Goanna Energy Consulting Pty Ltd

Tasmanian Small Business Council
Uniting Small Business

Consumer Review of the Project Assessment Draft Report (PADR) for Marinus Link

26 April 2020

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Executive Summary

Introduction

TasNetworks has invited submissions on its Project Assessment Draft Report (PADR) prepared as part of the Marinus Link Regulatory Investment Test – Transmission (RIT-T) process. The Tasmanian Small Business Council (TSBC) has initiated a review and compiled this report with sponsorship from Energy Consumers Australia (ECA). The research was undertaken by Goanna Energy and SavvyPlus Consulting.

The key perspective of this review was to consider the proposed Marinus Link from a consumer perspective. Furthermore, given consumers will be expected to pay for this regulated interconnector, it seems appropriate that consumer views are deeply incorporated into the decision-making process.

Findings

The highlights from this review are:

1. We are unconvinced that proceeding with the proposed Marinus Link is in the best interests of consumers.

2. By treating consumers as if they were investors in this project, it is our opinion that the risks have been understated and can be classified into the categories of:

    a. Technology;
    b. Modelling; and
    c. Market risks.

3. The modelling undertaken in the PADR has made some improvements beyond the Integrated System Plan (ISP) modelling, however given the PADR relies heavily upon the ISP, they remain intrinsically linked. The modelled Market Benefits arising from the PADR are considered unreliable given that:

    a. The methodology used to calculate the net Market Benefits are questionable given the:
        i. understatement of the project's capital expenditure in total and over the modelling period. (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);
        ii. assumption that fuel switching benefits will be passed through to consumers as we are not convinced this will be true;
        iii. fuel switching benefits measure the differential between gas costs for gas powered generation and the value of water for hydro plant which is opaque, subject to sudden and material change and subjective;
        iv. discount rate applied is not consumer risk-adjusted;

      v. margin of error associated with the Market Benefits forecasts are so great it makes the conclusions unreliable;
   b. The ISP and therefore the PADR, mis-represent the up-take of large-scale batteries already undertaken or under serious review by leading market participants, and therefore is disconnected from market developments;
   c. In terms of contingency planning, we believe the expected level of large-scale consumer plant closures included in ISP scenarios is understated, representing a major shortfall in the modelling design given what is happening in the market; and
   d. Behind-the-meter batteries and electric motor vehicle batteries (becoming more abundant over time) are poorly modelled and therefore do not reflect the likely commercial behaviour of these assets, nor contribute to potential management of system security and reliability.

4. 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. Furthermore, the Marinus Link proposal does not aid consumers by future proofing the system and allowing consumers the benefit of riding the technological benefits that are continually arriving, affecting consumer behaviour, learning curves, generation capacity and capability.

5. 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 is regarded as questionable. In a re-work of the modelling, we would be surprised if gas powered generation built in Latrobe Valley complemented with a better utilisation of battery technology, would not be a better Least Regret solution.

6. We tested an alternative which we called **Battery Link** that is based on fast-tracking behind-the-meter storage using the same annual 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. This **Battery Link** strategy also had the benefits of:

   a. Being a more nimble and technologically driven solution that can capitalise upon future technological breakthroughs;

   b. Delivering market benefits to the spot market, but also delivering greater benefits to consumers directly through avoided network charges as well as wholesale market costs, and therefore not suffering the risk that the fuel switching benefits that under-pinned the PADR Market Benefits are not passed through to consumers;

   c. Providing the opportunity to use behind-the-meter storage for:

      i. black-out protection (local and grid events);
      ii. providing local network support which has the subsequent potential benefit of lowering network charges for all consumers; and
      iii. aiding the management of over-voltage supply caused by solar PV, which is considered a growing challenge which must be addressed to avoid a punitive approach of limiting the adoption of solar PV.

d. Complementing messages from the AEMC, Energy Security Board and others regarding the pending consumer-led energy revolution. Battery Link is a platform to accelerate the revolution for the benefit of consumers;

e. Mitigating the risk of further market power concentration as both SnowyHydro and HydroTas are already critical market Price Setters that do not fundamentally have the same commercial driver as consumers for lower prices. These entities will have a greater financial burden caused by capital serving costs and operating costs associated with developing their respective deep-storage assets; and

f. Creating more competition as consumers, who are traditional demand-side participants, will now be able to compete against the supply-side of the market by demand responding and/or discharging storage. Such an initiative will be a game changer for competition, benefiting consumers.

Next Steps

The recommended next steps from this review are:

1. Discuss with TasNetworks the findings of this review to clarify any issues that may arise.

2. AEMO to take onboard the modelling issues identified in this review and explore other options such as the Battery Link concept outlined in this review. In consultation with TasNetworks, the TSBC and partners would welcome the opportunity to work with AEMO in this endeavour.

3. We contend that the findings and suggestions outlined in this review have relevance in the wide range of activities underway in relation to the NEM and therefore the TSBC and partners would welcome the opportunity to participate further, in conjunction with Energy Consumers Australia. These activities include, but not limited to:

    a. The Energy Security Board's Post 2025 Market Design review;
    b. The AEMC's Economic Regulatory Framework Review;
    c. Integrating Distributed Energy Resources for the Grid of the Future project;
    d. Open Energy Networks project;
    e. The COGATI review;
    f. Establishment of an expert ISP consumer panel to advise AEMO during the development of the ISP, as announced by the COAG Energy Council on the 27th March 2020; and
    g. The Distributed Energy Integration Program.

We acknowledge and thank the Department of State Growth and TasNetworks for making their key project staff available and for their valuable inputs. We look forward to discussing and clarifying any element of our review, as well as continuing cooperation on strategic energy solutions.

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Table of Contents

1 Introduction

1.1 Background

This report provides a consumer-focused assessment of TasNetworks' recently published Project Assessment Draft Report (PADR)[1] as the next step in the Marinus Link Regulatory Investment Test – Transmission (RIT-T) process. Furthermore, the PADR builds on the Project Marinus Project Specification Consultation Report (PSCR).

The Tasmanian Small Business Council (TSBC) has initiated this review with sponsorship from Energy Consumers Australia (ECA). The research was undertaken by Goanna Energy Consulting and SavvyPlus Consulting. This report follows our analysis of the RIT-T process as it is applied to the Marinus Link project and provides a critique of the PADR for discussion.

1.2 Project Approach

The TSBC's approach, with Goanna Energy and SavvyPlus, is to provide a review and analysis of the range of work undertaken by the many organisations who have provided contributions to the Marinus project. It is not our intent to replicate or 'out-model' those organisations who have the resources, information and or time; but rather the objective is to critique the work undertaken and test key inputs and findings.

Further, the end-goal is to create a blue-print to enable the assessment of major capital spend projects from a consumer perspective, ensuring the correct options are selected, and the expenditure is under-taken in a timely and prudent manner; not just for Marinus Link, but for all large scale transmission investments, including interconnectors.

1.3 Structure of Report

This report provides a word document of the findings which is also available in a PowerPoint format. The structure of this document follows a similar structure to the PowerPoint presentation, and reviews the PADR for the Marinus Link project in the context of:

- Section 2: Consumer Issues
- Section 3: Industry Modelling Critique
- Section 4: Industry Methodology
- Section 5: Industry Assumptions

Figure 1 provides an overview of the PowerPoint presentation structure which has been replicated in this report.

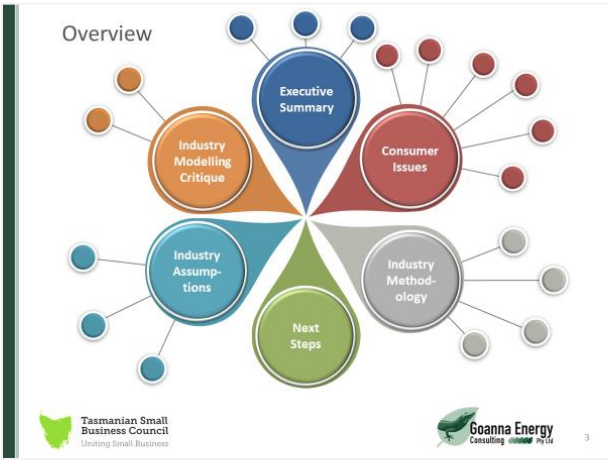


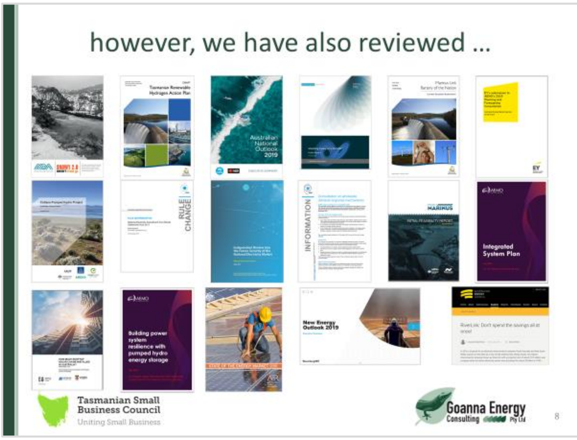
Figure 1: Overview of Presentation Structure

[1] https://www.marinuslink.com.au/rit-t-process/

1.4 Research Undertaken

In the preparation of this report, we have conducted a Literature Review which has included many reports prepared in Australia and some international reports. The key focus has been the PADR and the Draft ISP; however, a range of other reports have also been included in our review to accumulate knowledge, to be complemented with our own knowledge base.

Figure 2: Documents Included in Literature Review

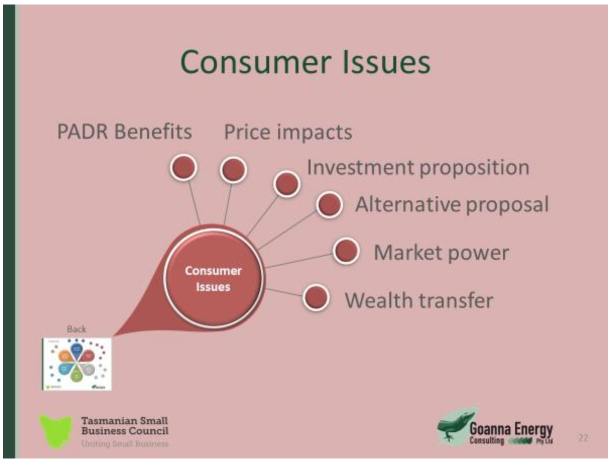


2 Consumer Issues

Our analysis begins with consumer issues and our starting point is that regulated assets are paid for by consumers, therefore it is only reasonable that consumers have a big say in how and when the money should be spent.

From a consumer perspective we have addressed:

Figure 3: Consumer Issues



2.1 PADR Benefits Analysis – Headline Calculations

We note the headline conclusion of the PADR, being that construction of Marinus Link would deliver net benefits of $1.674 billion to NEM customers on mainland Australia, averaged across the four scenarios which form the basis of the cost benefit analysis[2].

We also note the headline financial information provided in the PADR relating to the preferred option (1500MW link constructed in two 750MW stages, 2028 and 2032) being:

- Expected average net benefits $1.694 billion[3]
- Total capital cost $2.762 billion[4]
- Annualised total costs $193 million[5]

We were not able to identify within the PADR where the expected average gross benefits were calculated and discussed, or the calculation to determine average net benefits (that is, average gross benefits less total capital costs), but were able to calculate those from the information provided at table 16, page 86, which lists the relevant data for each of the four scenarios considered:

[2] PADR, page 14
[3] PADR, p14 and elsewhere
[4] PADR, Table 4, page 56
[5] Ibid

- Expected average gross market benefits $2.945 billion[6]
- Marinus Link estimated costs $1.271 billion[7]
- Marinus Link average net market benefits $1.674 billion[8]

We note the use of Marinus Link estimated costs in the above calculation of $1.271 billion, which is not the total capital cost of the project (which is $2.762 billion). Note 2 on page 86 of the PADR provides the following explanation:

"Marinus Link and supporting transmission estimated costs are less than the estimated capital cost of the 1500 MW option presented in section 4.7 because the market benefit calculation considers only the annualised costs which occur during the modelling period (to 2050), whereas Marinus Link has an asset life of 40 years."

There is no further explanation of the difference between $2.762 billion (total capital costs) and $1.271 billion (Marinus Link estimated costs), or the mathematical derivation of the $1.271 billion, which is 46% of $2.762 billion.

Such a difference is extremely material, given that electricity charges paid by the affected consumers will continue over the life of the Marinus Link assets, 40 years, assuming the link becomes part of TasNetworks' regulatory asset base. Those electricity charges will include a component for the full capital costs of Marinus Link.

The TSBC acknowledges the challenges involved in projecting benefits beyond the modelling period which extends to 2050, and agrees that such benefits should not be included in the benefits analysis, but questions the failure to include the full capital costs of the project.

We also note that the project is referred to in TasNetworks' media announcements, Hansard[9] and online information[10] as a $3.5 billion project. The only reference in the PADR to the project costing $3.5 billion is however at page 160:

"If accuracy and contingencies are included, the estimated Marinus Link and supporting transmission would have a total project cost in the range of $3.5 billion. This includes an approximate cost of $3 billion for the HVDC link and an approximate cost of $0.5 billion for the required supporting transmission. The total project cost estimates include allowances for accuracy and contingency, reflecting the fact that cost estimates for project elements are subject to a number of factors that may influence project costs".

The TSBC contends that the $3.5 billion total capital costs should be used as the basis for calculating net market benefits, noting that projects of the scale and complexity of Marinus Link invariably experience cost overruns, hence the legitimate application of contingencies. Use of the "base" capital costs for that purpose would appear to involve a level of optimism which cannot be justified.

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[6] PADR, table 16, page 86 - average of the Gross Market Benefits row
[7] PADR, table 16, page 86 – Marinus Link estimated costs
[8] PADR, table 16, page 86 – average of net market benefits row
[9] http://www.parliament.tas.gov.au/ctee/Council/Transcripts/GBA%202019/LC%20Thursday%205%20December%202019%20-%20TasNetworks%20Pty%20Ltd.pdf
[10] TasNetworks website, news 6th March 2020, At TasNetworks' Project Marinus, "women are carving out their own place on the $3.5 billion project".

We note the analysis presented at table 34, page 162, but suggest that the average gross benefits as calculated and represented in the PADR should be independent of the capital costs.

A representation of the average net benefits from the project, using the Base capital costs and Contingent capital costs, is shown below in Table 1.

Table 1: Marinus Link Average Net Benefits

	Base capital costs	Contingent capital costs
Average Gross Benefits	$2.945 billion	$2.945 billion
Capital costs	$2.762 billion	$3.500 billion
Average net benefits	**$0.183 billion**	**($0.555 billion)**

Using the information presented in Table 1, it would appear that Marinus Link at best would deliver marginal benefits, especially given the scale of the investment required and the issues and risks identified in the remainder of this review.

At worst Marinus Link would deliver negative benefits.

The TSBC suggests that TasNetworks should articulate any shortcomings it sees in the portrayal of benefits outcomes described in Table 1 above.

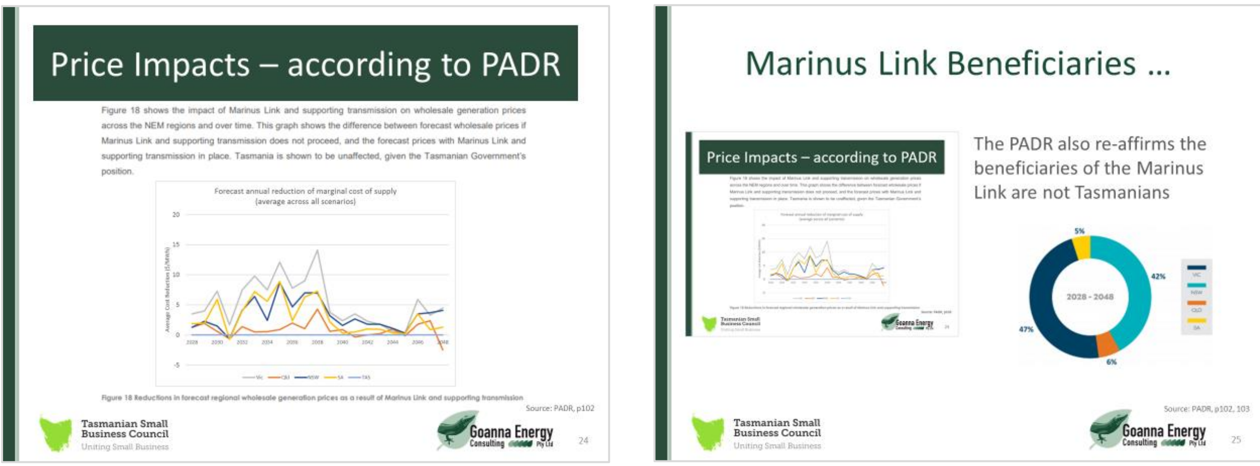
2.2 Price Impacts & Price Signals

This section of the report addresses Price Impacts of Marinus Link as well as the need to manage Price Signals to consumers in order to reduce cost for all.

2.2.1 Price Impacts

The PADR concludes that price impacts to consumers will be most evident in the first decade, and then dissipate in the second decade. On average it appears the average gain was about $3.20/MWh in the first decade and then decreasing to about $1.35/MWh in the next decade of Marinus Link. Furthermore, the beneficiaries are consumers on the mainland, rather than Tasmanians "given the Tasmanian Government's position"[11]

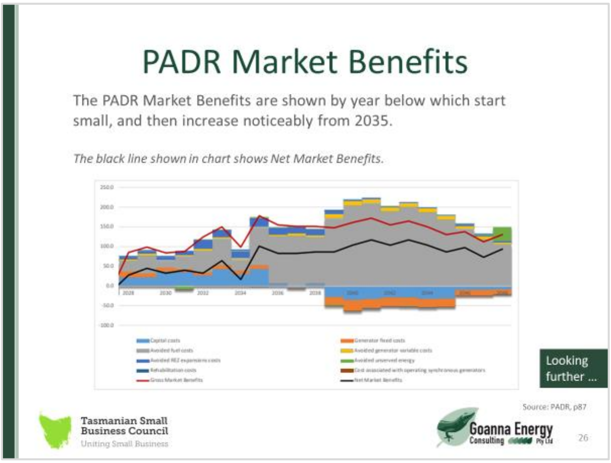
Figure 4: Price Impacts - According to PADR and beneficiaries



[11] PADR, p102

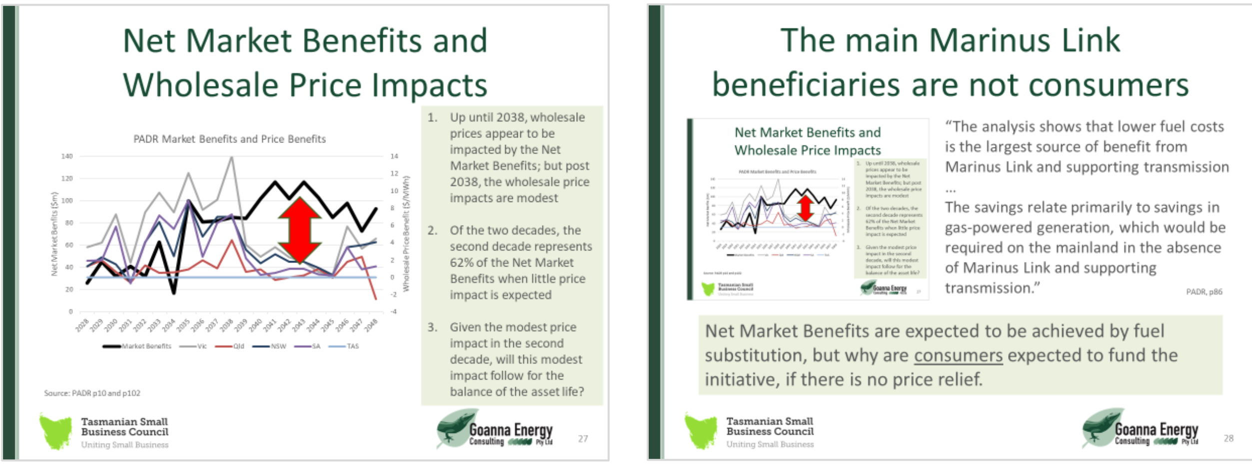
It is then observed that the PADR Market Benefits begin low and then increase noticeably from 2035, which is a different pattern to the price impacts re-produced in Figure 4 above; and therefore it follows that the main beneficiaries from Marinus Link are not consumers.

Figure 5: PADR Market Benefits



This conclusion that consumers are not the main beneficiary is observed more clearly when the Market Benefits are overlayed with the Price Impacts as shown below:

Figure 6: PADR Market Benefits and Wholesale Price Impacts, along with Beneficiaries



We conclude that if the driver of the Market Benefits arises from fuel substitution, and we have serious doubts about whether such benefits would be passed onto consumers, (see Section 2.5 Market Power) but also the PADR modelling itself demonstrates there is a disconnect between the timing of Market Benefits and the Price Impacts. Of the two decades considered in the PADR, the second decade represents 62% of the Net Market Benefits when little price impact is expected (i.e. about $1.35/MWh). Furthermore, we are concerned about the margin of error inherent with such modelling (see Section 4.3 *Margin of Error*), and the lack of risk adjustment applied to the discount rate used in the benefits measurement (see Section 2.3.2 *Modelling Risks*).

We therefore conclude that despite consumers being expected to pay for Marinus Link, consumers are not the main beneficiaries.

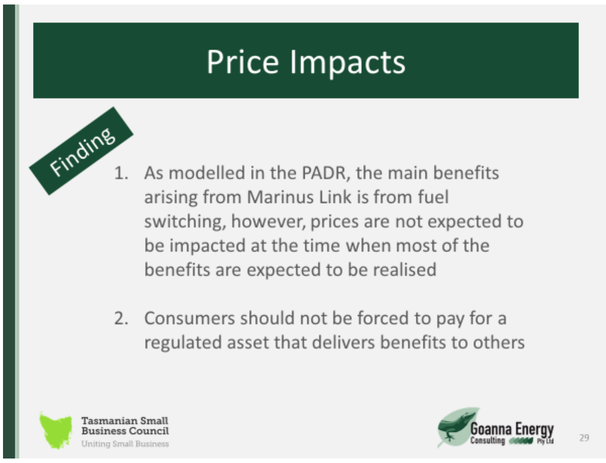


Figure 7: Price Impacts Finding

2.2.2 Price Signals

Price signals play an important role in building an efficient electricity market place so that demand response can contribute to the real-time balancing requirement, as evident by initiatives such as the 5-minute settlement rule change and the introduction of multi-part solar feed-in tariffs encouraging west-facing solar generation, to aid meeting evening peaks.

Figure 8: AEMC 5-Minute Rule Change and West Facing Solar PV

It is our conclusion that the ISP and therefore the PADR have not considered the role of consumer price signals in affecting demand response, leading to a lower cost solution to all. Retail price signals in the NEM are simplified and do not reflect the emerging power of the consumer. Artificial Intelligence, smart meters, and the internet of things (IoT) will accelerate the way in which users consume and generate power.

Our conclusion is that consumers have demonstrated their willingness to invest are adaptable given the correct incentives, as the technology is available and will only improve in terms of its application and affordability.

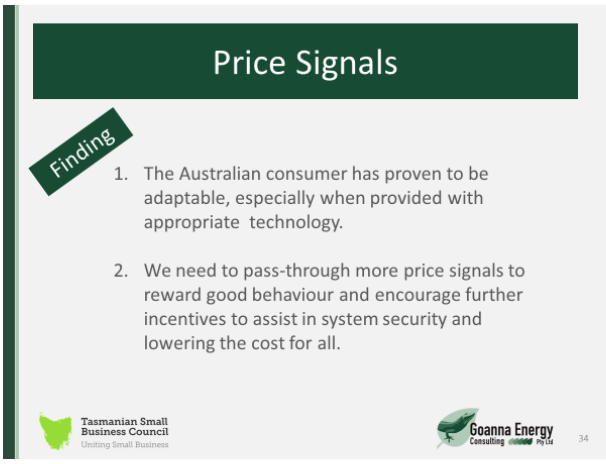
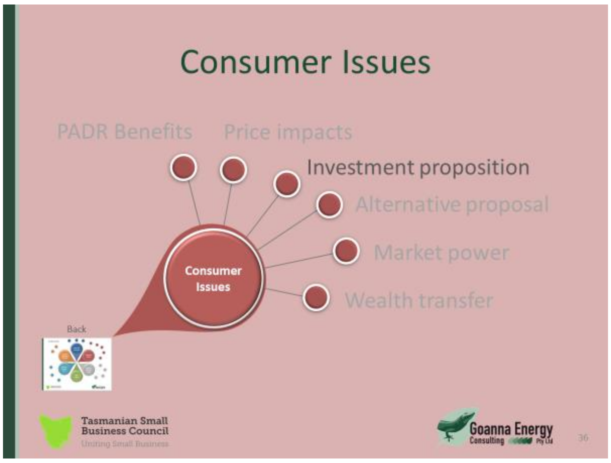


Figure 9: Price Signals Findings

2.3 Investment Proposition

The next step in the analysis was to consider the investment proposition where consumers pay for a regulated asset such as Marinus Link for the next 40-years. In other words, we are treating consumers in a similar way to any other investor where the risks and benefits are assessed.

Figure 10: Consumer Issues – Investment Proposition.



Treating a consumer as an investor, we have considered three (3) risks, which are then addressed individually.

Figure 11: Consumer Investment Risks.

2.3.1 Technology Risks

Technology is moving at a rapid pace and when the Marinus Link is considered, it is providing transportation of energy from one region to another, and therefore does not itself generate any more energy for the grid. Marinus Link may enable more energy to be offered to the market, but nevertheless the link is exposed to rapid advances in technology and changes in consumer behaviours.

It is no secret that the energy market is very much exposed to technology changes ranging from management to generation. It is our conclusion that the technology risk associated with Marinus Link is material and therefore the value proposition needs to be compelling for an investor (like consumers) to accept the 40-year technology risk.

The sample slide shows some of the many potential changes mentioned in recent press clippings. This sample does not claim to portray every break-through development, but rather is intended to give an insight into the potential change.

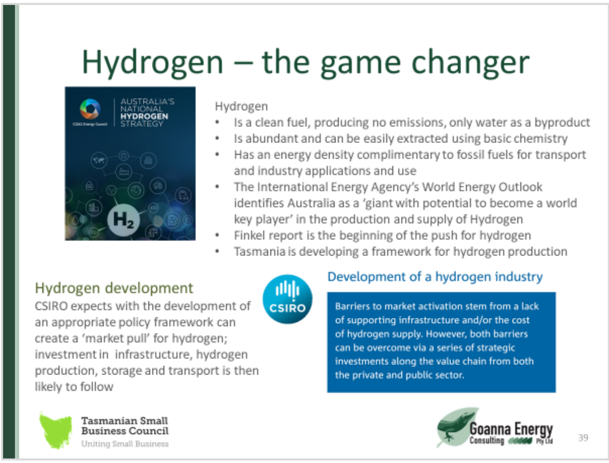
Figure 12: Consumer Technology Risk is Huge

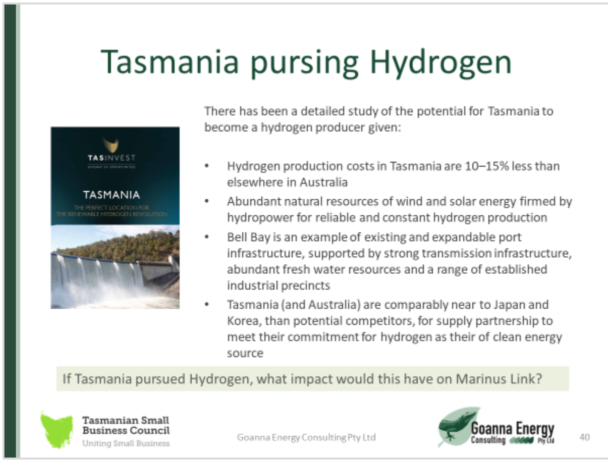
The other point to note is this investment in energy markets is not constrained to the province of Australia, which is relatively speaking, in global terms, a small market. The research and development being undertaken is global and significant, and therefore the leverage opportunities for Australia are very high.

Figure 13: Renewable Transition is Global

As an example, one of the technology risks noted for Australia and indeed Tasmania, is renewable hydrogen which could have a profound impact on the NEM.

Figure 14: Renewable Transition is Global





2.3.2 Modelling Risks

The second risk identified for our consumer investor, relates to modelling risks. In other words, all these long-term benefits are predicted and as with any prediction are exposed to errors, with the questions being "to what degree?" and "is there a materiality that would undermine any modelled conclusion?".

Our finding is that we have concerns regarding:

a) The modelled market benefits which we have already discussed in Section 2.1, *PADR Benefits Analysis – Headline Calculation*;
b) Price Impacts & Price Signals, where consumers do not appear to be the primary beneficiary, but are expected to pay-for the asset;
c) Market power and whether these modelled benefits will be passed through to consumers which is discussed further in Section 2.5, *Market Power*;
d) Margin of error of any modelling which is discussed in Section 4.3, *Margin of Error*; and
e) The discount rate used in measuring the benefits which is discussed below.

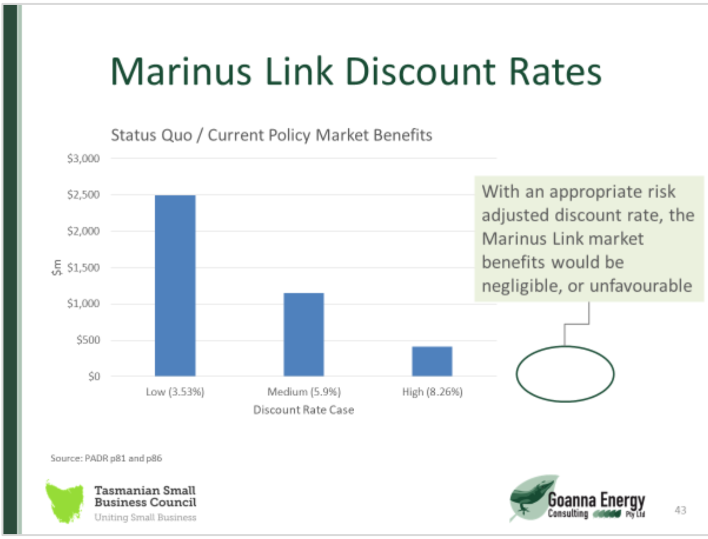
Looking at the discount rates used, the PADR used the Energy Network Australia RIT-T Economic Handbook base discount rate of 5.9% (real, pre-tax), along with a high and low case of 3.54% and 8.26% respectively.[12]

However, looking at the Marinus Link as a consumer investment proposition, these discount rates are considered inappropriate when one considers the risks outlined in this report. Using the PADR results of the Net Present Value of the benefits, it can be shown that the so-called "High Case" materially diminishes the benefits, and if this discount rate was risk-adjusted (which is what a typical investor would do), the benefits would be marginal assuming no modelling errors.

[12] PADR, p158

Figure 15 shows how appreciably the Net Present Value of the discounts appreciably falls with a high rate.

Figure 15: Marinus Link Discount Rates Impact on Benefits



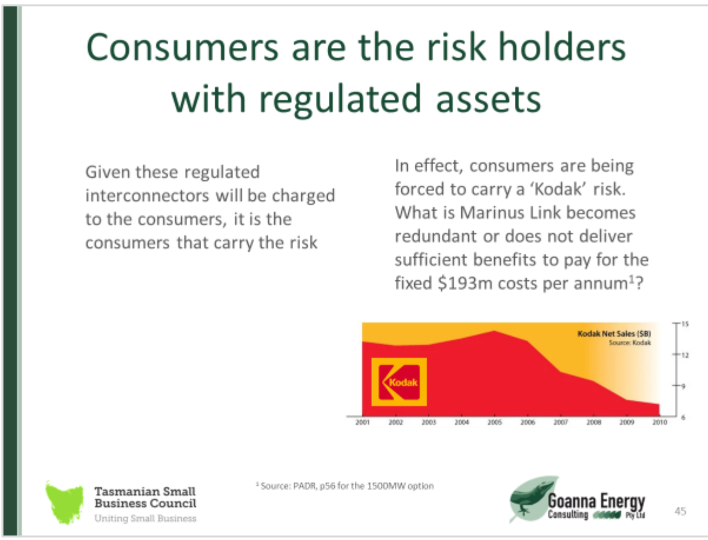
It is our conclusion that whilst the discount rates applied in the PADR conform to the Energy Network Australia RIT-T Economic Handbook, such a rate is not appropriately risk-adjusted from a consumer perspective.

2.3.3 Market Risks

In our view the Marinus Link has significant market risks where, due to changes in consumer enabled behaviour; technology; consumer demand; and the list goes on; that a regulated asset such as Marinus Link entails a significant risk to the party who will pay for the asset for the next 40-years, irrespective of whether the investment delivers the modelled benefits.

We have called this risk the “Kodak Risk” where through a profound change in market conditions could lead to the investment never delivering the modelled benefits.

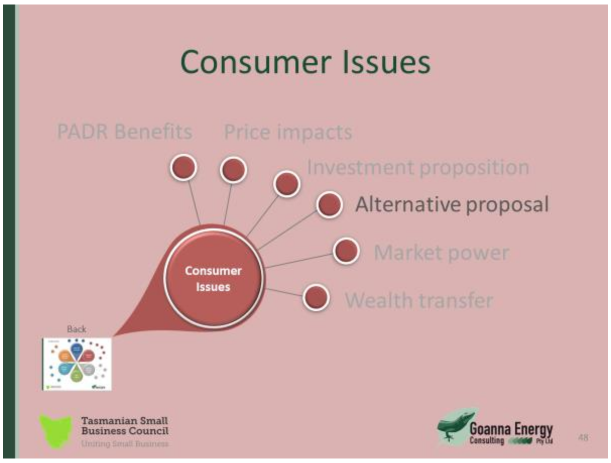
Figure 16: Kodak Risk



2.4 Alternative Proposal

Having discussed Price Impacts and Price Signals, followed by the Investment Proposition, we now address the third Consumer Issue of an Alternative Proposal.

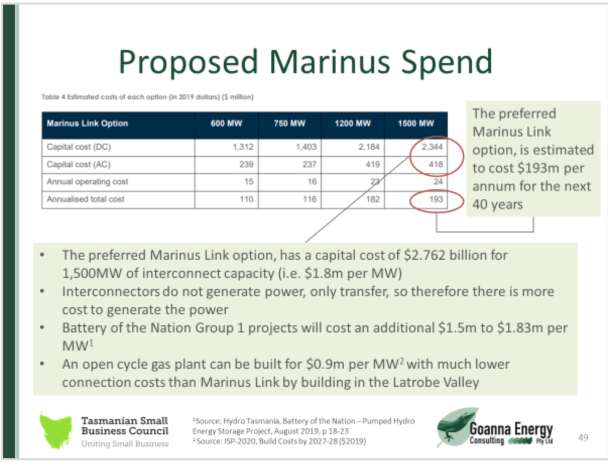
Figure 17: Consumer Issues – Alternative Proposal

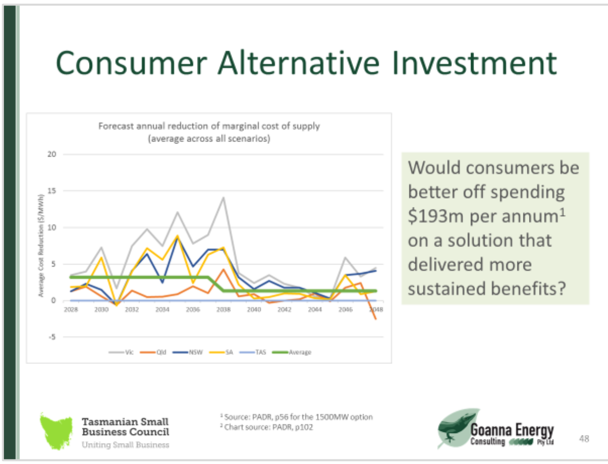


2.4.1 Investment Recap

The proposed Marinus Link investment would cost consumers $193m per annum[13] for the next 40-years. In return for such an investment, the modelled benefits are as re-produced below which average about $3.20/MWh in the first 10 years and then $1.35/MWh for the next 10 years across all regions, before accounting for the additional network charges required to pay for the link. We pose the question is there a better alternative worth exploring?

Figure 18: Consumer Issues – Alternative Proposal



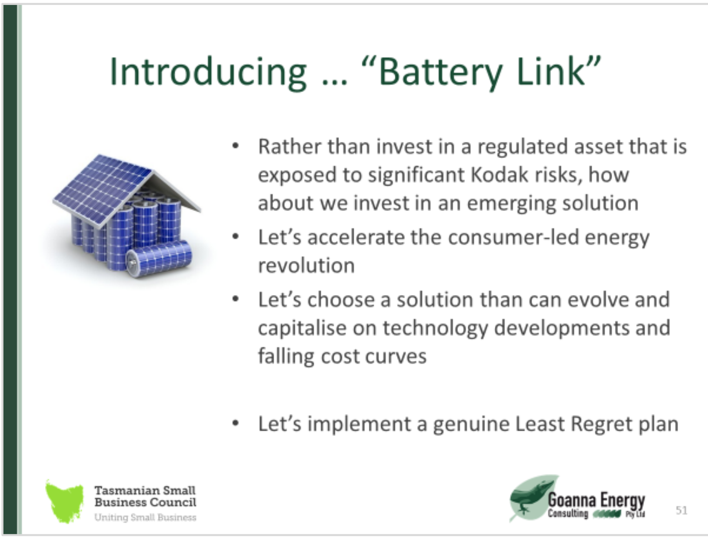


[13] PADR, p56 for the 1500MW option

2.4.2 Introducing Battery Link

The objective from the outset of this project was not to develop or explore an alternative to Marinus Link, but as the project unfolded, it became apparent the proposed Marinus Link proposal has several shortcomings which are outlined in this report. We considered what criteria we would set and what solution would look viable to explore further. This led to the project we called "Battery Link".

Figure 19: Introducing Battery Link

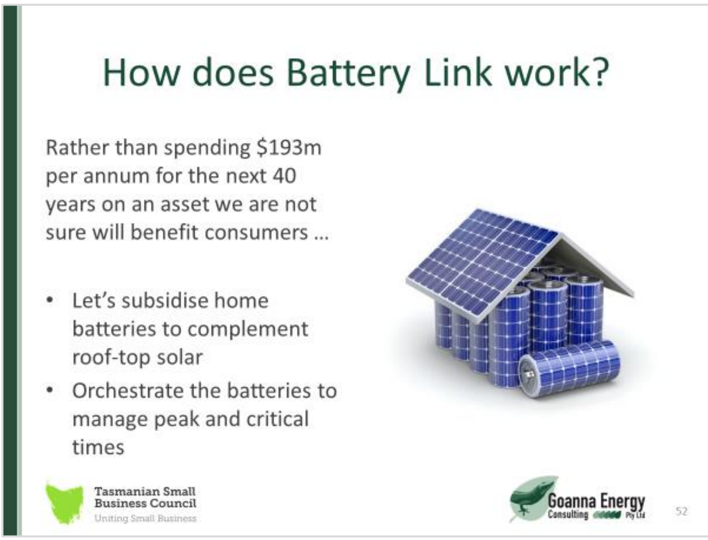


2.4.3 How Would Battery Link Work?

The principles of Battery Link are outlined in Figure 19 where we wanted to avoid the "Kodak Risks", accelerate long-term benefits for consumers, capitalise on technology enablement and advances, and therefore introduce a genuine Least Regret plan (i.e. smaller and nimble investments).

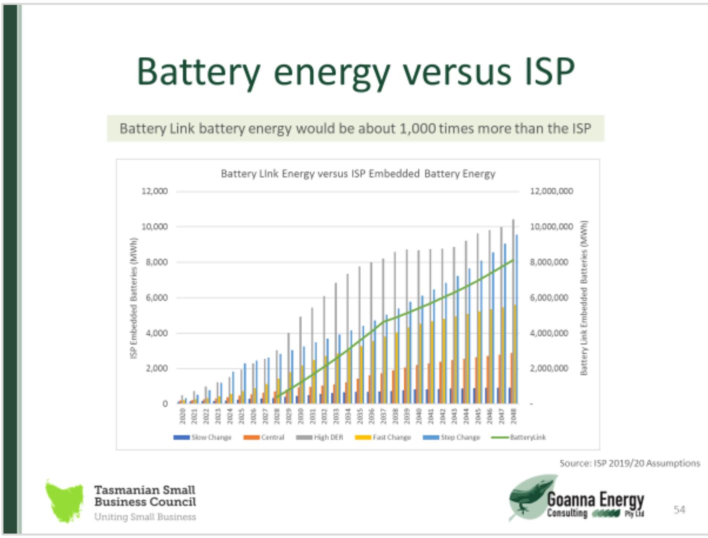
The simple concept is to use the expected $193m annual spend to accelerate the development of home and business behind-the-meter battery energy storage systems investments.

Figure 20: How Does Battery Link work?



This would lead to a massive roll-out of batteries which would be about 1,000 times more than assumed in the Draft ISP 2020. Initially the roll-out would be about 40,000 batteries in 2028 and then increase over time as the cost per battery would fall due to an acceleration of the Learning Curve.

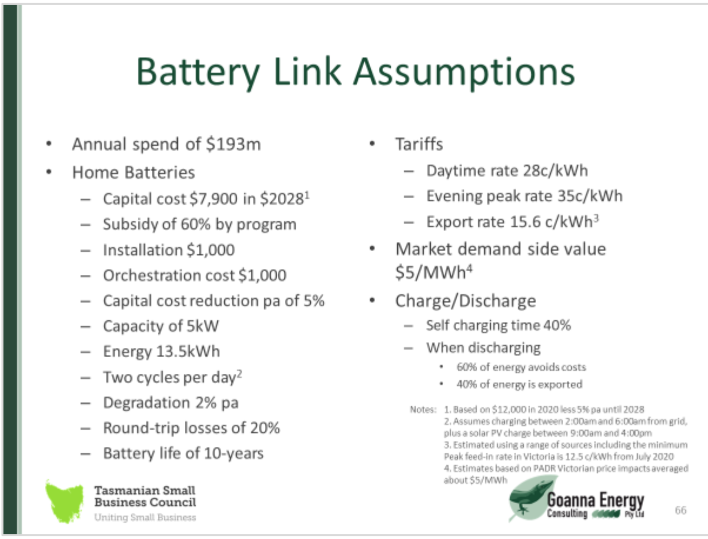
Figure 21: Battery Link Energy versus ISP



2.4.4 Battery Modelling Assumptions

The financial modelling assumptions of the batteries leading to a measurement of consumer benefits are shown in Figure 22.

Figure 22: Battery Modelling Assumptions



2.4.5 System Reliability and Security

A detailed assessment of the contribution from Battery Link towards the System Reliability and Security has not been performed at this stage of the project, however a preliminary assessment of the capacity has been compared to the Marinus Link as a reference.

The key assumptions regarding system capability are:

1. The ISP did not plan for any additional large-scale batteries which is contrary to market behaviours and endeavours (see Section 5.2 Large Scale Batteries). It has been assumed new large-scale batteries will emerge (1,000MW by 2028 plus 100MW pa)

2. In addition to the small-scale and large-scale batteries, it has been assumed gas-powered Victorian generation would be built to support Battery Link. The staged development would begin with 500MW in 2028, and then an additional 250MW each year until 2032 when Yallourn is expected to be retired. These gas-powered units would be constructed in the Latrobe Valley, therefore using the same transmission as Marinus Link. The additional fuel cost compared to Marinus Link has been considered in the evaluation of Battery Link.

3. It has been assumed that gas supply would be sufficient to support the gas-powered generation by shipping gas through the gas pipeline network from Queensland, or via a gas import terminal in Victoria.

4. Battery of the Nation Group 1 projects will cost an additional $1.5m to $1.83m per MW[14] plus an extra $1.8m per MW[15] to transport the energy to Victoria. This compares to an open cycle gas plant capital cost of $0.9m per MW[16] installed. The higher running cost of gas-powered generation has been included in this analysis.

When Battery Link with large-scale batteries and gas -powered generation is compared to Marinus Link, then we conclude that:

1. In the first year, Battery Link would offer 500MW instead of 750MW of continuous power from Marinus Link, but there would be an additional 2.5 battery hours running at 750MW

2. In the second year (2029), gas powered capacity would match Marinus Link's capacity, and an additional 3.2 battery hours of running at 750MW would be available

3. In years 2030 and 2031, Battery Link would have more capacity than Marinus Link plus an extra 3.9 and 4.6 battery hours respectively running at 750MW

4. By 2032, gas powered generation would match Marinus' capability plus there would be 2.7 hours increasing each year up to 7.5 battery hours, running at 1,000MW. It is possible with more detailed modelling, the gas-powered generation could remain below the 1500MW capacity.

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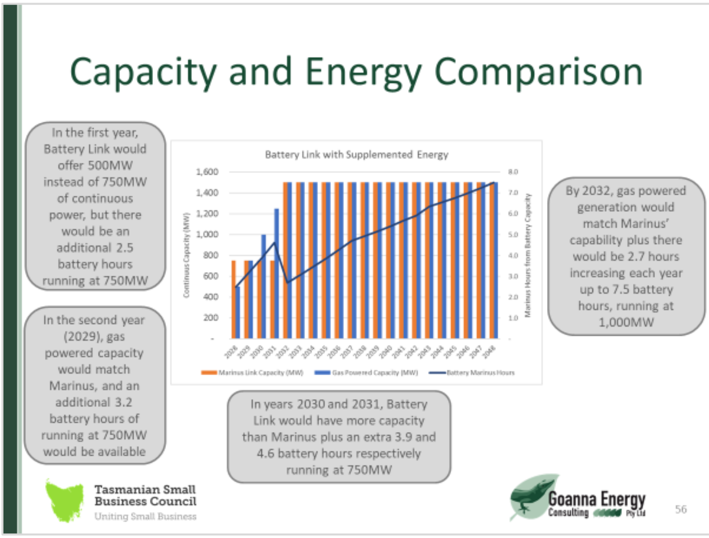
[14] Source: Hydro Tasmania, Battery of the Nation – Pumped Hydro Energy Storage Project, August 2019, p 18-23

[15] PADR, Table 4

[16] Source: ISP-2020, Build Costs by 2027-28 ($2019)

Figure 23: Capacity and Energy Comparison of Marinus Link and Battery Link



2.4.6 Consumer Benefits

The next stage of the analysis is to measure the consumer benefits of Battery Link.

Firstly, in the PADR evaluation undertaken, fuel switching benefits were identified, therefore for Battery Link these costs have been re-instated to ensure the additional operating costs of gas-powered units is reflected in the analysis. No account has been taken of the change in capital costs, which appears to be lower for Battery Link.

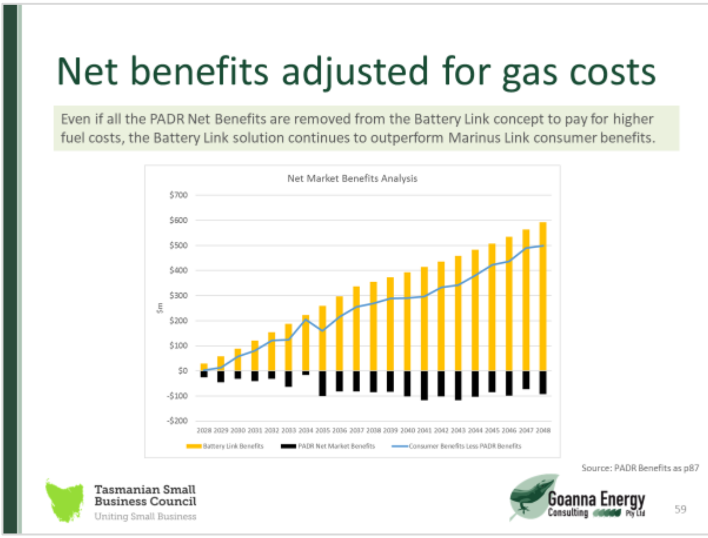
The next step was to consider consumers. The key benefit of accelerating behind-the-meter technologies is that consumers not only avoid the contestable energy costs (i.e. wholesale market costs), but also other charges such as variable network charges and pass-through environmental charges such as NEM-wide environmental costs of Large Generation Certificates (up to 2030), Small-scale Technology Certificate (up to 2030), market fees, ancillary services, and any other State based scheme.

Given contestable commodity costs represent about 45% of the total delivered cost, the cost saving arising from behind-the-meter can be more than double the market wholesale cost benefits. With Battery Link, the consumers with batteries funded via Battery Link will capture the benefits; whereas the fuel switching benefit identified in the PADR remains debatable in our view, in terms of whether or not these benefits would be passed through in full to consumers.

Given the greater consumer prize with behind-the-meter initiatives, the benefits of Battery Link far outstrip the estimated Market Benefits of Marinus Link. Figure 24 shows the estimated Battery Link Benefits.

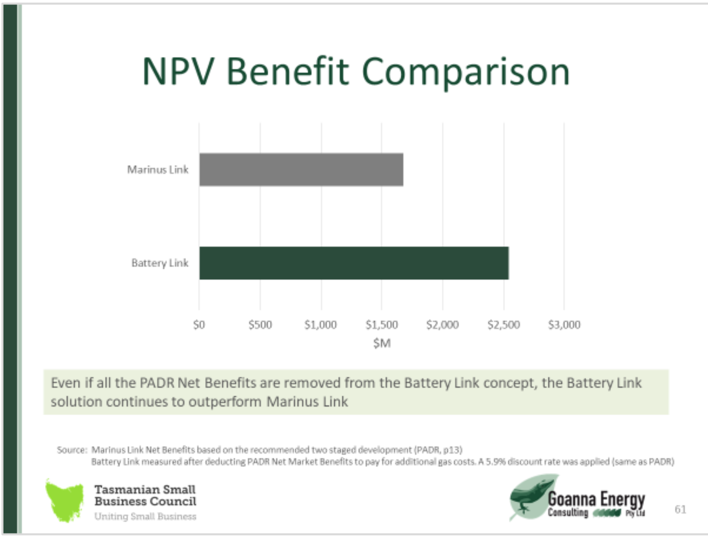
It is important to note that these consumer benefits do not include the capital contribution of consumers which was done to be consistent with the PADR methodology, where the cost of HydroTas to build Battery of the Nation was also excluded.

Figure 24: Estimated Battery Link Consumer Benefits



In comparison to the Net Present Value of the benefits of Marinus Link, Battery Link is estimated to deliver more than $2,500m[17] compared to Marinus Link of $1,674m[18].

Figure 25: Net Present Value Comparison between Marinus Link and Battery Link



Investment in Battery Link will have the ability to quickly adjust to prevailing conditions and access technology improvements progressively. Given such a strategy the risk-adjusted discount rate would be lower for Battery Link, which would accentuate the gap between the two options given that Marinus Link investment is a 'big bang' approach – very large investment, with substantial risks, but evaluated using the discount rate applicable to low risk, regulated assets. Low risk to investors because of the regulated status of the investment, high risk to consumers.

Using a risk-adjusted discount rate would amplify the benefits of Battery Link over the proposed Marinus Link.

[17] A discount rate of 5.9% was applied to be consistent with the PADR

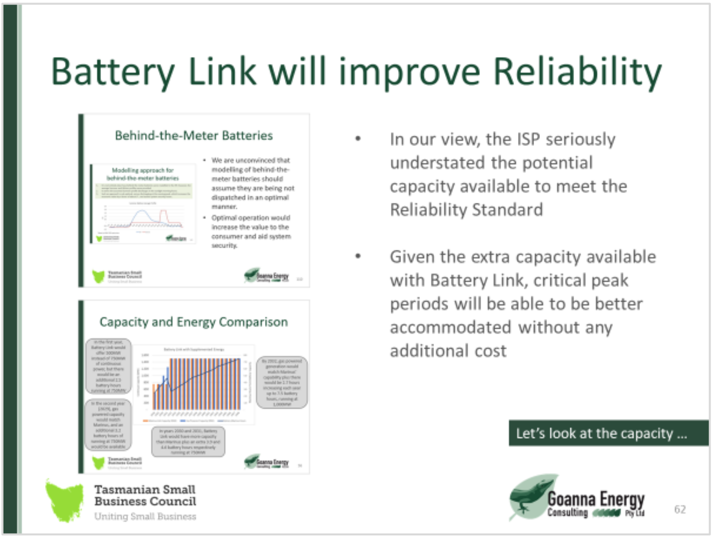
[18] Marinus Link benefits based on the recommended two-staged development (PADR, p13)

2.4.7 System Security Benefits of Battery Link

If the full 1,500MW of gas-powered generation was installed, then in terms of a matching of capacity capability, the Marinus Link and the Battery Link proposal would be equal, plus Battery Link would have the benefit of battery storage.

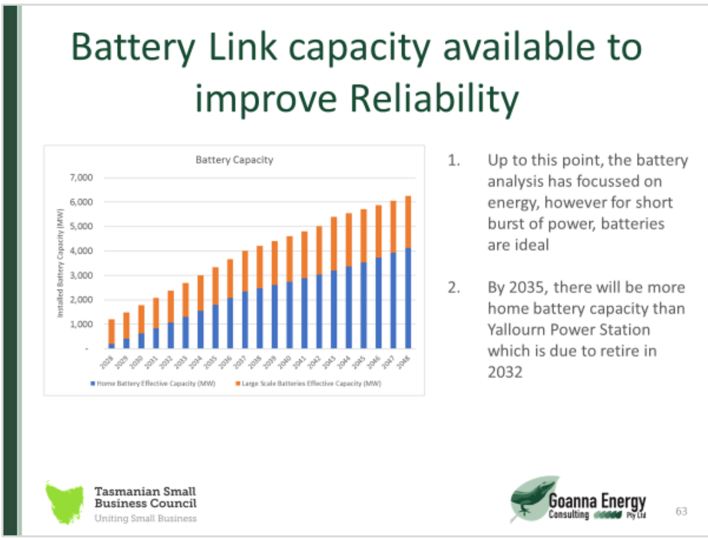
In our view, the ISP seriously understated the role that batteries can play to assist in managing system short-term stresses. This is further addressed in Section 5 - *Industry Assumptions*.

Figure 26: Battery Link Improving Reliability



Battery storage under Battery Link would continue to increase and be available for short-term needs. By 2035, Battery Link would have the same capacity as Yallourn Power Station for short periods of time (i.e. up to 2-hours).

Figure 27: Battery Link Capacity

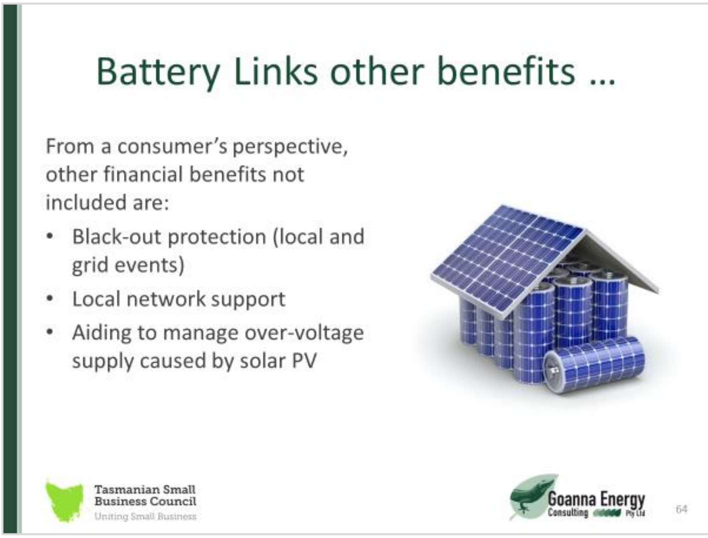


2.4.8 Other Benefits Offered by Battery Link

There are other benefits to Battery Link which have not been quantified in this analysis and these relate to:

a) Black-out protection from local and grid events which would likely require additional capital;
b) Local network support; and
c) Aiding the management of the growing over-voltage supply caused by solar PV.

Figure 28: Other Benefits of Battery Link



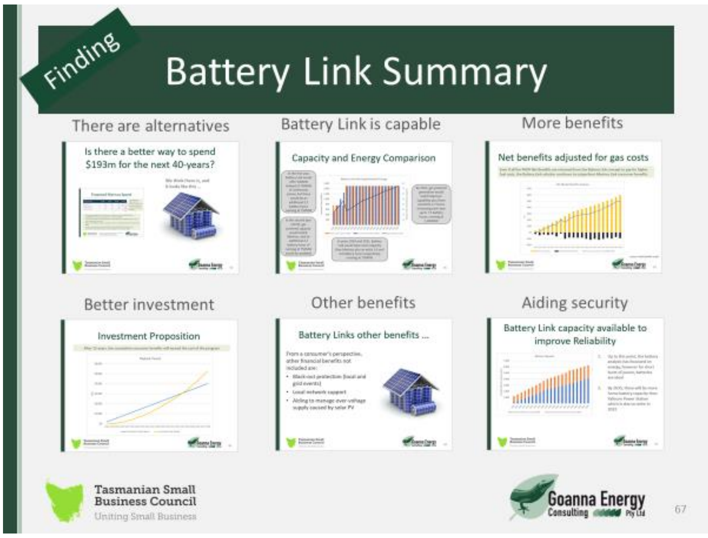
2.4.9 Battery Link Summary

We are of the view that a proposal like Battery Link will out-strip the consumer benefits of Marinus Link and deliver greater market benefits. In short Battery Link is a better Least Regret plan.

Figure 29: Battery Link is a Better Least Regret Plan

In summary, Battery Link is a serious concept worthy of further consideration.

Figure 30: Battery Link Summary



2.4.10 Battery Link Concept Complementary with AEMC, ESB, etc Messages

Outlined below are series of extracts taken over time sourced from the AEMC, ESB, etc. The general theme is the Battery Link concept is in alignment with these key messages.

Extracts from: Powering the grid of the future
by AEMC Chairman John Pierce
Published on 26 September 2019 in the Australian Financial Review

1. Australians are at the forefront of a technological revolution in energy – which has the potential to significantly improve our day to day lives and bring down power bills.
2. Households and businesses are now able to produce and store energy through rooftop solar and batteries.
3. At a high level, the Commission is recommending that the electricity network be fundamentally reoriented away from a one-way supply chain model to a platform for energy production, consumption, storage and trading.
4. Unfortunately, networks still largely charge for energy consumed and not necessarily the services consumers will now require.
5. But with the increased cost competitiveness of battery storage and the growth of electric vehicles, there is an opportunity to consider concepts of access pricing and cost-reflective or customer reward pricing
6. Conversely, if we don't make changes to the way networks operate, consumers will bear the cost of distributed energy resources being poorly integrated into the system.
7. Ultimately, the grid must transition in a way that meets the national energy objectives – the long-term interests of consumers.

Extract from: Developing strategies to guarantee power
AEMC Chairman John Pierce
Published on 14 November 2019 in The Australian
Our work on establishing a demand response framework for the future potentially puts us among the pioneers of a truly two-sided market — focused just as much on consumer choices and do-it-yourself generation as multi-billion dollar investments in supply infrastructure.

Extract from: ENERGY SECURITY BOARD POST 2025 MARKET DESIGN ISSUES PAPER September 2019, p16
The future level of demand, and the shape of demand, is unclear due to increasing penetration of distributed energy resources and energy efficiency, the potential for new sources of demand such as electric vehicles, the prospect of more active demand participation and uncertainty about the future requirements of large commercial and industrial customers.

Extracts from: DISTRIBUTED ENERGY INTEGRATION PROGRAM OVERVIEW / DEIP AT A GLANCE, February 2019

(Note - The Distributed Energy Integration Program (DEIP) is a collaboration of government agencies, market authorities, industry and consumer associations (AEMO, AER, ENA, ECA *etc.) aimed at maximising the value of DER for all energy users.*

1. The growth of customer-owned energy technology such as rooftop solar, batteries, demand response and electric vehicles (collectively referred to as distributed energy resources or DER) has the potential to support a reliable, affordable and lower emissions electricity grid.
2. DER could supply almost half of Australia's electricity by 2050.
3. The *Independent Review into the Future Security of the National Electricity Market, June 2017,* identified that making best use of DER could avoid significant future infrastructure expenditure, reduce electricity costs for all customers, while also enabling a transition to a decarbonised electricity system.

Extracts from: *Future energy storage trends - An assessment of the economic viability, potential uptake and impacts of electrical energy storage on the NEM 2015–2035* Report prepared for the Australian Energy Market Commission, CSIRO, September 2015.

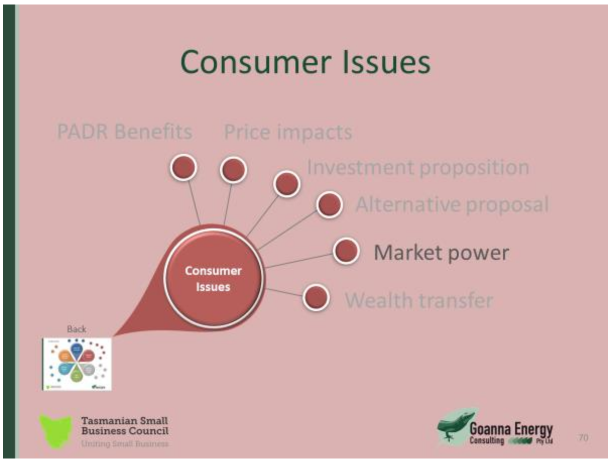
Key finding 6: Energy storage in the NEM could compete against gas in 20 years.

Key finding 8: We should expect significant adoption of stationary and vehicle battery storage by 2035

2.5 MARKET POWER

The fourth Consumer Issue to be addressed is Market Power.

Figure 31: Consumer Issues - Market Power



In theory, an interconnector like Marinus Link would increase competition in Victoria (and Tasmania), and therefore should increase competition and deliver consumer benefits. However, the NEM is not a perfect market due to significant consolidation of market players, high entry barriers and the strategic positioning of particular market participants.

Consumers are concerned that with the development of large inter-connectors with supporting pump storage, market power will be further concentrated to specific participants with dispatchable generation capabilities.

Currently, Snowy Hydro and HydroTas are already key Price Setters with pump storage facilities that will endeavour to secure price benefits from low renewable generation to complete storage levels, then dispatch when returns can be maximised in the NEM. Such a strategy creates a wealth transfer for consumers which is discussed further in Section 2.6 - *Wealth Transfer*.

2.5.1 Snowy Hydro

Snowy Hydro's current portfolio consists of 16 power stations, generating 4,500 gigawatt hours (GWh) on average per annum, with more than 5,500 megawatts (MW) of multi-fuel generation capacity across New South Wales, Victoria, and South Australia.

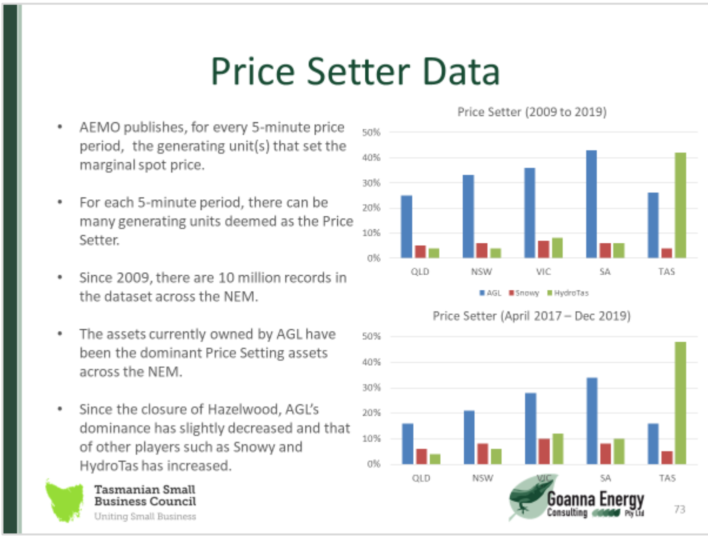
In addition, Snowy 2.0 will add 2,000 megawatts of energy generation and provide 175 hours of storage for the National Electricity Market (NEM).

Project EnergyConnect is the proposed link between SA and NSW; the connection point being at Wagga Wagga, NSW close to Snowy Hydro generating resources. This will effectively place Snowy 2.0 as a "hub" in the NEM, being able to readily affect price outcomes in NSW, Victoria, and SA.

2.5.2 Price Setting Behaviour

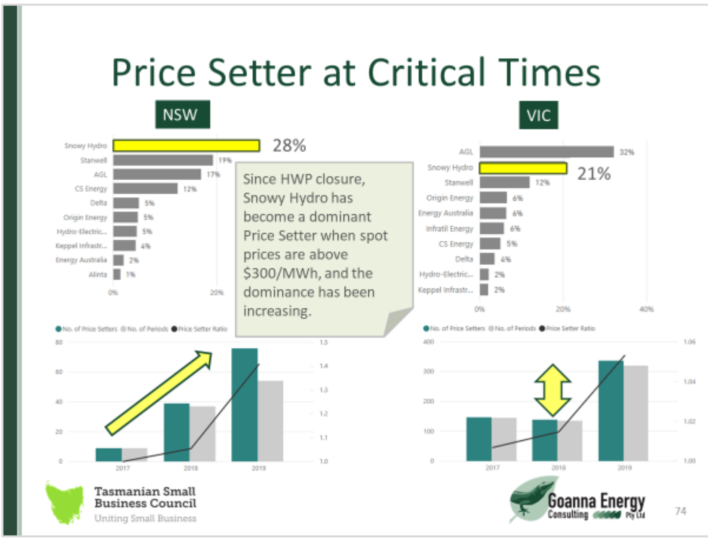
AEMO publishes, for every 5-minute price period, the generating unit(s) that set the marginal spot price, and for each 5-minute period there can be many generating units deemed as the Price Setter. Since 2009 there are 10 million records in the dataset across the NEM, with the assets owned by AGL being the dominant Price Setting assets across the NEM. However, since the closure of Hazelwood (HWP), AGL's dominance has slightly decreased and that of other players such as Snowy and HydroTas has increased.

Figure 32: Price Setter Data



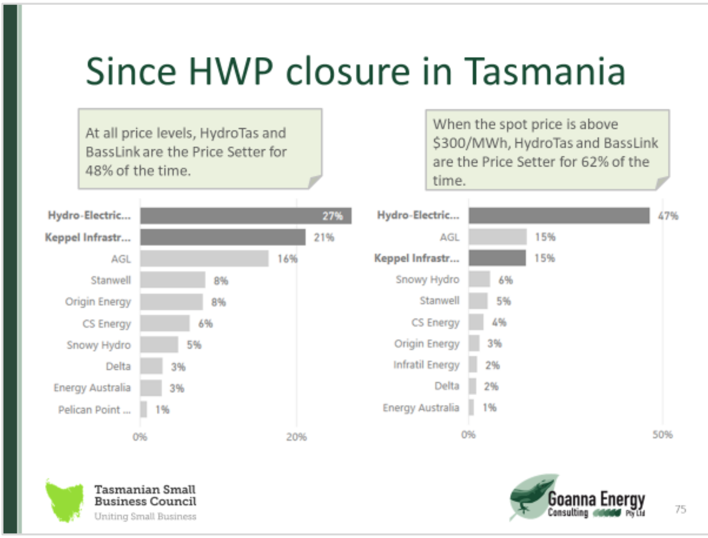
Looking at Price Setting at critical times since Hazelwood Power Station closure, Snowy Hydro has become a dominant Price Setter when spot prices are above $300/MWh, and this dominance as a Price Setter has been increasing.

Figure 33: Price Setter at Critical times in NSW and Vic



Extending the analysis into Tasmania, looking at prices set since Hazelwood Power Station's closure, HydroTas and BassLink set prices 48% of the time, and 62% of the time when spot prices were above $300/MWh.

Figure 34: Price Setting in Tasmania

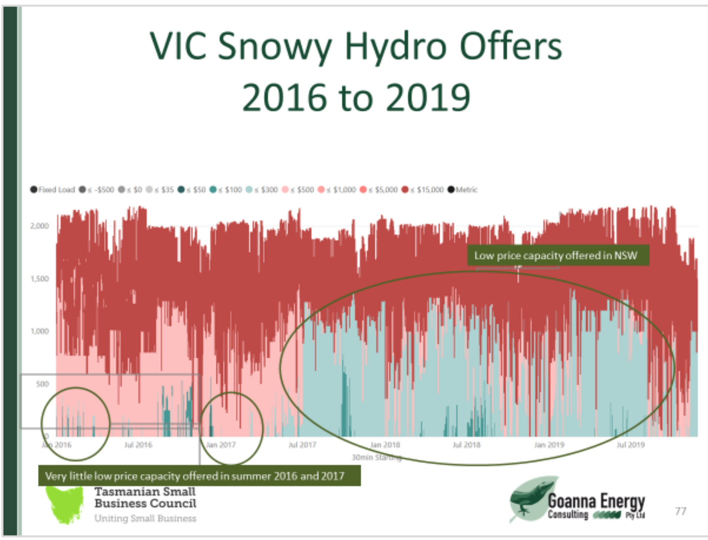


2.5.3 Commercial Pressures and Market Power

It comes as no surprise that both Snowy Hydro and HydroTas act in commercial manner to maximise their shareholder value. Therefore, when these parties make offers to the market, these offers will vary dependent on the constraints on the business, and on commercial objectives. Further, while the commercial strategies appear to change over time, these offers highlight that their objective is not to minimise the spot price.

Figure 35 to Figure 37 shows the SnowyHydro and HydroTas offers to the market and it can be noted that their strategies continually change as they endeavour to maximise shareholder value and work with the hydrological constraints on their businesses.

Figure 35: Victorian Snowy Offers 2016-2019



Each colour of the charts represents a price band, where the red palette colours mark higher prices, while the green palette colours represent lower price bands. As noted in Figure 36 below, the circled area marks a time where the green shaded colours are absent which means very little low price capacity was offered for many months.

Figure 36: NSW Snowy Offers 2016-2019

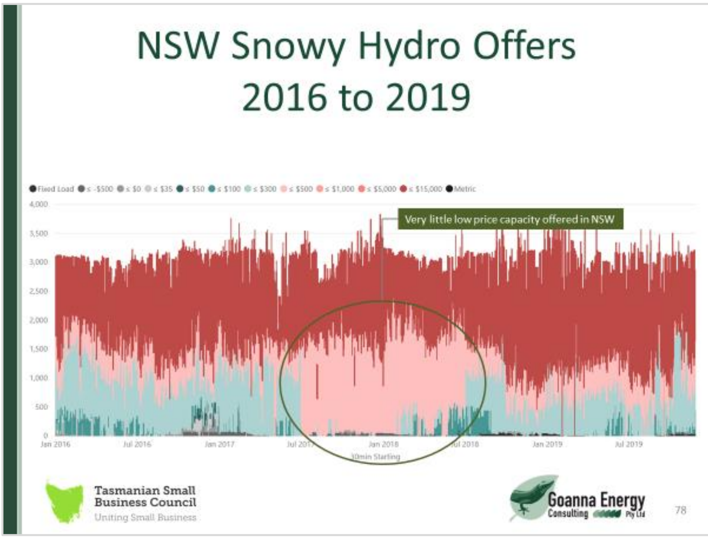


Figure 37: HydroTas Offers 2016-2019

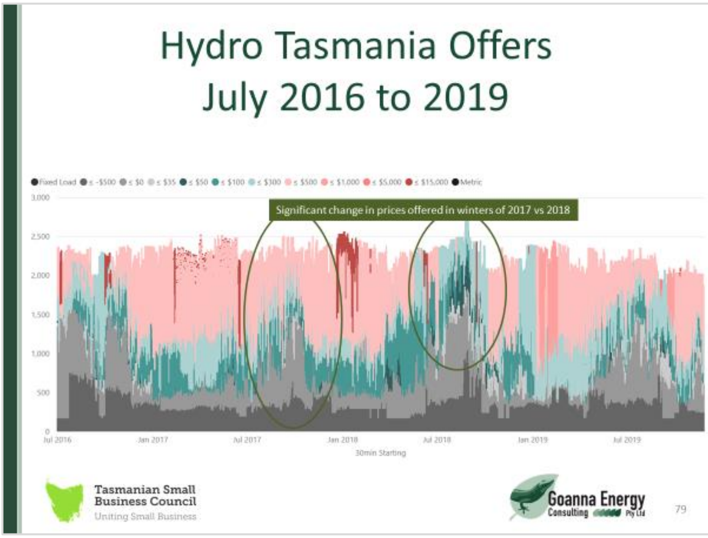
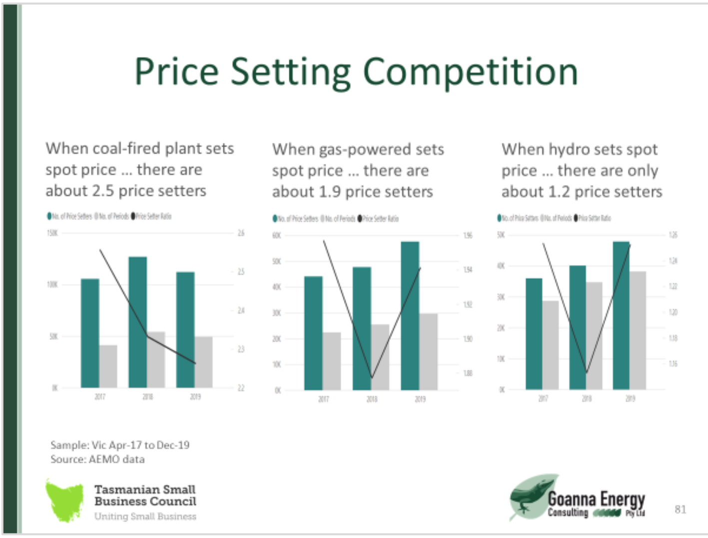


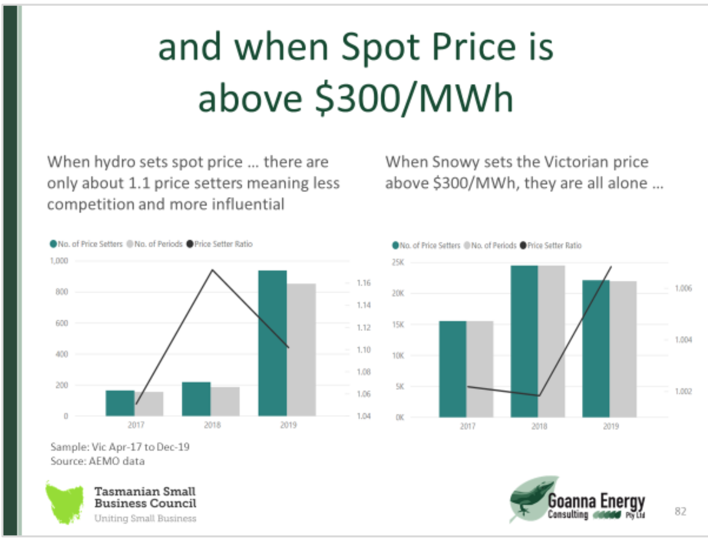
Figure 38 shows the number of Price Setters (given there can be simultaneously many), by fuel type. The results show that for coal-fired plant, the number of Price Setters is about 2.5, for gas-powered generation there are about 1.9 and for Hydro there are only about 1.2. This demonstrates that when Hydro sets the spot price, there are less offers at the same price point compared to other technologies.

Figure 38: Price Setting Competition by Fuel Type



Looking further at prices only above $300/MWh, there are less Price Setters than when either SnowyHydro or HydroTas sets the price. A Price Setter ratio of 1.1 existed when hydro technology set the price above $300/MWh, and when SnowyHydro set the price in Victoria above $300/MWh, the Price Setting ratio was 1.0 proving they have been extremely influential.

Figure 39: Price Setting Above $300/MWh for SnowyHydro and HydroTas



2.5.4 Market Power Findings

There is a concern on behalf of consumers that these interconnectors will not necessarily lead to greater competition and the market influence of SnowyHydro and HydroTas is likely to increase with the addition of significant pump storage facilities. Consequently, the Market Benefits assumptions underpinning the PADR, being that these fuel switching benefits will be reflected in lower spot market prices and therefore lower consumer costs, is questionable.

These organisations have an obligation to maximise shareholder value and they will operate in a manner that achieves that goal, and as evident from their historical behaviour, their strategies change over time in order to achieve that goal.

In contrast, Battery Link will distribute the application of the battery assets to many decision makers which in effect increases competition, as users could be competing against each other. The supply-side of the market would then be competing against the traditional demand-side of the market. Consequently, in our view Battery Link will create more competition.

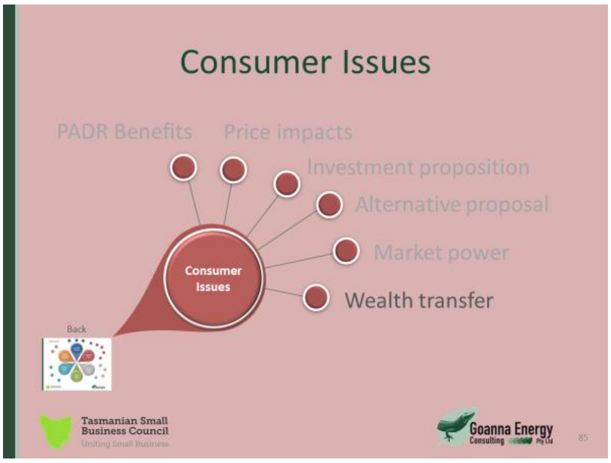
Even if the Battery Link control rights are sold to a Retailer (or aggregator), there are more competing Retailers in the market than there are participant generators.

Figure 40: Market Power Findings

2.6 Wealth Transfer

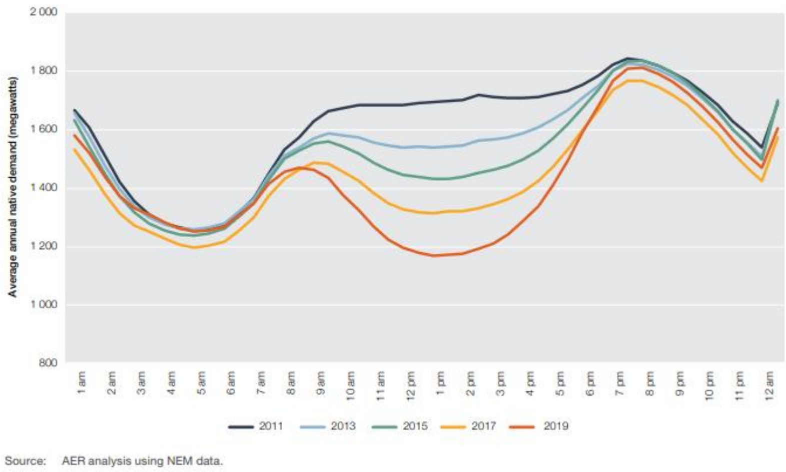
The final Consumer Issue is to deal with Wealth Transfer.

Figure 41: Consumer Issues - Wealth Transfer



Given the continual growth of solar PV and the many more applications of the technology, daytime prices are likely to continue the trend of being suppressed. As shown by the AER for South Australia[19], average annual native demand has been significantly impacted by solar PV.

Figure 42: Average Annual Native Demand – SA (2011-2019)



Such a dynamic of suppressing daytime spot prices will create an opportunity where:

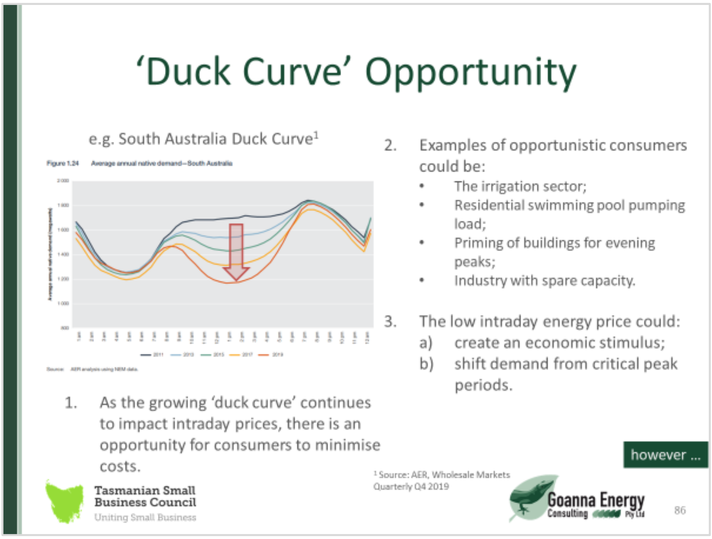
1. For some consumers, low spot daytime prices will create an opportunity to reduce cost, assuming an appropriate Price Signal is established by a retail tariff (see Section 2.2.2 - *Price Signals* for further discussion).

2. Examples of consumer groups able to benefit are:
   a. Irrigation sector;
   b. Residential pool pumping; and
   c. Industry with spare capacity.

[19] AER, Wholesale Markets Quarterly Report, Q4 2019

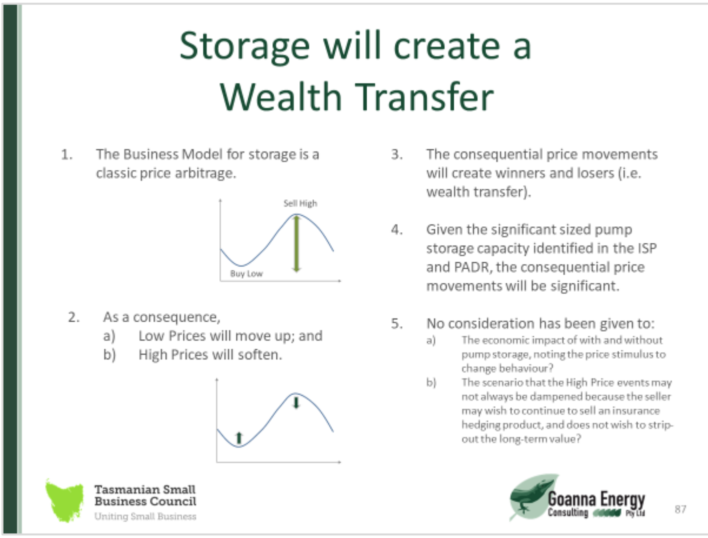
3. Consequently, low daytime prices could create an economic stimulus and encourage demand shifting.

Figure 43: Duck Curve Opportunity



In contrast the storage market based on pump-storage will create a wealth transfer as shown in Figure 44.

Figure 44: Storage will Create a Wealth Transfer



The PADR does not seem to address the economic impact on consumers of having or not having pump storage given the likely elevation of daytime prices caused by pumping, in return for possible suppressed evening peak prices.

As discussed in Section 2.5 - *Market Power*, it is not always in the commercial interests of peaking plant such as hydro generation to always cap extreme or high price events. If they do so, then the buyers will rely upon such behaviour and therefore not pay for the hedging risk management product. The sellers of these products need to ensure there remains uncertainty of when, how many and how extreme such events will occur, which maintains the demand for these risk management products.

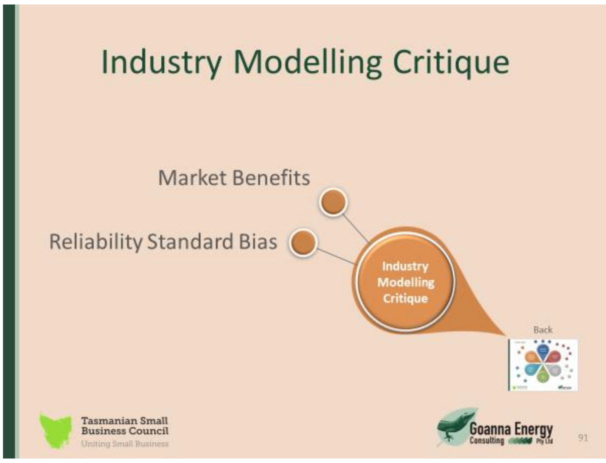
Our finding with Wealth Transfer is that the ISP and PADR have not considered the wider economic impacts that large scale pump storage will have on consumers and consider that high price events may not be averted.

Figure 45: Wealth Transfer

3 Industry Modelling Critique

The next section of our report critiques the modelling approach of the PADR and related ISP 2020. In doing so, the focus is limited to the Market Benefits developed in the PADR and the Reliability Standard Bias.

Figure 46: Industry Modelling Critique

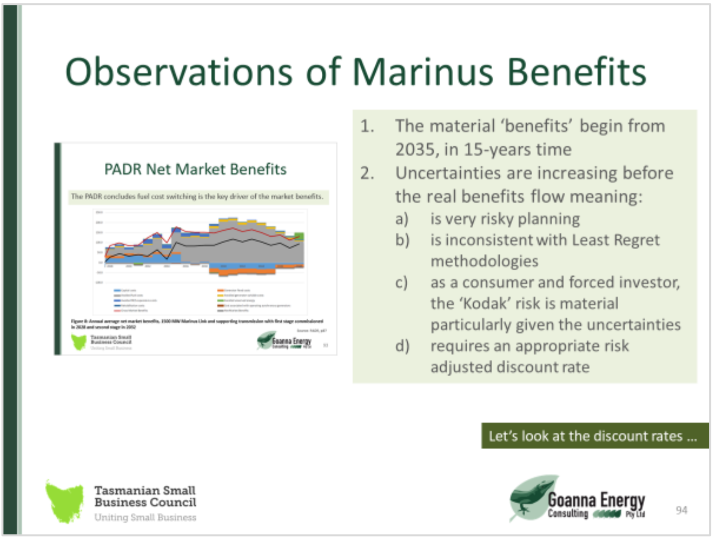


3.1 Market Benefits

The PADR Market Benefits financial assessment has been discussed in section 2.1 - *PADR Benefits Analysis*, and this section looks at the pricing aspects of the benefits.

As shown in Figure 47 below, the observations of the PADR Market Benefits are that the material benefits begin from 2035, and therefore this is very risky planning given the long lead time. It is also inconsistent with the Least Regret methodology; holds significant "Kodak Risk" for consumers and uses a discount rate which has not been risk adjusted.

Figure 47: Observation of PADR Market Benefits

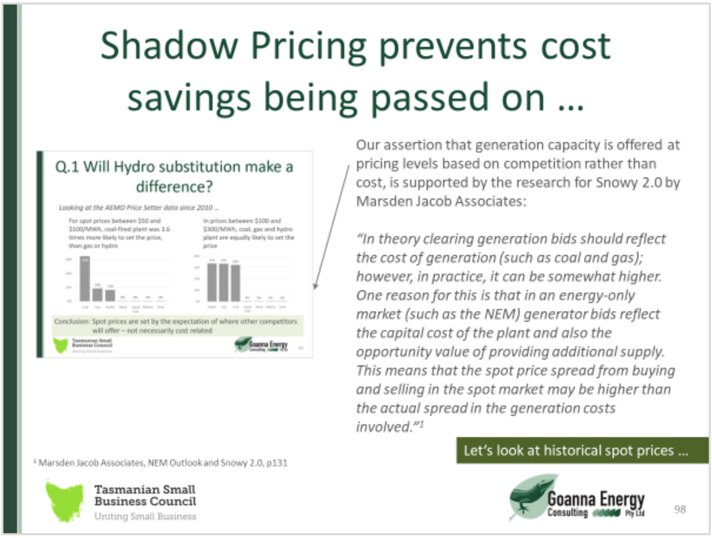


We are also not convinced that the benefits will be passed onto consumers as discussed in Section 2.5 - *Market Power*.

Furthermore, it is important to recall that the PADR Market Benefits are driven by fuel switching costs from gas to hydro. Unlike gas prices which has a much more transparent and clear alternative market opportunity, the value of water is a much more nebulous factor. Consequently, to assume the assumed water value becomes the marginal price and will set the price outcomes, therefore flowing through the benefits to consumers, is considered a highly risky assumption.

It is also clear that the market operates under a perception of cost levels and gas pricing is a critical factor. Hydro generation and other technologies usually offer their marginal capacity at a level which they believe the gas market will offer. Therefore, it is not a matter of the value of water, but rather what the competitive gas marketplace will do, and what the market will bear to maximise commercial value. Such an approach is endorsed by Marsden Jacob Associates in the modelling of Snowy 2.0 as shown below:

Figure 48: Shadow Pricing



Looking at history, the conventional wisdom was the cost of generation was about $40/MWh in real terms in 1995 for Victoria and New South Wales and therefore over the long run the spot price outcomes will deliver a similar result. As shown in Figure 49 , the actual price outcomes has never delivered the assumed cost level, and there have been 4 years in the 26 year period when prices were above the long-term average, and 22 years below.

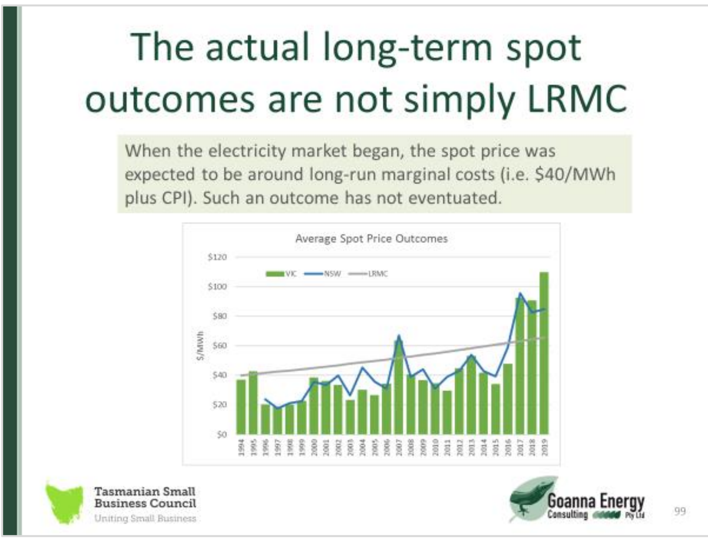
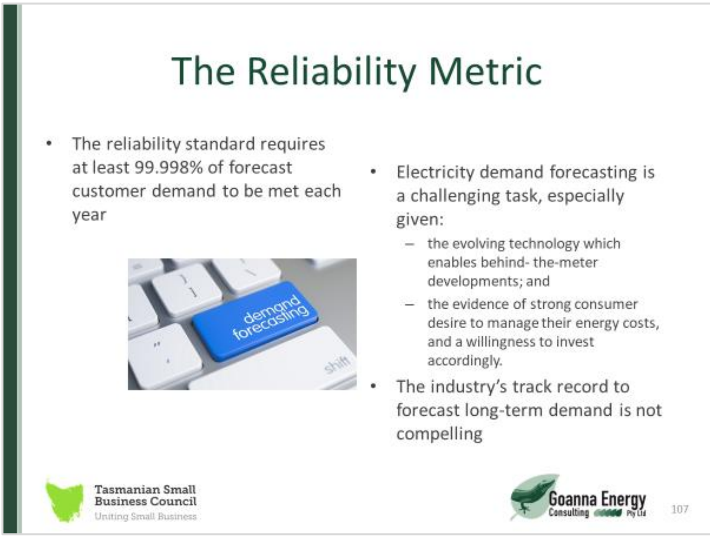


Figure 49: Historical Track Record of Cost Based Outcomes

3.2 Reliability Standard

The reliability metric is finely tuned and therefore key assumptions and modelling is critical under these tests. The first component of the task requires forecasting demand and, as outlined in Figure 50, there are challenges with demand forecasting which are further discussed in Section 4 - *Industry Methodology*.

Figure 50: Reliability Metric



When critiquing the modelling of the Reliability Standard, there are four (4) key concern areas and these relate to:

1. Large scale user withdrawals;
2. Behind-the-meter batteries;
3. Electric Motor Vehicles; and
4. Large Scale batteries.

These issues are discussed further in Section 5 - *Industry Assumptions* of this report, and are summarised here in Figure 51 though to Figure 54.

Figure 51: Demand Forecast Modelling

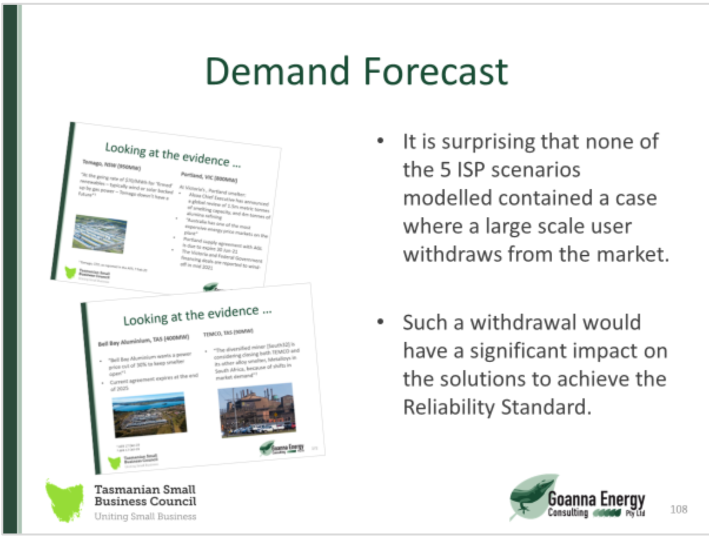


Figure 52: Behind-the-Meter Batteries Modelling

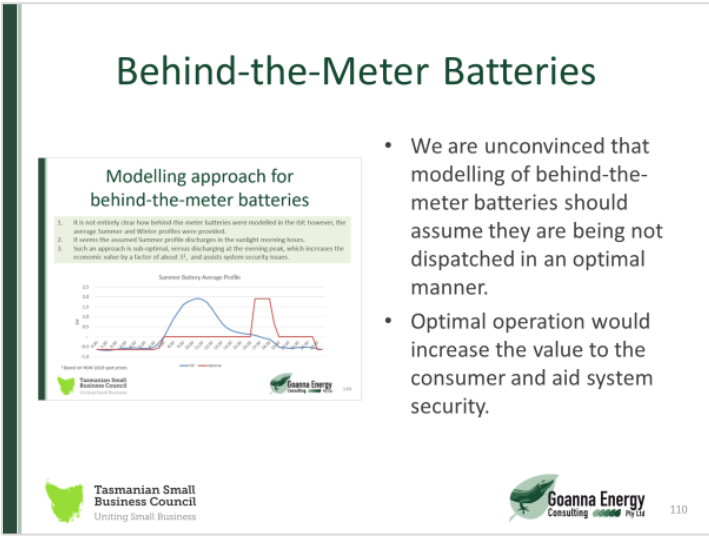


Figure 53: Charging of Electric Motor Vehicles Modelling

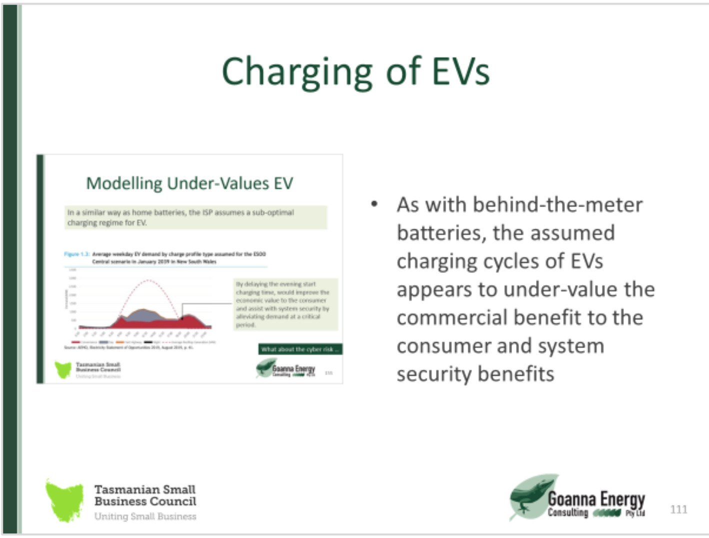
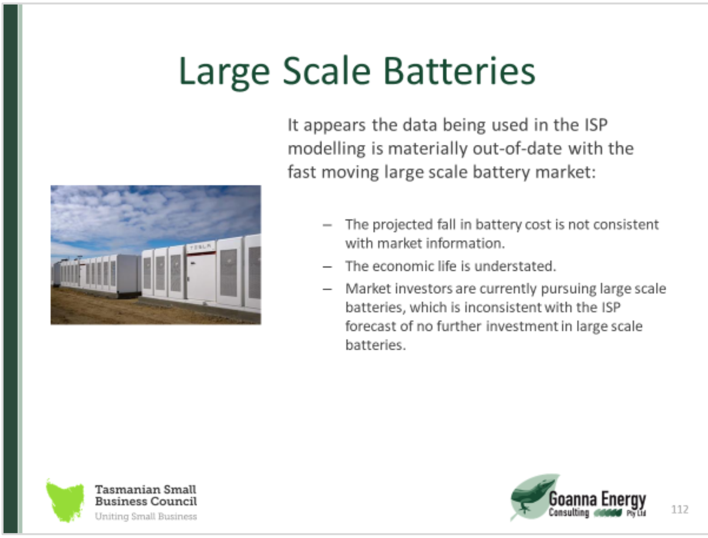


Figure 54: Large Scale Battery Modelling



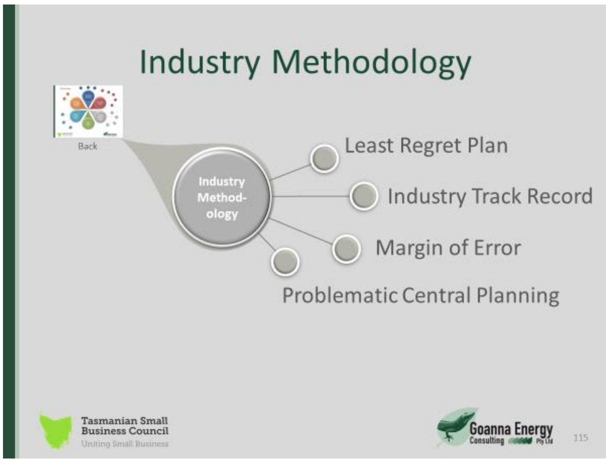
In summary, we are concerned the assumptions driving the Reliability Standard metric are problematic and need addressing.

Figure 55: Reliability Standard Findings

4 Industry Methodology

This section of the report focusses on the Industry Methodology by addressing four (4) elements:

Figure 56: Industry Modelling



4.1 Least Regret Plan

Our first conclusion is that whilst the theory of choosing a Least Regret plan is well explained in the ISP, it does not appear to be practised in the ISP 2020.

Figure 57: Least Regret Plan

What is unclear is how the Least Regret plan has been selected in terms of selection criteria, weightings, metrics and scoring.

Figure 58: Strategy of Least Regret Criteria and Evaluation Methodology

There are well documented principles for investing in uncertain times as demonstrated by the Harvard Business School. When the Australian environment is tested against these scenarios, it is difficult to envisage how 40-year investments are deemed to be the best Least Regret option.

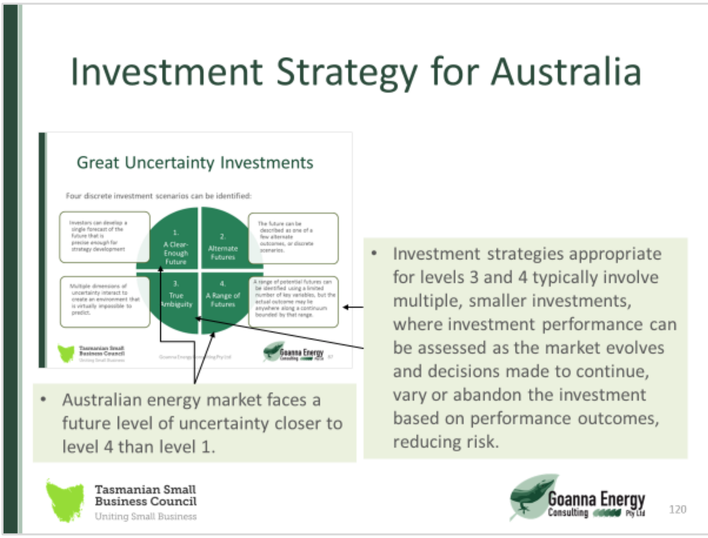


Figure 59: Investment Strategy for Australia

When the investment of initiatives like Battery Link are measured against the principles of investment at times of high uncertainty, in our view, Battery Link performs better than large interconnector investments such as Marinus Link.

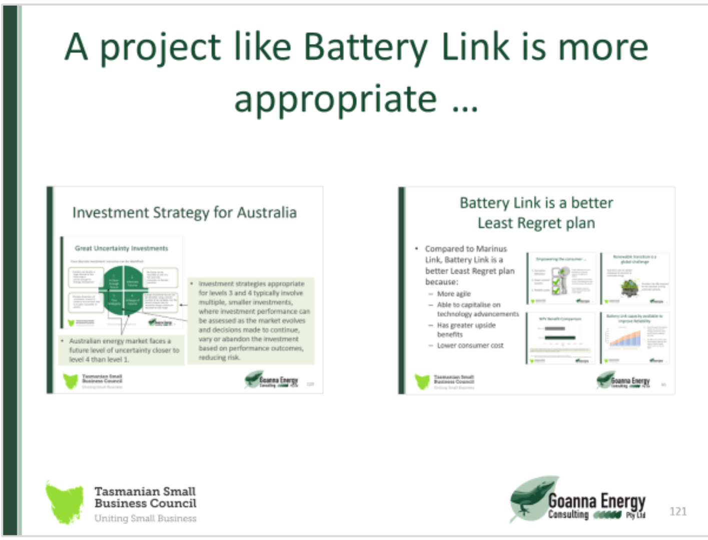


Figure 60: Battery Link meets the Criteria of Least Regret

4.2 Industry Track Record

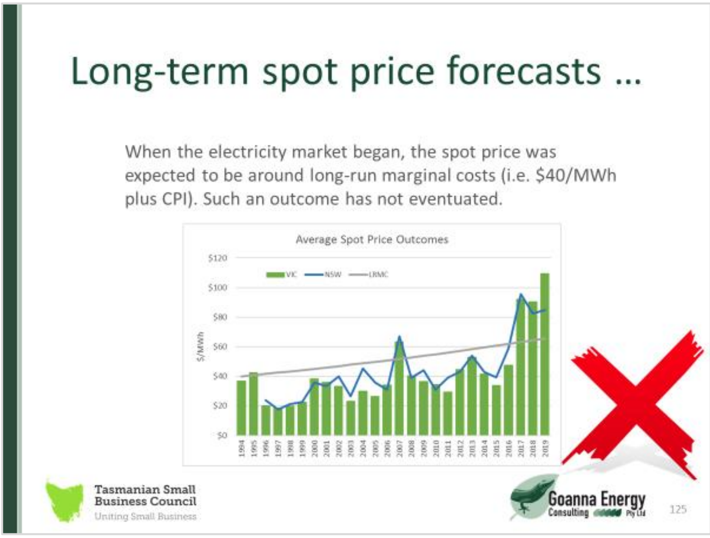
Long-term modelling is a difficult task and has become more difficult at a time of heightened uncertainty driven by economic circumstances, consumer behaviours, industry viability and technology advancements.

Looking at the track record of the industry to predict the future, it is not a compelling success story. Examples provided relate to:

1. Long term price forecasts dating back to 1995;
2. Wholesale forward hedging market;
3. Central Planners forecasting capacity;
4. Industry expectation of the transition path to renewables;
5. Demand and Supply forecasting 1998-2017;
6. Roof-top solar forecasting; and
7. ISP assumption changes from 2018 to 2019.

When the market commenced the expected cost was about $40/MWh, escalating at CPI, but the Victorian and NSW markets have delivered far different results over the 26 year period.

Figure 61: Long-term Vic and NSW Price Forecasting



SavvyPlus Consulting uses this measure, called Traders Error, which measures the difference between the forward hedging market traded price and the actual spot price.

The errors are constructed as box-and-whisker plot measured daily as the forward market price changes daily for a future year.

Looking at NSW for example, the error margins have been material, which demonstrates that the wholesale forward market is a poor predictor of actual spot prices.

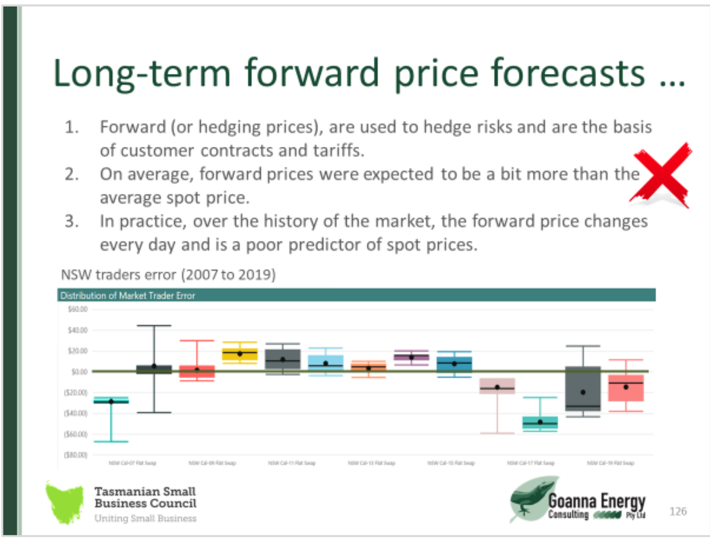


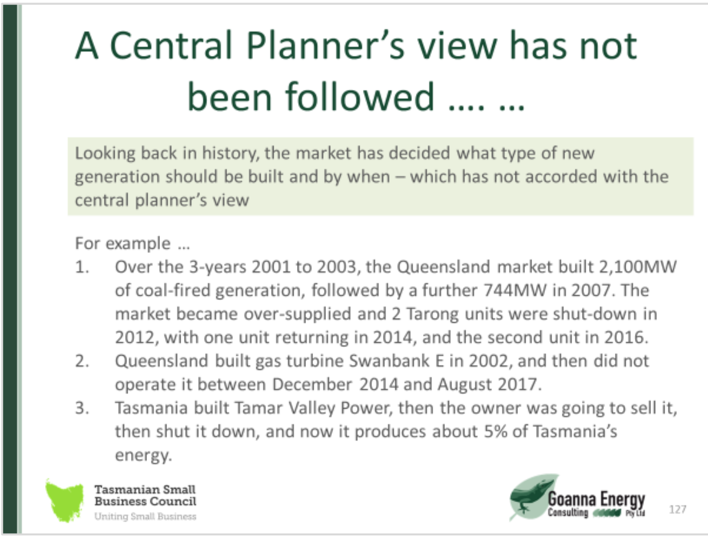
Figure 62: NSW Forward Market Errors

The market decides what technology to introduce and when, not a central planner.

The following are examples where the industry has proceeded down a path not predicted by a Central Planner.

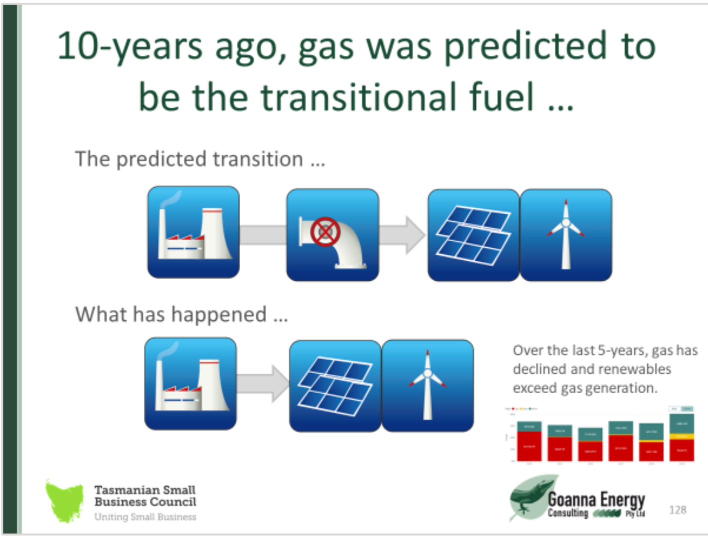
A more recent example is the pursuing of large-scale batteries by AGL and Origin Energy despite the ISP not forecasting any new large-scale batteries. This is further examined in Section 5 - *Industry Assumptions* in this report.

Figure 63: Disconnect between Central Planning and Market Delivery



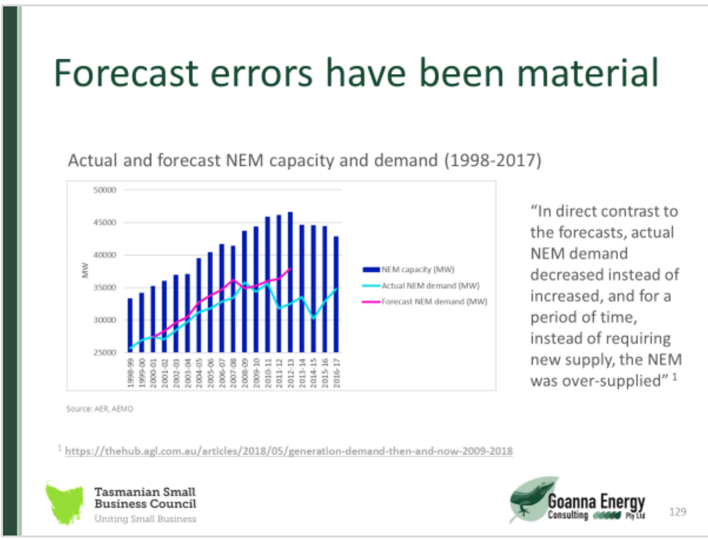
Some 10-years ago, it was expected the transition from fossil fuel to renewables would be via gas technologies. However, the market has decided otherwise, and gas appears to have been over-stepped as a transitional fuel

Figure 64: Predicted Transition Path to Renewables



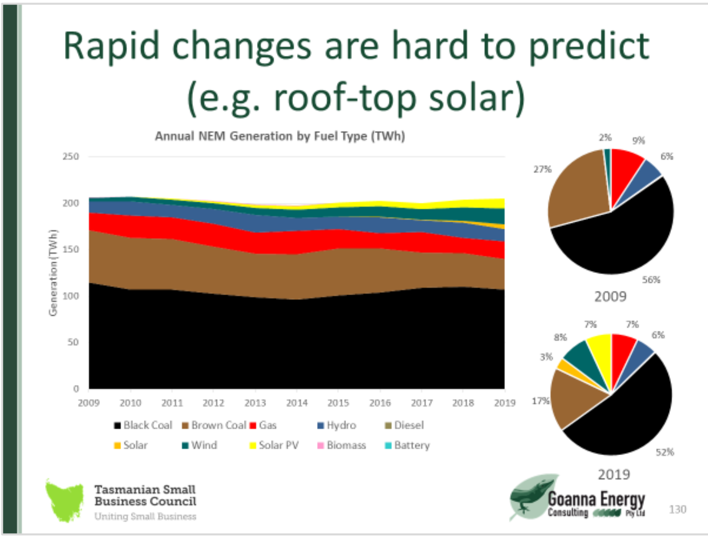
In previous forecasts prepared by AEMO, instead of a shortage of supply as predicted, the market had a surplus.

Figure 65: Demand and Supply Forecasting 1998-2017



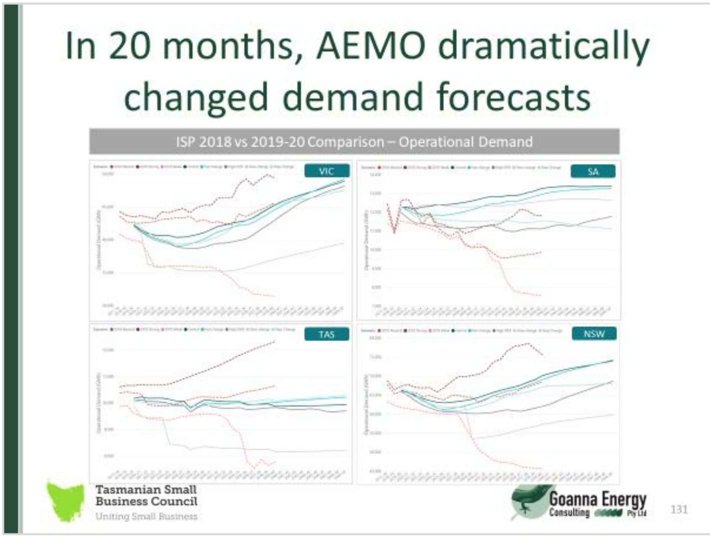
The industry did not predict the almost insatiable appetite of Australian consumers to invest in solar PV.

Figure 66: The Challenge of Forecasting Roof-Top Solar



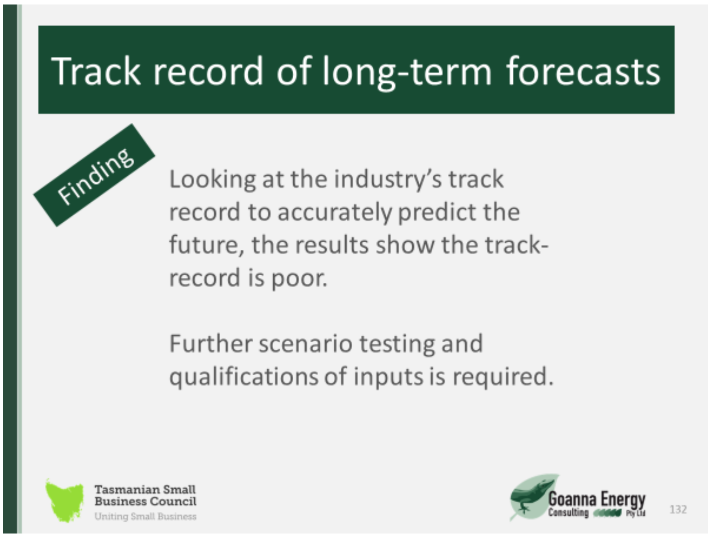
In a relatively short period of time, key assumptions under-pinning the ISP 2018 report were dramatically changed in the draft ISP 2020 version.

Figure 67: ISP Forecast Changes



Our conclusion is that the industry has a poor track record to predict the future, which therefore re-enforces the strategy of smaller and more nimble investment paths as a more appropriate path to follow.

Figure 68: Track Record of Long-Term Forecasts



4.3 Margin of Error

The next stage of the review of the Industry Methodology was to remind ourselves of the margin of error inherent in the task of forecasting benefits, costs, demand and technology developments.

Looking at the work undertaken by Marsden Jacob and Associates[20] in predicting the impact of Snowy 2.0 there are two key findings:

1. Jacobs only considered it appropriate to forecast the first 10-years, due to high level of uncertainty
2. The impact of Snowy 2.0 on prices, was deemed to be small

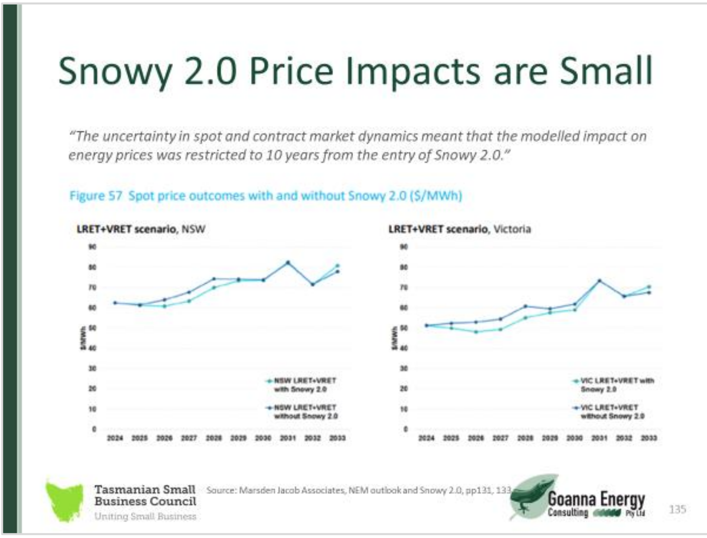


Figure 69: Snowy 2.0 Price Impacts

A 10-year Victorian probabilistic spot forecast prepared by SavvyPlus Consulting has been compared to the forecast prepared by Jacobs listed above, expressed in nominal terms.

The comparison shows that whilst there are differences in the average price outcome for each year, the SavvyPlus' probabilistic view shows the inherent volatility of the potential outcomes.

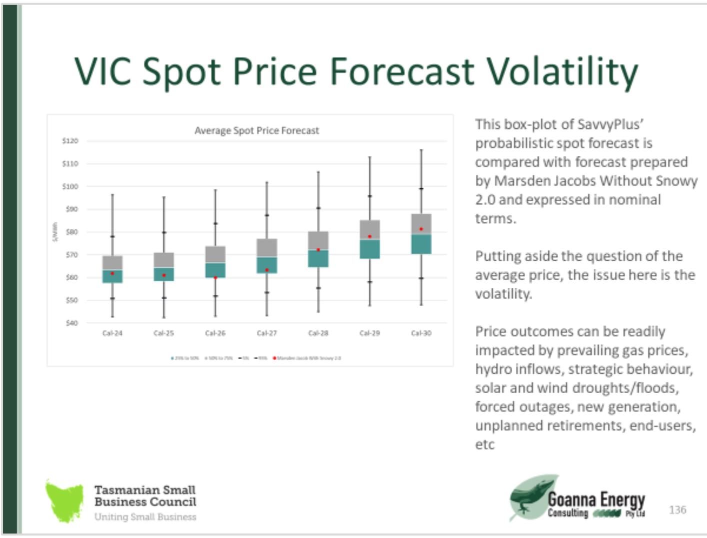


Figure 70: Comparison of Vic Spot Forecasts

Looking at the PADR price impacts under-pinning the Market Benefits, and remembering the benefits are weighted to the second decade and not the first, the price impacts are relatively small.

The margin of error of these estimates is considered far beyond the price impacts, particularly in the second decade.

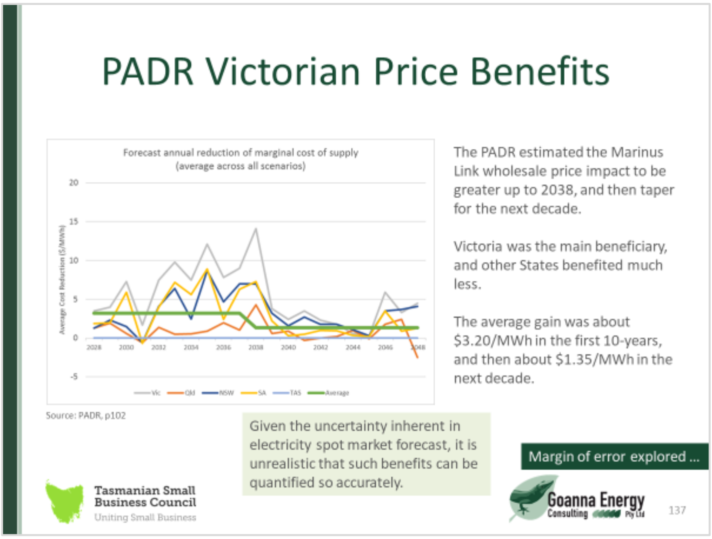


Figure 71: PADR Victorian Price Benefits

[20] Marsden Jacob and Associates, NEM outlook and Snowy 2.0, pp131, 133

The margin of error was then assessed by comparing the pre-dispatch spot price for each half hour and then comparing the spot price to the actual spot price for the same half hour. This analysis was undertaken for all regions from 2017.

The results show the errors are material (e.g. average Vic absolute error was about $20/MWh and for Tas was about $27/MWh), and are represented as a box-and-whisker plot.

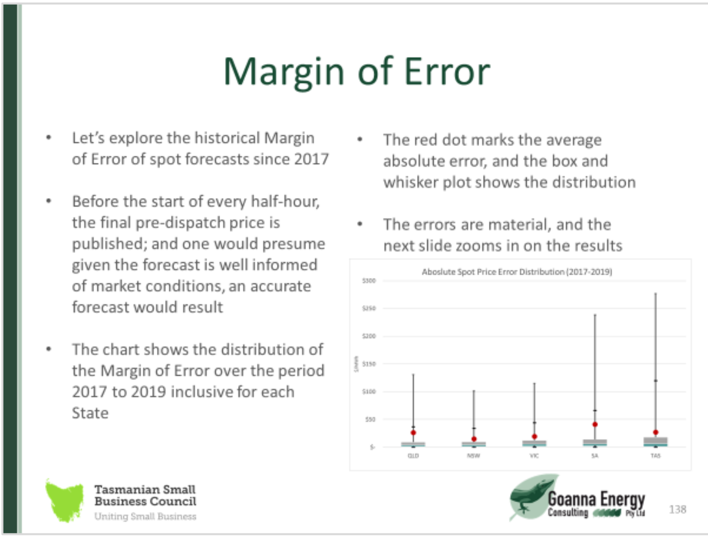


Figure 72: Margin of Error of Pre-dispatch Prices - all regions since 2017

By zooming into the errors less than $50/MWh, the margin of errors when estimating the next half-hour far exceed the benefits modelled in the PADR in 10- or 20-years' time. The reality is such modelling has a high margin of error, which heightens the risk for consumers who are expected to pay for these investments.

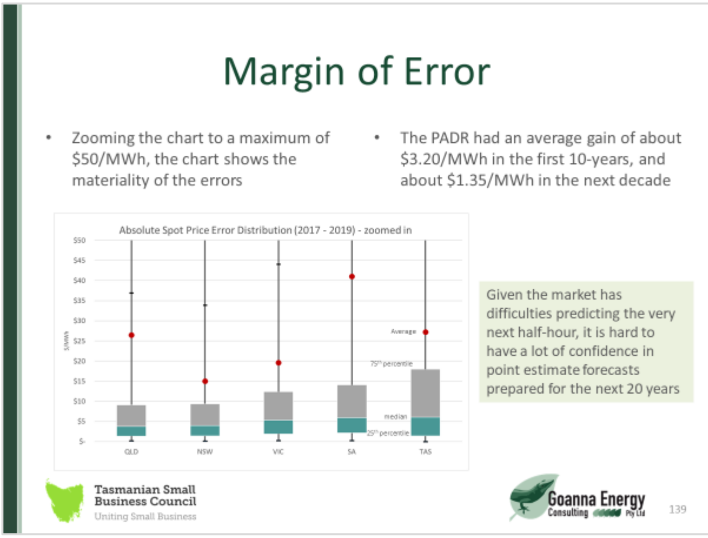
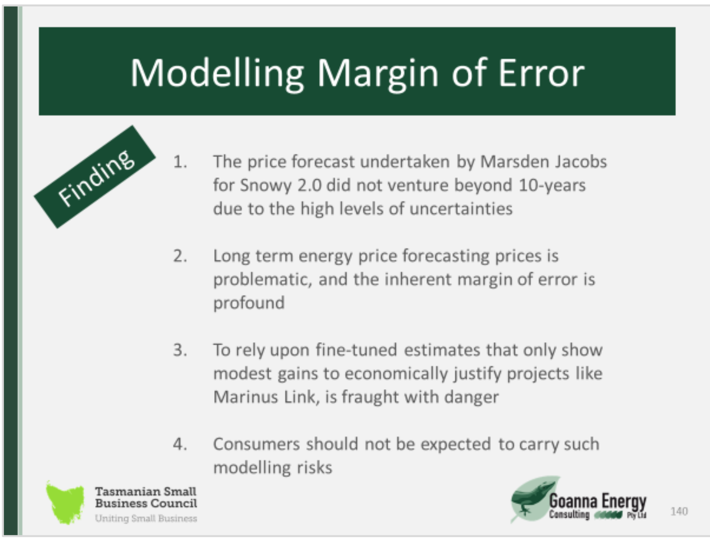


Figure 73: Margin of Error of Pre-dispatch Prices - all regions since 2017 zoomed

Our conclusion is that the Margin of Error of the PADR modelling is inherently high, which makes the reliance on the findings problematic; leading to the need for a better risk adjusted approach.

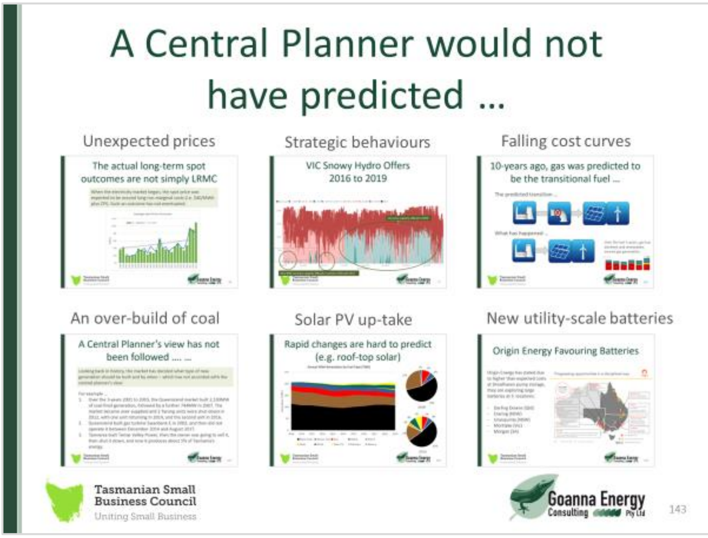


4.4 Problematic Central Planning

The task of central planning is difficult because of all the uncertainties and the evidence has been that individual market participants react and behave differently than a central planner assumes. The PADR and ISP are both exposed to this dynamic.

Looking at the evidence, central planning does not have a good track record.

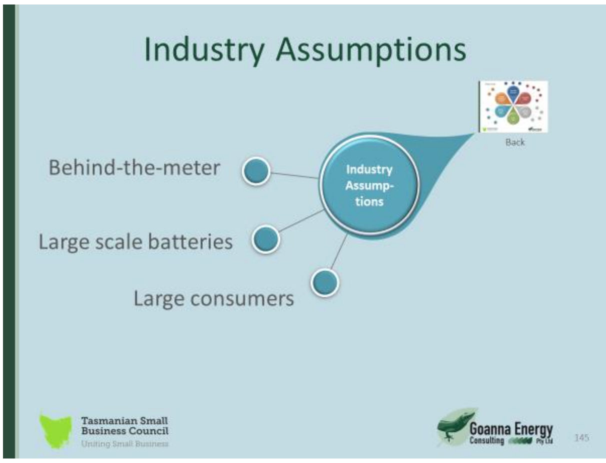
Figure 74: Central Planner Track Record



5 Industry Assumptions

The final stage of this report is to review some of the key assumptions adopted in the ISP and flowed through to the PADR.

Figure 75: Industry Assumptions



5.1 Behind-the-Meter

The modelling for behind-the-meter capability appears not to maximise the benefit to the consumer, or to the industry in increasing security of supply. As a result, the conclusions reached for the Least Regret plan are questionable.

Further, we submit that the behind-the-meter capability, including batteries and electric motor vehicles, together with smart orchestration, offer the consumer significant benefits and if used correctly, will assist in managing the security of the system.

5.1.1 Home Batteries

Looking at the way in which the charge and discharge times were assumed, the ISP, significantly underestimates the consumer benefits and system benefits.

Using NSW spot prices for 2019, the economic market value of an optimal charge/discharge regime was 3 times more valuable than the assumed profile of the ISP.

An optimal charging/discharging regime would also assist to manage System Security and Reliability.

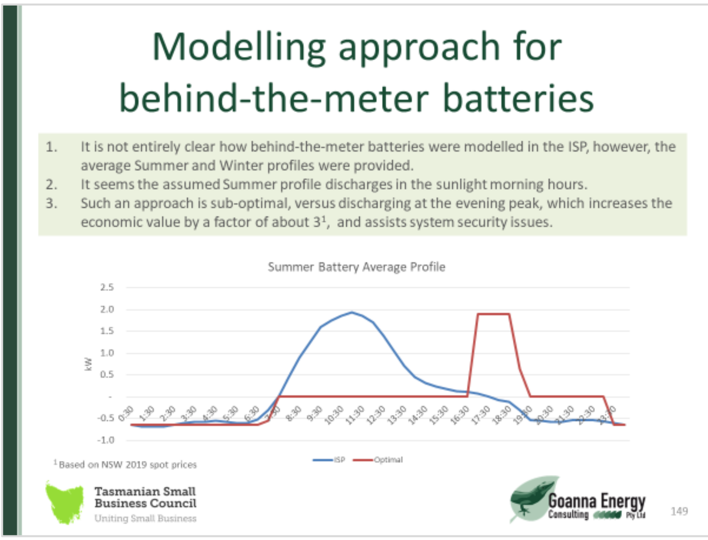


Figure 76: Comparison of Modelling Batteries

The optimal use of home batteries could easily be adapted to deploy Artificial Intelligence and management of the battery will therefore not be undertaken by the user, but rather by an intelligent system.

Figure 77: Artificial Intelligence Managing Home Batteries

With appropriate Price Signals the benefits to consumers will flow to consumers, reduce the stress on the grid and potentially assist in black-out management, local network support and over-voltage supply caused by solar PV (see Section 2.4.8 - *Other Benefits Offered by Battery Link*).

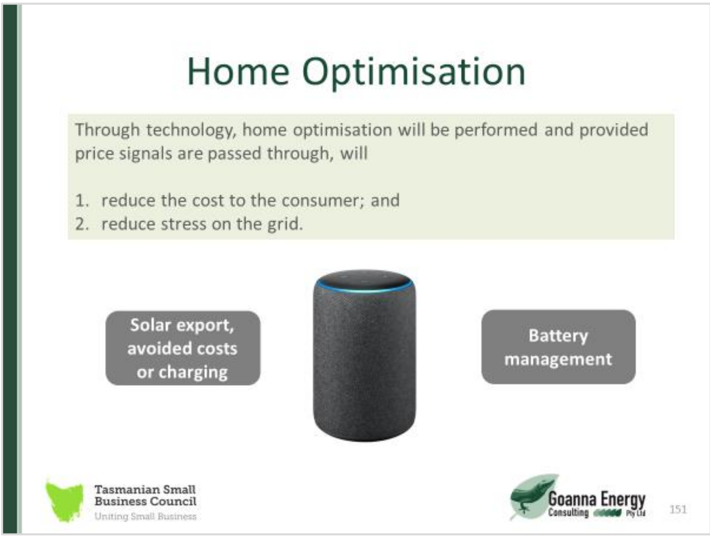


Figure 78: Home Battery Optimisation

Depending upon the ISP scenario selected, the amount of capacity available to manage the stress points of the grid would exceed the capacity of pump storage. Even though it would not offer deep storage, it is an asset that we believe is under-modelled in the ISP.

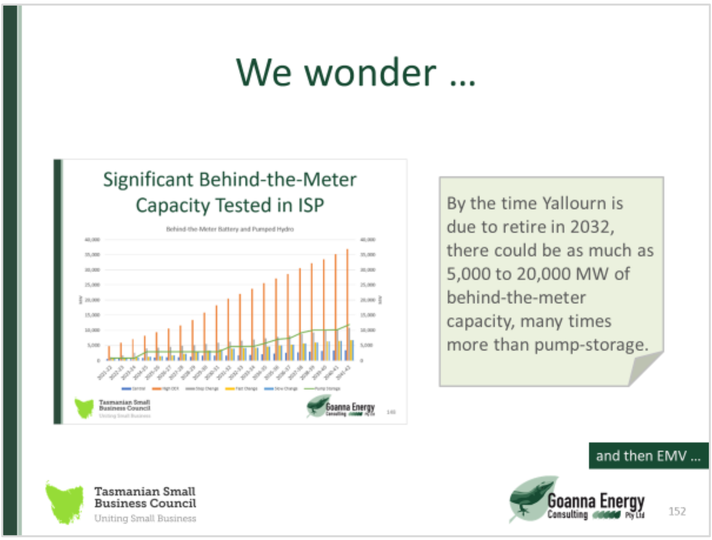


Figure 79: ISP Battery Capacity and Potential Application

5.1.2 Electric Motor Vehicles

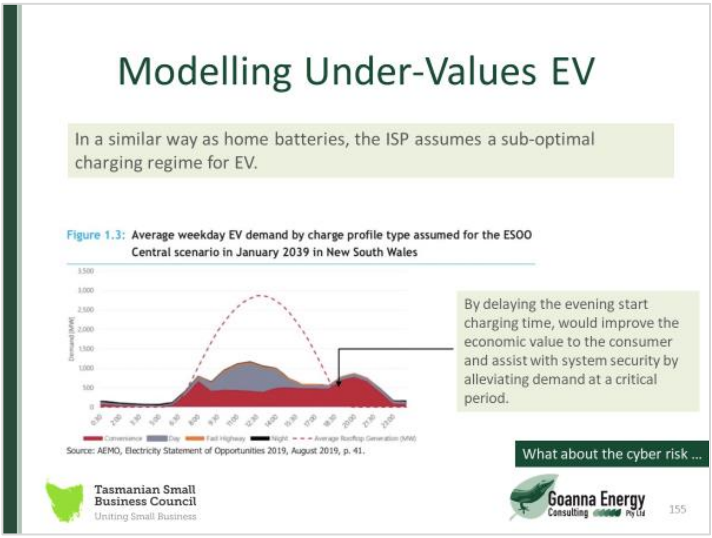
Electric Motor Vehicles (EV's) are in effect a two-way battery and therefore offer similar benefits to home batteries.

The use of Artificial Intelligence is achievable with EV as demonstrated in the figure opposite.

Figure 80: Utilisation of EMV Batteries

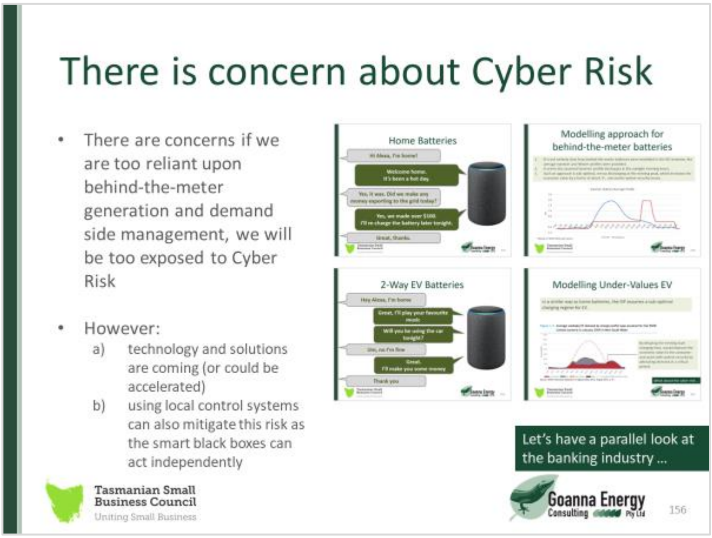
We believe this is another demonstration of where the ISP Modelling under-values the role that these assets can contribute in managing system security and reliability, as well as providing higher value to consumers.

Figure 81: Modelling Under-Values EV



Home batteries and EV's could be optimised locally with a Price Signal feed or could be centrally orchestrated. It is recognised that Cyber Security is a risk, but just like the banking industry, it seems a sensible strategy to solve the Cyber Security issue early, so that these assets can be deployed to maximise consumer value and improve system security.

Figure 82: Cyber Security



5.2 Large Scale Batteries

On review, we have found there are no additional large-scale batteries assumed in the ISP, despite commitments from AGL to pursue such technology, and Origin Energy indicating a commitment to investigate using Large Scale Battery technology across the NEM.

The absence of large-scale batteries, in our view, skews the findings towards large scale interconnectors and pump-storage technology.

Figure 83: ISP Large Scale Battery Storage

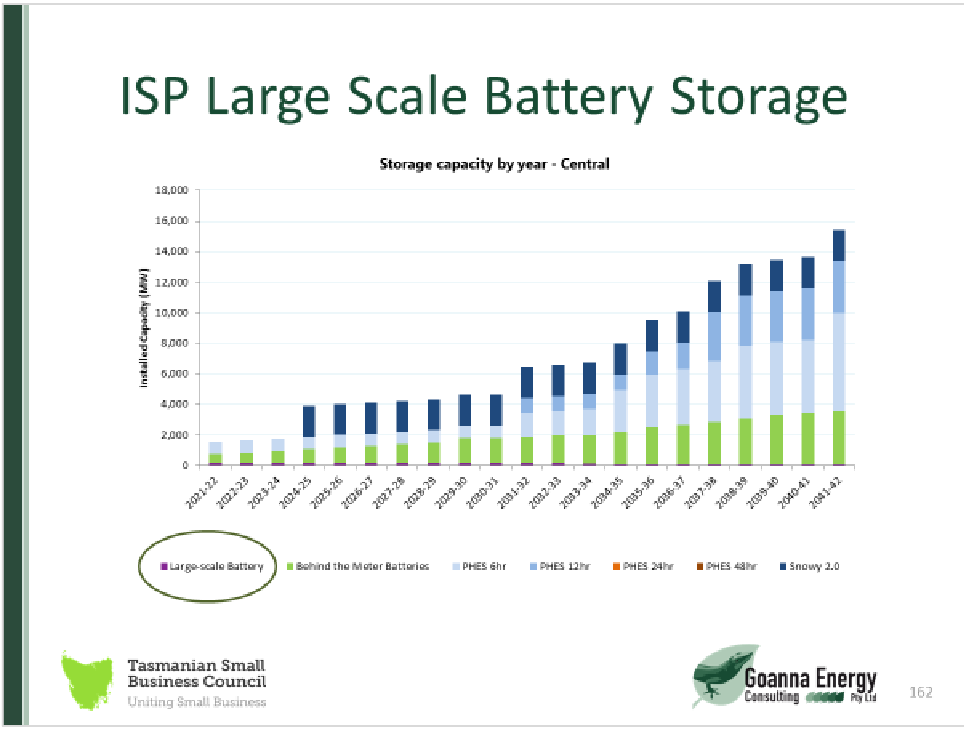


Figure 84: Origin Energy Favouring Batteries

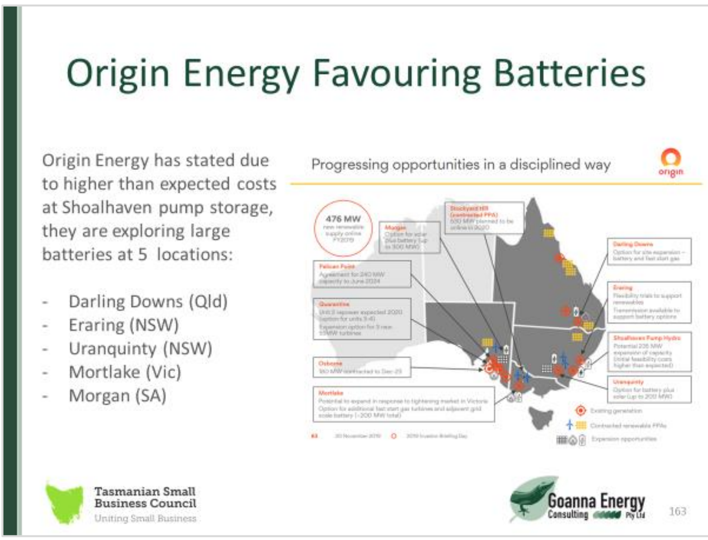
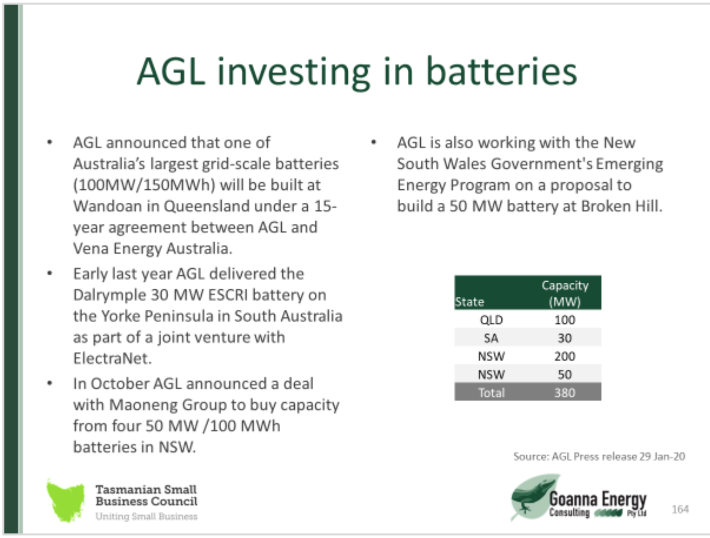
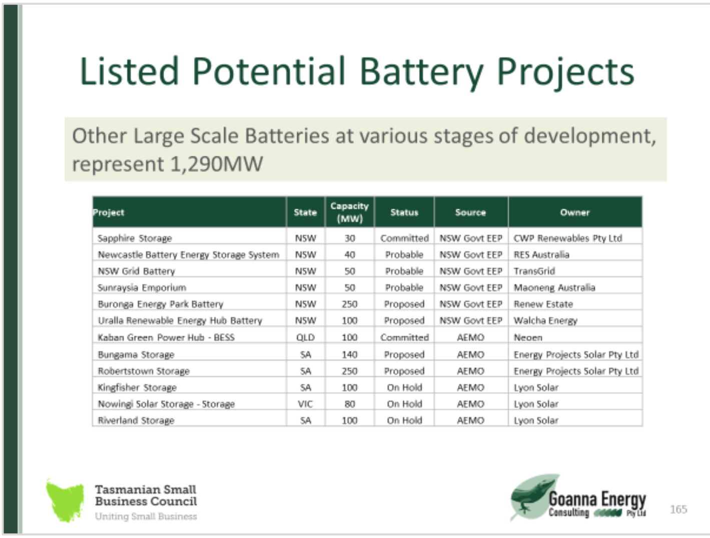


Figure 85: AGL Investing in Batteries



State	Capacity (MW)
QLD	100
SA	30
NSW	200
NSW	50
Total	380

Figure 86: Listed Potential Battery Projects



Project	State	Capacity (MW)	Status	Source	Owner
Sapphire Storage	NSW	30	Committed	NSW Govt EEP	CWP Renewables Pty Ltd
Newcastle Battery Energy Storage System	NSW	40	Probable	NSW Govt EEP	RES Australia
NSW Grid Battery	NSW	50	Probable	NSW Govt EEP	TransGrid
Sunraysia Emporium	NSW	50	Probable	NSW Govt EEP	Maoneng Australia
Buronga Energy Park Battery	NSW	250	Proposed	NSW Govt EEP	Renew Estate
Uralla Renewable Energy Hub Battery	NSW	100	Proposed	NSW Govt EEP	Walcha Energy
Kaban Green Power Hub - BESS	QLD	100	Committed	AEMO	Neoen
Bungama Storage	SA	140	Proposed	AEMO	Energy Projects Solar Pty Ltd
Robertstown Storage	SA	250	Proposed	AEMO	Energy Projects Solar Pty Ltd
Kingfisher Storage	SA	100	On Hold	AEMO	Lyon Solar
Nowingi Solar Storage - Storage	VIC	80	On Hold	AEMO	Lyon Solar
Riverland Storage	SA	100	On Hold	AEMO	Lyon Solar

Figure 87: Utility Scale Battery Costs

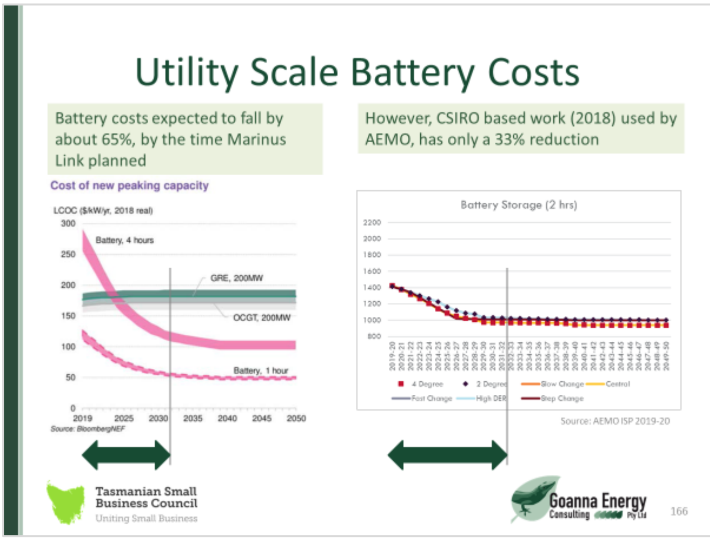


Figure 88: Battery Life and Warranties

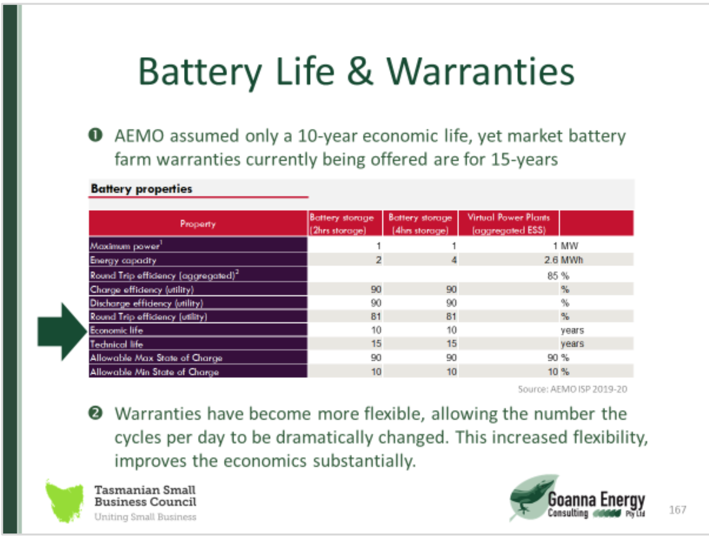
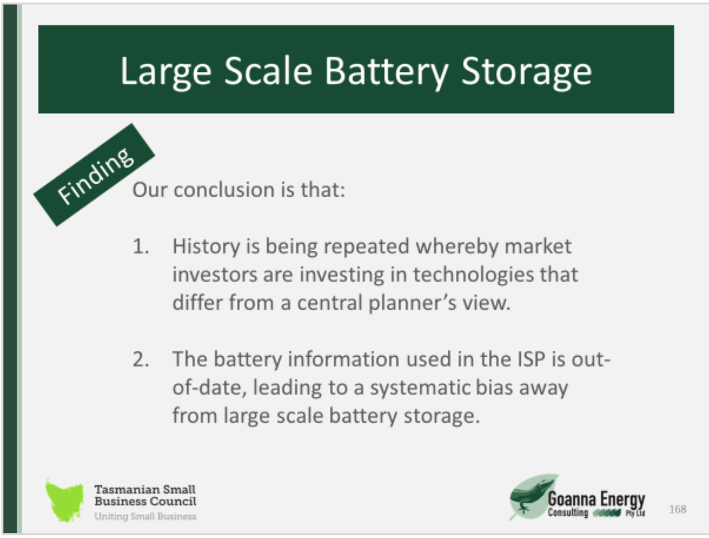


Figure 89: Large Scale Battery Findings



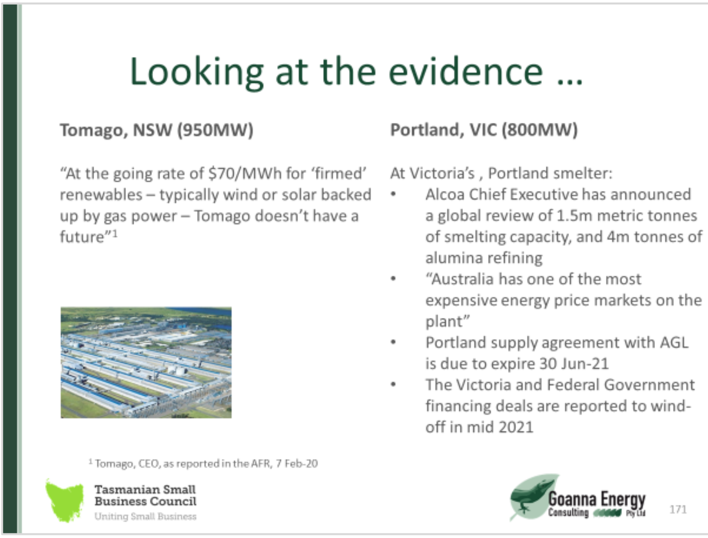
5.3 Large Consumers

TSBC notes that the ISP scenarios consider the possibility that a large-scale consumer will face closure by way of sensitivity analysis for all five scenarios, and a specific consideration in the slow change scenario. In terms of contingency planning, we believe this to be a major shortfall in the modelling design, given what is happening in the market.

Further, it is noted the PADR did consider the potential closure of Large Consumers as part of its modelling.

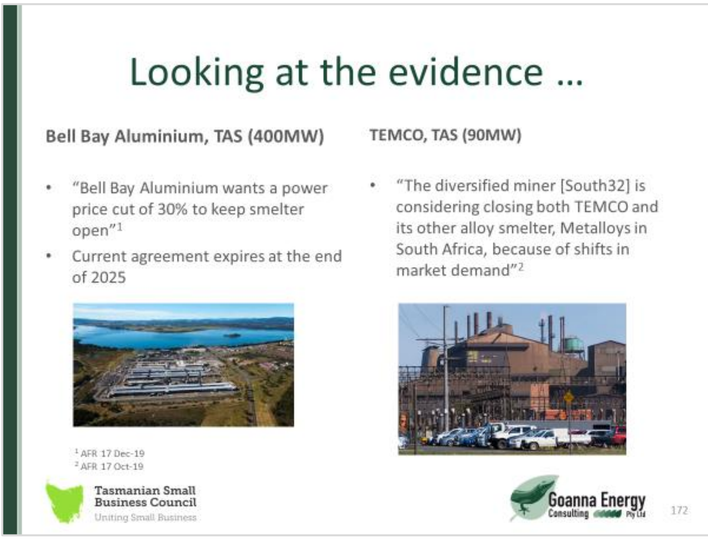
At the time of preparing this report, the public information regarding Tomago and Portland smelters is shown in the figure opposite.

Figure 90: Looking at the Evidence of Large User Closures (part 1)



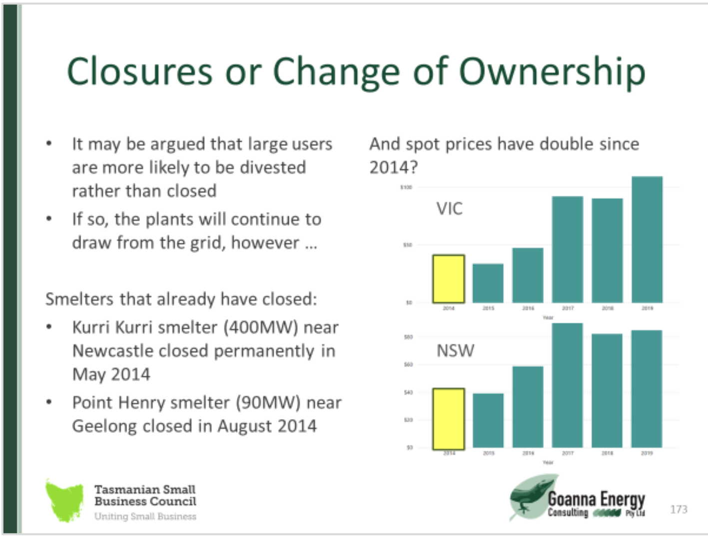
For Tasmania, using the information at the time of preparing this report, the public information on large users were as shown in the figure opposite.

Figure 91: Looking at the Evidence of Large User Closures (part 2)



It would be imprudent to assume that whilst these large users may have a change of owner, the operations will continue. Evidence shown in the figure below demonstrates Australia has already faced closures, and since this time the spot price has doubled, creating more financial pressure.

Figure 92: Closure or Changes of Ownership



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