight further reinforces the need for long duration storage that provide insurance against forecasting inaccuracies possible with shorter duration storage.

Despite the perfect foresight nature of the modelling in this report, our modelling outcomes still attribute significant value to long duration storage. The snapshot below is taken from the hourly simulation results for NSW in the winter of 2037 under a Step Change scenario (Figure 18).

Figure 18: Case for deep storage (NSW, July 2037, Step Change scenario)



In this snapshot, the majority of the NEM experiences a wind drought that lasts between 30-36 hours depending upon the region. The wind output from Thursday evening through to Friday night is less than 1,000 MW, a sustained low capacity factor of under 12.5%, noting that it drops to below 1% at times. This low wind output period coincides with an overcast day that lowers the solar output to less than a quarter of the average production for the week.

During this coincident VRE drought, each of the technology resources contribute to meet the energy consumption needs of the power system. As the above figure indicates, the shorter duration resources like 4 hour batteries and 6 hour pumped hydro shift any excess middle of the day solar generation to evening peaks and occasionally to the morning peak. However, the long duration storages, typically 12 hours in duration and longer, along with conventional hydro, gas-powered generators and remaining coal fired generators, assist in meeting the system requirements throughout the drought until the weather conditions revert to a more 'expected' pattern; contribution from the demand side participants is also noticed during this period.

This phenomenon of VRE drought is noticed in other states too, but the reason for highlighting NSW is to demonstrate the role played by interconnection and its assistance in sharing resources between regions. The interconnectors contribute as much as 40% of the energy supplied to the NSW, by transferring generation from other states, during various times of the drought that lasted less than two days.

The weather pattern such as noted in the above snapshot is expected to occur on a handful of occasions annually to varying extents. For instance, earlier this year on 11th July, a cold front and complex low pressure system crossed southeast Australia leading to overcast skies and limited wind speeds.[70] The combination of increased demand due to the cold front and reduced renewable generation led to dispatchable generation sources contributing more than 80% of the total demand. Similar overcast weather patterns, but this time accompanied by high wind speeds, also occurred in early August. The reason for highlighting these weather patterns is to demonstrate that while these weather events currently appear benign, in a future power system with significant amount of VRE these conditions will require reliable long duration storage to navigate through these periods.

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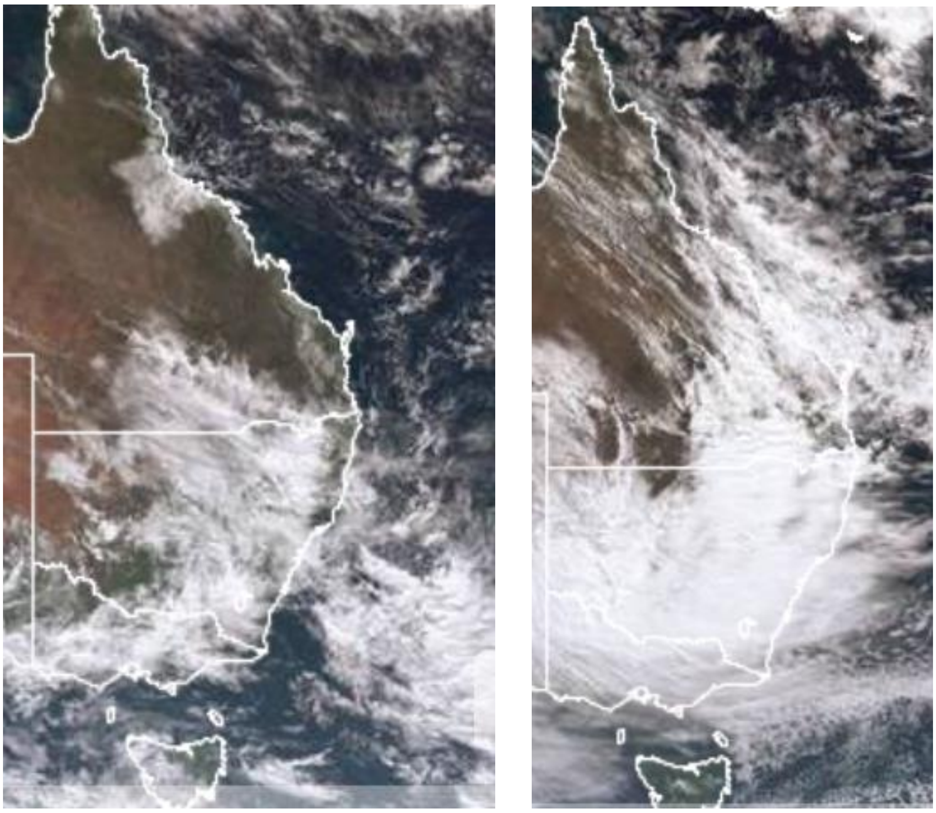
[70] BOM, Monthly summary for Australia in July 2020

Figure 19: Satellite map of Southeast Australia (11 July and 6 August)



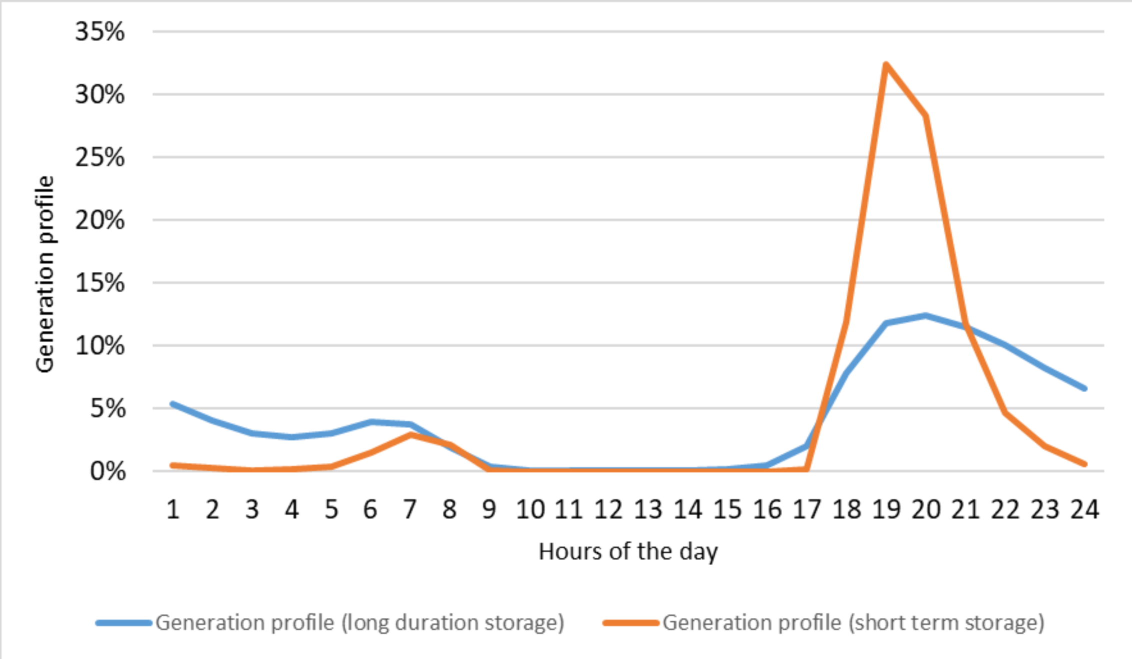
Source: Theweatherchaser.com, BOM, JMA

8.3 Role of batteries in the ongoing transition

The previous section demonstrated the benefits of firm dispatchable sources along with long duration storage during a VRE drought. In this section, modelling insights from the role played by batteries in the ongoing NEM transition is discussed. As explained in section 7.6, the operational load profile has evolved considerably and will continue to evolve such that minimum system demand is coincident with the daylight hours (the period with cost effective rooftop and utility scale solar generation). The maximum system demand is forecast to occur during the hours following the sunset. This places an enormous operational strain on the generators to modulate their output to match the needs of the system.

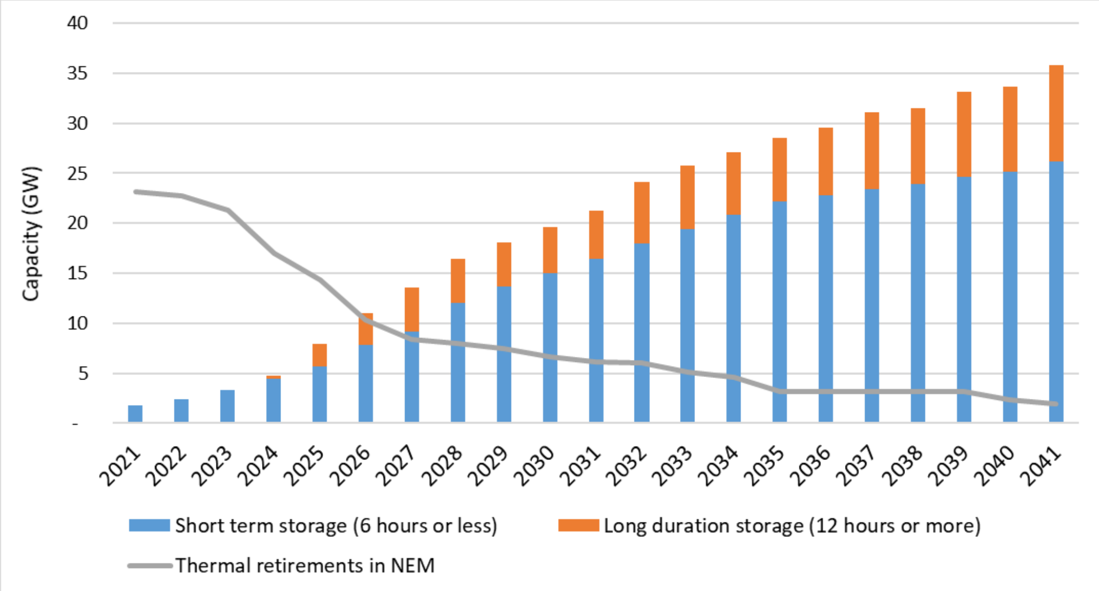
In the future, this strain on generators can be reduced with the installation of shallow storage technology. With the forecast reduction in battery costs over this decade, short term duration storages like batteries will be able to provide dispatchable capacity during super-peak periods. The figure below on the storage generation profile shows that almost 85% of discharge from short term storages occurs during the four hours following sunset. In contrast, the generation profile of long duration storage is more evenly spread across the non-daylight hours. While the long duration storage assists in meeting the evening peak, investing in long duration storage exclusively to meet this evening super-peak demand would lead to sub-optimal utilisation of this dispatchable storage capacity. In summary, long duration storage is typically optimised for seasonal shifting of energy and is dispatched to manage the variability of supply (reduction in output of wind or solar) whereas short term storage is typically dispatched to shift excess mid-day energy to later in the evening, thereby managing the intraday needs of the power system.

Figure 20: Generation profile of shallow and deep storage (NSW, 2026 – 2029, Step Change scenario)



With the benefit of perfect foresight, the least cost modelling optimises the system need for short term and long duration storage over the modelling period. Figure 21 depicts the development of dispatchable capacity in the NEM. By the end of the modelling horizon, over 70% of the capacity installed in the NEM is of short term storage duration (26 GW out of total installed capacity of 36 GW). The long duration storage is progressively added to the system as thermal generation assets retire from the NEM. This further validates the insights from previous sections that demonstrate that the long duration storage provides prudent insurance to the power system while daily super-peak requirements of the system are met by short term storage.

Figure 21: Capacity expansion profile of short term and long duration storage in NEM along with NEM-wide thermal retirements under Step Change scenario (with Marinus Link commissioned in 2027 & 2030) (GW)



8.4 Economic comparison between batteries and long duration pumped hydro

The capacity expansion and the selection of storage duration occurs endogenously within the model based on inputs and assumptions related to the scenario. Therefore, the model's preference to build long duration pumped storage over batteries, despite the projected reduction in battery costs as discussed in section 6.4, is purely based on least cost economics.

However, if VRE droughts (as explained in section 8.2) were to be met with four hour batteries instead of long duration pumped hydro facilities, then at least three of these batteries would have to be daisy-chained (connected in series) to provide sufficient coverage for these weather events. It should be noted that a 12 hour storage duration is still a conservative comparison; in reality storages with at least 18-24 hours duration, as available in Tasmania, should be developed to manage issues relating to forecasting accuracy.

The following discussion compares the economics of pumped hydro and battery storage to meet a 12 hour VRE drought. Table 11 outlines key input parameters based on the inputs and assumptions provided in the 2020 ISP. As noted previously, Hydro Tasmania's submission to our PADR suggested using a capital cost of $1.5 - $1.8 million per MW ($2019) for long duration pumped hydro projects in Tasmania. However, the modelling for this report is based on the higher 2020 ISP input costs, as it provides a more recent cost estimate.

Table 11: Input parameters for 12 hour pumped hydro and 4 hour battery storage (2020 ISP Step Change scenario inputs)

	12 hour pumped hydro in Tasmania	4 hour battery storage
Capacity (MW)	750	750
Storage duration (hrs)	12	4
Total energy in storage (MWh)	9,000	3,000
Technical life (years)	50	20
Battery capital cost in 2025, 2045, 2065 ($M/MW) ($2019)	N/A	$0.98, $0.75, $0.38
Capital cost pumped hydro – 2025 ($M/MW) ($2019)	$2.10[71]	N/A
Fixed operating expense (% of installed cost)	0.9%	2.5%

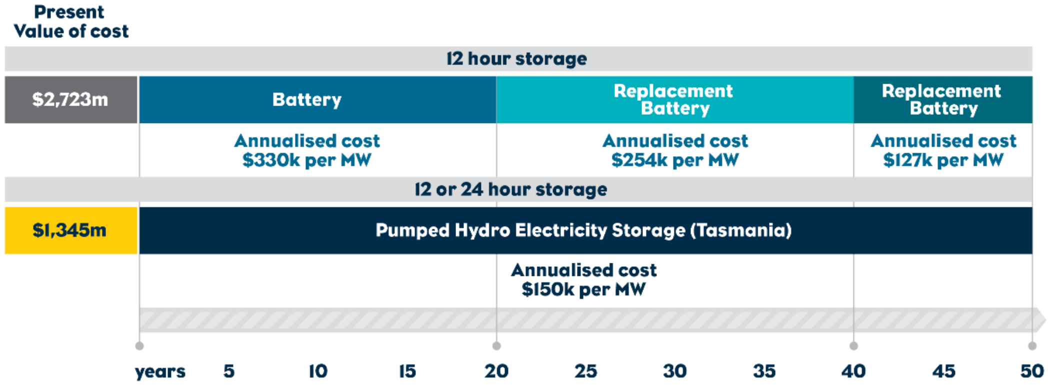
Besides needing three 4 hour battery packs in comparison to a single 12 hour pumped hydro facility, the shorter technical life of batteries requires new capital investment every 20 years to maintain operability. This implies that if both the technologies were committed in 2025 then batteries would need to be replaced in 2045 and again in 2065 to be comparable to pumped hydro storage.[72] Given the lack of battery cost projections post 2050, it is assumed that the battery cost will reduce by half in 2065, as compared to 2045.

[71] While the calculations are based on 12 hour pumped hydro duration, the capital costs are based on 24 hour pumped hydro duration. The adoption of a higher capital cost estimate for pumped hydro reflects a conservative approach to estimating the value of long duration pumped hydro storage as compared to batteries.

[72] In the economic analysis, the second battery replacement cost is prorated to 10 years so the period is comparable to technical life of pumped hydro.

Based on the above inputs, Figure 22 represents the estimated present value costs of long duration pumped hydro storage and batteries[73]. The present value cost of PHES is less than half of the batteries. The lower cost of PHES is the primary driver for the model selecting long duration storage over daisy-chaining multiple shorter duration energy storage solutions like batteries.

Figure 22: Present value cost of batteries and pumped hydro for 750 MW dispatchable capacity with 12 hour storage duration (PV, $)



On the basis of the assumptions set out in Table 11, PHES is a clearly superior option compared to batteries. It is worth noting, however that the economic analysis is based on several conservative assumptions regarding the economics of batteries. These assumptions would tend to favour batteries, and they include:

- the modelling currently assumes that the batteries will undergo no degradation over their lives, whereas a degradation rate of 30% is mentioned in specifications of some batteries;[74]
- as previously discussed, the life of a battery is assumed to be 20 years whereas based on our analysis of over 50 different battery storage options indicates that the majority of the manufacturers only provide a warranty for up to 3,750 cycles or 10 years (whichever comes first).[75] In comparison, our modelling suggests that batteries in NSW could cycle up to 400 times annually, or almost 8,000 times over their lifetime (illustrated in the chart below); and

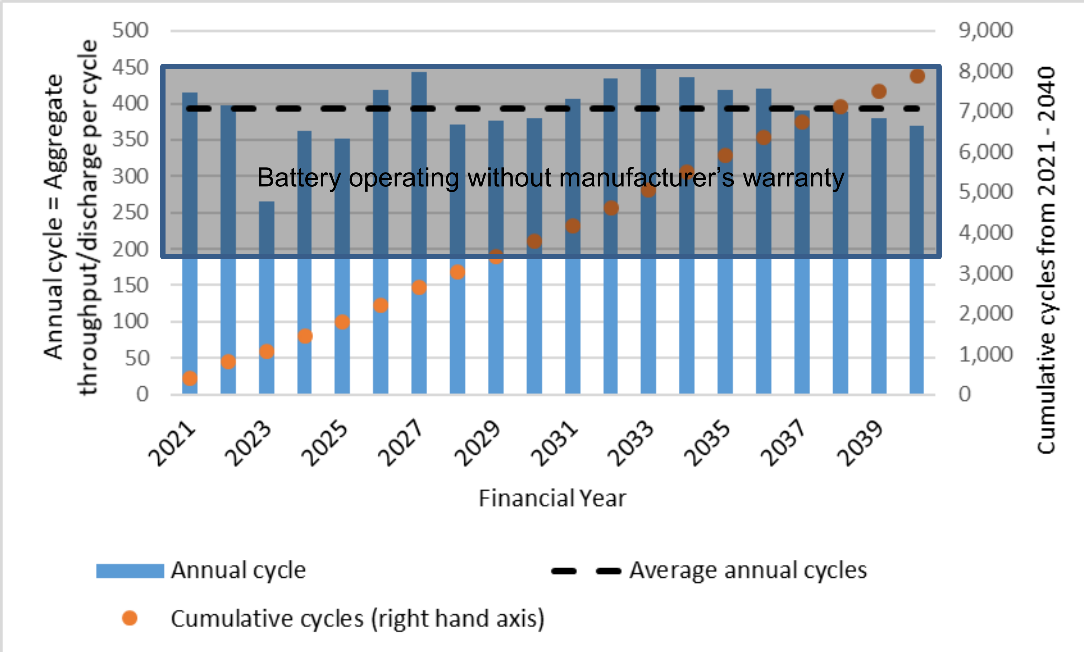
[73] The amounts shown are discounted cash flow series that commence in 2025, expressed in present value terms as at 2019.

[74] Savingwithsolar.com.au, Tesla Powerwall 3 specifications

[75] Solar battery storage comparison table, Solarquotes.com.au

- the cost of battery refurbishment and potential future environmental impact cost are also not accounted for in this analysis.

Figure 23: Annual and cumulative cycling of a 4 hour duration battery (NSW, Step Change scenario, 2021 – 2040)



In conclusion, Marinus Link unlocks the conventional hydro and longer duration pumped hydro storage potential of Tasmania to the rest of the NEM. This access to Tasmanian resources allows the NEM to confidently invest in a diverse variety of shorter duration storage solutions that enable day shifting of energy, while seasonal energy storage shifting capability and VRE drought protection are supported on a cost-effective basis by Marinus Link.

9 Other project considerations

9.1 Transmission pricing

In the PADR, TasNetworks identified the 'who pays' question as an outstanding issue to be resolved in relation to Marinus Link. As highlighted by a number of stakeholders, a key concern is that the current transmission pricing arrangements would result in Tasmanian customers paying a disproportionate share of the costs of Marinus Link when compared to the distribution of benefits across the NEM regions.

TasNetworks' primary concern is to ensure that the transmission pricing arrangements deliver fair and reasonable outcomes for customers in each region. The ESB and the Energy National Cabinet Reform Committee (formerly the COAG Energy Council) are considering potential options to address the identified shortcomings in the existing transmission pricing arrangements.[76] In broad terms, this requires better matching of the costs borne by each region with the benefits they receive.

In addition to working collaboratively with ESB and other stakeholders to identify an approach that provides an acceptable outcome to each jurisdiction, TasNetworks has engaged energy market consultants to assess the benefits of Marinus Link in terms of lowering the wholesale electricity prices paid by consumers across the NEM. The outcomes from this engagement will be shared with stakeholders in coming months.

As previously noted, it is conceivable that Marinus Link may not proceed if the pricing issues cannot be resolved, even where the project provides more benefits than it costs. It is therefore important to complete the RIT-T so that all parties understand the potential benefit that Marinus Link can provide, and then work to achieve a satisfactory pricing outcome. The RIT-T assessment can be completed independently of the resolution of the 'who pays' issue. Consistent with views shared previously, the cost recovery for the project would only commence once this issue is satisfactorily resolved.

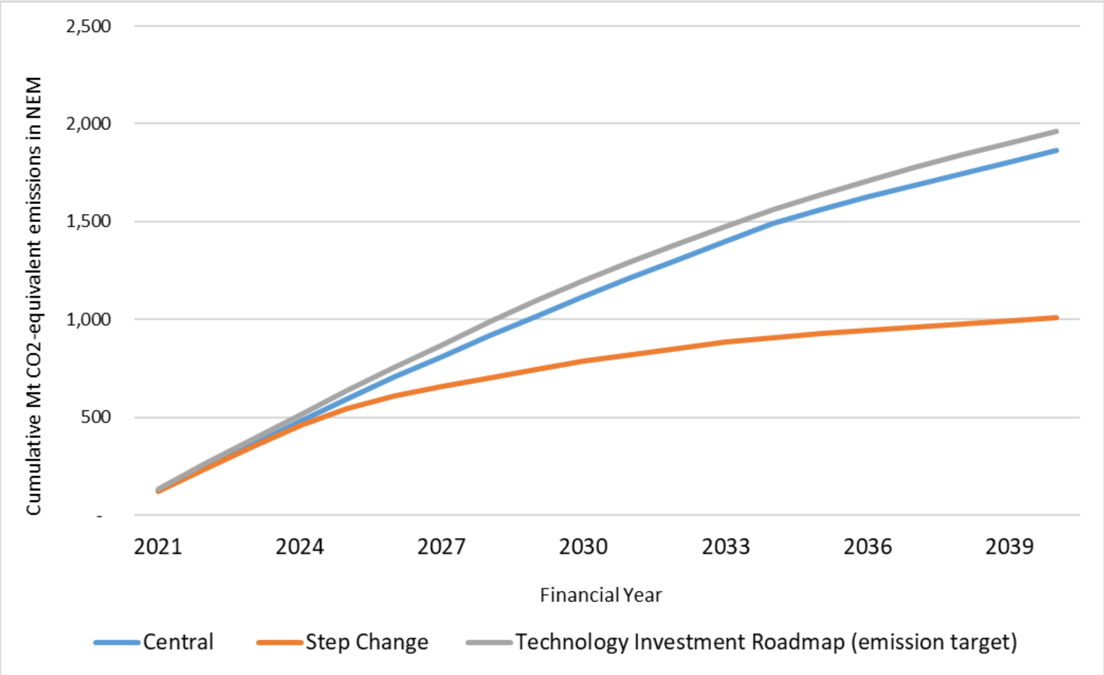
[76] Australian Financial Review, 18 August 2020

9.2 Emission reduction benefits of Marinus Link

As outlined in section 5.5, the Technology Investment Roadmap aims to reduce Australian emissions while delivering more affordable, clean and reliable energy to households and industry.

In addition to providing net market benefits to the NEM from its earliest commissioning timeline, Marinus Link unlocks Tasmania's renewable energy and renewable storage resources to provide energy storage at one of the lowest costs in the NEM, thereby helping achieve emission reduction target envisioned under the Roadmap. Figure 24 shows the cumulative CO2-equivalent emission in the NEM under Central and Step Change scenarios with Marinus Link commissioned in 2027 & 2030. Under both the scenarios, Marinus Link assists in achieving the emission reduction target set under the Technology Investment Roadmap.[77]

Figure 24: Cumulative CO2-equivalent emission in NEM until 2040



[77] The cumulative emissions for Central and Step Change scenario is calculated based on modelling undertaken for this report. The technology investment roadmap emission target is based on estimates from the 2019 Australian emissions projects supplied by the Australian Government Department of Industry, Science, Energy and Resources.

10 Next steps

In accordance with the RIT-T process, we propose to publish the PACR for Marinus Link in the first half of 2020. In the meantime, we invite stakeholder feedback on the analysis presented in this report. As noted in section 1.3, submissions on this Supplementary Analysis Report should be provided to:

Stephen Clark
Project Director, Marinus Link
TasNetworks 1–7 Maria Street
Lenah Valley 7008
PO Box 606, Moonah, TAS 7009
Email: team@marinuslink.com.au

The closing date for submissions is 7 December 2020.

Following the completion of the PACR, we expect to seek a contingent project determination from the AER in relation to the early works component of the project, in accordance with the new ISP Rules. The first step in this process will be to seek AEMO's confirmation regarding the scope and cost of this work. Consistent with views shared previously, the cost recovery for the project would only commence once transmission pricing discussed in section 9.1 is resolved satisfactorily.

The first stage of the project will be subject to a separate contingent project application once the decision rules specified in the ISP have been satisfied.

Appendix 1 – Summary of submissions to the Project Assessment Draft Report

	Key points raised by submitter	TasNetworks' consideration of the issues raised
AEMO	• The market modelling and supplementary information papers published alongside the PADR, including the hourly data relating to generation, demand and interconnector flows, are a positive initiative in delivering transparency for those interested in participating in this RIT-T process. • In the Draft 2020 ISP, AEMO recommended progressing with the design and regulatory approvals process for Marinus Link, with the intent of making the project 'shovel- ready'. The ISP identified this as a low-regret approach that will allow time for further assessment and certainty before the 2022 ISP, while ensuring project delivery remains possible by as early as 2027-28 if a decision to proceed is made by 2023-24. • AEMO has worked co-operatively with TasNetworks to ensure that any impacts of Marinus Link on the Victorian transmission network are well understood and factored into the analysis. This has included an understanding of network impacts across a range of possible Victorian landing points, and the broader implications for network utilisation and Victorian interconnections with other States. These impacts have been shared with the Project Marinus team and summarised in AEMO's Victorian Annual Planning Report.	• TasNetworks welcomes AEMO's observations regarding the transparency of the information we provided alongside the PADR. Our view is that the Supplementary Analysis Report will further advance the transparency of the RIT-T process and encourage stakeholder engagement. • TasNetworks notes AEMO's comments in relation to the draft 2020 ISP and the rationale for requiring Marinus Link to be 'shovel ready' as a low-regret approach. As explained in this Supplementary Analysis Report, the 2020 ISP has provided additional clarity regarding the staging of Marinus Link and the application of decision rules to determine the timing for the completion of stage 1 and 2 of the project. The further analysis in this report supports the conclusions in the 2020 ISP. • TasNetworks welcomes the assistance provided by AEMO throughout the RIT-T process for Marinus Link, in addition to AEMO's engagement in the development of the 2020 ISP. We look forward to continuing to work with AEMO in the next phases of Marinus Link.
Basslink Pty Ltd (BPL) and ACIL Allen for BPL	• BPL refers to the findings in ACIL Allen's report (summarised below). BPL comments that Basslink has capacity for expansion in a bipolar configuration, but has not been engaged on this option (which could double existing capacity). • The estimated gross market benefits in the PADR scenarios are between 45 per cent and 200 per cent higher than gross market benefits in the earlier IFS Neutral scenario.	• The expansion of Basslink was discussed in section 4.8 of the PADR, but found to be technically infeasible and therefore was not considered further. One issue of concern is that increasing the capacity of Basslink does not offer any route diversity and, therefore, a single event could render the entire interconnector inoperable. The proximity to the North West Tasmanian Renewable Energy Zone is also a factor in selecting the Tasmanian connection and transmission upgrade options, as it allows existing and new generation resources in the region to access the interconnector capacity.

	Key points raised by submitter	TasNetworks' consideration of the issues raised
BPL and ACIL Allen for BPL (continued)	• ACIL Allen conclude that the new investment in CCGTs projected by EY is highly unlikely and the projected operation of these CCGT at high capacity factors would also be highly unlikely. The estimated gross benefits are dependent on these projections and therefore are 'fundamentally flawed'. • ACIL Allen considers the demand forecasts utilised in three of the four main PADR scenarios unreasonable and likely to overstate the market benefits of Project Marinus. • ACIL Allen also raise concerns that cost benefit analysis is only conducted to 2049-50, with assumptions made about the remaining 20 years of the asset life. ACIL Allen consider these assumptions to be unrealistic (because they rely on gas fuel savings post 2050) and they overstate the total benefits from the project. • BPL also comment that many issues still need to be resolved in relation to the location, configuration and environmental issues associated with Marinus Link. BPL is happy to contribute to exploring these issues with Project Marinus.	• The Initial Feasibility Study (IFS) concluded that there are plausible circumstances where Marinus Link could be economically feasible from the mid-2020s. Following the completion of the IFS and consultation on its findings, TasNetworks completed the cost benefit analysis in accordance with the RIT-T requirements and published the PADR. As demonstrated in this report, the net market benefits of Marinus Link have remained robust between the PADR and this Supplementary Analysis Report. • In relation to ACIL Allen's comments regarding the new investment in CCGTs, the modelling in this report principally relies on AEMO's input data and assumptions, including those relating to CCGT performance. The conclusions reached in this report are also consistent with the ISP. • ACIL Allen is correct that our analysis has been limited to 30 years from 2020/21 to 2049/50. The shortening of the study period is a standard approach, which has been adopted in other recent RIT-Ts and the ISP. As explained in the PADR, there are good reasons to expect that the project will continue to provide benefits beyond the end of the study period that exceed the residual costs of the assets. On this basis, if the study period were extended, the conclusions in the PADR would be unchanged. The benefit of limiting the study period is that we substantially reduce the modelling requirements without affecting our conclusions. As mentioned in this report, TasNetworks released an explanatory note providing additional detail regarding computation of benefits for a shortened period. • TasNetworks agrees with BPL that many issues need to be resolved in relation to the location, configuration and environmental issues. TasNetworks looks forward to working with stakeholders in resolving these issues.
Clean Energy Council (CEC)	• The CEC strongly supports new transmission investment in the National Electricity Market (NEM) that demonstrates rigorously tested benefits to consumers. The lack of transmission is now one of the most critical challenges facing the transition of Australia's energy system. • While robust and thorough scrutiny of large-scale transmission investments should occur, we believe that TasNetworks has adequately	• TasNetworks agrees with CEC that efficient investment in transmission can deliver substantial benefits, including lower total electricity costs for customers and improved system strength and resilience. This is one of the key findings of the 2020 ISP. For regulated transmission investments that are financed by electricity customers, it is essential that the case for investment is warranted on efficiency grounds in accordance with the RIT-T.

	Key points raised by submitter	TasNetworks' consideration of the issues raised
Clean Energy Council (CEC) (continued)	demonstrated the significant benefits that Marinus Link can deliver, alongside other interconnection investments. • CEC identifies three key benefits from Marinus Link: (1) Facilitating the benefits of the Battery of the Nation project; (2) Contributing to the achievement of Victoria's VRET ambitions; and (3) Obtaining the benefit of diversity in wind generation between Victoria and Tasmania. • The CEC supports the significant potential that Tasmania presents to the energy system through the storage assets that would be unlocked through Marinus Link.	• TasNetworks welcomes CEC's observations regarding the likely benefits that Marinus Link can provide alongside other interconnector investments. This report confirms that the expected net economic benefits from Marinus Link are significant. • TasNetworks agrees with CEC's observations in relation to the types of benefits that Marinus Link is expected to deliver. Table 16 of the PADR quantifies the different categories of benefits from Marinus Link. • TasNetworks welcomes CEC's support and shares its view that Tasmania has material value to provide in relation to storage assets, as the share of renewable generation across the NEM increases. This report further confirms this view.
Energy Australia	• The optimal timing of Marinus Link appears to be considerably uncertain. Our view is that the evidence currently before stakeholders, in addition to the uncertainty posed by COVID-19 impacts, justifies a delay in considering this project for regulatory purposes. • TasNetworks should be clearer where its analysis of government subsidies reflects modelling requests from governments or other stakeholders, and clearly call out where possible policy interventions would result in departures from optimal project scope or timing and added costs for consumers. • The allocation of costs of transmission interconnection is an important issue. TasNetworks should ensure its RIT-T produces relevant and robust data to inform consultation on this issue (which is being led by the Energy Security Board). • Least cost optimisation and perfect foresight modelling relied on by TasNetworks has inherent shortcomings which over-state the value of interconnection and pumped hydro over the modelling period. Modelling may assume that the cost of this capacity is sunk and therefore always bid into the market at zero cost, whereas other bidding assumptions are likely to be more realistic. • As we have separately stated to AEMO in its draft ISP consultation, we seek further justification for progressing Marinus Link to a 'shovel ready' status ahead of the 2022 ISP. In particular, we would like to see a demonstration that the project would stall for an extended period if not	• TasNetworks agrees with Energy Australia that there is uncertainty regarding the optimal timing of Marinus Link. In part, this reflects the unprecedented transformational changes that are taking place across the NEM as we move towards a lower carbon future. COVID-19 is a factor to consider in our scenarios and sensitivity analysis as part of the RIT-T process. As noted in this report, we have adopted the ISP Rules to ensure that Marinus Link provides the greatest benefits to the customer depending upon the evolving NEM rather than locking in a particular timing now. • TasNetworks concurs with Energy Australia's comments regarding Government subsidies and policy positions. Section 6.3.1 of the PADR discussed the possibility of Government supporting early delivery of the project. TasNetworks will continue to adopt a transparent approach in relation to such matters, in accordance with the RIT-T requirements. • TasNetworks also agrees with Energy Australia's comments in relation to transmission pricing. We will continue to work with the regulatory bodies and other stakeholders to find a workable solution, having regard to the expected distribution of benefits across the NEM regions. • As explained in the PADR, Ernst & Young's market modelling examines the total integrated system costs of meeting customers' future electricity needs. The model selects the lowest cost combination of generation, storage, and demand-side response. It also considers the optimal timing and capacity of other interconnector options. TasNetworks

	Key points raised by submitter	TasNetworks' consideration of the issues raised
Energy Australia (continued)	progressed now, including the inability to achieve an earlier commissioning date e.g. 2028 if this is subsequently found to be prudent given changing market conditions. • The resolution of the 'who pays' question will be assisted if TasNetworks, AEMO and other RIT-T proponents produce estimates of regional costs and benefits. • We have concerns that TasNetworks' analysis has accommodated the potential for government interventions that would result in suboptimal investment timing. • We also have some detailed suggestions for TasNetworks in improving its modelling, including the treatment of Snowy 2.0, scrutinising the heavy reliance on Tasmanian wind capacity, and a possible accelerated timing of VNI West.	recognises that this modelling approach assumes that bidding is cost reflective, which is a reasonable assumption for the purpose of assessing optimal transmission projects. • The 2020 ISP concluded that early works for Marinus Link should be an actionable project without decision rules. As explained in this report, the possibility that Marinus Link may be required by 2027 supports the progress of early works for the reasons outlined in the ISP. • TasNetworks agrees with Energy Australia that the 'who pays' question may be informed by providing estimates on the regional costs and benefits. We will continue to work with the regulatory bodies and other stakeholders to resolve the pricing issues. • The PADR explains that a government may want to bring forward the timing of Marinus Link, but would need to make an appropriate financial contribution in order to satisfy the RIT-T. TasNetworks considers this approach to be appropriate and transparent. • TasNetworks welcomes the feedback on the treatment of Snowy 2.0. The PADR modelling has been updated to reflect the assumptions and scenarios in the 2020 ISP. An accelerated delivery date of 2027 is considered for VNI West across all scenarios.
ENGIE	• ENGIE is concerned that the scenarios used to quantify project benefits are not sufficiently stretching and are not sufficient to correctly assess proposed benefits. Specifically, in this time of uncertainty and pandemic a scenario capturing the potential impacts of the COVID-19 on the economy and the energy sector must be developed and used to properly assess the benefits of the Marinus Link. • Given the recent media coverage of commentary on the impacts on the economy, employment, manufacturing, and business and commerce in general, the impacts of COVID-19 on the electricity sector are likely to be profound. • ENGIE recommends that the RIT-T process must be repeated and include the potential impacts of a COVID-19 pandemic-like scenario. • The benefits are risky and occur way into the future, so the project should be delayed until an acceptable risk profile is obtained (or is	• The PADR explained that our modelling approach relies on AEMO's 2019 Planning and Forecasting Consultation Paper assumptions published in February 2019 (at the time of commencing our RIT-T assessment) as a starting point, recognising we must explain any deviation from AEMO's forecasts. The PADR noted that AEMO's position would continue to evolve in response to stakeholder feedback and new information. In this report, we have adopted the scenarios developed for the 2020 ISP. • COVID-19 is a significant national and international crisis, which has undoubtedly led to unprecedented shocks to economic activity. As a major infrastructure project with an asset life in excess of 40 years, careful consideration needs to be given to the impact of COVID-19 on the cost-benefit assessment for Marinus Link. The analysis in this report is based on 2020 ESOO to capture the impact of the pandemic on energy consumption. TasNetworks waited for the release of the ESOO

	Key points raised by submitter	TasNetworks' consideration of the issues raised
	funded by Tasmanian generators and customers without a need for a RIT-T assessment).	before commencing the modelling to ensure that the impacts of the pandemic were adequately captured to address stakeholder concerns. • As noted above, this report considers the impact of COVID-19 and the latest scenarios, inputs and assumptions from the 2020 ISP. Whilst TasNetworks does not consider it appropriate to repeat the RIT-T process, this report should address the substance of ENGIE's concerns. • In relation to the riskiness of the benefits from Marinus Link, TasNetworks notes that the purpose of the RIT-T is to identify the option that maximises the present value of net economic benefits. As such, the RIT-T has been designed to take account of risk and uncertainty in selecting the preferred option. The RIT-T analysis shows that the 'do nothing' option is more costly than Marinus Link. As a consequence, a decision to defer the project would not be the most economic option. The updated cost-benefit assessment in this report confirms that conclusion.
Energy Users Association of Australia (EUAA)	• We caution that during this time of significant change and uncertainty it will be vital to remain flexible regarding project scope including capacity and timing. We also urge you to consider new approaches to cost recovery that seek to spread the cost and inevitable risks over a broader group of stakeholders, including generators, than is currently the case. • While we note that TasNetworks have modelled a number of key sensitivities. We would encourage you to keep reviewing not only these sensitivities, as they can change in nature and impact, but also new risks and sensitivities as they emerge. • EUAA highlights the significant uncertainty in relation to the cost estimates for Energy Connect. We strongly suggest that TasNetworks maintains a close watch on this situation and to take a conservative approach to capex assumptions given they are highly likely to trend toward the upper boundary of expectations if not beyond. • The recent decisions at COAG Energy Council (including in relation to Retailer Reliability Obligations and other energy market initiatives) and the outcome of the post 2025 Market Review may have significant implications for Marinus Link, which should be included in the sensitivity analysis to the extent possible.	• TasNetworks agrees with EUAA that change and uncertainty must be factored into the assessment of Marinus Link. This report has reviewed the case for Marinus Link, based on the latest AEMO scenarios, inputs and assumptions. Based on findings of the 2020 ISP and the conclusions of this report, we hope to complete the early works (reach Financial Investment Decision) of the project by 2023-24. In relation to cost recovery, we are continuing to work with the regulatory bodies and other stakeholders to develop a workable approach that is equitable and efficient. • TasNetworks concurs with EUAA's comments in relation to the importance of sensitivity analysis. COVID-19 is an issue, in particular, that needs to be given careful consideration. We consider that this report presents appropriate sensitivity analysis. In addition, any material change in circumstances will be considered as it arises. • TasNetworks agrees with EUAA's comments in relation to uncertainty in the cost estimates for major capital projects. This report adopts the 2020 ISP cost estimates and considers the impact of higher capital costs. In addition, by adopting the ISP Rules, each stage of the project will be subject to AEMO's feedback loop, which will consider whether

	Key points raised by submitter	TasNetworks' consideration of the issues raised
EUAA (continued)	• EUAA support a staged approach to Marinus Link, similar to TransGrid's approach to its project 'Powering Sydney's Future'. • A case could be reasonably made that due to the impacts of COVID-19 that the "Global Slowdown" scenario is likely to occur, significantly reducing net market benefits. When combined with higher capex and a weak Australian dollar, charging ahead with a 1500 MW link may be optimistic. • We believe that if you are going to broaden the concept of who pays to go beyond consumers in the two regions connected by Marinus Link (because it is argued that the benefits go beyond those jurisdictions) then the same rationale must hold true for the expansion of the concept of who is a beneficiary. • We are concerned that the rapid rate of change in technology, fundamental changes in end user behaviour and significant political and regulatory uncertainty make the benefits from future investments such as Project Marinus difficult to assess from a consumer perspective. The EUAA are of the view that where there are multiple beneficiaries of new energy assets like Project Marinus then the costs and risks should be equitably shared.	the latest cost estimates are consistent with its optimal development path. • TasNetworks notes that the COAG Energy Council reforms are focused on co-optimising generation and transmission investments, in addition to promoting non-network solutions. The RIT-T modelling for Marinus Link implicitly assumes that the market arrangements will support co-optimisation to deliver the lowest cost outcomes for customers. Accordingly, any reforms introduced by the COAG Energy Council are likely to support our modelled outcomes. At this stage, therefore, we do not anticipate that the RRO or post 2025 Market Reform initiatives will affect the cost-benefit assessment for Marinus Link. We will, however, continue to monitor these developments. • Our report has reconsidered the staging options for the project, which should address the points raised by EUAA. • As already noted, COVID-19 is a significant shock to the national and international economy. We have given further consideration to this issue in this report. TasNetworks also notes the recent Australian government support, in light of the pandemic, for the manufacturing sector which employs over 850,000 Australians. • The question of 'who benefits' from Marinus Link and the pricing arrangements is being progressed by ESB and the Energy National Cabinet Reform Committee. As outlined in section 9.1, TasNetworks supports a practical resolution of these issues that is acceptable to all parties. • In relation to the RIT-T, the Rules require the assessment of the project to be made on behalf of all those who produce, transport and consume electricity. TasNetworks notes that the RIT-T does not require the sharing of the benefits across the sectors to be identified.
Hydro Tasmania	• Hydro Tasmania supports a 1500 MW Marinus Link delivered progressively as two cables in 2027 and 2028. This provides the greatest resilience to the NEM and in particular to the Victorian region. It will support the development of further wind and solar by providing a customer for this energy during high generation periods.	• TasNetworks notes Hydro Tasmania's support for Marinus Link and the benefits it expects the project to deliver to Victoria and the NEM. • As explained in the PADR, Ernst & Young's modelling assumed that the 'Group 1' and 'Group 2' projects will proceed. In addition, where specific projects have progressed, such as Western Victoria RIT-T and project EnergyConnect, these projects were also included in the market

	Key points raised by submitter	TasNetworks' consideration of the issues raised
Hydro Tasmania **(continued)**	• Marinus Link will complement the other strategic Group 1 and 2 investments outlined in the ISP including those currently going through the RIT-T process. It is Hydro Tasmania's view that Marinus Link will enhance the energy security of the NEM, particularly the Victorian region; increase competition; and support the development of wind and solar resources both in Tasmania and Victoria. • TasNetworks should continue to progress the RIT-T, design work and approvals for Marinus Link to ensure that it can be available as soon as is technically feasible. Maintaining current momentum will be critical to ensure optionality and can provide additional resilience to AEMO NEM-wide planning processes. • It is of paramount importance that TasNetworks, the AER and AEMO continue working together so that these benefits can be realised. Hydro Tasmania strongly supports maintaining current progress and optionality for MarinusLink (targeting delivery of 1500 MW by 2028) and examining an appropriate cost-allocation methodology for this strategic interconnection. • The competitive advantage of the Tasmanian pumped hydro development opportunity must be accurately reflected in the next round of Marinus Link and ISP modelling. Further, confidential evidence can be provided to both TasNetworks and AEMO if necessary. • Long-duration pumped hydro storage will be hard to find in Australia and sites identified through desk-top studies can experience significant challenges when progressing to full feasibility, mainly due to geological challenges. AEMO's ISP has identified the strong future system demand for deep energy storage. Sites in later stages of development, with studies confirming cost competitiveness, with technically and environmentally feasible outcomes should be prioritised.	modelling. In this report, we have aligned our project assumptions with the 2020 ISP. • TasNetworks notes Hydro Tasmania's comments that the project should continue so that momentum can be maintained and the benefits achieved. From a RIT-T perspective, it is important that the project is justified on economic grounds. In this regard, the benefits of completing early works of the project by 2023 has been assessed in this report, in addition to other staging options. • TasNetworks agrees with Hydro Tasmania that the resolution of the pricing issues requires close collaboration between a number of stakeholders, including the ESB and other stakeholders. TasNetworks is continuing to work with all stakeholders to reach a resolution on these issues. • TasNetworks agrees with Hydro Tasmania that assumptions regarding the costs of pumped storage in Tasmania compared to alternatives in the mainland is an important element in understanding the benefits that Marinus Link can provide. Further work has been undertaken in conjunction with AEMO to ensure that the assumptions adopted in this report reflect the best available information. In addition, this report also contains a sensitivity regarding a commitment of 750 MW of pumped hydro in Tasmania. • TasNetworks notes Hydro Tasmania's comments in relation to long-duration pumped storage options in Australia. It should be noted that Ernst & Young's modelling approach does not require similar pumped storage options to be adopted on the mainland if Marinus Link does not proceed. Instead, the modelling seeks the lowest cost solution to meeting the energy requirements of customers, without any preference for a particular technology mix or storage type. Nevertheless, the natural cost advantage of long duration pumped storage in Tasmania is a factor that is reflected in the model outcomes.
Origin Energy	• Delay the RIT-T until the outcomes of the 2022 Integrated System Plan (ISP) are known. We consider that it is inappropriate to finalise the RIT-T now for a project that is not required until at least 2028. In our view,	• TasNetworks appreciates the concerns raised by Origin Energy in relation to the desirability of ensuring that the RIT-T is robust to potential futures, particularly as the PADR indicated that the project may not be

	Key points raised by submitter	TasNetworks' consideration of the issues raised
Origin Energy (continued)	for the RIT-T to be robust to potential futures, it is best carried out as close as possible to when the project is likely to be required. • We are concerned about the inconsistency between the outcomes of the draft 2020 ISP and the Marinus Link PADR. Our understanding of the draft 2020 ISP is that Marinus Link is not an actionable ISP project and does not yet form part of the optimal development path. • Assuming the RIT-T is not delayed, TasNetworks should at a minimum update its inputs and assumptions to reflect the 2020 ISP and consider re-issuing the PADR if the outcomes are materially different. • TasNetworks should reconsider its SA-related assumptions in light of the AER's findings in relation to Energy Connect, to the extent that they are relevant. • Origin Energy suggest additional sensitivity analysis including giving zero weight to the accelerated transition scenario; the impact of Government underwriting generation projects in Victoria and Queensland; and the impact of smelter closures in NSW and Victoria.	required until 2028. This report has re-examined the case for staging the project and its optimal timing. • TasNetworks recognises the importance of aligning the RIT-T with AEMO's latest forecasts and scenarios, as set out in its 2020 ISP. A key purpose of this report is to address the concerns raised by Origin Energy and other stakeholders regarding the need for consistency between the RIT-T and the latest ISP. • TasNetworks agrees with Origin Energy's observations. This report addresses Origin Energy's request that the inputs and assumptions should be updated. • TasNetworks notes the assessment of Project Energy Connect by the regulator and the need to ensure that the cost estimates for the project are robust. This matter is addressed by the adoption of the ISP Rules and aligning our costs with the ISP's cost estimate for Marinus Link. • TasNetworks recognises the importance of sensitivity analysis as part of the RIT-T process. The impact of smelter closure is addressed in the Slow Change scenario. This report revisits the sensitivity analysis based on latest market development.
Phil Bayley	• Private sector participation in funding the project, particularly equity, would highlight Tasmania's success in global capital markets and its potential as a place to invest in the future. There should be little difficulty in securing the private sector capital required to build Marinus Link. • Economic and capital market conditions will affect the appropriate discount rate to apply in the next stage of the RIT-T, but this will be affected by the COVID-19 pandemic which is contributing to uncertainty in the wholesale market. Inflows to the hydro system and energy storage, particularly the price of batteries, also have the potential to change the economics of Marinus Link. • Snowy 2.0 will have a material impact on the optimal timing of Marinus, but it is neither a regulated project nor is the final investment decision likely to be solely based on a fully commercial and risk-weighted WACC given its political support. Tasmania's projects could be stranded by this	• TasNetworks notes Mr Bayley's comments in relation to attracting private sector funding for the project. At this stage, the ownership and funding arrangements for Marinus Link have not been settled. It is a matter for the Tasmanian Government and others to determine the future funding arrangements. • TasNetworks agrees with Mr Bayley's comments in relation to the potential impact of COVID-19. This report has considered the impact of COVID-19 on the project, noting that there remains considerable uncertainty regarding the longer term impact of the pandemic. Investment decisions – including assessment of 'do nothing' options – must be made in the context of the uncertainties that have resulted from COVID-19. • TasNetworks agrees with the observation that the economic case for Marinus Link depends, both positively and negatively, on other projects that are expected to proceed. TasNetworks' approach is to adopt

	Key points raised by submitter	TasNetworks' consideration of the issues raised
	re-ranking, particularly if Victoria and other states resist contributing through the price re-allocations in favour of their own preferred projects.	assumptions regarding these future projects that are aligned with the 2020 ISP.
TasCOSS	• TasCOSS acknowledges the great potential inherent in Project Marinus. A project of this size and scope has the potential to benefit many aspects of Tasmanian life, including through increased investment, boosting the local workforce and their communities, increased returns to government and importantly, supporting Australia to transition to a low-emissions, renewable energy future. • Our core concern is that the costs of Marinus Link also have the potential for detrimental consequences for Tasmanian consumers, in particular, residential consumers. • The illusive question of 'who pays' for the Marinus Link remains unanswered. Yet it is critical that Tasmanian households are not burdened with increased costs to fund an infrastructure project that principally benefits mainland customers and Tasmanian generators. • TasCOSS is not aware of a commitment by the Tasmanian Government that prices in Tasmania will not increase as a consequence of Marinus Link. If it can be confirmed by the Government, such a commitment would provide comfort to TasCOSS in our assessment of Project Marinus. • We support changes to the National Electricity Rules (NER) that will deliver network cost allocations for interconnectors that are reflective of the benefits that those interconnectors provide across the NEM. In this regard, we welcome moves to implement a 'fair cost methodology' that are being progressed through the Energy Minister's COAG. • TasCOSS is yet to be convinced Tasmanian households will be net-beneficiaries of the Marinus Link, or that it will benefit Tasmania in general to the extent that it has the potential to, including delivering lower wholesale electricity prices to Tasmanian consumers and returns on investment that provide long-term benefits to the state as a whole.	• TasNetworks notes TasCOSS' comments in relation to the potential benefits of Marinus Link. It should be noted that a number of the benefits mentioned cannot be included in the RIT-T analysis, which is focused solely on the benefits to those that consume, transport and produce electricity. Nevertheless, it is useful to note the wide benefits highlighted by TasCOSS. • TasNetworks notes TasCOSS' concerns regarding the potential cost consequences for Tasmanian customers if Marinus Link proceeds. The Tasmanian Government has highlighted this issue as a matter that will need to be addressed. TasNetworks has been working closely with regulatory bodies and other stakeholders to assist in resolving this issue. • TasNetworks concurs with the views expressed by TasCOSS in relation to the 'who pays' question. As noted in section 9.1, TasNetworks has been working collaboratively with relevant stakeholders for a satisfactory resolution of this issue. • TasNetworks notes TasCOSS' observations in relation to commitments made by the Tasmanian Government in relation to prices in Tasmania. Such commitments are outside the scope of the RIT-T and are matters for the Tasmanian Government. • ESB is currently considering the case for changing the existing transmission pricing arrangements, which may result in a change to the National Electricity Rules. TasNetworks will continue to work with regulatory bodies and other stakeholders to identify a workable solution. • TasNetworks notes TasCOSS' concern that Tasmanian households may not be net beneficiaries if Marinus Link proceeds. TasNetworks recognises that this is an important issue for Tasmanians. From a RIT-T perspective, TasNetworks notes that the investment decision considers the net economic benefits across the NEM, rather than the regional distribution of benefits to customers in each region.

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Tasmanian Minerals, Manufacturing & Energy Council (TMEC)	• TMEC would like to acknowledge and commend TasNetworks for the work gone into this PADR. It is pleasing to read that both the documented feedback, verbal feedback and forum feedback has been taken seriously. • TMEC supports the two-staged proposal of a staged 1500 MW Marinus Link, constructed in 750 MW increments in 2028 and 2032. • TMEC is concerned about the question of 'who pays' for Marinus Link, noting that the link does not benefit Tasmanian customers. • TMEC is also concerned that imports from the mainland may not be renewable energy, damaging the Tasmanian renewable energy brand that the Tasmanian Government has committed to. • It is unclear why the reduction in 'prudent storage levels' has been included in the PADR when the levels are set by the Tasmanian Government and Hydro Tasmania. Making an assumption the levels will be reduced as part of a justification for Project Marinus is not considered in the best interests of TMEC members. • Project Marinus may provide a real alternative to the current FCAS market service providers for which customers will benefit from reduced charges in the market. TMEC has some concerns about what it will do to network system strengths, and welcomes TasNetworks openly discussing this in the PADR and understanding it must be addressed.	• TasNetworks welcomes the positive feedback from TMEC regarding the PADR and our consultative approach. TasNetworks is committed to effective engagement with its stakeholders to ensure that we understand and respond to our customers' views. • TasNetworks notes TMEC's support for the two-staged 1500 MW Marinus Link in 2028 and 2032, which was the preferred option in the PADR. This report provides a detailed reconsideration of the options in light of the scenarios, inputs and assumptions in the 2020 ISP. • TasNetworks notes TMEC's concerns in relation to the 'who pays' question. This issue is discussed in section 9.1 of the report. • The RIT-T does not consider the potential damage to Tasmania's 'renewable energy brand'. Nevertheless, TasNetworks does not share TMEC's concern in this regard, as Marinus Link would capture the benefits of Tasmania's natural advantage in renewable energy for the benefit of the wider NEM. • In relation to 'prudent storage levels', it is important to recognise that Marinus Link will provide additional energy security to Tasmania and therefore a less conservative approach to storage for energy security purposes may be adopted. TasNetworks notes that a sensitivity was also conducted in the PADR with the prudent storage levels left unchanged. • TasNetworks notes TMEC's feedback in relation to the importance of network system strength.
Tasmanian Small Business Council	• TSBC submission was supported by two reports from its consultants, Goanna Energy and SavvyPlus Consulting, with financial support from Energy Consumers Australia. • There are very large risks to consumers in progressing with the investment in or evaluation of very expensive interconnectors, which are part of a future scenario as envisaged by AEMO, ahead of the ESB's assessment of future scenarios for the NEM design/framework. • The RIT-T in its current form is adequate for the assessment of "traditional" network assets such as a zone substation required to meet	• TasNetworks welcomes the detailed feedback and analysis provided by TSBS and its consultants, Goanna Energy and SavvyPlus Consulting. • TasNetworks notes the comments regarding the 'very large risks' to consumers in progressing the investment, given the possible changes to the NEM. Equally, however, there are risks to consumers in terms of higher prices if interconnector projects, such as Marinus Link, do not proceed. The purpose of the RIT-T is to undertake a balanced assessment of the competing options (including the 'do nothing' option), and to make an appropriate investment decision given the prevailing uncertainties and risks.

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Tasmanian Small Business Council (continued)	expected load growth, but it is not appropriate for interconnector projects. • The ESB should undertake an extensive review of the RIT-T and require that the RIT-T clearly identifies all parties who will benefit from interconnector investments, in all applicable jurisdictions of the NEM, the value of those benefits, and that the resulting cost allocations and changes to transmission prices are directly aligned to those benefits. • Tasmania should not pay higher transmission charges in order to provide surety of supply and/or lower prices in mainland jurisdictions. • It is not yet clear who would build and own Marinus. The Tasmanian government could be expected to be under considerable pressure to take an ownership position, which would see Tasmanian taxpayers taking on the associated project, investment and operating risks. • We are unconvinced that proceeding with the proposed Marinus Link is in the best interests of consumers. If consumers were regarded as being investors in this project, it is our opinion that the risks have been understated. • We question TasNetworks' discounting of the capital costs of the project, from $2.762 billion to $1.271 billion, in order to derive the figure for net market benefits of $1.674 billion, and we suggest that the $3.5 billion total capital costs, including accuracy and contingencies, should be used. • The modelled Market Benefits arising from the PADR are considered unreliable. Given Marinus Link is a 'big bang' solution with a 40-year legacy, it fails to meet the internationally accepted principles of smaller and nimble investments being more appropriate at times of high uncertainty. • Given the ISP modelling has a systematic bias of under-playing the role of batteries (large and small), then the conclusion that pump-storage and the associated interconnectors are the best Least Regret solution can be regarded as questionable. • We tested an alternative which we called Battery Link that is based on fast-tracking behind-the-meter storage using the same annual	• TasNetworks notes TSBC's views and extensive analysis regarding the appropriateness of the RIT-T. The RIT-T has been reviewed on a number of occasions. TasNetworks' role is to apply the test as it currently stands. • TasNetworks agrees with TSBC that there is potential value in proponents explaining how the benefits from a proposed project would be distributed across the different parties in the NEM. TasNetworks notes that the AER has recognised the benefit of this approach in its final Cost Benefit Analysis guidelines that would apply to AEMO in identifying the optimal development path in its ISP. • TasNetworks notes TSBC's comments in relation to transmission charges. As discussed in section 9.1, this is an important issue that TasNetworks is engaging collaboratively with the relevant regulatory bodies and other stakeholders. • TasNetworks concurs with TSBC's observation that the ownership and construction of Marinus Link has not yet been settled. It is a matter for the Tasmanian Government and others to determine the preferred position on these questions. • TasNetworks notes that the PADR shows that Marinus Link can be expected to provide very significant benefits to customers. The cost-benefit assessment in the PADR has been revisited in this report. • TasNetworks' modelling approach is consistent with practice in other RIT-Ts, where the study period is truncated so that it is shorter than the technical life of the assets. To assist stakeholders in understanding this issue, we have prepared a short paper to explain the different approaches that could be adopted. It explains why the approach adopted by TasNetworks is reasonable. • TasNetworks notes the comments in relation to modelling benefits beyond the ISP horizon. TasNetworks' view it that it has adopted a reasonable study period given TasNetworks recognises the concern that Marinus Link may be regarded as a relatively inflexible solution, given the size of the investment and its asset life. However, the analysis in this report shows that it delivers substantial benefits by harnessing the renewable and storage capacity in Tasmania. The analysis has not

	Key points raised by submitter	TasNetworks' consideration of the issues raised
Tasmanian Small Business Council (continued)	expenditure as proposed for Marinus Link, and concluded that, when complemented with gas-powered generation in Victoria's Latrobe Valley (at a much lower capital cost than the Battery of the Nation and Marinus Link), there are greater comparable consumer benefits.	identified alternative options that deliver greater net market benefits, which is consistent with the findings in the 2020 ISP. • TasNetworks does not accept that the ISP modelling has demonstrated a systematic bias of underplaying the role of batteries. Nevertheless, AEMO has carefully reconsidered the role of batteries in its 2020 ISP, which has been reflected. • TasNetworks has adopted the latest battery cost projections as included in the 2020 ISP. Moreover, in this report, TasNetworks has also conducted an additional sensitivity wherein the battery cost projections are reduced by a further 30%. In addition to ISP costs, TasNetworks in this report has included cost projections from NREL. TasNetworks welcomes feedback from stakeholders regarding any further battery cost projections for our future modelling.
UPC Renewables	• UPC considers that TasNetworks has provided an extensive analysis of the market benefits that Marinus Link can provide, but also as part of the business case, highlights the significant value proposition through jobs and economic activity Marinus Link can deliver for both Tasmania and Victoria. • We see the process of achieving a successful RIT-T outcome and finalising the "who pays" question are key to realising the development of Marinus Link. • We consider Marinus Link being developed earlier provides both risk mitigation and option value to managing some of the high impact events that may materialise earlier than the central/base case analysis. • The concept of "shovel ready" as indicated in AEMO draft 2020 ISP should be progressed as fast as possible so that Marinus Link is closer to being ready to be built if circumstances change. As a developer, we consider that early 2025/2026 is very achievable for the first 750 MW and that TasNetworks should aim to deliver the link on this timing. • UPC is concerned that the cost estimates for Marinus Link are conservatively high. These estimates should be revisited. • A key concern is the current misalignment with both the outcomes and assumptions in the draft 2020 ISP, which UPC believes is caused by AEMO discounting the Tasmanian opportunities.	• TasNetworks notes UPC's comments in relation to the analysis presented in the PADR and welcomes the positive feedback. • TasNetworks concurs with UPC's views in relation to the importance of resolving the pricing issues discussed in the PADR. • TasNetworks notes UPC's comments that developing the project early will mitigate risk and create option value. As noted in relation to feedback from other stakeholders that indicated the project should be delayed, it is important that the RIT-T assesses the optimal timing, given the uncertainties and risks. The analysis should take a balanced approach, which means neither favouring bringing forward nor deferring the project from its optimal timing. • As envisioned by the 2020 ISP, TasNetworks agrees that the early works for Marinus Link should be completed by 2023 in case Step Change scenario eventuates. • TasNetworks notes UPC's comments regarding the project cost estimates. As noted earlier, TasNetworks has given careful consideration to the cost estimates in this report. • In relation to consistency with AEMO's ISP, a key purpose of this report is to align the RIT-T analysis with the 2020 ISP.

	Key points raised by submitter	TasNetworks' consideration of the issues raised
UPC Renewables (continued)	• UPC advocates a more coordinated modelling of Tasmanian development as it is clear once Marinus Link is built, wind development will occur and pumped hydro development is likely to coincide with Marinus Link being operational. • Marinus Link being brought forward to be ready by 2027 can add $85M, if Yallourn closure is brought forward to 2027. The timing of Snowy 2.0 seems optimistic for such a large and complex project based on recent budget increases and challenges. • UPC would strongly advocate the beneficiaries pays principle is adopted to ensure a fair and equitable approach for cost allocation of interconnectors. It is understood that one issue raised on this is the potential for the beneficiaries to change over time. This issue could be managed similar to the current AER regulatory revenue approach by continual review or review on material change in circumstances (i.e. new interconnectors developed, material change in flows on interconnectors, etc.).	• TasNetworks agrees with UPC's comments that Marinus Link will encourage developments of wind projects and pumped storage in Tasmania. These linkages between the developments is captured in Ernst & Young's market modelling. • TasNetworks notes UPC's comments in relation to the closure of Yallourn and the possible benefits of bringing forward Marinus Link to 2027. As already noted, it is important that the RIT-T takes a balanced approach, having regard to the uncertainties that exist and the range of possible outcomes that may emerge. TasNetworks has updated its modelling and cost-benefit analysis in light of the best available information. • TasNetworks welcomes UPC's comments in support of the beneficiaries pay principle. We continue to work with relevant authorities and other stakeholders to develop a workable solution to this issue.

Glossary

Terms	Description
Ancillary services	Ancillary services perform the essential role of ensuring a continuously stable power system operation, especially when subjected to unforeseen contingency events. Examples include a device which can rapidly alter the network voltage to correct for voltage disturbances (caused, for example, by a lightning strike), or the ability of a generator to rapidly change its power output in response to a sudden change in customer demand.
Battery of the Nation	An initiative by Hydro Tasmania, supported by funding from ARENA, investigating and developing a pathway of future development opportunities for Tasmania to make a greater contribution to the NEM.
Capex	Capital expenditure; the expenditure required to develop and construct an asset
Dispatchable on-demand	A generator, such as a hydroelectric, gas- or coal-fuelled generator, in which the electrical output can be increased or decreased as required in order to meet varying customer demand. This contrasts with non-dispatchable generators, such as solar and wind, the output of which will fluctuate depending on the input power source. e.g., how strongly the wind is blowing or the sun is shining.
Economic worth	Present value of the benefits of Marinus Link minus the present value of its costs
Energy security	Refers to the certainty of being able to supply customers' energy needs in the medium and long-term
Financial Investment Decision	Relates to the stage in a project where everything is in place to execute the project (contracts are signed). Getting to this stage involves arranging all financing, permits, approvals and any other requirements that are needed prior to construction starting. It is the point where contracts for all major equipment can be placed, allowing procurement and construction to proceed and engineering to be completed
Firming	Firming, in relation to variable generation sources such as solar or wind, is the action of adding additional power from a separate dispatchable on-demand source that can compensate for the potential lack of output from a variable generator when the power is needed.
Load shedding	Reducing or disconnecting load from the power system. (Rules chapter 10).
Marinus Link	A proposed second transmission interconnector linking Tasmania and Victoria

Terms	Description
NEM Regulatory process	The process of seeking approval to provide a regulated service via the regulatory investment test for transmission; obtaining a revenue allowance which includes an amount to recover the costs associated with providing that service, and recovering that revenue amount from customers via approved transmission pricing. This process requires approval by the Australian Energy Regulator at each step. See also 'Regulated Model'.
Net present value	The difference between the present value of benefits and the present value of costs over a period of time.
On-demand	Available when requested or required.
Opex	Operational expenditure; the ongoing expenditure required to operate and maintain assets and the supporting activities to provide services.
Power system security	Operation of the power system within its technical limits (for frequency, voltage, etc.) such that it will maintain stable operation including after a contingency event.
Supply reliability	Maintaining sufficient capacity (generation, network, and demand response) to meet customer power demands in the short-term
Unserved energy	The volume of energy that customers desired but could not supplied (e.g. due to a blackout). The technical definition of unserved energy is set out in chapter 10 of the Rules.

Acronym	
2020 ESOO	AEMO's 2020 Electricity Statement of Opportunities
AC	alternating current
AEMO	Australian Energy Market Operator
AEMC	Australian Energy Market Commission
AER	Australian Energy Regulator
ARENA	Australian Renewable Energy Agency
capex	capital expenditure
DC	direct current
DER	distributed energy resources
EY	Ernst & Young
FCAS	frequency control ancillary services

Acronym	
GPG	gas-powered generation
GW	gigawatts
HV	high voltage
HVAC	high voltage alternating current
HVDC	high voltage direct current
IDC	interest during construction
ISP	AEMO's 2020 Integrated System Plan
kV	kilovolt
MW	megawatts
NEM	National Electricity Market
NPV	net present value
NSP	Network Service Provider
opex	operating expenditure
O&M	operations and maintenance
PADR	Project Assessment Draft Report
PSCR	Project Specification Consultation Report
PV	photovoltaic
QRET	Queensland Renewable Energy Target
REZs	renewable energy zones
RIT-T	regulatory investment test for transmission
TNSP	transmission network service provider
VRET	Victorian Renewable Energy Target