



**Tasmanian Small
Business Council**
Uniting Small Business

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

6 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 discount rate applied is not consumer risk-adjusted;
 - b. The margin of error associated with the Market Benefits forecasts are so great it makes the conclusions unreliable;
 - c. 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; 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 can be 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 s 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 in 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 look forward to any feedback from TasNetworks on our submission and would be prepared to meet directly to discuss and clarify any element of our review.

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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 and SavvyPlus Consulting. This report follows our analysis of the RIT-T process as it 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.

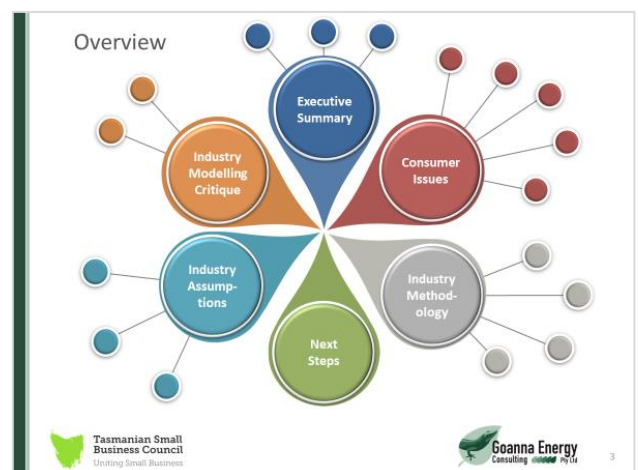
1.3 STRUCTURE OF REPORT

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

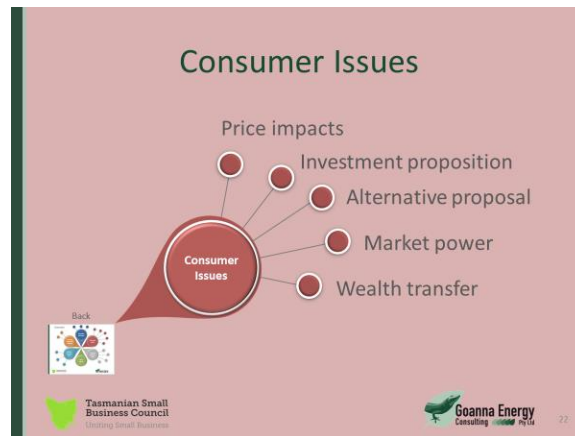


2 Consumer Issues

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

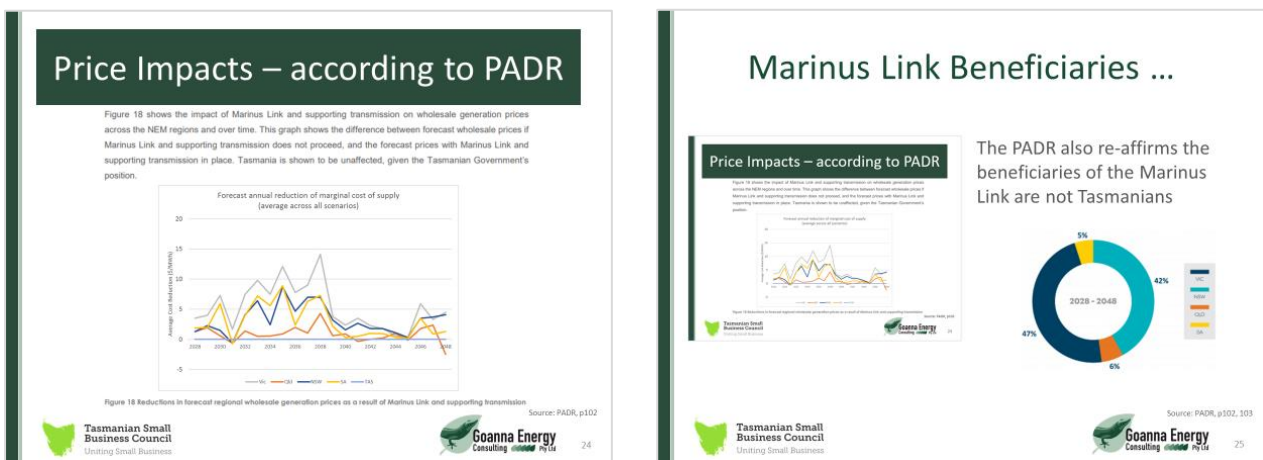


2.1 PRICE IMPACTS & PRICE SIGNALS

2.1.1 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”²

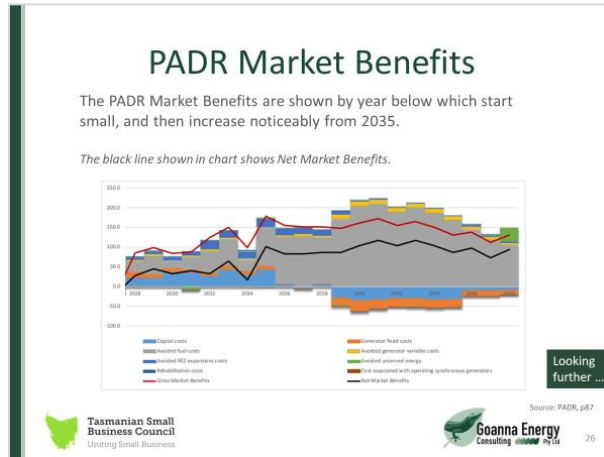
Figure 4: Price Impacts - according to PADR and beneficiaries



² PADR, p102

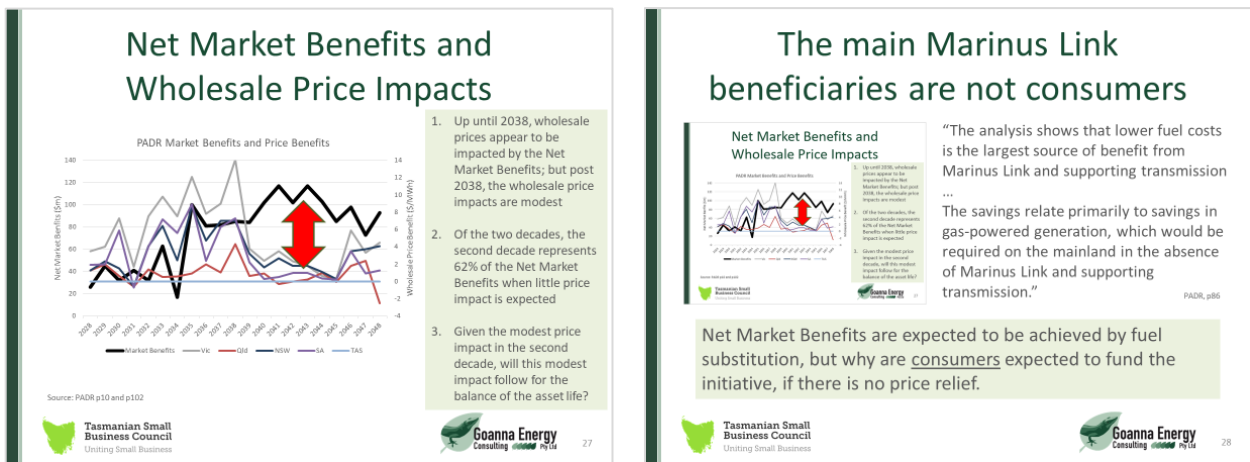
It is then observed that the PADR Market Benefits begin low and then increase noticeably from 2035, which is a different pattern to the price impacts re-produced in Figure 4 above; and therefore it follows that the main beneficiaries from Marinus Link are not consumers.

Figure 5: PADR Market Benefits



This conclusion that consumers are not the main beneficiary is observed more clearly when the Market Benefits are overlaid 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 2.4 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 2.2.2 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

Price Impacts

Finding

1. As modelled in the PADR, the main benefits arising from Marinus Link is from fuel switching, however, prices are not expected to be impacted at the time when most of the benefits are expected to be realised
2. Consumers should not be forced to pay for a regulated asset that delivers benefits to others

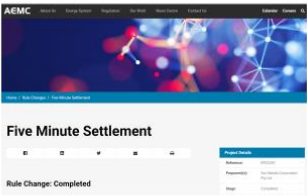


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2.1.2 Price Signals



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

AEMC Approves 5-Minute Settlement

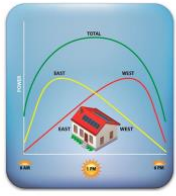


1. AEMC approved 5-minute settlement and takes effect from 1 July 2021.
2. The proponent for the change was a customer.
3. The wholesale market will have 105,120 five-minute prices per annum.
4. The retail market needs to change.





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West Facing Solar PV

- The Victorian Government has set in place a multi-part minimum feed-in tariff as well as the traditional single part tariff.
- Such an initiative will encourage more west facing solar PV panels.



- West facing panels will produce more energy at more valuable times.



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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.

Price Signals

Finding

1. The Australian consumer has proven to be adaptable, especially when provided with appropriate technology.
2. We need to pass-through more price signals to reward good behaviour and encourage further incentives to assist in system security and lowering the cost for all.



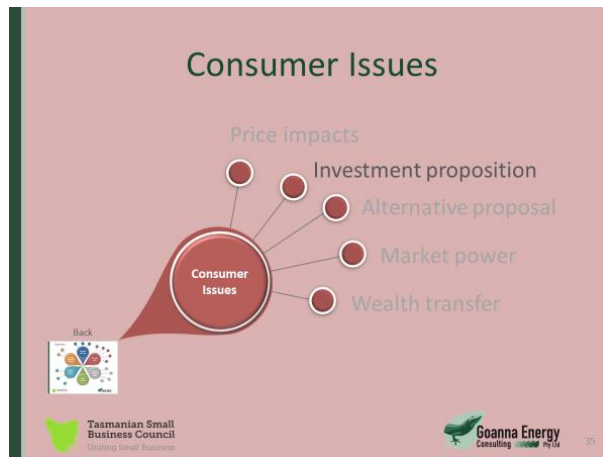
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Figure 9: Price Signals Findings

2.2 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.



2.2.1 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.

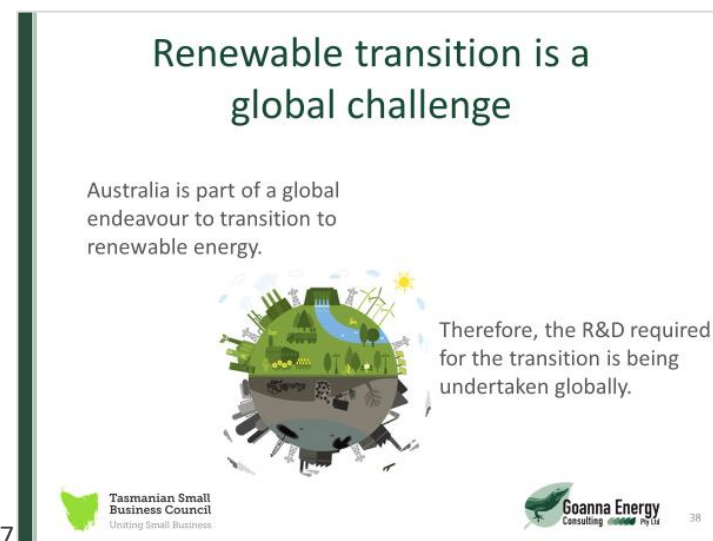
The sample slide shows some of the many potential changes mentioned in recent press clippings. This sample does not claim to portray every break-through development, but rather is intended to give an insight into the potential change.

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



2.2.2 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, *Price Impacts & Price Signals*, where consumers do not appear to be the primary beneficiary, but are expected to pay-for the asset;
- b) Market power and whether these modelled benefits will be passed through to consumers which is discussed further in Section 2.4, *Market Power*;
- c) Margin of error of any modelling which is discussed in Section 4.3, *Margin of Error*; and
- d) The discount rate used in measuring the benefits which is discussed below.

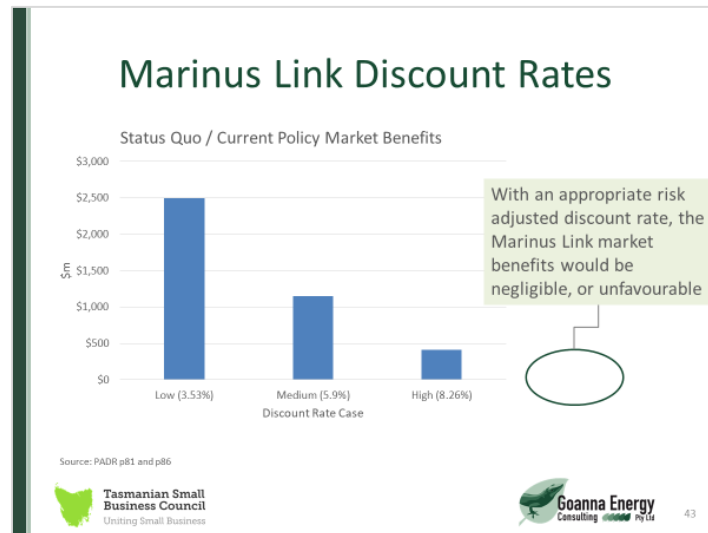
Looking at the discount rates used, the PADR used the Energy Network Australia RIT-T Economic Handbook base discount rate of 5.9% (real, pre-tax), along with a high and low case of 3.54% and 8.26% respectively.³

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.

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

³ PADR, p158

Figure 15: Marinus Link Discount Rates Impact on Benefits



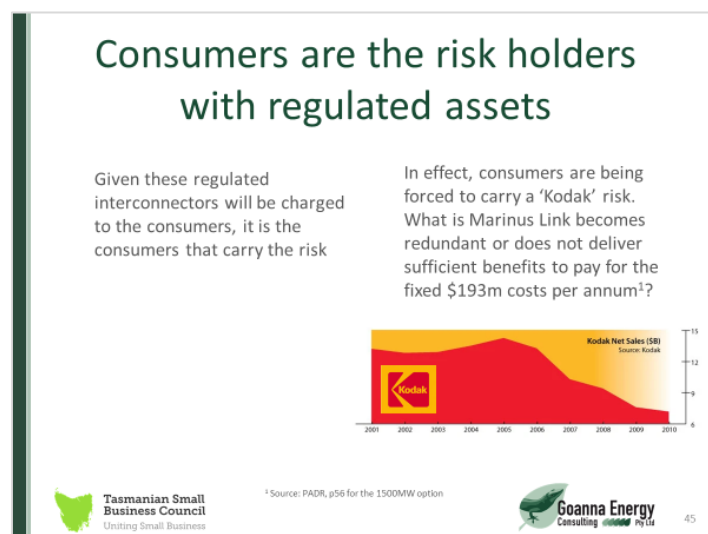
It is our conclusion that whilst the discount rates applied in the PADR conform to the Energy Network Australia RIT-T Economic Handbook, such a rate is not appropriately risk-adjusted from a consumer perspective.

2.2.3 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.

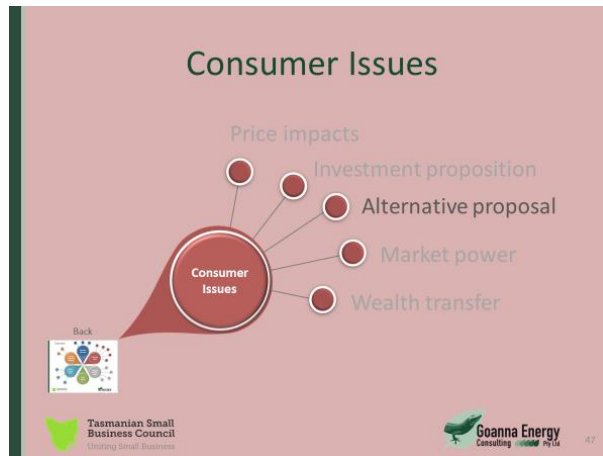
Figure 16: Kodak Risk



2.3 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.

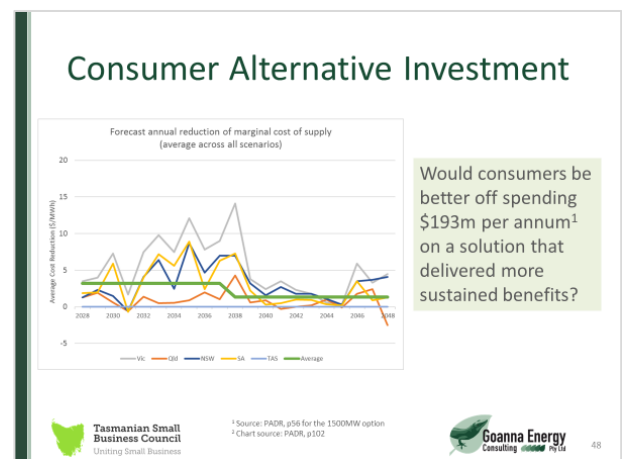
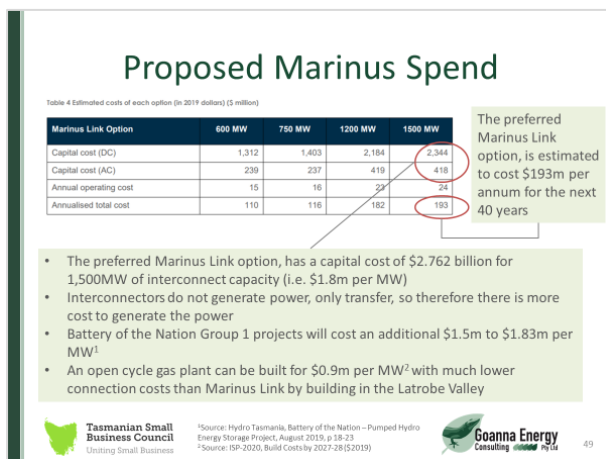
Figure 17: Consumer Issues – Alternative Proposal



2.3.1 Investment Recap

The proposed Marinus Link investment would cost consumers \$193m per annum⁴ 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



⁴ PADR, p56 for the 1500MW option

2.3.2 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

Introducing ... “Battery Link”

- Rather than invest in a regulated asset that is exposed to significant Kodak risks, how about we invest in an emerging solution
- Let’s accelerate the consumer-led energy revolution
- Let’s choose a solution than can evolve and capitalise on technology developments and falling cost curves
- Let’s implement a genuine Least Regret plan

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2.3.3 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?

How does Battery Link work?

Rather than spending \$193m per annum for the next 40 years on an asset we are not sure will benefit consumers ...

- Let’s subsidise home batteries to complement roof-top solar
- Orchestrate the batteries to manage peak and critical times

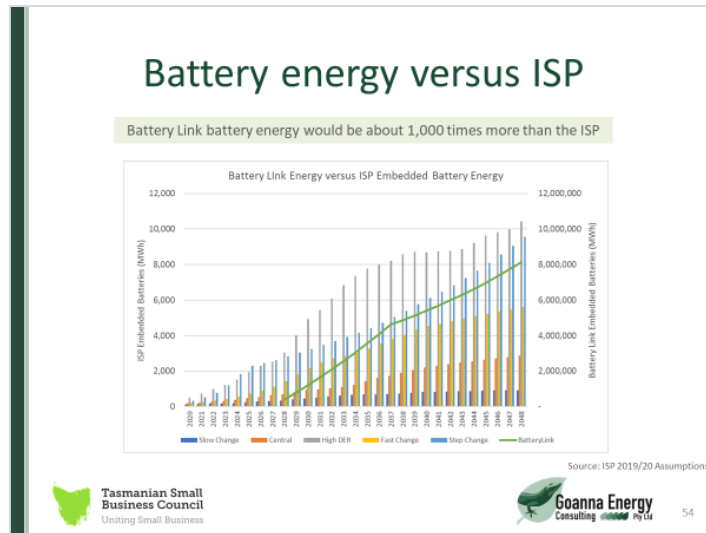
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This would lead to a massive roll-out of batteries which would be about 1,000 times more than assumed in the Draft ISP 2020. Initially the roll-out would be about 40,000 batteries in 2028 and then increase over time as the cost per battery would fall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

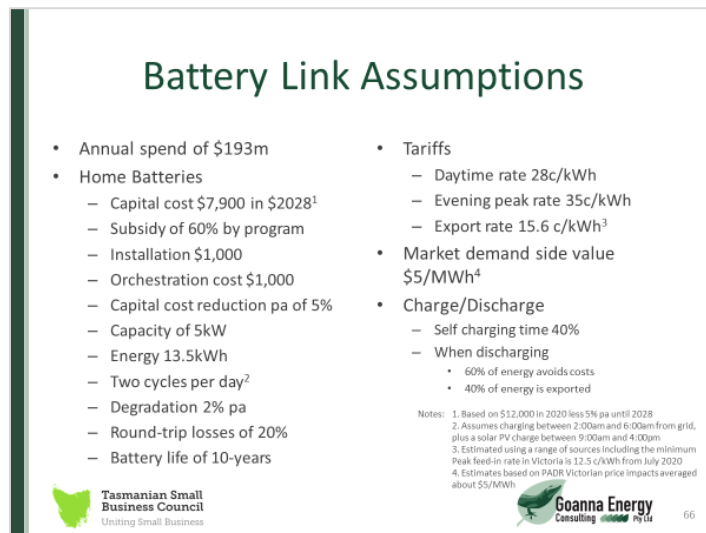
Figure 21: Battery Link Energy versus ISP



2.3.4 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



2.3.5 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 MW⁵ plus an extra \$1.8m per MW⁶ to transport the energy to Victoria. This compares to an open cycle gas plant capital cost of \$0.9m per MW⁷ 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:

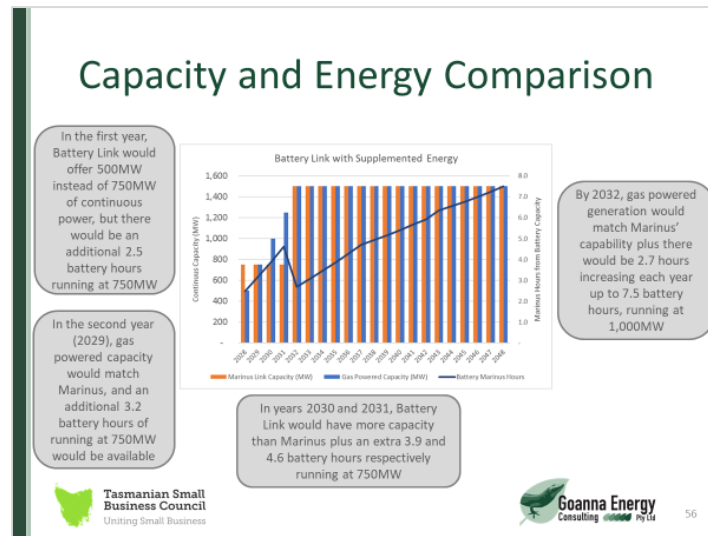
1. In the first year, Battery Link would offer 500MW instead of 750MW of continuous power from Marinus Link, but there would be an additional 2.5 battery hours running at 750MW
2. In the second year (2029), gas powered capacity would match Marinus Link's capacity, and an additional 3.2 battery hours 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.

⁵ Source: Hydro Tasmania, Battery of the Nation – Pumped Hydro Energy Storage Project, August 2019, p 18-23

⁶ PADR, Table 4

⁷ Source: ISP-2020, Build Costs by 2027-28 (\$2019)

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



2.3.6 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.

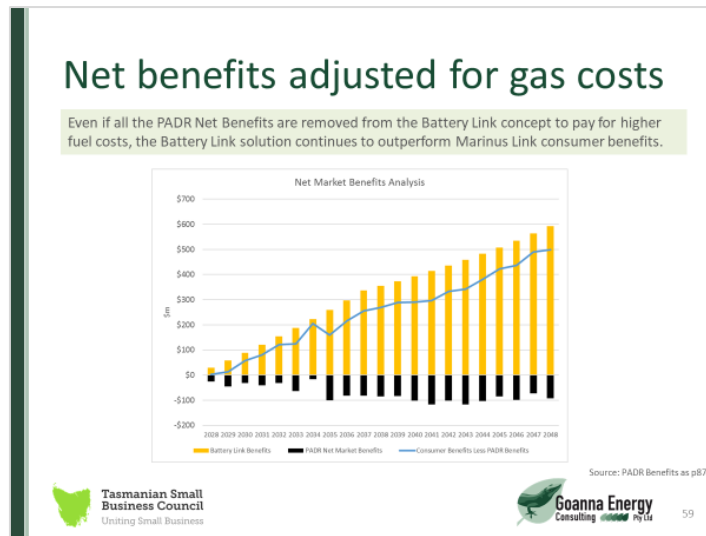
The next step was to consider consumers. The key benefit of accelerating behind-the-meter technologies is that consumers not only avoid the contestable energy costs (i.e. wholesale market costs), but also other charges such as variable network charges and pass-through environmental charges such as NEM-wide 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.

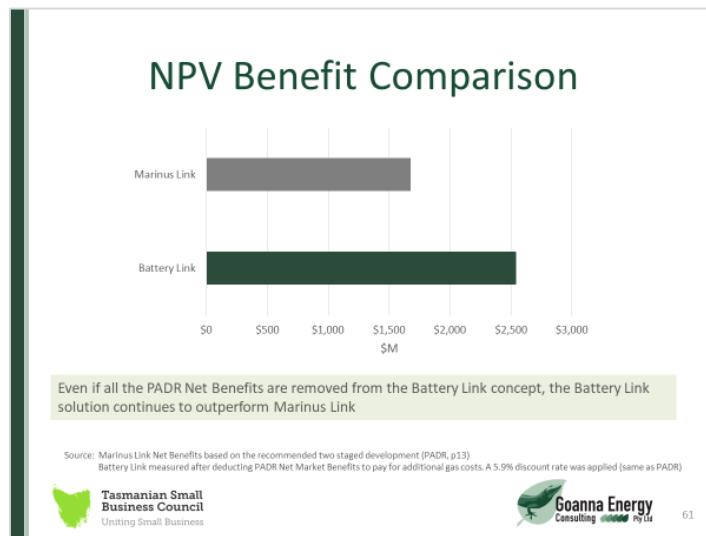
It is important to note that these consumer benefits do not include the capital contribution of consumers which was done to be consistent with the PADR methodology, where the cost of HydroTas to build Battery of the Nation was also excluded.

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 \$2,500m⁸ compared to Marinus Link of \$1,674m⁹.

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.

⁸ A discount rate of 5.9% was applied to be consistent with the PADR

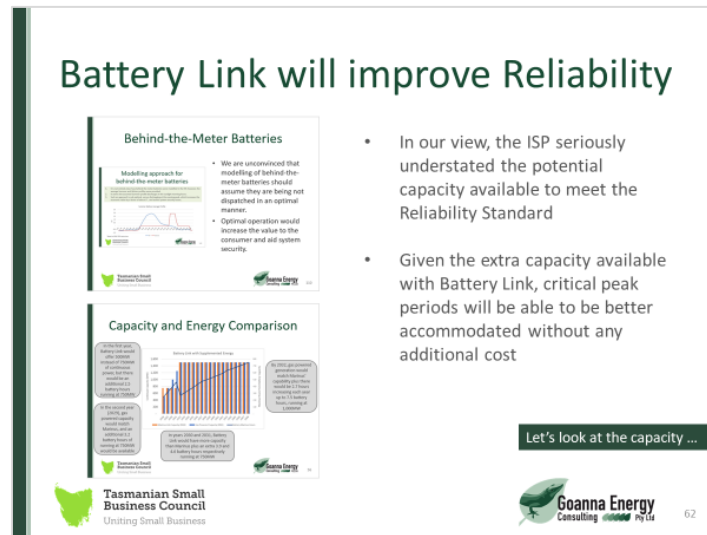
⁹ Marinus Link benefits based on the recommended two-staged development (PADR, p13)

2.3.7 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.

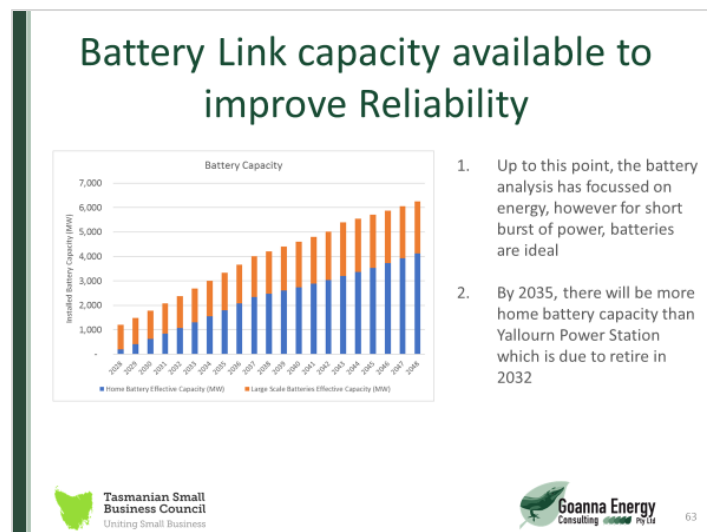
In our view, the ISP seriously understated the role that batteries can play to assist in managing system short-term stresses. This is further addressed in Section 5 - *Industry Assumptions*.

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



2.3.8 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

Battery Links other benefits ...

From a consumer's perspective, other financial benefits not included are:

- Black-out protection (local and grid events)
- Local network support
- Aiding to manage over-voltage supply caused by solar PV





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2.3.9 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

Battery Link is a better Least Regret plan

- Compared to Marinus Link, Battery Link is a better Least Regret plan because:
 - More agile
 - Able to capitalise on technology advancements
 - Has greater upside benefits
 - Lower consumer cost




Empowering the consumer ...



Renewable transition is a global challenge



NPV Benefit Comparison



Battery Link capacity available to improve Reliability



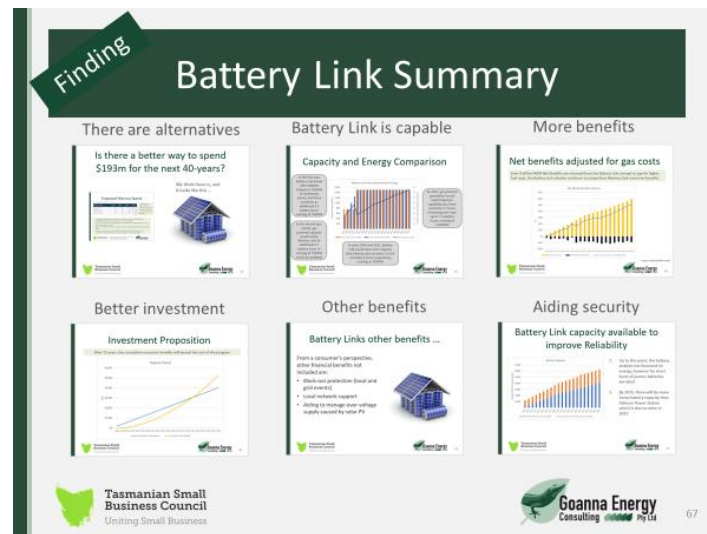
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In summary, Battery Link is a serious concept worthy of further consideration.

Figure 30: Battery Link Summary



2.3.10 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.

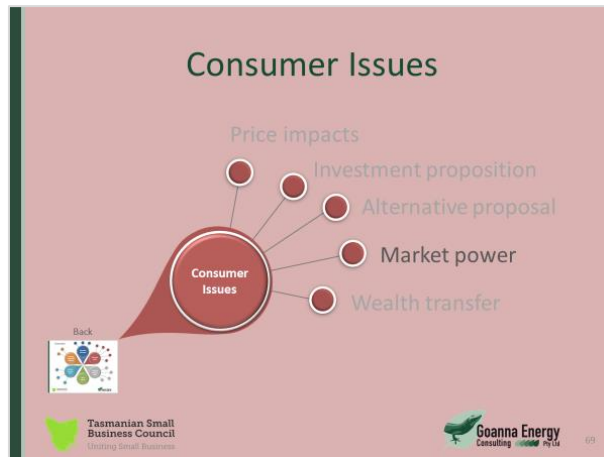
Key finding 6: Energy storage in the NEM could compete against gas in 20 years.

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

2.4 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 2.5 - *Wealth Transfer*.

2.4.1 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.

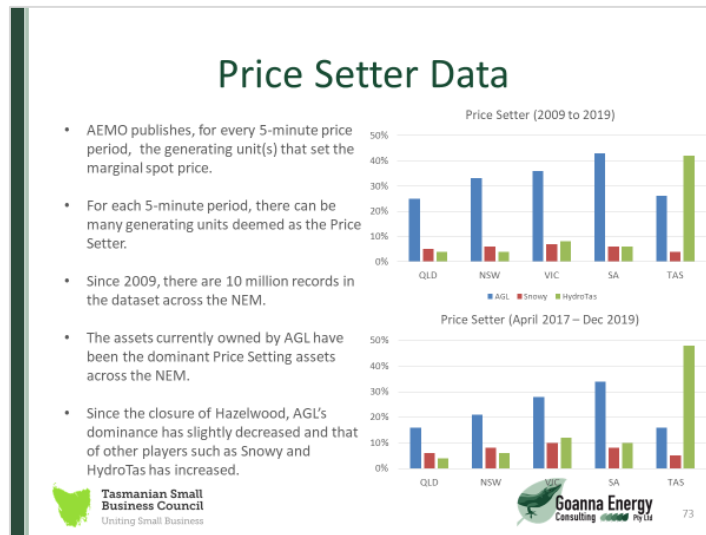
In addition, Snowy 2.0 will add 2,000 megawatts of energy generation and provide 175 hours of storage for the National Electricity Market (NEM).

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.

2.4.2 Price Setting Behaviour

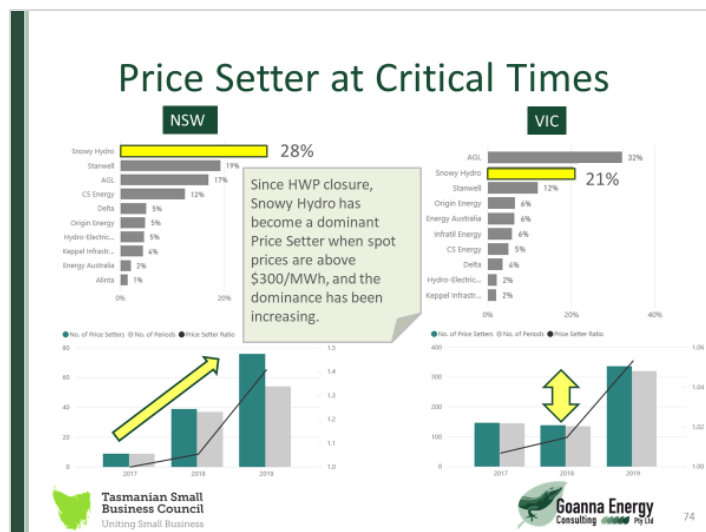
AEMO publishes, for every 5-minute price period, the generating unit(s) that set the marginal spot price, and for each 5-minute period there can be many generating units deemed as the Price Setter. Since 2009 there are 10 million records in the dataset across the NEM, with the assets owned by AGL being 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



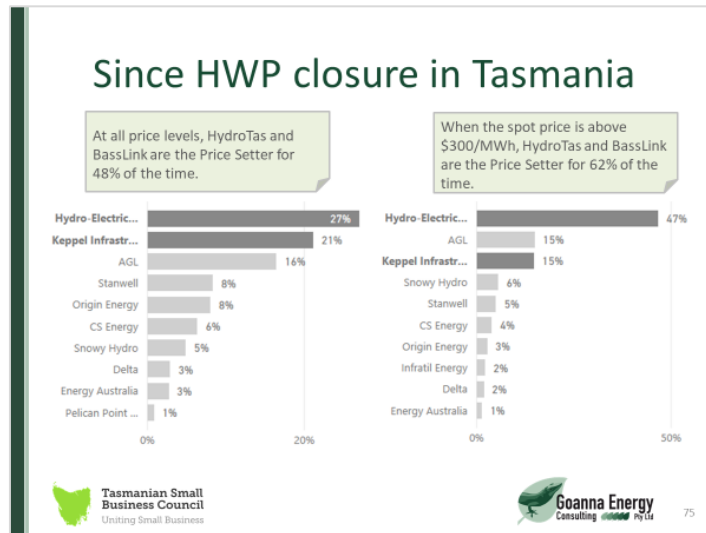
Looking at Price Setting at critical times since Hazelwood Power Station closure, Snowy Hydro has become a dominant Price Setter when spot prices are above \$300/MWh, and this dominance as a Price Setter has been increasing.

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

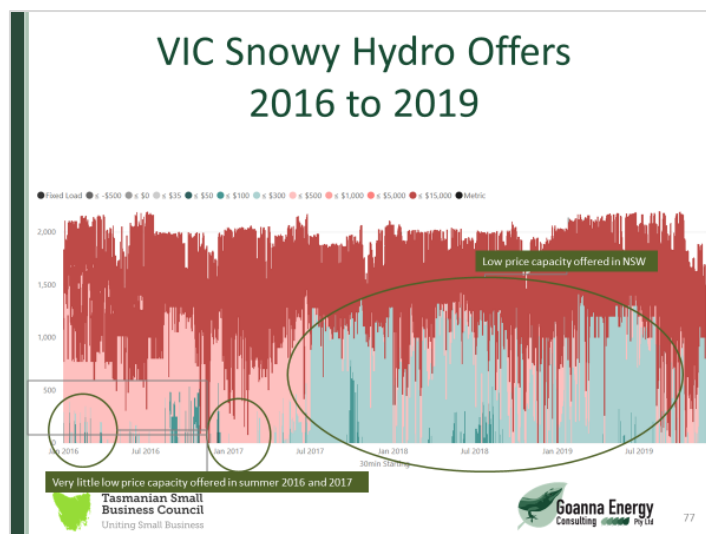


2.4.3 Commercial Pressures and Market Power

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

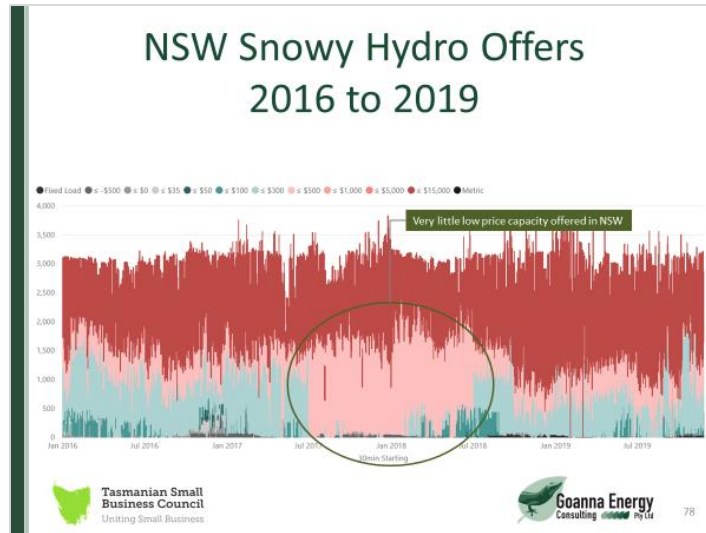


Figure 37: HydroTas Offers 2016-2019

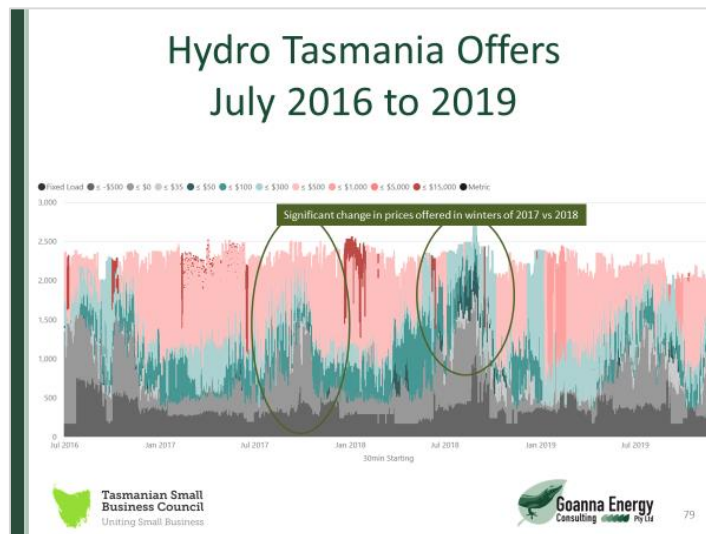
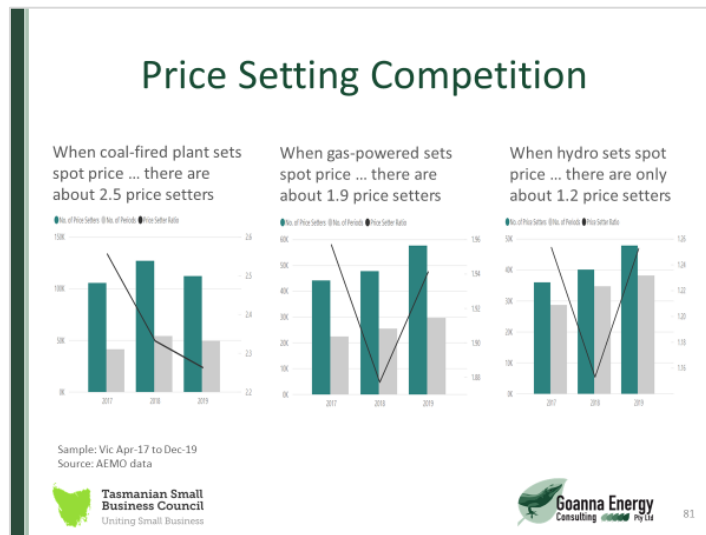


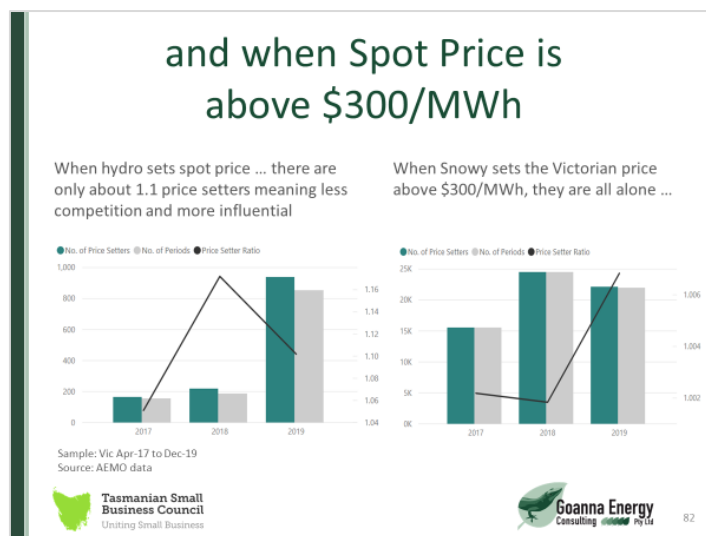
Figure 38 shows the number of Price Setters (given there can be simultaneously many), by fuel type. The results show that for coal-fired plant, the number of Price Setters is about 2.5, for gas-powered generation there are about 1.9 and for Hydro there are only about 1.2. This demonstrates that when 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



2.4.4 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

Market Power

Finding

Consumers are concerned that as a consequence of large interconnectors being constructed in a market place that has limited effective competition, that market power will become further concentrated.

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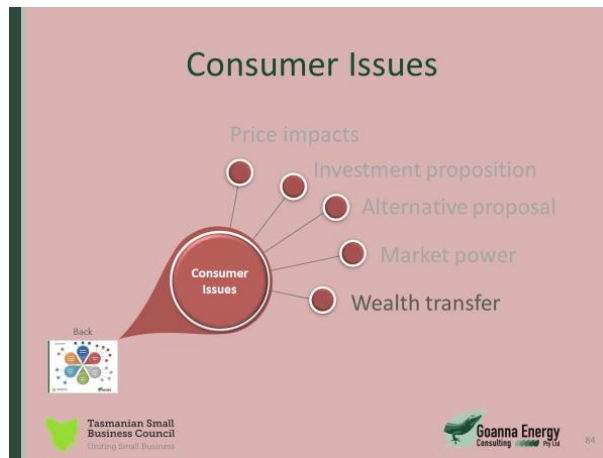
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2.5 WEALTH TRANSFER

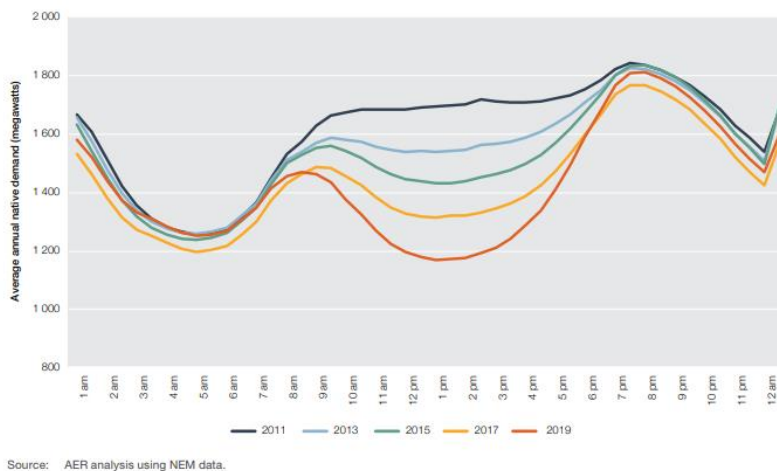
The final Consumer Issue is to deal with Wealth Transfer.

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 Australia¹⁰, average annual native demand has been significantly impacted by solar PV.

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



Source: AER analysis using NEM data.

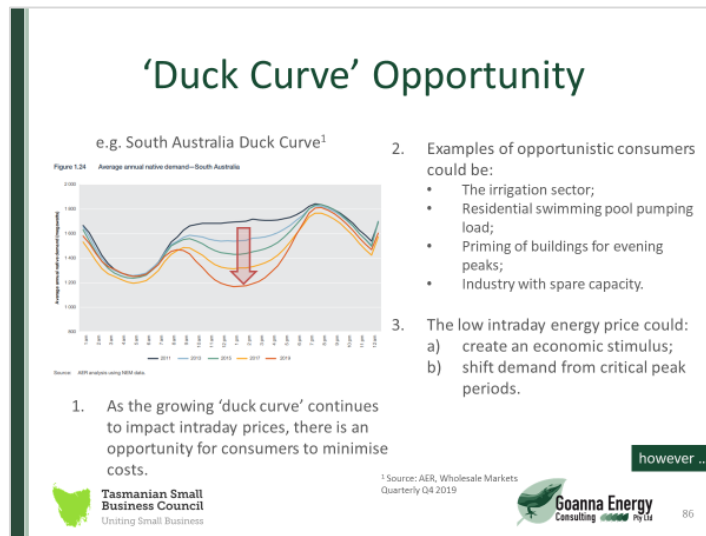
Such a dynamic of suppressing daytime spot prices will create an opportunity where:

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 2.1.2 - *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.

¹⁰ AER, Wholesale Markets Quarterly Report, Q4 2019

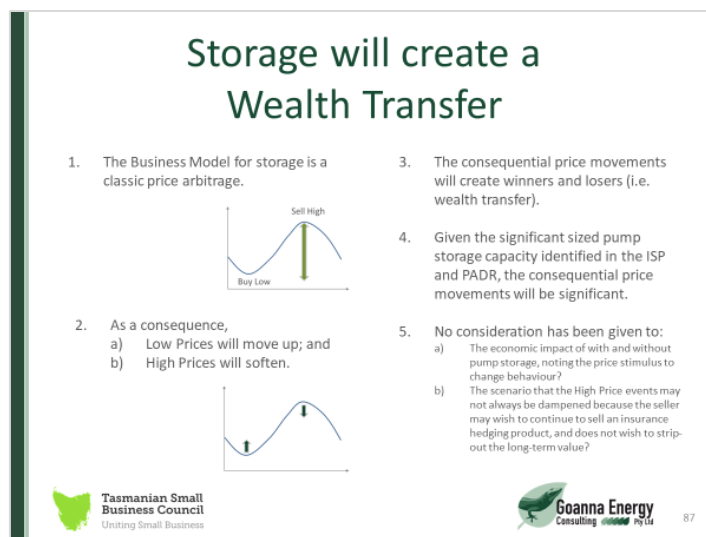
- Consequently, low daytime prices could create an economic stimulus and encourage demand shifting.

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

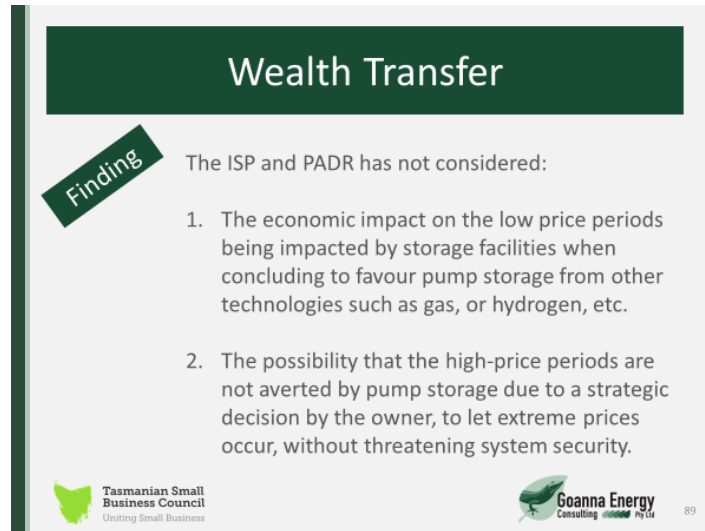


The PADR does not seem to address the economic impact on consumers of having or not having pump storage given the likely elevation of daytime prices caused by pumping, in return for possible suppressed evening peak prices.

As discussed in Section 2.4 - *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





Wealth Transfer

Finding

The ISP and PADR has not considered:

1. The economic impact on the low price periods being impacted by storage facilities when concluding to favour pump storage from other technologies such as gas, or hydrogen, etc.
2. The possibility that the high-price periods are not averted by pump storage due to a strategic decision by the owner, to let extreme prices occur, without threatening system security.

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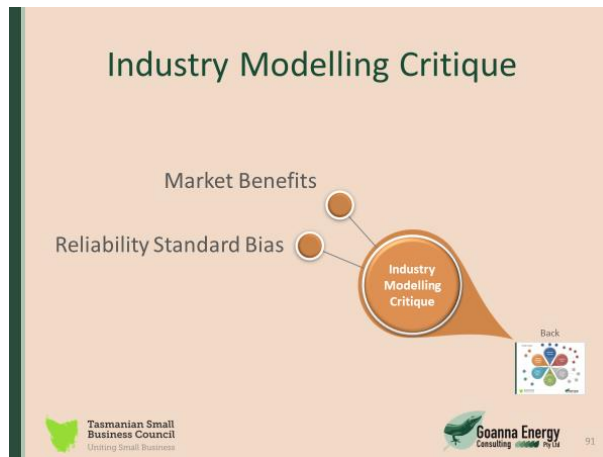
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3 Industry Modelling Critique

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.

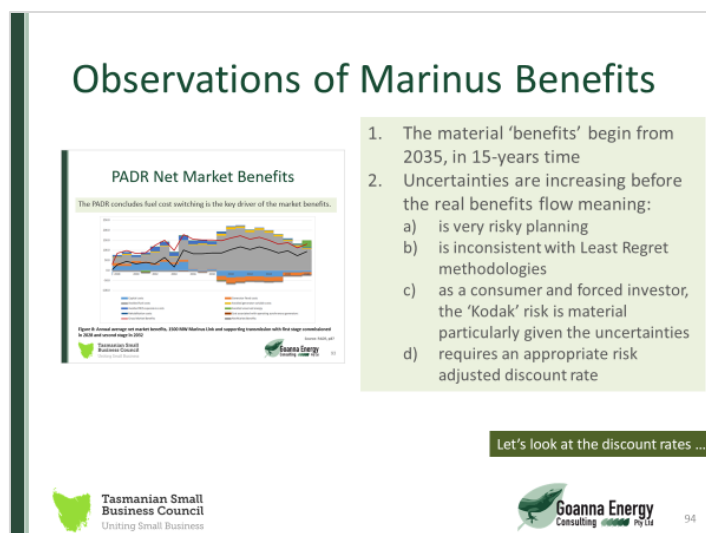
Figure 46: Industry Modelling Critique



3.1 MARKET BENEFITS

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

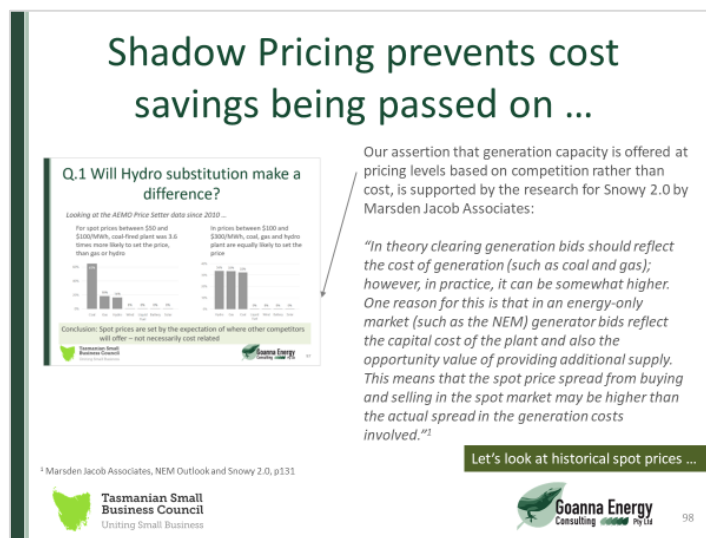


We are also not convinced that the benefits will be passed onto consumers as discussed in Section 2.4 - Market Power.

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.

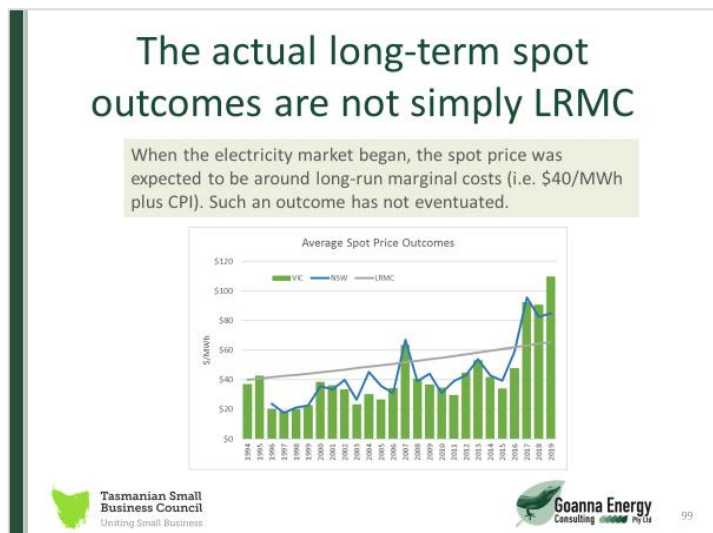
It is also clear that the market operates under a perception of cost levels and gas pricing is a critical factor. Hydro generation and other technologies usually offer their marginal capacity at a level which they believe the gas market will offer. Therefore, it is not a matter of the value of water, 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

The Reliability Metric

- The reliability standard requires at least 99.998% of forecast customer demand to be met each year
- Electricity demand forecasting is a challenging task, especially given:
 - the evolving technology which enables behind-the-meter developments; and
 - the evidence of strong consumer desire to manage their energy costs, and a willingness to invest accordingly.
- The industry's track record to forecast long-term demand is not compelling





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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

Demand Forecast



- It is surprising that none of the 5 ISP scenarios modelled contained a case where a large scale user withdraws from the market.
- Such a withdrawal would have a significant impact on the solutions to achieve the Reliability Standard.



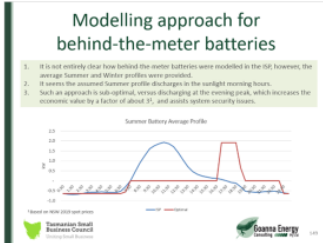


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Figure 52: Behind-the-Meter Batteries Modelling

Behind-the-Meter Batteries



Modelling approach for behind-the-meter batteries

- It is not entirely clear how behind-the-meter batteries were modelled in the ISP; however, the average Summer and Winter profiles were provided.
- It seems the assumed Summer profile discharges in the daylight morning hours.
- Such an approach is sub-optimal, versus discharging at the evening peak, which increases the economic value by a factor of about 3%, and assists system security issues.

Summer Battery Average Profile

Figure 5.2.1 Average weekday EV demand by charge profile type assumed for the ISP

- We are unconvinced that modelling of behind-the-meter batteries should assume they are being not dispatched in an optimal manner.
- Optimal operation would increase the value to the consumer and aid system security.



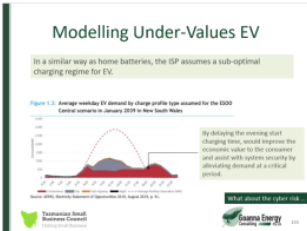



Figure 53: Charging of Electric Motor Vehicles Modelling

Charging of EVs



Modelling Under-Values EV

In a similar way as home batteries, the ISP assumes a sub-optimal charging regime for EV.

Figure 5.2.2 Average weekday EV demand by charge profile type assumed for the ISP

Central scenario in January 2019 in New South Wales

By deferring the morning start charging time, we could improve the economic value to the consumer and assist with system security by alleviating demand at a critical period.

- As with behind-the-meter batteries, the assumed charging cycles of EVs appears to under-value the commercial benefit to the consumer and system security benefits









Figure 54: Large Scale Battery Modelling

Large Scale Batteries

It appears the data being used in the ISP modelling is materially out-of-date with the fast moving large scale battery market:



- The projected fall in battery cost is not consistent with market information.
- The economic life is understated.
- Market investors are currently pursuing large scale batteries, which is inconsistent with the ISP forecast of no further investment in large scale batteries.

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

Figure 55: Reliability Standard Findings

Reliability Standard

Finding

The Reliability Standard has been measured based on the assumptions used in the ISP modelling, however, we have concerns that the modelling has a systematic bias skewing the results from battery storage and other technologies.

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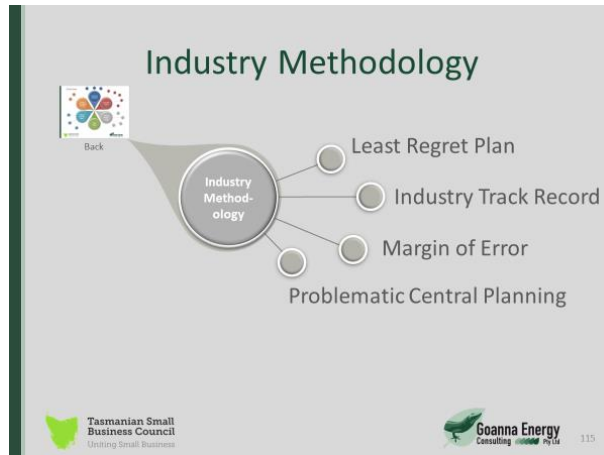
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4 Industry Methodology

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

Least Regret Plan

“The ISP must similarly consider any potential regrets on behalf of consumers ... To minimise these regrets, decision-makers can choose to invest now in the option with the least downside risk, or defer investment until there is more certainty, or stage investment or select options that retain flexibility, or invest as well in a way that hedges their major investment.”

ISP Draft 2019/20, AEMO, p23.

In the ISP, there appears to be a disconnect in the methodology and application of the principle of “least-regret”.

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

Strategy of Least Regret

- What is the selection criteria?
- Who set the criteria?
- What are the weightings?
- What are the metrics?
- How close were the results?

There is a clear lack of transparency associated with the implementation of this Strategy of Least Regret

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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

Investment Strategy for Australia

Four discrete investment scenarios can be identified:

- 1. Investors can identify a single focus of the future that is precise enough for strategic development.
- 2. The future can be described as one of a few alternate outcomes, or discrete scenarios.
- 3. Multiple dimensions of uncertainty interact to create an environment that is virtually impossible to predict.
- 4. A range of potential futures can be identified using a broad number of key variables, but the social outcome may be anywhere along a continuum bounded by the range.

- Investment strategies appropriate for levels 3 and 4 typically involve multiple, smaller investments, where investment performance can be assessed as the market evolves and decisions made to continue, vary or abandon the investment based on performance outcomes, reducing risk.

Australian energy market faces a future level of uncertainty closer to level 4 than level 1.

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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

A project like Battery Link is more appropriate ...

Investment strategies appropriate for levels 3 and 4 typically involve multiple, smaller investments, where investment performance can be assessed as the market evolves and decisions made to continue, vary or abandon the investment based on performance outcomes, reducing risk.

Australian energy market faces a future level of uncertainty closer to level 4 than level 1.

Battery Link is a better Least Regret plan

- Compared to Marinus Link, Battery Link is a better Least Regret plan because:
 - More agile
 - Able to capitalise on technology advancements
 - Has greater upside benefits
 - Lower consumer cost

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4.2 INDUSTRY TRACK RECORD

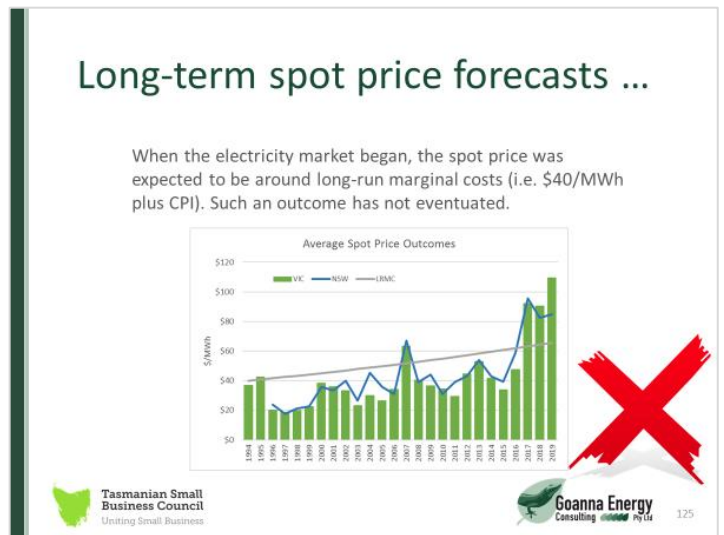
Long-term modelling is a difficult task and has become more difficult at a time of heightened uncertainty driven by economic circumstances, consumer behaviours, industry viability and technology advancements.

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

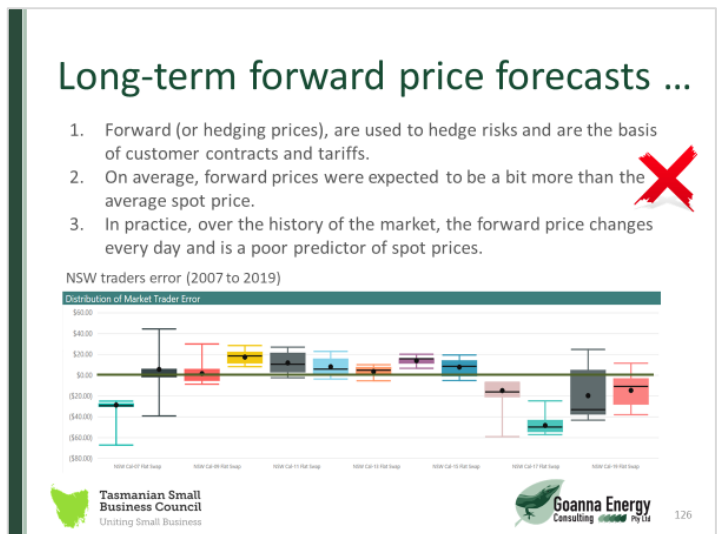


SavvyPlus Consulting uses this measure, called Traders Error, which measures the difference between the forward hedging market traded price and the actual spot price.

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

A Central Planner's view has not been followed

Looking back in history, the market has decided what type of new generation should be built and by when – which has not accorded with the central planner's view

For example ...

1. Over the 3-years 2001 to 2003, the Queensland market built 2,100MW of coal-fired generation, followed by a further 744MW in 2007. The market became over-supplied and 2 Tarong units were shut-down in 2012, with one unit returning in 2014, and the second unit in 2016.
2. Queensland built gas turbine Swanbank E in 2002, and then did not operate it between December 2014 and August 2017.
3. Tasmania built Tamar Valley Power, then the owner was going to sell it, then shut it down, and now it produces about 5% of Tasmania's energy.



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

10-years ago, gas was predicted to be the transitional fuel ...

The predicted transition ...



What has happened ...



Over the last 5-years, gas has declined and renewables exceed gas generation.

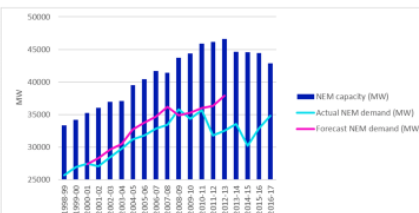


In previous forecasts prepared by AEMO, instead of a shortage of supply as predicted, the market had a surplus.

Figure 65: Demand and Supply Forecasting 1998-2017

Forecast errors have been material

Actual and forecast NEM capacity and demand (1998-2017)



Source: AER, AEMO

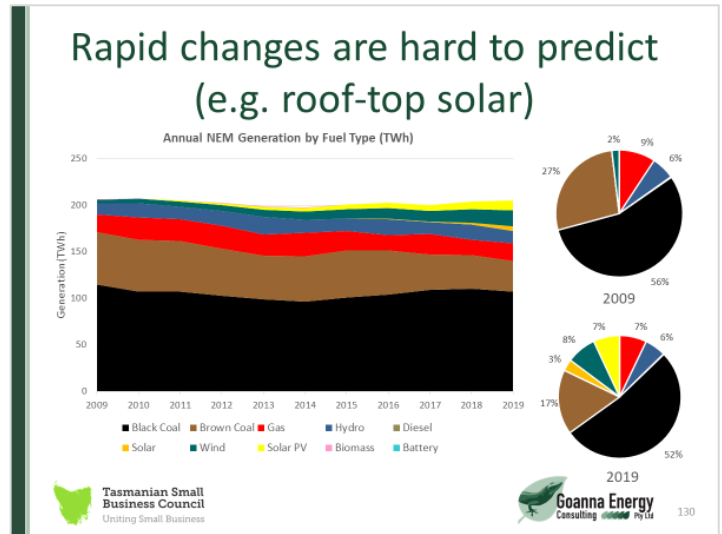
¹ <https://thehub.agl.com.au/articles/2018/05/generation-demand-then-and-now-2009-2018>

“In direct contrast to the forecasts, actual NEM demand decreased instead of increased, and for a period of time, instead of requiring new supply, the NEM was over-supplied”¹



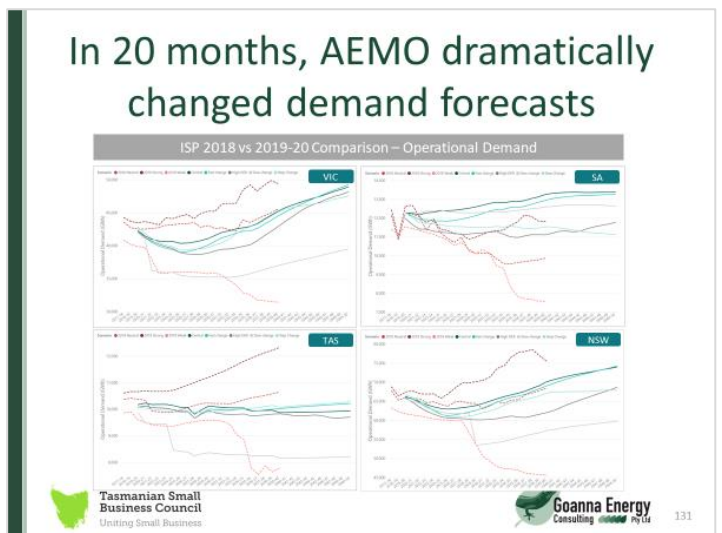
The industry did not predict the almost insatiable appetite of Australian consumers to invest in solar PV.

Figure 66: The Challenge of Forecasting Roof-Top Solar



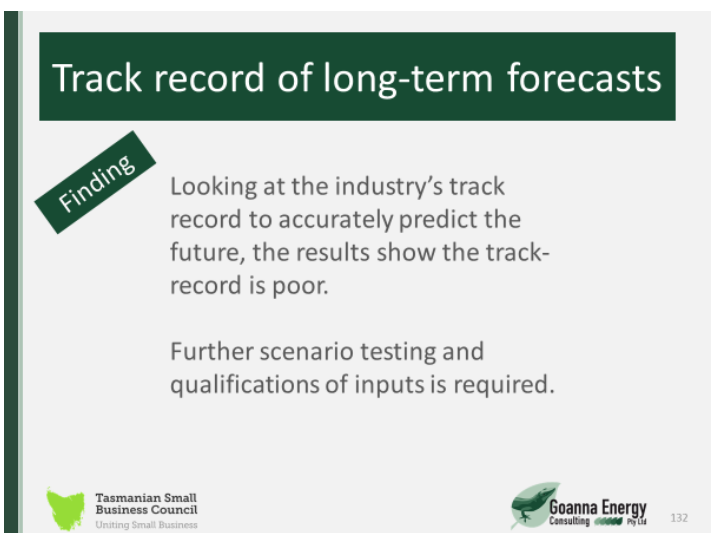
In a relatively short period of time, key assumptions under-pinning the ISP 2018 report were dramatically changed in the draft ISP 2020 version.

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 Associates¹¹ 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.

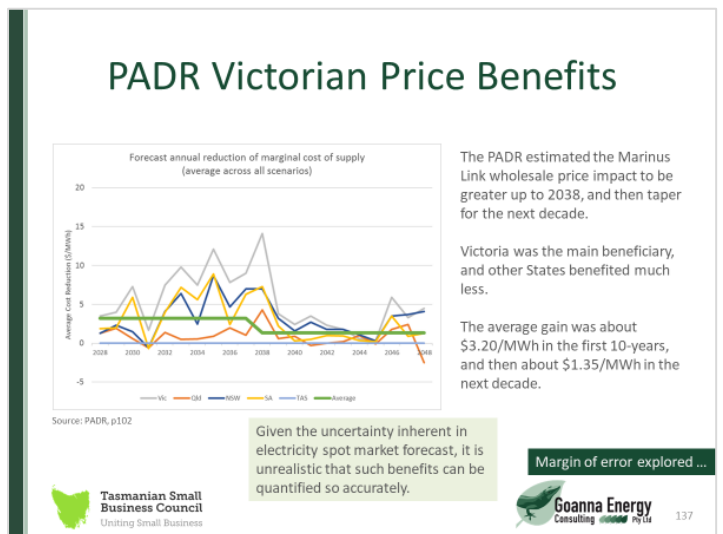
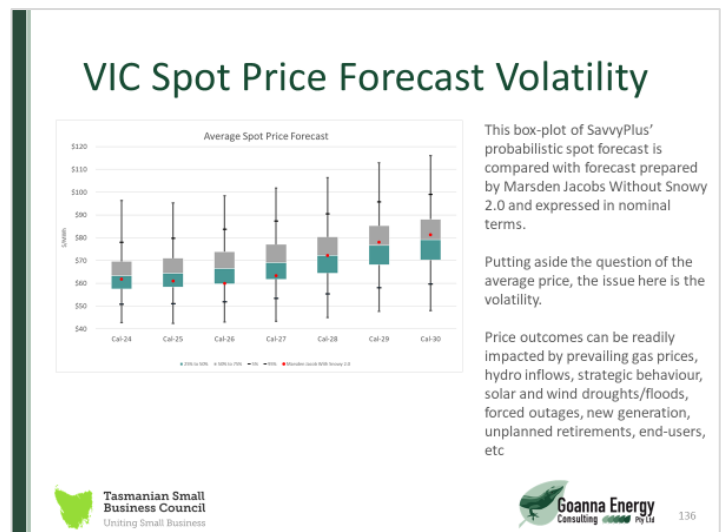
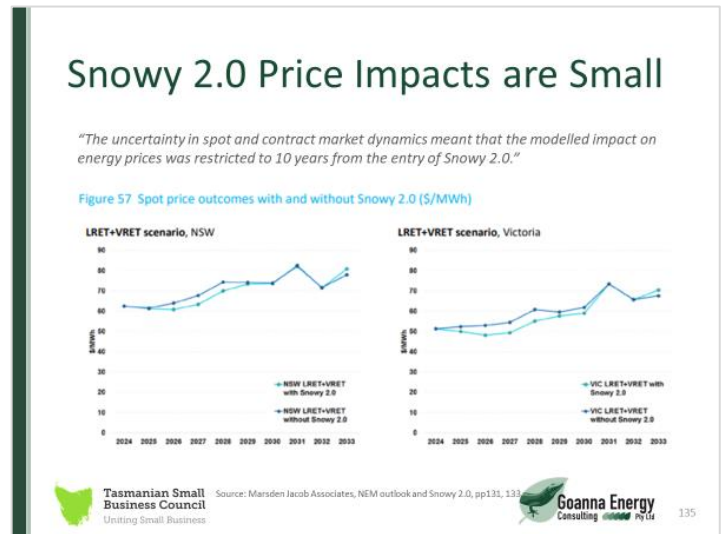
The comparison shows that whilst there are differences in the average price outcome for each year, the SavvyPlus’ probabilistic view shows the inherent volatility of the potential outcomes.

Figure 70: Comparison of Vic Spot Forecasts

Looking at the PADR price impacts underpinning 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

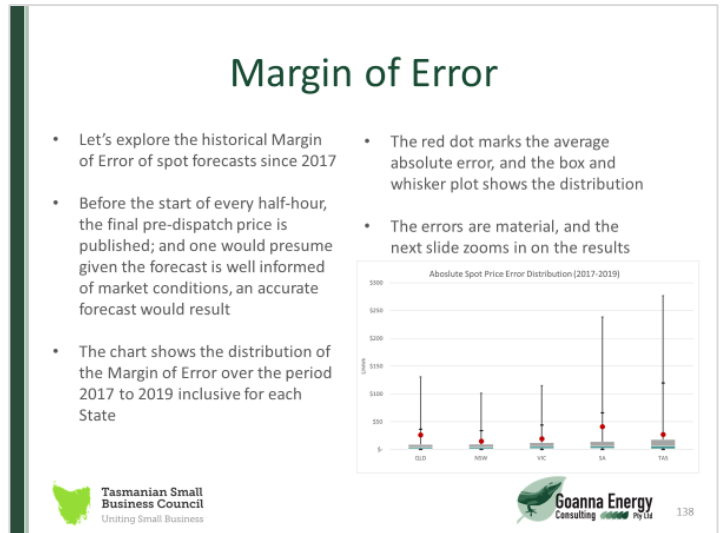


¹¹ Marsden Jacob and Associates, NEM outlook and Snowy 2.0, pp131, 133

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.

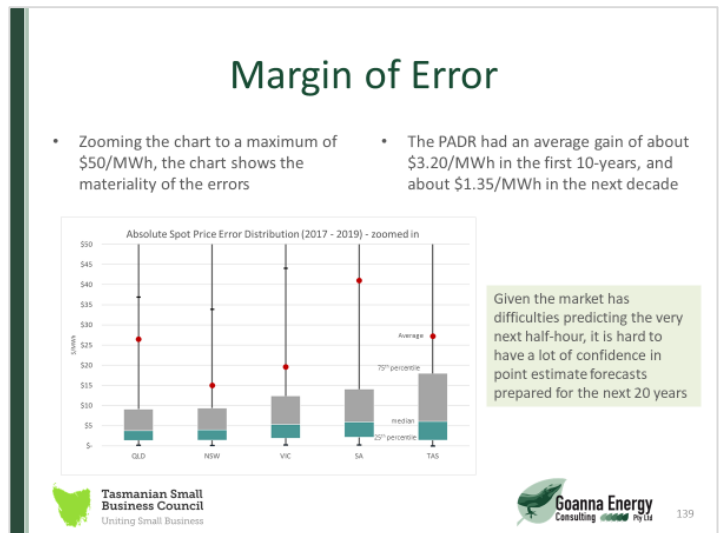
The results show the errors are material (e.g. average Vic absolute error was about \$20/MWh and for Tas was about \$27/MWh), and are represented as a box-and-whisker plot.

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

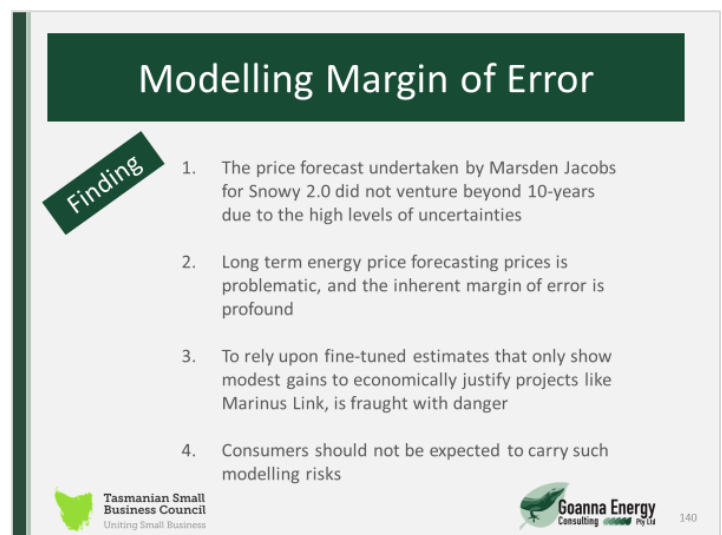


By zooming into the errors less than \$50/MWh, the margin of errors when estimating the next half-hour far exceed the benefits modelled in the PADR in 10- or 20-years' time. The reality is such modelling has a high margin of error, which heightens the risk for consumers who are expected to pay for these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

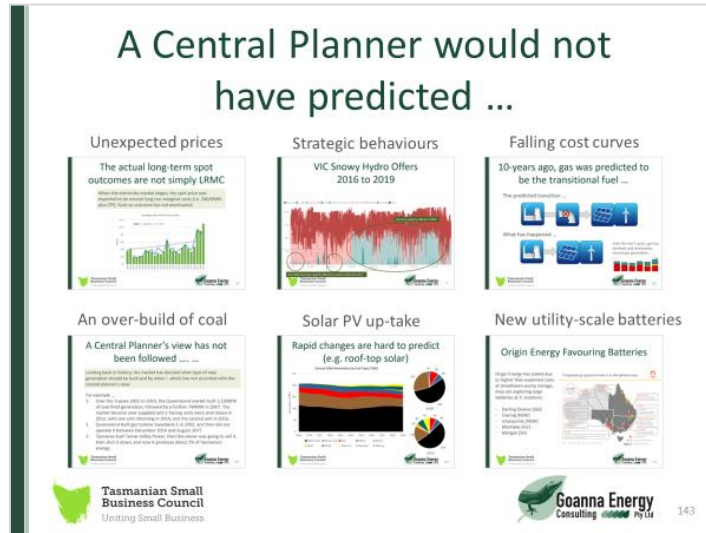


4.4 PROBLEMATIC CENTRAL PLANNING

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.

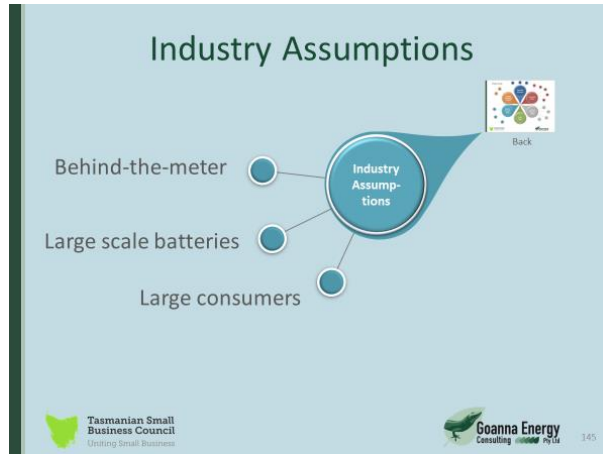
Figure 74: Central Planner Track Record



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.

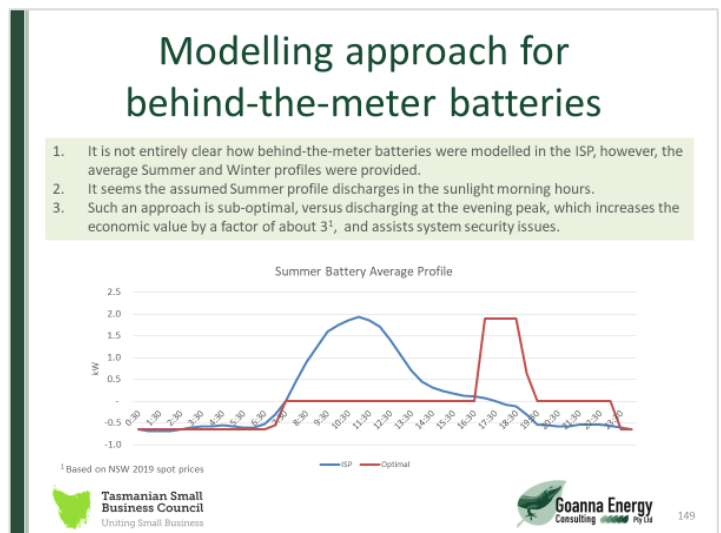
5.1.1 Home Batteries

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

Home Batteries

Hi Alexa, I'm home!

Welcome home. It's been a hot day.

Yes, it was. Did we make any money exporting to the grid today?

Yes, we made over \$100. I'll re-charge the battery later tonight.

Great, thanks.





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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 2.3.8 - *Other Benefits Offered by Battery Link*).

Figure 78: Home Battery Optimisation

Home Optimisation

Through technology, home optimisation will be performed and provided price signals are passed through, will

1. reduce the cost to the consumer; and
2. reduce stress on the grid.

Solar export, avoided costs or charging



Battery management



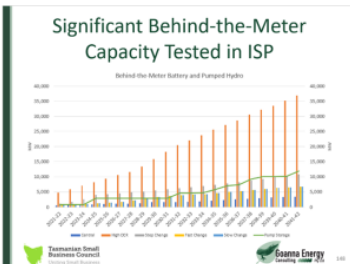
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Depending upon the ISP scenario selected, the amount of capacity available to manage the stress points of the grid would exceed the capacity of pump storage. Even though it would not offer deep storage, it is an asset that we believe is under-modelled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

Figure 79: ISP Battery Capacity and Potential Application



We wonder ...

Significant Behind-the-Meter Capacity Tested in ISP



By the time Yallourn is due to retire in 2032, there could be as much as 5,000 to 20,000 MW of behind-the-meter capacity, many times more than pump-storage.

and then EMV...



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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

2-Way EV Batteries

Hey Alexa, I'm home

Great, I'll play your favourite music

Will you be using the car tonight?

Um, no I'm fine

Great. I'll make you some money

Thank you

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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

Modelling Under-Values EV

In a similar way as home batteries, the ISP assumes a sub-optimal charging regime for EV.

Figure 1.3: Average weekday EV demand by charge profile type assumed for the ESO0 Central scenario in January 2039 in New South Wales

By delaying the evening start charging time, would improve the economic value to the consumer and assist with system security by alleviating demand at a critical period.

What about the cyber risk ...

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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

There is concern about Cyber Risk

- There are concerns if we are too reliant upon behind-the-meter generation and demand side management, we will be too exposed to Cyber Risk
- However:
 - technology and solutions are coming (or could be accelerated)
 - using local control systems can also mitigate this risk as the smart black boxes can act independently

Home Batteries

2-Way EV Batteries

Modelling approach for behind-the-meter batteries

Modelling Under-Values EV

Let's have a parallel look at the banking industry ...

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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

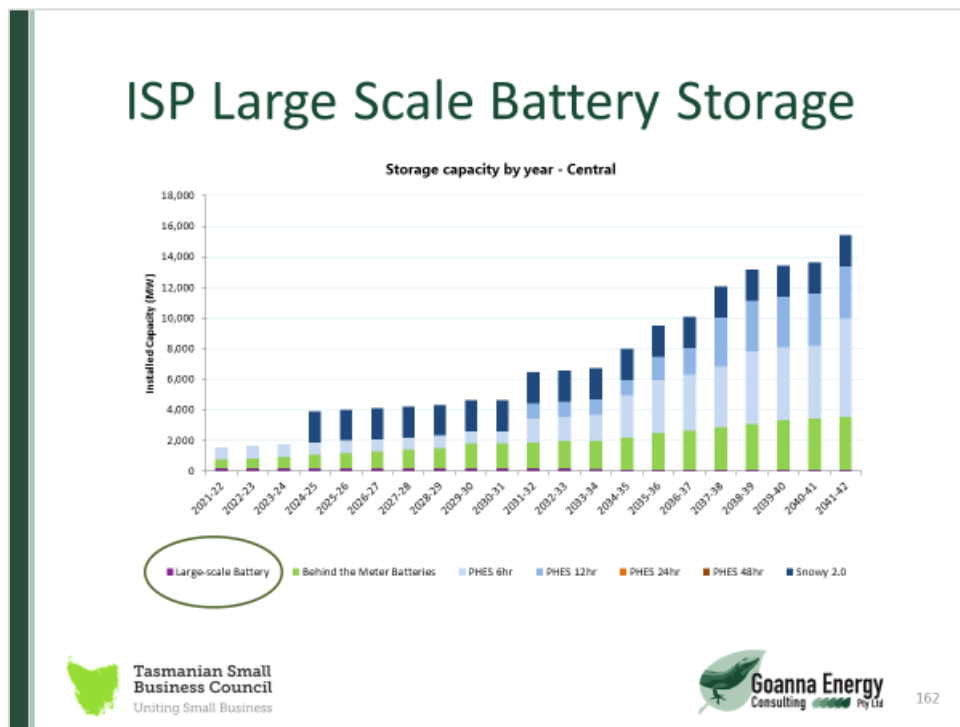


Figure 84: Origin Energy Favouring Batteries

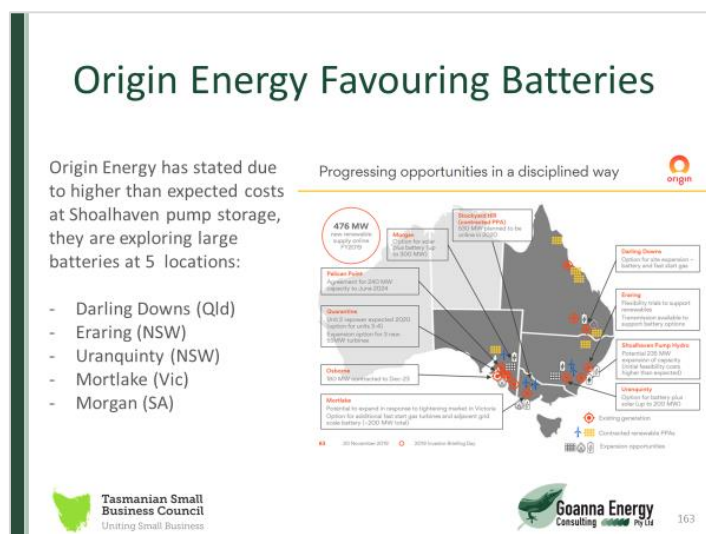


Figure 85: AGL Investing in Batteries

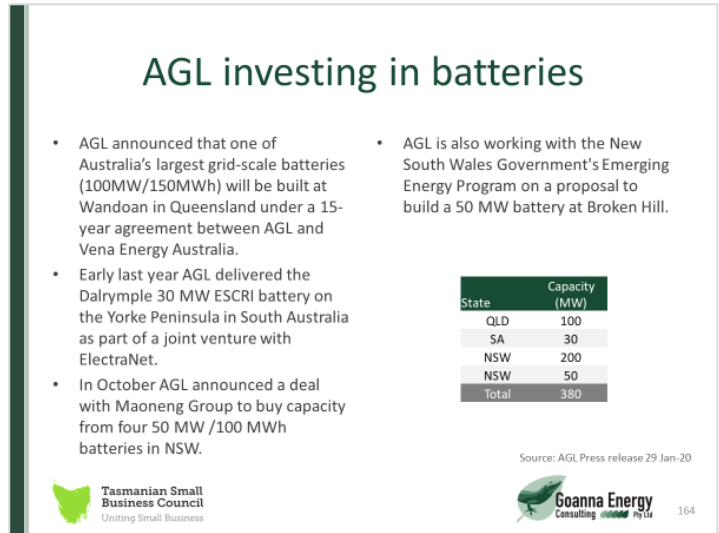


Figure 86: Listed Potential Battery Projects

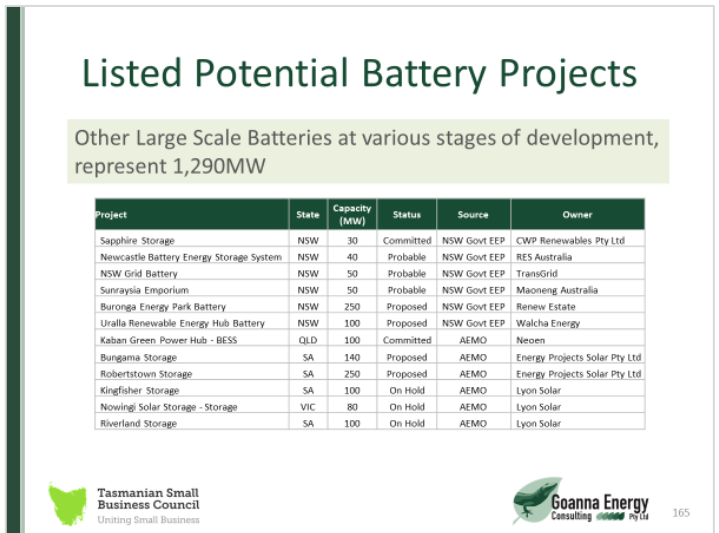


Figure 87: Utility Scale Battery Costs

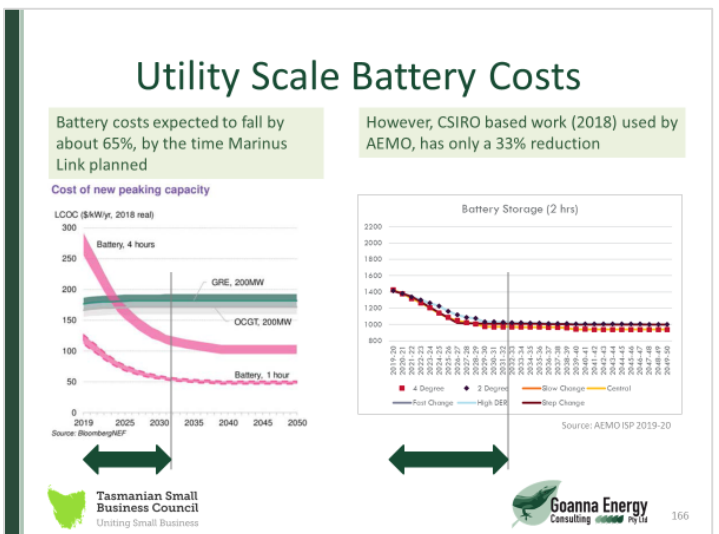


Figure 88: Battery Life and Warranties

Battery Life & Warranties

1 AEMO assumed only a 10-year economic life, yet market battery farm warranties currently being offered are for 15-years

Battery properties

Property	Battery storage (2hrs storage)	Battery storage (4hrs storage)	Virtual Power Plants (aggregated ESS)
Maximum power ¹	1	1	1 MW
Energy capacity	2	4	2.6 MWh
Round Trip efficiency (aggregated) ²			85 %
Charge efficiency (utility)	90	90	%
Discharge efficiency (utility)	90	90	%
Round Trip efficiency (utility)	81	81	%
Economic life	10	10	years
Technical life	15	15	years
Allowable Max State of Charge	90	90	90 %
Allowable Min State of Charge	10	10	10 %

Source: AEMO ISP 2019-20

2 Warranties have become more flexible, allowing the number the cycles per day to be dramatically changed. This increased flexibility, improves the economics substantially.





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Figure 89: Large Scale Battery Findings

Large Scale Battery Storage

Finding

Our conclusion is that:

1. History is being repeated whereby market investors are investing in technologies that differ from a central planner's view.
2. The battery information used in the ISP is out-of-date, leading to a systematic bias away from large scale battery storage.



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5.3 LARGE CONSUMERS


TSBC was surprised to observe that none of the ISP scenarios consider the possibility that a large-scale consumer will face closure. In terms of contingency planning, this is considered a major shortfall in the modelling design.



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)

Looking at the evidence ...



<p>Tomago, NSW (950MW)</p> <p>“At the going rate of \$70/MWh for ‘firmed’ renewables – typically wind or solar backed up by gas power – Tomago doesn’t have a future”¹</p>  <p><small>¹ Tomago, CEO, as reported in the AFR, 7 Feb-20</small></p>	<p>Portland, VIC (800MW)</p> <p>At Victoria’s, Portland smelter:</p> <ul style="list-style-type: none"> Alcoa Chief Executive has announced a global review of 1.5m metric tonnes of smelting capacity, and 4m tonnes of alumina refining “Australia has one of the most expensive energy price markets on the plant” Portland supply agreement with AGL is due to expire 30 Jun-21 The Victoria and Federal Government financing deals are reported to wind-off in mid 2021
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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)

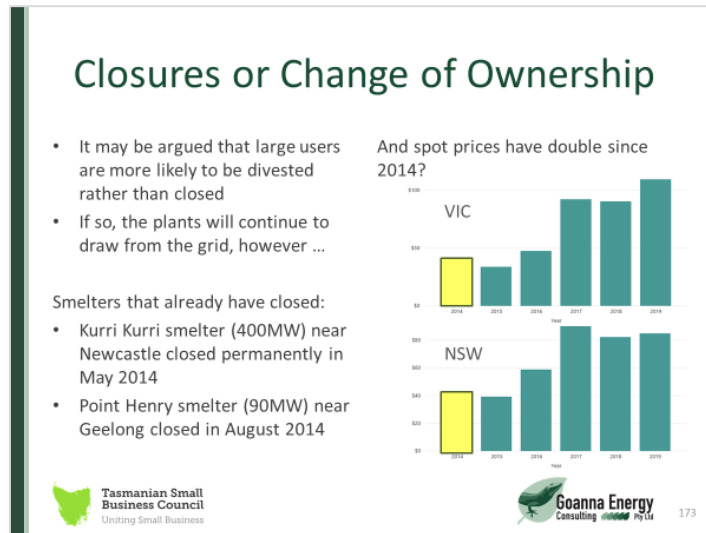
Looking at the evidence ...

<p>Bell Bay Aluminium, TAS (400MW)</p> <ul style="list-style-type: none"> “Bell Bay Aluminium wants a power price cut of 30% to keep smelter open”¹ Current agreement expires at the end of 2025  <p><small>¹ AFR 17 Dec-19 ² AFR 17 Oct-19</small></p>	<p>TEMCO, TAS (90MW)</p> <ul style="list-style-type: none"> “The diversified miner [South32] is considering closing both TEMCO and its other alloy smelter, Metalloys in South Africa, because of shifts in market demand”² 
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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



ENDS

* * * *