Review of Tasmania’s electricity industry

A REPORT PREPARED FOR THE ELECTRICITY SUPPLY INDUSTRY EXPERT PANEL

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Executive summary

The Electricity Supply Industry Expert Panel (Panel) has been established to conduct an investigation into, and provide guidance to Parliament on, the current position and future development of Tasmania’s electricity industry.

Frontier Economics has been appointed to advise the Panel on a number of economic issues related to the Panel’s investigation. The primary objectives of our advice to the Panel are to:

- Assist the Panel in analysing the current economic efficiency of the Tasmanian wholesale electricity sector, and its interaction with related markets, in the context of:
  - Tasmania’s participation in the NEM
  - existing policy and regulatory arrangements
  - efficient management of Tasmania’s hydro-electricity system with its variable water inflows
  - the size and profile of Tasmania’s electricity demand.
- Work with the Panel in the development of structural, regulatory and governance options to address any identified inefficiencies in the performance of the Tasmanian wholesale electricity sector
- Undertake analysis and modelling of structural, regulatory and governance reform options to determine the nature and extent of anticipated changes in the performance of the Tasmanian wholesale electricity sector, including the impact of introducing full retail contestability
- Undertake modelling and analysis of the forward projections for Tasmanian electricity prices, with particular regard to the impact of national carbon pricing arrangements

Efficiency under existing Tasmanian arrangements

Concerns regarding the economic efficiency of the Tasmanian wholesale electricity sector are largely derived from concerns about whether Hydro Tasmania has market power and, if so, how it uses that market power to influence outcomes in the market.

In this report, we analyse historical outcomes and forecast outcomes under existing Tasmanian arrangements to assess three forms of market power:

- Transient market power – the exercise of transient market power is defined as bidding behaviour that does not reflect economic costs and that results in
Executive summary

A higher wholesale spot price than would otherwise be the case for a relatively short period of time.

Our analysis shows that exercise of transient market power is not a significant concern in Tasmania. Our historical analysis of bidding behaviour indicates that there were only a limited number of instances in the period from 2007/08 to 2010/11 when Hydro Tasmania exercised transient market power. Certainly, high price events have tended to be less frequent in Tasmania than in other regions. As a result, allocative and production efficiency losses resulting from transient market power are unlikely to be a significant issue in Tasmania.

- **Sustained market power** – the exercise of sustained market power is defined as bidding behaviour that does not reflect economic costs and that results in average prices that are in excess of the economic costs of serving load on a long term basis.

Our analysis shows that the exercise of sustained market power is also not a significant concern. Our historical analysis indicates that, on average, Hydro Tasmania’s bidding behaviour has tended to be consistent with its fully competitive opportunity cost of water over the period from 2007/08 to 2010/11. Our analysis of observed contract prices supports this conclusion. Our forecasts also support the view that, at its assumed level of hedging contract cover, Hydro Tasmania’s bidding behaviour is consistent with its competitive opportunity cost. In other words, on average, Hydro Tasmania’s bidding behaviour has tended to be consistent with what would be expected in a competitive market. As a result, allocative and production efficiency losses resulting from sustained market power are unlikely to be a significant issue in Tasmania given the external restrictions currently imposed on Hydro Tasmania.

- **Latent market power** – latent market power is defined as the sustained market power that a generator possesses but chooses not to exercise. Latent market power is damaging to the Government’s objective of progressively creating a competitive market in Tasmania because it can have the effect of deterring new entrants. New entrants may be fearful of investing in the Tasmanian market if they expect that, once they have entered, they will be held hostage to the decisions of the incumbents. If new competitors do not enter the Tasmanian market then choice is limited and where there is limited choice there is a lack of competitiveness.

Our analysis shows that the exercise of latent market power is a concern. Indeed, casual observation of the structure of the Tasmanian market will attest to the lack of choice that is available for customers in respect of retailers and in generators to contract with in respect of retailers.
Our historical analysis indicates that Hydro Tasmania is not limited to being able to drive up spot prices only during high demand periods or periods when other generators are not available. Rather, the evidence indicates that Hydro Tasmania is able to drive up spot prices even when demand levels are low and when Tamar Valley is available. Our forecast outcomes also support the view that there are a wide range of demand conditions under which Hydro Tasmania would be able to drive up spot prices if it were not highly contracted. Given this, and given that Hydro Tasmania is ultimately responsible for choosing its contract position (subject, of course, to its risk limits) and, therefore, choosing if and when to be exposed to the spot market, retailers and major energy users are likely to be concerned that they may be subject to Hydro Tasmania’s latent market power in the future. This is likely to act as a deterrent to new entry and investment with potentially significant implications for dynamic efficiency.

**Reform options**

Given concerns about the efficiency implications of outcomes under the existing Tasmanian arrangements, particularly as a result of Hydro Tasmania’s latent market power, in preparing its Draft Report, the Panel is considering three potential reform options for the Tasmanian wholesale electricity sector:

- **Hydro Tasmania Contract Auction** – Hydro Tasmania would be required to formally auction a defined quantity of hedging contracts. The objective would be to ensure that contracts are made available on an ongoing basis to new entrant retailers and new major loads, and to create a competitive process for the sale of these contracts.

- **Vic-Tas Region** – the separate Victorian and Tasmanian NEM regions would be combined into a single pricing region. Under this reform option, the spot price in Tasmania would be determined by dispatch outcomes at the Victorian RRN. The objective would be to create competitive tension within the Tasmanian wholesale electricity sector while leaving all operational and bidding control of Hydro Tasmania’s assets with Hydro Tasmania.

- **Hydro Tasmania Trader** – The Hydro Tasmania Trader reform option would contractually transfer bidding rights over Hydro Tasmania’s capacity to a number of independent Government-owned trading entities. The objective of the Hydro Tasmania Trader reform option would be to create ongoing competitive tension within the Tasmanian wholesale electricity sector without the need to structurally separate or privatise Hydro Tasmania.

We have undertaken wholesale market modelling of outcomes under the Vic-Tas Region reform option and the Hydro Tasmania Trader reform option. Our modelling points to the following general conclusions:
Both the Vic-Tas Region reform option and the Hydro Tasmania Trader reform option result in substantial reductions in Hydro Tasmania’s latent market power. Under these options, the ability and incentive to exercise market power, even in the absence of hedging contracts, is substantially diminished. Indeed, the ability and incentive to exercise market power is comparable to the Base Case, in which Hydro Tasmania is substantially contracted.

For the Hydro Tasmania Trader reform option, the greatest reduction in latent market power occurs when moving from a single Trader to two Traders. Thereafter, the additional reductions in latent market power from increasing the number of Traders are much smaller. However, it is worth bearing in mind that the modelling assumes that the individual Traders act unilaterally. Given that the Traders would remain Government-owned, there may remain some concern among retailers and major energy users that two individual Traders may, more easily, act in a coordinated fashion. If this is the case, there may be an argument more than two Traders in order to address these concerns.

Ultimately, given that our analysis of outcomes under the current arrangements in the Tasmanian wholesale electricity sector concluded that transient market power is not a significant concern, and found no evidence of sustained market power, the benefits to be achieved from these reform options are a result of providing retailers and major energy users that they need not be concerned with latent market power.
1 Overview of this report

The Electricity Supply Industry Expert Panel (Panel) has been established to conduct an investigation into, and provide guidance to Parliament on, the current position and future development of Tasmania’s electricity industry. The terms of reference for the Panel require it to investigate and report on:

- the efficiency and effectiveness of the industry
- the primary factors that have driven changes in electricity prices in Tasmania, including the impact of major infrastructure decisions
- the financial position of the three State-owned electricity businesses
- the implication of national developments and Tasmania-specific circumstances on the future of electricity prices
- actions that would guide and inform the development of a Tasmanian Energy Strategy
- the advice that was provided to the State Government by the senior management or Directors of Aurora Energy from 1 October 2009 to 16 June 2010.

1.1 Frontier Economics’ advice to the Panel

Frontier Economics has been appointed to advise the Panel on a number of economic issues related to the Panel’s investigation. The primary objectives of our advice to the Panel are to:

- Assist the Panel in analysing the current economic efficiency of the Tasmanian wholesale electricity sector, and its interaction with related markets, in the context of:
  - Tasmania’s participation in the NEM
  - existing policy and regulatory arrangements
  - efficient management of Tasmania’s hydro-electricity system with its variable water inflows
  - the size and profile of Tasmania’s electricity demand.
- Work with the Panel in the development of structural, regulatory and governance options to address any identified inefficiencies in the performance of the Tasmanian wholesale electricity sector.
- Undertake analysis and modelling of structural, regulatory and governance reform options to determine the nature and extent of anticipated changes in the performance of the Tasmanian wholesale electricity sector, including the impact of introducing full retail contestability.
Undertake modelling and analysis of the forward projections for Tasmanian electricity prices, with particular regard to the impact of national carbon pricing arrangements.

This report sets out our advice to the Panel on these matters. This report is structured as follows:

- **PART A** describes the framework, methodology and assumptions used in this report, including:
  - Section sets out the framework for assessing outcomes in the Tasmanian wholesale electricity sector
  - Section 3 provides an overview of the economic modelling framework used by Frontier Economics for analysing outcomes in wholesale electricity markets
  - Section 4 sets out the key modelling assumptions used by Frontier Economics in its modelling work for the Panel

- **PART B** provides our analysis of historical outcomes under the existing Tasmanian industry structure and market arrangements, including:
  - Section 6 provides our analysis of historical spot outcomes in the Tasmanian wholesale electricity sector over the last three years
  - Section 7 provides our analysis of observed contract outcomes in the Tasmanian wholesale electricity sector over the same period
  - Section 8 sets out our forecasts of Tasmanian wholesale electricity sector outcomes under the existing structure

- **PART C** provides our analysis of likely outcomes under reform options considered by the Panel, including:
  - Section 10 outlines the reform options considered by the Panel
  - Section 11 provides our analysis of the Vic-Tas Region reform option
  - Section 12 provides our analysis of the Hydro Tasmania Trader reform option.
PART A – Framework, methodology and assumptions
2 Framework for assessment

The Tasmanian Government has been committed to delivering lower electricity prices to customers. In 2001 the Tasmanian Government embarked on a series of reforms designed to initiate the development of a competitive electricity market in Tasmania. These reforms included:

- Vertically separating the retailing, transmission and generation functions to provide the structural footings for the development of electricity wholesale and retail competition
- Adopting the National Electricity Market rules and system for bidding, dispatch and price setting
- Securing the reliability of supply for Tasmanian’s by investing in the interconnect with the mainland through Basslink and sponsoring the completion of Tamar Valley gas turbine

Now that these reforms are bedded in the Government is considering additional reforms to accelerate the pace of the development of competition in Tasmania with the aim of putting more downward pressure on electricity prices.

Frontier Economics’ task includes advising the Panel on the economic efficiency of the current Tasmanian wholesale electricity sector and advising the Panel on the effects on economic efficiency of the Reform Options. In order to provide this advice, it is important to have a framework for assessing economic efficiency. This section explains the economic framework we have adopted.

2.1 Choice and competition

The key driver of competition is customer choice. If customers have choice of suppliers then suppliers will have to compete for sales. Suppliers will compete through the quality and range of services they provide but mostly through the price they offer, particularly for a service such as electricity supply where the ability to differentiate products is limited. If there is limited choice customers will receive poor and/or high priced service.

Currently, the Tasmanian market is characterised by:

- a dominant generator that owns and operates 2,276 MW of capacity that supplies around 80 per cent of Tasmania’s electricity demand
- a dominant retailer (Aurora) that serves the vast majority of customers in Tasmania. Aurora also operates the low voltage distribution system and owns and operates the 387 MW Tamar Valley gas power station that supplies just over 10 per cent of the State’s electricity demand
- a separate high voltage transmission company (Transend)
two major wind farms (Woolnorth) with a capacity of 140 MW owned by Hydro Tasmania. The vertically separated Tasmanian market is dominated by a single large participant at each functional layer of the market. While dominance of the regulated network functions does not cause any competition issues, dominance at the generation and retail levels does limit customer choice and, hence, competition.

For example, retailers who wish to enter the Tasmanian market have the choice of negotiating with Hydro Tasmania who serves 80% of the market, or a competitor retailer (Aurora) who owns and operates the only other major generator plant (Tamar Valley gas turbine). Alternatively a new retailer can organise relatively complicated and risky inter-regional hedges to support their entry to the Tasmanian market. None of these choices are likely to be conducive to easing retailer entry to the Tasmanian market.

In terms of customer choice, of those customers who are entitled to choose their electricity retailer (i.e. any customer that uses more than 50MWh), in practical terms, only very large users have a choice of being supplied by the incumbent retailer, Aurora, and new entrant ERM, who specialises in supplying large industrial and commercial loads. No retailer other than Aurora is active in competing for medium sized customers in Tasmania. Therefore, on any measure Tasmanian electricity customers either have no choice of their retailer or very limited choice.

If the Tasmanian Government wishes to accelerate the development of competition in the electricity market so that there is greater downward pressure on costs and prices then it must focus on developing and implementing reforms that extend the range of choice of generators that retailers can trade with and, similarly, extend the range of retailers that customers can contract with.

### 2.2 Market power

Concerns regarding the economic efficiency of the Tasmanian wholesale electricity sector are largely derived from concerns about whether Hydro Tasmania has market power and, if so, how it uses that market power to influence outcomes in the market.

Market power is of concern to policy makers because it can harm economic efficiency and welfare. The following section defines the concept of economic efficiency and considers the relationship between market power and economic efficiency. Before turning to questions of efficiency, however, it is important to define what is meant by the term market power.

There is an extensive literature in economic theory and competition case law that seeks to define market power. While market power may be described in different
ways by different economic theorists or in different case law judgements, there is a common theme that runs through most concepts of market power. In essence, it is the idea that in competitive markets, firms (either acting individually or in concert) are unable by their own actions to influence the level of output and prices in the market. In turn, this means they are unable to reduce the supply of their product to increase its price above its cost. Each firm in a competitive market is said to be a ‘price taker’. By contrast, where a firm has market power, it is able to influence the market price of its product by choosing to supply less. By restricting its output, it is able to increase price above cost. In other words, it becomes a ‘price maker’.

An important finding in both economic theory and competition law is that the ability of a firm to increase prices above cost is of less concern if this ability is only temporary in nature. This is because short term outbreaks of market power tend to result in small, if any, economic efficiency loss. This is explained in the famous words of the United States Attorney-General’s National Committee to Study the Antitrust Law in its report of 1955:

The basic characteristic of effective competition in the economic sense is that no one seller, and no group of sellers acting in concert, has the power to choose its level of profits by giving less and charging more. Where there is workable competition, rival sellers, whether existing competitors or new or potential entrants into the field, would keep this power in check by offering or threatening to offer effective inducements …

In this regard it is worth reflecting on what French J (as he was then) said in his AGL decision:

No doubt, as Victoria’s largest generator, it is in a position opportunistically to respond to supply/demand imbalance in very short time intervals and if all the variables are in the right place, to affect both spot and forward contract prices. The question is whether the existence of such opportunities and the fact that it responds to them from time to time reflects the existence of market power. There is here a distinction to be drawn between what was referred to as ‘transient market power’ and ‘persistent but intermittent’ market power.

Further:

I am prepared to accept that there are periods of high demand where a generator may opportunistically bid to increase the spot price. I do not accept that such inter-temporal market power reflects more than an intermittent phenomenon nor does it reflect a longrun phenomenon having regard to the possibilities of new entry through additional generation capacity and the upgrade of interconnections between regions. It does not amount to an ongoing ability to price without constraint from competition.

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1 Quoted in Brunt, *op. cit*, p. 95.
3 Para 493.
It is possible to specify a spectrum of definitions of generator market power, with transient market power at one end of the spectrum and sustained market power at the other end.

### 2.2.1 Transient market power

For the purposes of this analysis, the exercise of transient market power will be defined as bidding behaviour that does not reflect economic costs and that results in a higher wholesale spot price than would otherwise be the case for a relatively short period of time. Focusing on Hydro Tasmania, this implies that the exercise of transient market power will be defined as bidding behaviour that does not reflect the opportunity cost to Hydro Tasmania of dispatching its water and that results in a Tasmanian spot price in excess of what it would otherwise be for a relatively short period of time.

The extent of transient market power in the Tasmanian wholesale electricity sector will be assessed by identifying price spikes that have occurred in Tasmania, analysing Hydro Tasmania’s bidding behaviour during these periods and determining whether Hydro Tasmania’s bidding behaviour during these periods can be explained by reference to economic costs. This is discussed in more detail in Section 6.2.

### 2.2.2 Sustained market power

For the purposes of this analysis, the exercise of sustained market power will be defined as bidding behaviour that does not reflect economic costs and that results in average prices that are in excess of the economic costs of serving load on a long term basis. Focusing on Hydro Tasmania, this implies that the exercise of sustained market power will be defined as bidding behaviour that does not reflect the opportunity cost to Hydro Tasmania of dispatching its water and that results in Tasmanian wholesale prices that are in excess of economic costs on a sustained basis. Hydro Tasmania might exercise sustained market power in either the spot market (by bidding in the spot market in excess of economic costs on a long term basis) or through its wholesale contracting (by pricing contracts in excess of economic costs on a long term basis).

The extent of sustained market power operating in the Tasmanian wholesale electricity sector will be assessed in two ways. First, by identifying whether the spot prices bid by Hydro Tasmania have exceeded the opportunity cost of water on a long term basis. This approach has been adopted because over the long run, bidding in a competitive market should reflect costs and the competitive market should produce average spot prices that would cycle around LRMC. This is discussed in more detail in Section 6.3. Second, by identifying whether there is evidence that Hydro Tasmania’s observed contract prices have exceeded the opportunity cost of water on a long term basis.
2.2.3 Latent market power

The concepts of transient and sustained market power are almost always discussed in terms of the exercise of market power through bidding behaviour and, to a lesser extent, through contracting behaviour. As a result, the overt use of transient and sustained market power can generally be observed through careful analysis of market behaviour and market outcomes, particularly where regulators have the power to require market participants to reveal information, such as hedging contracts.

However, generators may possess market power without choosing to overtly exercise that market power, and by definition it is less obvious, but may be equally damaging to consumers interests.

A generator may choose not to overtly exercise market power for a number of reasons. For instance, a generator may be concerned about attracting greater attention from regulators if it visibly exercises market power in the spot market. A Government-owned generator may also be concerned about shareholder intervention if it exercises market power in the spot market that has the effect of increasing electricity prices. A generator may also have no incentive to exercise market power in the spot market if it is highly contracted; in this case, the profit to the generator of bidding up spot market prices is diminished by the presence of contracts, at least in the short term.

Generally speaking, policy makers seem less concerned with market power that is not exercised. However, in the longer term, the presence of a generator with market power, even if not exercised, may act as a disincentive for investment by large consumers, retailers or even other generators. In terms of consumers and retailers, they will be concerned that if they invest in a market comprising generators that could exercise market power on a sustained basis that, once they enter the market, generators will exercise that market power, thereby undermining the consumers’ and/or retailers’ returns. On the other hand, potential new entrant generators will be concerned about the prospect that incumbent generators with market power, keen to deter any further entry that may erode their ability to sustainably control prices, may use their market power to suppress prices in order to destroy the value of the new entrants’ (sunk) investment in a new power station.

This latter concern by potential new entrant generators is probably exacerbated in instances where the incumbent generators with market power are Government owned. The reason for this additional concern is that new generators will be concerned that a Government may not act to prevent their generator reducing prices, even if it results in the market remaining concentrated in the long term. A Government may be reluctant to rebuke a Government owned generator from artificially suppressing prices because it will be concerned that the public will accuse the Government of interfering with a commercial business, albeit
Government owned. The Government may also be concerned about the risk of its rebuke to their business for suppressing prices being interpreted as a direction to gouge customers in order to fill State coffers. In any case, whether the new entrants’ concerns are real or perceived, to the extent that it deters them from entering the market, it will result in long term damage to the competitiveness of the market.

For the reasons described above, in this analysis, we will also assess the extent of market power in the Tasmanian wholesale electricity sector that is present but not exercised – which for the purposes of this analysis we refer to as latent market power. Latent market power will be defined as the sustained market power that a generator possesses but chooses not to exercise. This is discussed in more detail in Section 8.4.

2.3 Wholesale market efficiency

Policy makers are concerned with market power because the presence of market power can have detrimental effects on the efficiency of market outcomes. Economists typically think about efficiency across three dimensions:

- Allocative efficiency – refers to how well a market allocates resources to their highest-valued uses
- Productive efficiency – refers to the maximisation of outputs for given inputs or, alternatively, the production of given outputs for the minimum inputs
- Dynamic efficiency – refers to how well investment in new capital stock reflects efficient resource allocation over time

These efficiency concepts, in the context of the NEM, are discussed in more detail in the sections that follow.

2.3.1 Allocative efficiency

In the context of the NEM, allocative efficiency involves supplying consumers with electricity up to the point that their willingness to pay for electricity equals the marginal cost of supplying additional electricity. If prices are higher or lower than the level at which consumers’ willingness to pay equals the marginal cost of supply, this can result in a loss of potential welfare to the market, described as a ‘deadweight loss’.

The extent to which inefficiency results from prices being too low or high will depend on consumers’ responsiveness to electricity prices. If consumers consume the same amount of electricity irrespective of the price of electricity then no allocative inefficiency will result whether prices are too high or low.

In the short run, electricity demand is highly ‘inelastic’, meaning that it is relatively unresponsive to price. This means that any deadweight loss arising due
to the exercise of transient market power will be low to non-existent. This is one reason why transient market power is of little concern from an allocative efficiency perspective.

However, if demand is not perfectly inelastic – which is more likely to be the case in the longer term – then prices that are too low or high could be of more concern.

The fact that allocative inefficiency is more likely to emerge over a longer timeframe – when consumers can adjust their consumption of electricity in the face of higher prices – suggests that generator market power in the NEM is only likely to result in allocative inefficiency if it is sustained. Short term spikes in price caused by the exercise of transient market power are unlikely to result in any material inefficiency, not least because virtually every consumer is shielded from price spikes by the nature of the contract they have with a retailer.

### 2.3.2 Productive efficiency

In the context of the NEM, productive efficiency typically refers to serving load at least (avoidable) resource cost. This requires that the ‘cheapest’ generation (in terms of its short-run marginal cost or SRMC) is dispatched to meet load first and progressively more expensive generation is dispatched to meet load as the availability of cheaper generation is exhausted. This is the process by which the NEM dispatch engine, NEMDE, seeks to dispatch the market.

Any generator bidding above its SRMC or refraining from offering all its available capacity to the market can result in more expensive generation operating in place of cheaper generation. To the extent this occurs, it has the effect of increasing the resource costs of serving load (as well as the market price) and results in a loss of productive efficiency in the form of a deadweight loss.

### 2.3.3 Dynamic efficiency

In the context of the NEM, dynamic efficiency generally refers to the optimality of investment decisions. This can refer to investment decisions in generation assets or downstream investment decisions (including in retailing).

**Generation investment decisions**

Dynamic efficiency in generation generally refers to the optimality of the type, timing, size and location of new generation investment.

To understand dynamic efficiency in the context of the NEM, it is necessary to understand how incentives for investment occur within the design of the market. The NEM was designed as an energy-only market in which all plant would recover its variable and fixed costs through the spot market (and derivatives contracts settled against spot market outcomes). For this to happen, the spot price must be able to rise, at least occasionally, above the SRMC of the most
expensive plant in the market. Otherwise, that most expensive plant will not be able to recover its fixed costs. In a market with perfectly competitive bidding, prices in the spot market can rise above the SRMC of the most expensive plant only in the event of:

- voluntary load shedding – in which case the spot price is set by demand-side bids, or
- involuntary load shedding – in which case the price is set at the Market Price Cap (MPC)

Putting voluntary demand-side bids to one side, this means that there is a strong interdependence between the level of the MPC, generator costs and the duration of unserved energy. In an efficiently operating energy-only market, and with the MPC set at the required level, the spot price will provide signals for new investment to meet the targeted volume of unserved energy.

The energy-only market design is not only intended to result in installed generation capacity consistent with the targeted level of unserved energy, it can also produce an efficient technology mix of plant. In an efficiently operating energy-only market, for a given MPC, existing generation mix and shape of load, price-taking generator bidding behaviour should result in the optimal technology mix and timing of generation investment, as well as the optimal operation of these generators, together ensuring that long-run total costs of meeting load are minimised.

In practice, no energy-only market meets this theoretical ideal. One reason is that where there is market power in the generation sector, investment incentives may not match those that would occur in a fully competitive market. Whether this is the case will depend on the behaviour of generators with market power. If they exercise market power by increasing spot prices, then this may encourage investment before it is required on the basis of economic costs. However, recognising this, generators with market power may themselves invest in new generation prematurely and leave it idle in order to create an entry barrier (sunk capital costs can be a powerful barrier to entry in a capital intensive industry such as electricity generation).

It is important to recognise that there are a number of factors other than spot prices that affect investment decisions in generation plant. These include:

- the availability of fuel, land, water and the transmission infrastructure
- environmental obligations
- uncertainty over the introduction and nature of climate change policies

Many of these other influences will be far more important to the pattern of generation investment than market power in the generation sector leading to high spot prices.
It is also important to recognise that in Tasmania, new investment is unlikely to be required to meet demand for a number of years. The AEMO 2011 ESOO forecasts that new investment is not required in Tasmania until some point beyond 2021. Frontier Economics’ modelling suggests that (taking account of new wind investment in Tasmania to meet the LRET) new investment is not required in Tasmania until 2029. Given how long it is before new investment will be required in Tasmania, it is unlikely that the exercise of market power in the generation sector will significantly bring forward investment. Even if prices are high, investors will likely be concerned about the price impacts and profitability of new investment in a market with excess capacity, particularly if Hydro Tasmania possesses sufficient market power to suppress prices.

For these reasons, in the context of the Tasmanian energy sector, concerns about dynamic efficiency are more likely to arise in relation to downstream investment decisions.

**Downstream investment decisions**

Prices that are inefficiently high for an enduring period may have implications for downstream investment decisions in the NEM.

For electricity retailers, if prices are expected to be higher on average price and more volatile than they would be otherwise, retailers may change the type of hedging contracts they seek to help manage their spot market risks. It may also mean that retailers require higher margins to help compensate for any greater risk that cannot be managed by altering their mix of hedge purchases. Ultimately, a higher level of risk faced by retailers in purchasing energy from the wholesale market may deter new retailers from entering the market, particularly where prices remain regulated and do not reflect all the risks of retailing.

For customers, if prices are expected to be higher on average than they would be otherwise, customers may, in the long run, choose not to invest in electrical appliances or facilities or to invest in appliances or facilities that consume less power than would be efficient given underlying economic costs and benefits. While a short term reduction in demand by consumers in response to higher prices due to transient market power is unlikely to impose significant economic costs, more substantial costs can accrue over the long run. Furthermore, where customers – small or large – make investments that require costs to be sunk, they may respond to expectations about future electricity prices as well as actual electricity prices. In this case, even the expectation by customers that market power may be an issue may result in reduced or distorted demand-side investment and an associated deadweight loss.

This can be the case for both for small customers – residential and businesses – and large industrial customers.
3 Modelling methodology

A number of aspects of our advice to the Panel are informed by electricity market modelling. This section provides a brief overview of the modelling framework we have used to undertake this electricity market modelling.

3.1 Frontier Economics’ relevant energy market models

In modelling outcomes in the Tasmanian wholesale electricity sector, we have adopted a two-staged modelling approach that makes use of two proprietary electricity market models: WHIRLYGIG and SPARK. The key features of these models are as follows:

- **WHIRLYGIG** optimises total generation cost in the electricity market, calculating the least cost mix of existing plant and new plant options to meet load. WHIRLYGIG determines the least cost investment in, and operation of, generation plant to meet demand and to meet any regulatory obligations (such as renewable energy targets).

- **SPARK** uses game theoretic techniques to identify rational and stable bidding behaviour by generators in the electricity market. SPARK determines rational and stable bidding strategies by having regard to the scope for each generator to improve its position by changing it bids given the bids of other generators. The model determines profit outcomes from all feasible bidding combinations (and likely reactions to these combinations) and identifies those sets of bidding strategies that represent Nash equilibria. A Nash equilibrium is a set of bidding strategies where no generator has the ability to unilaterally and profitably deviate from its strategy. The output of SPARK is a set of equilibrium dispatch and associated spot price outcomes.

Both WHIRLYGIG and SPARK incorporate a representation of the physical infrastructure in the NEM that includes demand forecasts for each region in the NEM, all existing generation plant in the NEM (including technical and cost information for those existing plant), all existing inter-regional interconnectors in the NEM and options for new generation plant.

3.2 Modelling methodology

**WHIRLYGIG** and **SPARK** are integrated models. WHIRLYGIG modelling provides least cost investment and least cost dispatch outcomes for the generation sector, both of which become inputs into SPARK:

- Least cost investment is an important input into SPARK because as electricity demand grows over the modelling period there will usually be a need for new
investment simply to meet reserve constraints. Undertaking market modelling without incorporating this new investment would be unrealistic.

- Least cost dispatch is used in *SPARK* to frame the strategic decisions of certain generators. In particular, strategic decisions for hydro generation plant are framed in *SPARK* as decisions to withhold capacity relative to the efficient dispatch level derived from *WHIRLYGIG*. This is important in order to account for the energy constraints faced by hydro generation plant (due to the size of their inflows and storages) when modelling specific demand levels in *SPARK*. This relationship between the models is illustrated in Figure 1. For a given demand profile and stock of other generation plant, *WHIRLYGIG* will determine the efficient dispatch level for a hydro generation plant, subject to that plant’s capacity, inflows and storage levels. Within *SPARK*, the hydro generation plant will have the option to operate to that same efficient dispatch level, or to strategically withhold capacity below that efficient dispatch level.

Frontier Economics’ advice to the Panel requires modelling of a Base Case as well as two reform options: the Vic-Tas Region and the Hydro Tasmania Trader. The framework for modelling these three cases is illustrated in Figure 2. The same *WHIRLYGIG* modelling is appropriate for each modelling case: because the reform options do not alter the physical characteristics of the power system, least cost outcomes modelled under *WHIRLYGIG* will not change. However,
different SPARK modelling is required for each modelling case to account for the potential change in strategic incentives resulting from the reform options.

Figure 2: Modelling framework
4 Modelling assumptions

This section provides a brief overview of the key electricity market modelling assumptions we have used to model the effects of the reform options on the Tasmanian wholesale electricity sector.

Where possible, we have used input assumptions developed by AEMO. We adopted this approach on the basis that the input assumptions developed by AEMO are commonly used for modelling work of this type and, to varying extents, can be considered an industry standard. Therefore, to a large extent, we have relied on the following sources:

- **AEMO, Electricity Statement of Opportunities for the National Electricity Market, 2011** (AEMO 2011 ESOO). This is the source for system demand forecasts used in Frontier Economics’ modelling.

- **AEMO, National Transmission Network Development Plan, 2010** (AEMO 2010 NTNDP). The NTNDP Modelling Assumptions (supplied by ACIL Tasman and EPRI) and the NTNDP Input Tables, both released with the AEMO 2010 NTNDP, are the sources for most of the input assumptions for existing and potential new generation plant.

4.1 NTNDP scenarios

The National Transmission Network Development Plan (NTNDP) examines the future of the NEM through five market development scenarios. These scenarios reflect a range of plausible future market input variables and policy settings facing the energy industry and investors.

None of the NTNDP scenarios represent a base case forecast, or a forecast that reflects the most likely state of the world. The NTNDP scenarios are designed to reflect “different combinations of the principal energy sector and national transmission network development drivers”. AEMO makes clear that none of the five scenarios is a base case but neither does each scenario have an equal probability of occurring.

While none of the five scenarios is a base case, for a number of input assumptions that will be important determinants of the outcomes from this modelling project (including capital costs for new generation plant and fuel costs), the Decentralised World scenario has input assumptions that fall within the range for the other scenarios. Therefore, for these key input assumptions, the Decentralised World scenario provides as close to a mid-point as is available.

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from the NTNDP. For this reason, we largely adopted the input assumptions from the Decentralised World scenario for all WHIRLYGIG and SPARK modelling. The key exceptions to this are the assumed carbon price and demand forecasts, which are discussed in more detail below.

4.2 Modelling period

**WHIRLYGIG**

WHIRLYGIG modelling for the Base Case provides a forecast of least cost investment in, and operation of, generation plant to meet demand.

In order to appropriately account for long term investment in the presence of regulatory schemes such as the Large-Scale Renewable Energy Target (LRET), WHIRLYGIG modelling covers the period from 2011/12 to 2029/30.

**SPARK**

For each case that is modelled, SPARK modelling provides a set of Nash equilibrium bidding patterns for generators in the NEM, and the power station dispatch outcomes and pool prices outcomes that correspond to these equilibrium bidding patterns.

For each case that is modelled, SPARK modelling covers the period from 2011/12 to 2015/16. For the reform options, it is assumed that the reform option is implemented from the beginning of 2011/12. This provides five years of modelling results for which the outcomes under the reform options can be compared with the outcomes under the Base Case.

4.3 Discount rate

WHIRLYGIG optimises the total system costs of meeting demand over the entire modelling period. Total system costs are calculated as a net present cost in a specified base year using an assumed discount rate. The objective to be minimised by the model is net present system costs.

For the purposes of all modelling, we used the WACC of 9.79% from the Decentralised World scenario.

4.4 Electricity demand forecasts

In modelling outcomes in the Tasmanian wholesale electricity sector, it is necessary to appropriately account for both the size and profile of Tasmania’s electricity demand and the size and profile of demand in other NEM regions. The approach and assumptions we have used to develop the required demand forecasts over the modelling period are as follows:
The starting point is a half-hourly load profile for each NEM region. We have used the historic half-hourly load profiles for each NEM region since the start of the NEM to create a half-hourly load profile for each NEM region that reflects an average of these years.

Modelling every half-hourly demand point in a year is computationally very demanding. To make the modelling problem more tractable, we model a representation of the half-hourly load profile of each NEM region for each year, rather than the full half-hourly load profile for each year. The representative load profile for a region is generated by averaging regional demand during those half hours over a year in which demand is broadly similar. We select representative demand points to capture the shape of each region across the year, but also to preserve the correlation in demand between regions. This method allows us to best capture the correlation in demand between the different NEM regions in our forecasts while reducing the number of demand levels to be modelled from 8760 to a few dozen.

For each NEM region, the representative half-hourly load profile is then scaled to reflect forecast growth in both total demand and peak demand. We used the forecasts from the AEMO 2011 ESOO to scale the representative half-hourly load profiles.

Having reviewed the demand forecasts from the AEMO 2011 ESOO, we decided generally to adopt the low growth, 50% probability of exceedence demand forecasts for summer and winter to scale the representative half-hourly load profile for each year of the modelling period. The reason is that over recent years, medium growth forecasts from the ESOO have tended to imply growth rates significantly greater than actual historical growth rates, particularly in Queensland and New South Wales. Figure 3 shows all previous ESOO medium demand forecasts, as well as actual demand. Growth in actual demand in Queensland and New South Wales has been almost flat over the last 3 or 4 years. However, over that time, ESOO demand forecasts have continued to forecast significant growth rates. Comparing actual demand (the dashed black line) with the AEMO 2011 ESOO medium demand forecasts (the dashed red line) shows that there is a substantial difference between actual growth rates and forecast growth rates.
Given that medium demand forecasts over recent years have tended to overstate the rate of growth in demand, we decided to adopt the low demand forecasts from the AEMO 2011 ESOO. Figure 4 compares the three demand forecasts from the AEMO 2011 ESOO for each NEM region. This shows that the low demand forecasts typically have a lower growth rate, and one that is more consistent with historical growth rates.

One exception to the tendency for AEMO’s medium demand forecasts to overstate actual demand is Tasmania. Figure 5 compares the three demand forecasts from the AEMO 2011 ESOO for Tasmania only. This shows that the medium demand forecasts for Tasmania are quite consistent with historical growth rates. For this reason, for Tasmania only, we decided to adopt the medium demand forecasts from the AEMO 2011 ESOO.
Figure 4: AEMO 2011 ESOO demand forecasts – all regions

Source: AEMO

Figure 5: AEMO 2011 ESOO demand forecasts – Tasmania

Source: AEMO
The same system demand forecasts are used as an input to both *WHIRLYGIG* and *SP.ARK*. Importantly, however, in addition to using the low growth (or medium growth for Tasmania) 50% probability of exceedence demand forecasts to develop load profiles for each year, we also used the low growth (or medium growth for Tasmania), 10% probability of exceedence demand forecasts for summer and winter for the purpose of modelling reserve constraints. These 10% probability of exceedence demand forecasts are assumed to be 100% co-incident across NEM regions, implying that maximum demand occurs in each NEM region at the same time. This assumption of co-incident is made to ensure consistency with AEMO’s reported regional reserve margins in the reserve constraints.

### 4.5 Existing NEM generation plant

This section provides an overview of the key input assumptions we adopted for existing generation plant.

#### Capacity and ownership

We used the latest information available from AEMO’s website on existing and committed scheduled and semi scheduled generation plant in each region of the NEM. This provides both the identity of existing and committed generation plant and the summer and winter capacity of these generation plant.

In addition, our market modelling (using *SP.ARK*) also requires information on ownership of existing generation plant. We used up-to-date publicly available information on plant ownership in its modelling.

#### Outage rates

We used information on equivalent forced outage rates and planned maintenance rates from the NTNDP Input Tables.

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8. The exception is the equivalent forced outage rate for OCGT plant which is in excess of 25% in the 2010 NTNDP Input Tables. This outage rate reflects the fact OCGT plant may be unavailable during shoulder periods. However, the forced outage rate of OCGT plant during peak periods (when their capacity is needed) is much lower. For this reason, Frontier Economics has used an equivalent forced outage rate of 3% for OCGT plant.
Our modelling approach is to derate all generation plant at a flat outage rate throughout the year. The assumption is that while different plant will have outages at different times during the year, on average across the system, outages will occur at a constant rate.

**Maximum capacity factor, auxiliary power requirements, heat rate and emissions intensity**

We used assumptions on maximum capacity factor, auxiliary power requirements, heat rates and emissions intensities for each existing power station that are set out in the NTNDP Modelling Assumptions.

**VOM**

We used the same assumptions for variable operating and maintenance (VOM) costs for each existing power station as set out in the NTNDP Modelling Assumptions.

**Fuel costs**

We generally used the same fuel cost assumptions for each existing power station as set out in the NTNDP Modelling Assumptions.

The exception was the Tamar Valley gas plant. For this generation plant, we used confidential information on gas supply arrangements provided by Aurora Energy to develop fuel cost inputs.

**Hydro Tasmania assumptions**

In addition to the standard technical and cost assumptions that are required for all generation plant – including capacity, outage rates, auxiliaries, VOM – a number of additional assumptions need to be made regarding Hydro Tasmania’s water storages. These assumptions include:

- current water levels
- forecast inflows
- storage capacities, including minimum and maximum operating storage levels

To accurately describe the strategic bidding options available to Hydro Tasmania, the assumed current water levels and forecast inflows need to be disaggregated into ‘discretionary’ water (which Hydro Tasmania can store for release at a later date) and ‘non discretionary’ water (which Hydro Tasmania cannot store).
All of these required inflows were provided to us by Hydro Tasmania on a confidential basis. While specific details of these assumptions cannot be released publicly, some general comments can be made:
- current water levels are based on water levels in Hydro Tasmania’s storages at the time we undertook the modelling
- forecast inflows are based on a median forecast

The implication of this is that our modelling, of both the existing structure and the reform options, is based on a set of hydrological outcomes consistent with longer term average conditions, rather than the drought conditions observed last decade.

4.6 New generation plant

This section provides an overview of the key input assumptions we adopted for new generation plant.

Generation options

The new generation options assumptions we used were derived from the NTNDP Modelling Assumptions. However, given the timeframe for this modelling project, we excluded those generation options that involve carbon capture and storage. We also adopted constraints on construction times for new generation options and annual build limits as set out in the NTNDP Modelling Assumptions.

The available thermal generation options, and key renewable generation options, are set out in Table 1.
### Table 1: New generation options – thermal plant

<table>
<thead>
<tr>
<th>Technology</th>
<th>Fuel Type</th>
<th>First Year Available for Construction</th>
<th>Lead time for development (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCGT</td>
<td>Gas</td>
<td>2011</td>
<td>1</td>
</tr>
<tr>
<td>CCGT</td>
<td>Gas</td>
<td>2012</td>
<td>2</td>
</tr>
<tr>
<td>Supercritical PC - Black coal</td>
<td>Black Coal</td>
<td>2014</td>
<td>4</td>
</tr>
<tr>
<td>Supercritical PC - Brown coal</td>
<td>Brown Coal</td>
<td>2014</td>
<td>4</td>
</tr>
<tr>
<td>IGCC - Black coal</td>
<td>Black Coal</td>
<td>2015</td>
<td>4</td>
</tr>
<tr>
<td>IGCC - Brown coal</td>
<td>Brown Coal</td>
<td>2015</td>
<td>4</td>
</tr>
<tr>
<td>Wind - Small scale (50 MW)</td>
<td>Renewable</td>
<td>2012</td>
<td>2</td>
</tr>
<tr>
<td>Wind - Medium scale (200 MW)</td>
<td>Renewable</td>
<td>2012</td>
<td>2</td>
</tr>
<tr>
<td>Wind - Large scale (500 MW)</td>
<td>Renewable</td>
<td>2012</td>
<td>2</td>
</tr>
<tr>
<td>Geothermal - HSA</td>
<td>Renewable</td>
<td>2015</td>
<td>4</td>
</tr>
<tr>
<td>Biomass</td>
<td>Renewable</td>
<td>2012</td>
<td>2</td>
</tr>
</tbody>
</table>

*Source: NTNDP Modelling Assumptions*

### Outage rates

As for existing generation plant, we used information on equivalent forced outage rates and planned maintenance rates from the NTNDP Input Tables.\(^9\)

### Maximum capacity factor, auxiliary power requirements, heat rate and emissions intensity

As for existing generation plant, we used the same assumptions regarding maximum capacity factor, auxiliary power requirements, heat rates and emissions intensities for new generation plant as set out in the NTNDP Modelling Assumptions.

The exception was the maximum capacity factor for biomass plant. The NTNDP Modelling Assumptions have a maximum capacity factor for biomass plant of 90 per cent. At this capacity factor (and accounting for the other input assumptions

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\(^9\) As with existing generation plant, the exception is the equivalent forced outage rate for OCGT plant, for which Frontier Economics has used an equivalent forced outage rate of 3%.
in the NTNDP), biomass is in most instances built in preference to wind for the purposes of meeting the LRET. This does not seem to properly reflect the economics of these plants. For this reason, we have assumed that biomass has a maximum capacity factor of 65 per cent.

**Capital costs, FOM and VOM**

For existing generation plant, the only cost information required for our modelling is the variable costs of production: VOM and fuel costs (and carbon costs, once thermal generators are exposed to a carbon price).

For new entrant generation plant, our modelling also requires information on the capital costs and the fixed operating and maintenance costs (FOM) of generation plant. This cost information is an important factor in determining efficient investment outcomes.

We drew all required cost information for new entrant generation plant from the NTNDP Modelling Assumptions. Capital costs, FOM and VOM for important new generation options are set out in Table 1.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Capital costs (Real 2009-10 $/kW)</th>
<th>FOM ($/MW/year) for 2009-10</th>
<th>VOM ($/MWh sent-out) for 2009-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCGT</td>
<td>985</td>
<td>9,000</td>
<td>2.50</td>
</tr>
<tr>
<td>CCGT</td>
<td>1,368</td>
<td>14,000</td>
<td>2.00</td>
</tr>
<tr>
<td>Supercritical PC - Black coal</td>
<td>2,676</td>
<td>33,000</td>
<td>4.60</td>
</tr>
<tr>
<td>Supercritical PC - Brown coal</td>
<td>3,571</td>
<td>41,000</td>
<td>5.10</td>
</tr>
<tr>
<td>IGCC - Black coal</td>
<td>4,201</td>
<td>73,000</td>
<td>12.80</td>
</tr>
<tr>
<td>IGCC - Brown coal</td>
<td>5,025</td>
<td>50,000</td>
<td>5.20</td>
</tr>
<tr>
<td>Wind - Small scale (50 MW)</td>
<td>3,178</td>
<td>42,000</td>
<td>0.00</td>
</tr>
<tr>
<td>Wind - Medium scale (200 MW)</td>
<td>2,886</td>
<td>39,000</td>
<td>0.00</td>
</tr>
<tr>
<td>Wind - Large scale (500 MW)</td>
<td>2,744</td>
<td>37,000</td>
<td>0.00</td>
</tr>
<tr>
<td>Geothermal - HSA</td>
<td>7,260</td>
<td>125,000</td>
<td>0.00</td>
</tr>
<tr>
<td>Biomass</td>
<td>5,000</td>
<td>40,000</td>
<td>2.25</td>
</tr>
</tbody>
</table>

*Source: NTNDP Modelling Assumptions*
**Fuel costs**

As for existing generation plant, we used the same fuel costs assumptions for new generation plant as set out in the NTNDP Modelling Assumptions.

4.7 Demand side management

Assumptions regarding potential demand-side response in Tasmania were provided to us by Hydro Tasmania. We understand that Hydro Tasmania’s views on demand-side response are based on its observations of recent market behaviour. This reflects current contractual arrangements. Demand-side response in our modelling is treated like a generator: the demand-side response is incorporated in the merit order at its assumed capacity and price, and is dispatched whenever the spot price is sufficiently high.

4.8 Network constraints

For this project, we incorporated intra-regional network constraints in the SPARK market modelling stage. The intra-regional constraints modelled were the system normal constraints published in the AEMO 2010 ESOO Supply-Demand calculator.

The left hand side variables of these constraints were dynamically optimised in SPARK, thereby mimicking the computations conducted by NEMDE in practice. NEMDE takes the right hand side variable values as the variable values from the previous 5 minute dispatch interval. In contrast, WHIRLYGIG and SPARK model a representative, non-sequential load duration curve, therefore using values from the previous 5 minute interval is not possible. Instead we use the WHIRLYGIG dispatch results for the right hand side variable values, which implicitly assume that they equal their fully competitive values. In addition, since SPARK does not model non-scheduled generators, the variable values for non-scheduled generators were based on aggregate historic output levels.

4.9 Carbon price

Consistent with current policy, our modelling was undertaken on the basis that there will be a carbon price introduced from the beginning of 2012/13. The carbon price we assumed was the announced price for the fixed price period (2012/13 to 2014/15) followed by the carbon price path from the modelling report released by Commonwealth Treasury. The carbon price path is shown in Figure 6.
4.10 LRET target

From 1 January 2011, the RET scheme has been split into the Large-scale Renewable Energy Target (LRET) and the Small-Scale Renewable Energy Scheme (SRES). As part of this process, the RET target was amended to include the LRET target and the adjusted LRET target (which accounts for the surplus of RECs available at the end of 2010). Figure 7 shows the RET target, the LRET target and the adjusted LRET target. We used the adjusted LRET target in our modelling.
Figure 7: LRET target

Source: ORER, Frontier Economics.
PART B –
Market outcomes under existing Tasmanian arrangements
5 Introduction

This Part B of our report provides our analysis of outcomes in the Tasmanian wholesale electricity sector under the existing industry structure and market arrangements. Our assessment is informed by a number of pieces of analysis:

- Section 6 examines historical spot market outcomes in Tasmania over the last three years. The intention of this analysis is to inform the Panel as to whether there is evidence from spot market outcomes that Hydro Tasmania has exercised transient or sustained market power.

- Section 7 examines observed hedging contract outcomes in Tasmania. The intention of this analysis is to inform the Panel as to whether there is evidence from contract outcomes that Hydro Tasmania has exercised sustained market power.

- Section 8 forecasts spot market outcomes in Tasmania under the existing industry structure and market arrangements over the period from 2011/12 to 2015/16. The intention of this analysis is twofold:
  
  - First, to inform the Panel as to whether Hydro Tasmania is likely to exercise sustained market power if it remains highly contracted.
  
  - Second, to assess the extent of Hydro Tasmania’s latent market power.

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Note, we have not used the expression ‘market’ to describe wholesale electricity outcomes in Tasmania on the basis that the Federal Court in the AGL case found the relevant market for trade practices purposes to be NEM-wide and this may continue to be the case.
6 Historical spot market outcomes

The first stage of our assessment of outcomes under the existing Tasmanian industry structure and wholesale market arrangements involves an analysis of historical outcomes in the spot market. Historical outcomes can provide an indication of whether Hydro Tasmania has exercised either transient market power or sustained market power.

We assessed the exercise of transient market power by examining high price events at the Tasmanian Regional Reference Node (RRN), and considering the extent to which these high price events were driven by bidding behaviour by Hydro Tasmania that is not consistent with Hydro Tasmania’s opportunity cost of water. This is discussed in Section 6.2.

We assessed the exercise of sustained market power by considering price outcomes at the Tasmanian RRN over the longer term. In particular, one way to assess sustained market power is by determining whether average prices at the Tasmanian RRN, and average bidding by Hydro Tasmania, have tended to be greater than Hydro Tasmania’s opportunity cost of water. This is discussed in Section 6.3.

6.1 Methodology

6.1.1 Historic spot market data

AEMO releases detailed information regarding outcomes in the NEM.11 The information released by AEMO includes:

- half-hourly bidding data for each generator in the NEM
- half-hourly availability of each generator in the NEM
- half-hourly dispatch of each generator in the NEM
- half-hourly demand for each region in the NEM
- half-hourly spot prices for each region in the NEM

These data enable us to examine historical outcomes in Tasmania, including the relationships between demand levels, generation availability, generator bidding and spot prices. We undertook this analysis of these relationships for each financial year from 2007/08 to 2010/11.

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6.1.2 Opportunity cost of water

The opportunity cost of water to Hydro Tasmania is that revenue Hydro Tasmania could earn by generating from its storages in future, which Hydro Tasmania foregoes by using that water to generate today. Hydro Tasmania would earn less revenue (over time) if it were to dispatch water today at less than this opportunity cost. If Hydro Tasmania were to dispatch their plant more or less than it would had it dispatched it at their opportunity cost, this would also mean that other generators would be dispatched inefficiently. This would result in inefficient production costs and would almost certainly also result in inefficient electricity prices.

We determine Hydro Tasmania’s opportunity cost of water based on least cost dispatch in the NEM, using WHIRLYGIG. In effect we incorporated an energy constraint for Hydro Tasmania into WHIRLYGIG: in any period Hydro Tasmania was not permitted to generate any more than the sum of the available water in storages at the beginning of that period and the inflows during that period. The opportunity cost of water can be thought of as the incremental cost of tightening this energy constraint by assuming, for instance, that Hydro Tasmania has 1 MWh less of energy available to generate in that period. As a result of this reduction in energy available to Hydro Tasmania, the pattern of least cost generation over the modelling period would adjust (primarily by requiring 1 MWh of additional generation from thermal generation plant). The additional efficient cost resulting from this can be thought of as the opportunity cost of water, within a competitive market. Determined in this way, the opportunity cost of water is the efficient dispatch price for Hydro Tasmania’s generation plant.

In order to compare Hydro Tasmania’s opportunity cost of water with historic bidding and spot market outcomes, we determined Hydro Tasmania’s opportunity cost of water over the period from 2007/08 to 2010/11 based on the approach described above. This involved performing a forecasting exercise to determine the opportunity cost of Hydro Tasmania’s water from the perspective of a generator making dispatch decisions over this time. The objective was not to ‘backcast’ but rather to determine a reasonable estimate of what opportunity cost Hydro Tasmania appeared to have attached to water over this period. We determined this value by populating WHIRLYGIG with input assumptions that were publically available as of the beginning of 2007/08. This included the NEMMCo Statement of Opportunities that was available at the time, the version of ACIL Tasman’s report to NEMMCo on generation input assumptions that was available at the time, and hydrological assumptions that were available at the time (including storage levels and forecast inflows).
6.2 Assessment of transient market power

As discussed in Section 2.1, the exercise of transient market power is defined as bidding behaviour that does not reflect economic costs and that results in, for a short period of time, a higher wholesale spot price than would otherwise be the case. We assessed the extent of transient market power operating in Tasmania by identifying price spikes that have occurred at the Tasmanian RRN, analysing Hydro Tasmania’s bidding behaviour during these periods and determining whether Hydro Tasmania’s bidding behaviour during these periods can be explained by reference to economic costs.

6.2.1 Data analysis

Figure 9 through Figure 12 each show three series of half-hourly data, in three separate panels:

- Hydro Tasmania bidding, disaggregated to show volumes (in MW) bid in various price bands. Low price bands are depicted by cool colours and higher price bands are depicted by warm colours.
- Hydro Tasmania’s marginal dispatch price (in $/MWh). This is the price of the last of Hydro Tasmania’s bid bands to be dispatched. When compared with spot prices in the same half-hour, the marginal dispatch price indicates whether or not Hydro Tasmania’s plant was the marginal plant during high price events.\(^\text{12}\)
- The Tasmanian regional reference price (in $/MWh)

Figure 9 shows these data for 2007/08, Figure 10 for 2008/09, Figure 11 for 2009/10 and Figure 12 for 2010/11.

A number of things stand out from these figures.

First, where high price events occurred in Tasmania over this period, they were almost always associated with high price bidding by Hydro Tasmania. One way of seeing this is by comparing the time series for Hydro Tasmania’s marginal dispatch price and for the Tasmanian regional reference price: during the majority of high price events, Hydro Tasmania’s marginal dispatch price was also high, indicating that Hydro Tasmania’s bidding was directly driving the high price event.

Second, patterns of bidding by Hydro Tasmania in 2007/08 were quite different from patterns of bidding by Hydro Tasmania in later years. In particular, throughout 2007/08, Hydro Tasmania consistently bid significant proportions of

\(^{12}\) Note that Figure 9 through Figure 12 show some instances of Hydro Tasmania’s marginal dispatch price being higher than the Tasmanian spot price. This is a result of the process required to convert five minute bids and dispatch to a half-hourly marginal dispatch prices for Hydro Tasmania.
its capacity at prices above $5,000/MWh. This is far less evident in later years. As discussed in the following section, the explanation for this appears to be the lower water inflows during 2007/08.

Despite Hydro Tasmania consistently bidding significant proportions of its capacity at prices above $5,000/MWh during 2007/08, high spot price events were infrequent during the year. Indeed, there was only one period, during October 2007, when spot prices exceeded $5,000/MWh. This event was caused by Hydro Tasmania offering a substantial proportion of its total quantity at prices in excess of $5,000/MWh (although for such a short period of time that it is not easily visible in Figure 9). That it was Hydro Tasmania’s bid that set the spot price is confirmed by the fact that Hydro Tasmania’s marginal dispatch price spiked at the same time.

Third, Hydro Tasmania did not consistently bid significant proportions of its capacity at prices above $5,000/MWh in 2008/09, 2009/10 or 2010/11. Rather, the instances in which Hydro Tasmania bid significant proportions of its capacity at prices above $5,000/MWh were confined to certain periods of the year (June 2009, March 2010 and August 2010 stand out as particular examples). During these periods of high bidding in 2008/09, 2009/10 or 2010/11, high spot price events were relatively common (and certainly more common than in 2007/08). In order to more clearly understand the market dynamics during these periods of high price bids and high spot prices, we more closely examined outcomes during four months that contained high price events: June 2009, May 2010, August 2010 and November 2010. For each of these months, Figure 13 shows four series of half-hourly data, in four separate panels:

- Hydro Tasmania bidding, disaggregated to show volumes (in MW) bid in various price bands. These are the same data that appear in Figure 9 through Figure 12.
- Aurora’s bidding for the Tamar Valley CCGT, disaggregated to show volumes (in MW) bid in various price bands. This provides an indication of the availability of the Tamar Valley CCGT plant during periods of high price bidding by Hydro Tasmania.
- The Tasmanian regional reference price (in $/MWh). These are the same data that appear in Figure 9 through Figure 12.
- The Tasmanian scheduled demand (in MW). This provides an indication of the level of demand during high price events in Tasmania.

In each of the price panels, the red dots indicate half-hours during which the Tasmanian regional reference price was higher than $1,000/MWh.

A number of things stand out from Figure 13.

First, the extended periods of high price bidding by Hydro Tasmania in June 2009 and May 2010 coincide almost exactly with periods during which the Tamar
Valley CCGT was unavailable. Immediately before and after Tamar Valley’s unavailability, Hydro Tasmania bid the majority of its capacity at prices below $100/MWh. For extended periods during Tamar Valley’s unavailability, however, Hydro Tasmania bid the majority of its capacity at prices in excess of $9,000/MWh.

Second, the high prices events that occurred during these four months did not necessarily coincide with high demand periods. In fact, the red dots in the time series for Tasmanian scheduled demand show that high price events driven by Hydro Tasmania’s bidding occurred even at very low demand levels. Indeed, in some instances, high price events occurred at or near daily minimum demand. Ordinarily, it would be expected that high price events would occur at or near daily maximum demand.

Finally, even with Tamar Valley fully available, high price events are not necessarily confined to high demand periods. This can be seen in August 2010 and November 2010, during which time Tamar Valley was fully available and high price events occurred at moderate levels of demand.

### 6.2.2 Conclusion on transient market power

Taken as a whole, the analysis of historical spot market outcomes shows that prices remained at moderate levels for the vast majority of half hours over the period from 2007/08 to 2010/11. However, there were a limited number of instances during this period when Hydro Tasmania’s bidding behaviour resulted in high spot price events. Indeed, for the most part, the instances of high spot price events in Tasmania were significantly fewer than in other NEM regions, as seen in Figure 8.
Given that instances of transient market power leading to high spot price events in Tasmania were limited, there are unlikely to be substantial efficiency losses due to transient market power. Certainly, Hydro Tasmania’s bidding behaviour is likely to have led to some instances in which higher cost plant has operated instead of Hydro Tasmania’s plant, but the costs associated with this would have been relatively minor.

Of more concern than the exercise of transient market power itself is the fact that the analysis shows that Hydro Tasmania was able to exercise transient market power even during low demand periods, including low demand periods when Tamar Valley was available. This suggests that Hydro Tasmania may be able to drive up the spot price through its bidding behaviour far more often than it has done so to date. In other words, Hydro Tasmania may have significant latent market power.
Figure 9: Hydro Tasmania bidding, marginal dispatch price and Tasmanian spot price (2007/08)

Source: AEMO data, Frontier Economics analysis
Figure 10: Hydro Tasmania bidding, marginal dispatch price and Tasmanian spot price (2008/09)

Source: AEMO data, Frontier Economics analysis
Figure 11: Hydro Tasmania bidding, marginal dispatch price and Tasmanian spot price (2009/10)

Source: AEMO data, Frontier Economics analysis
Figure 12: Hydro Tasmania bidding, marginal dispatch price and Tasmanian spot price (2010/11)

Source: AEMO data, Frontier Economics analysis
Figure 13: Hydro Tasmania bidding, Tamar Valley bidding, Tasmanian spot price and Tasmanian demand

Source: AEMO data, Frontier Economics analysis
6.3 **Assessment of sustained market power in the spot market**

As discussed in Section 2.1, the exercise of sustained market power is defined as bidding behaviour that does not reflect economic costs and that results in average prices that are in excess of the economic costs of serving load on a long term basis. In this section we assess the extent of sustained market power operating in the Tasmanian wholesale electricity sector by identifying whether the prices bid by Hydro Tasmania into the wholesale spot market have exceeded the opportunity cost of water on a long term basis (Section 7 considers the evidence for sustained market power in the context of Hydro Tasmania’s contract prices). This approach has been adopted because over the long run, bidding in a competitive market should reflect costs and the competitive market should produce average spot prices that cycle around LRMC.

6.3.1 **Data analysis**

Figure 14 shows average annual spot prices in each NEM region over the period from 2007/08 to 2010/11. Figure 14 shows that spot prices at the Tasmania RRN have generally been within the range of spot prices in other jurisdictions. Spot prices in Tasmania in 2008/09 were above those in other regions, but this coincided with the low storage levels and inflows in Tasmania during that period and further exacerbated by Hydro Tasmania’s bidding behaviour in June 2009. More recently, as inflows have increased, spot prices in Tasmania have fallen significantly, and have been among the lowest in the NEM.
While the fact that average Tasmanian spot prices have been within the range of average spot prices in other NEM regions suggests that sustained market power has not been exercised in Tasmania, this is not conclusive. The reason it is not conclusive is that in a ‘workably’ competitive market (as described in Section 2.1 above), it may be reasonable to expect Tasmanian spot price to be consistently below prices in other NEM regions. Ultimately, to form a view on whether Hydro Tasmania has exercised sustained market power, it is necessary to compare Hydro Tasmania’s bids with the opportunity cost of its water in a fully competitive market.

Figure 15 shows Hydro Tasmania’s opportunity cost of water (calculated under a least cost approach using WHIRLYGIG) for 2006/07 through to 2010/11. The opportunity cost of water is calculated under two cases: one with sustained medium inflows and one with sustained low inflows. With sustained medium inflows, Hydro Tasmania’s opportunity cost of water is between $20/MWh and $30/MWh. With sustained low inflows, Hydro Tasmania’s opportunity cost of water is initially between $50/MWh and $60/MWh. This higher opportunity cost of water reflects the fact that, with lower inflows, Bell Bay power station will need to run on occasion to supply energy, and while doing so will set the Tasmanian spot price. The opportunity cost of water with lower inflows subsequently drops to the same level as the medium inflow case, as new investment in Tasmania and Victoria occurs in response to the assumed low

Figure 14: Average annual prices

Source: AEMO
inflows (as well as in response to demand growth and the renewable energy target). The difference between these cases reflects the fact that under the low inflow case, Hydro Tasmania has lower levels of efficient dispatch and when Hydro Tasmania does dispatch, it effectively displaces more expensive plant (until an investment response occurs).

Figure 15 also shows Hydro Tasmania’s marginal dispatch price for each quarter for 2005/06 through to 2010/11. The median quarterly marginal dispatch price and the 25% to 75% range of quarterly marginal dispatch prices are both shown.

Comparing Hydro Tasmania’s opportunity cost of water with Hydro Tasmania’s marginal dispatch price suggests that Hydro Tasmania’s bidding has been reasonably consistent with opportunity cost. During 2006/07 and 2007/08, when inflows were low and storage levels were falling, the marginal dispatch price steadily increased from around the level of the estimated opportunity cost for the medium inflow case to around the level of the estimated opportunity cost for the low inflow case. This is consistent with what would have been expected of a firm bidding, on average, competitively. As inflows increased over 2008/09, the marginal dispatch price steadily decreased back to around the level of the estimated opportunity cost for the medium inflow case. During 2009/10 and 2010/11, marginal dispatch prices have remained, on average, at around the level of the estimated opportunity cost for the medium inflow case.

**Figure 15: Hydro Tasmania bidding, Tasmanian spot prices and opportunity cost of water**

Source: Frontier Economics
6.3.2 Conclusion on sustained market power in the spot market

The comparison of historical marginal dispatch prices for Hydro Tasmania with estimates of Hydro Tasmania’s opportunity cost of water shows that Hydro Tasmania has, on average, bid in a way that would be expected of a firm in a workably competitive market. So, while the detailed analysis of half-hourly bidding over the period 2007/08 to 2010/11 indicated a limited number of instances when Hydro Tasmania’s bidding behaviour resulted in high spot price events, there is no evidence that Hydro Tasmania exercised sustained market power during this period.
7 Contract prices

The second stage of our assessment of outcomes under the existing Tasmanian industry structure and wholesale market arrangements involves an analysis of Hydro Tasmania’s observed contract prices. These observed contract prices can provide an indication of whether Hydro Tasmania has exercised sustained market power through its contracting behaviour. We assessed the exercise of sustained market power by assessing whether Hydro Tasmania’s observed contract prices have tended to be greater than Hydro Tasmania’s opportunity cost of water.

7.1 Methodology

7.1.1 Hydro Tasmania’s observed contract prices

We have been provided with confidential data on all of Hydro Tasmania’s hedging contracts as of 30 June 2011. The information includes the size of these contracts and the strike price of these contracts (but not the counterparty).

Based on this contract information we have been able to calculate:

- the total volume of firm swaps at the Tasmania RRN held by Hydro Tasmania over time
- the volume-weighted strike price of firm swaps at the Tasmania RRN held by Hydro Tasmania over time (where the strike price reflects the level of carbon pass through under each contract).

7.1.2 Opportunity cost of water

As discussed in Section 6.1.2, the opportunity cost of water to Hydro Tasmania is that revenue Hydro Tasmania could earn by generating from its storages in future, which Hydro Tasmania foregoes by using that water to generate today. Hydro Tasmania would earn less revenue (over time) if it were to dispatch water today at less than this opportunity cost.

As for our historical analysis, we determined Hydro Tasmania’s opportunity cost of water based on least cost dispatch in the NEM, using WHIRLYGIG. We effectively incorporated an energy constraint for Hydro Tasmania into WHIRLYGIG: in any period Hydro Tasmania was not permitted to generate any more than the sum of the available water in storages at the beginning of that period and the inflows during that period. The opportunity cost of water can be thought of as the incremental cost of tightening this energy constraint by assuming, for instance, that Hydro Tasmania has 1 MWh less of energy available to generate in that period. As a result of this reduction in energy available to Hydro Tasmania, the pattern of least cost generation over the modelling period would adjust (primarily by requiring 1 MWh of additional generation from
thermal generation plant). The additional efficient cost resulting from this can be thought of as the opportunity cost of water, within a competitive market. Determined in this way, the opportunity cost of water is the efficient dispatch price for Hydro Tasmania’s generation plant.

In order to compare Hydro Tasmania’s opportunity cost of water with observed contract prices, we determined Hydro Tasmania’s opportunity cost of water over the period from 2011/12 to 2015/16. This involved performing a forecasting exercise to determine the opportunity cost of Hydro Tasmania’s water from the perspective of a generator making dispatch decisions over this period. We determined this value based on the WHIRLYGIG input assumptions used to mode the Base Case (which reflects current expectations).

It is important to recognise that comparing Hydro Tasmania’s opportunity cost of water, calculated in this way, with Hydro Tasmania’s observed contract prices is, at best, indicative of whether Hydro Tasmania’s contract prices reflect economic costs. The reason is that Hydro Tasmania’s observed contract price reflects a set of existing contracts that were signed at various points in time. At the time of signing each of these contracts, expectations regarding future market outcomes would have varied, and so Hydro Tasmania’s opportunity cost of water calculated at those various points in time would also have varied. For this reason, comparing contract prices that reflect these different expectations with an opportunity cost of water calculated with current expectations is not a like-for-like comparison, and care should be exercised in drawing firm conclusions from this comparison.

7.2 Data analysis

[Commercial-in-confidence]

7.3 Conclusion on sustained market power and wholesale contracts

The comparison of Hydro Tasmania’s average contract price with estimates of Hydro Tasmania’s opportunity cost of water shows that Hydro Tasmania’s contract prices tend to be somewhat higher than Hydro Tasmania’s opportunity cost of water. However, this difference could well reflect an efficient risk premium to Hydro Tasmania in entering into firm forward contracts. Given this, this analysis supports the conclusion from the analysis of historical spot outcomes: there is no evidence that Hydro Tasmania has exercised sustained market power.
8 Forecast spot market outcomes under Tasmania’s existing electricity industry

The third stage of our assessment of outcomes in the Tasmanian wholesale electricity sector is an analysis of forecast outcomes. The purpose of this stage is to assess the degree of sustained market power and latent market power likely to be held by Hydro Tasmania over a 5 year modelling period from 2011/12 to 2015/16.

This assessment required us to model a number of different cases:

- **Base Case** – The Base Case incorporates assumptions that reflect our view of expected future market conditions. In particular, we assume that Hydro Tasmania holds a relatively large quantity of hedging contracts.

- **SRMC Case** – The SRMC Case is a sensitivity on the Base Case. In addition to the Base Case assumptions, it assumes that Hydro Tasmania does not engage in strategic bidding and bids solely at its fully competitive opportunity cost of water. Therefore, this case provides a set of forecast pool prices that embody Hydro Tasmania’s economic cost of production. It is a reference point from which we can assess the extent of Hydro Tasmania’s sustained market power.

- **Latent Case** – The Latent Case is also a sensitivity on the Base Case. It assumes that Hydro Tasmania is completely uncontracted (although it maintains ownership over all Basslink inter-regional revenues (IRRs)). Removing Hydro Tasmania’s contracts allows us to assess the limit of Hydro Tasmania’s latent market power, since the spot price received on its output is no longer moderated by swap and cap strike prices. This case is a reference point from which we can assess the extent of Hydro Tasmania’s latent market power.

As discussed in Section 2.2.2, sustained market power is defined as bidding behaviour that does not reflect economic costs and that results in average prices that are in excess of the economic costs of serving load on a long term basis. The extent to which Hydro Tasmania exercises sustained market power is assessed over the forecast period by comparing the Base Case to the SRMC Case. This assessment is presented in detail in Section 8.2 and 8.3.

Similarly, as discussed in Section 2.2.3, latent market power is defined as the sustained market power that a generator possesses but chooses not to exercise.

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13 The assumed quantity of hedging contracts held by Hydro Tasmania was developed, in part, following discussions with Hydro Tasmania. We have compared the assumed quantity of hedging contracts with the contracts currently held by Hydro Tasmania and found that the assumed quantity of hedging contracts is close to Hydro Tasmania’s current contract position.
The extent of Hydro Tasmania’s potential latent market power over the forecast period is assessed by comparing the Latent Case to the Base Case, and is discussed in detail in Section 8.4.

8.1 Methodology

Spot market outcomes were modelled in a two stage process, using WHIRLYGIG and SPARK, as described in Section 3. In particular, SPARK is ideal for this forecasting exercise because it considers not only forecast generator costs and physical constraints, but also strategic bidding behaviour. This type of modelling approach is well suited to identifying latent market power because it does not rely on using past patterns of bidding in any way to determine rational and stable patterns of bidding. Instead it relies on working out the bidding that delivers the maximum sustainable profit.

A key input into SPARK is the quantity bid levels that generators can choose under the range of forecast market conditions. With this information, SPARK creates a Cournot-Nash game where the players are the major electricity generation portfolios and their strategies are the set of quantity bids assigned to each of their generators. SPARK then computes the Nash equilibria, which represent the combinations of strategies at which no generator has an incentive to deviate given the bidding strategies chosen by its competitors. This calculation is performed over all representative demand points used in WHIRLYGIG, thereby providing a set of equilibria that we would expect to observe in future given forecast generator costs and physical constraints. For the purpose of this modelling, we have assumed that Hydro Tasmania has 12 possible withdrawal strategies for its discretionary generation, ranging from no withdrawal relative to efficient dispatch levels to complete withdrawal (implying Hydro Tasmania does not offer any of its discretionary generation). These strategies do not affect Hydro Tasmania’s non-discretionary generation, so that regardless of its chosen strategy, Hydro Tasmania’s non-discretionary generation remains the same.

Another key determinant of the outcomes from SPARK is the level of financial hedging of major NEM participants, especially Hydro Tasmania. In the absence of such contracts, Hydro Tasmania, like a number of other NEM generators, would be more likely to have the ability and incentive to profitably bid up spot prices. The fact that we have not historically observed Hydro Tasmania bidding up spot prices on a sustained basis does not mean that Hydro Tasmania is unable to bid up spot prices on a sustained basis. Rather, with a different contract position or a different motivation, Hydro Tasmania’s bidding incentives may be significantly different.
8.2 Base Case outcomes

Wholesale Market Outcomes

Figure 15 shows the Base Case annual time-weighted average spot prices for the five NEM regions. On average, prices trend upwards over the forecast period. This is primarily due to the introduction of a rising carbon price, increasing fuel prices and strong demand growth in QLD and NSW (see Section 4 for details on these modelling assumptions). In the second half of the forecast period, price growth is more moderate in the southern states as a result of lower assumed demand growth and investment in wind and biomass plant.

Figure 15 also illustrates that the Base Case prices are reasonably consistent with the d-cyphaTrade forward curve. This suggests that our modelling assumptions are broadly in line with industry expectations. Differences between the two price forecasts are likely a result of differences in expectations of future market conditions, such as demand and fuel prices, and differences in expectations of the likely future carbon prices.

Figure 16: Base Case – forecast spot price

Source: Frontier Economics and d-cyphaTrade

The d-cyphaTrade forward curve is presented as of 17/10/2011 and adjusted for an assumed contract premium of 5%. d-cyphaTrade prices for 2013/14 are included in Figure 16. However, the market for these forward contracts is not currently liquid.
The Tasmanian price follows a markedly different trajectory to the mainland prices. This pattern is largely driven by the difference in generation mix across the different regions. In particular, the majority of Tasmanian energy is supplied by Hydro Tasmania. Hydro Tasmania is energy constrained, since its output level is primarily constrained by its existing storage levels and inflows rather than its installed capacity. Being energy constrained, Hydro Tasmania has an incentive to store water to increase dispatch during periods of high prices. Our modelling framework captures this by allowing Hydro Tasmania to shift water to periods of high value within limits based on its physical storage capacity. Figure 17 shows Hydro Tasmania’s forecast storage levels over the modelling period, and Figure 18 shows its optimal annual dispatch. These figures show that Hydro Tasmania stores water in 2011/12 for use in 2012/13 when the pool price increases significantly due to the carbon price. As a result, there is relatively less supply from Hydro Tasmania in 2011/12 and, correspondingly, a relatively high spot price in Tasmania for that year.

Figure 17: Base Case – Hydro Tasmania forecast storage levels

![Storage Levels Graph](image-url)
In order to better understand the relationship between Hydro Tasmania’s bidding behaviour and Tasmanian pool price outcomes, this section analyses the way Hydro Tasmania bids in the Nash equilibria identified by SPARK for the Base Case. This analysis provides a more detailed picture of Hydro Tasmania’s bidding behaviour, from which we can assess the extent of market power exerted by Hydro Tasmania in the wholesale market forecast.

Figure 19 is an illustration of the Nash equilibria that comprise the 2012/13 wholesale market outcomes in the Base Case. It presents the representative Tasmanian load duration curve modelled in SPARK (grey line), overlaid with the associated Nash equilibrium solution(s). The size of each point represents the percentage of available capacity that Hydro Tasmania bids into the market at the Nash equilibrium solutions, and the colour of the point represents the average Tasmanian pool price across these solutions.

Figure 18: Base Case – Hydro Tasmania output

Source: Frontier Economics

**Hydro Tasmania - Bidding Analysis**

In order to better understand the relationship between Hydro Tasmania’s bidding behaviour and Tasmanian pool price outcomes, this section analyses the way Hydro Tasmania bids in the Nash equilibria identified by SPARK for the Base Case. This analysis provides a more detailed picture of Hydro Tasmania’s bidding behaviour, from which we can assess the extent of market power exerted by Hydro Tasmania in the wholesale market forecast.

Figure 19 is an illustration of the Nash equilibria that comprise the 2012/13 wholesale market outcomes in the Base Case. It presents the representative Tasmanian load duration curve modelled in SPARK (grey line), overlaid with the associated Nash equilibrium solution(s). The size of each point represents the percentage of available capacity that Hydro Tasmania bids into the market at the Nash equilibrium solutions, and the colour of the point represents the average Tasmanian pool price across these solutions.

Source: Frontier Economics
Figure 19 indicates that Hydro Tasmania does not exercise a significant degree of sustained market power. Hydro Tasmania bids 100% of its available capacity for the majority of the forecast period, which implies that the resulting Tasmanian pool price largely reflects the competitive economic cost of supply. Ultimately, the key reason for this (as will become clear when considering the Latent Case) is that Hydro Tasmania’s assumed high level of hedging contract cover reduces the incentive that Hydro Tasmania has to bid in a way to drive up spot prices.

### 8.3 SRMC bidding by Hydro Tasmania

**Wholesale Market Outcomes**

Figure 20 shows the annual time-weighted average pool prices for the SRMC Case (light blue), as well as the Base Case prices and the d-cyphaTrade forward curve. The SRMC and Base Case pool prices are almost identical, a result that is consistent with our analysis of Hydro Tasmania’s bidding behaviour in the Base Case. It reaffirms the finding that Hydro Tasmania does not exert a significant degree of sustained market power in the Base Case.

This result is also consistent with the historical analysis presented in Section 6. This historical analysis found that Hydro Tasmania’s bidding behaviour over the
past five years has been largely in line with the estimated opportunity cost of water in a competitive market.

**Figure 20: SRMC Case – forecast spot price**

![Figure 20: SRMC Case – forecast spot price](image)

Source: Frontier Economics

### 8.4 Assessment of latent market power

Neither the Base Case nor the SRMC Case can be used to assess latent market power. The reason is that both cases assume external restrictions on Hydro Tasmania’s strategic behaviour. In the Base Case, we limit the profitability of strategic bidding by assuming that Hydro Tasmania holds a large quantity of hedge contracts. In the SRMC Case, we remove Hydro Tasmania’s ability to bid strategically altogether. In reality, generators do not face such restrictions: it is possible for generators to choose their level of financial hedging, including by reducing their hedge cover and increasing their exposure to the spot market (subject to their risk limits), and it is also possible for generators to bid strategically on both price and volume.

In order to model Hydro Tasmania’s latent market power, we consider a variation on the specification of the Base Case assumptions where we remove all of Hydro Tasmania’s contracts. This Latent Case models Hydro Tasmania with no financial hedging contracts, and complete exposure to the spot market. In practice, of course, this position is extremely unlikely, because Hydro Tasmania will no doubt have risk limits that require it to maintain a degree of contract...
cover. However, the purpose of the Latent Case is to assess the extent to which retailers and major energy users are likely to be concerned about Hydro Tasmania’s ability to exercise market power at times during the year. The Latent Case does this by investigating the market conditions (particularly levels of demand and competing supply) under which Hydro Tasmania would be in a position to exercise market power if it were fully exposed to the spot market. Ultimately, since Hydro Tasmania chooses its contract position, and retailers and major energy users are not in a position to forecast Hydro Tasmania’s contract position, these counterparties will be concerned with what Hydro Tasmania would be in a position to do if it did choose to remain exposed to the spot market.

**Hydro Tasmania - Bidding Analysis**

illustrates Nash equilibria that comprise the 2012/13 wholesale market outcomes in the Base Case. Like Figure 19, it shows the Tasmanian load duration curve modelled in *SPARK*, the percentage of available capacity bid by Hydro Tasmania at the Nash equilibria found at each level of demand (the size of each point), and the average price across these Nash equilibria (the colour of each point). Compared to the same results for the Base Case, there is a significant increase in both the regularity and extent of strategic withholding as well as the average prices found at each level of demand. What this clearly demonstrates is that the competitive outcomes observed in the Base Case are a result of the assumed contract levels, and without these contracts in place Hydro Tasmania has the incentive and ability to withhold capacity to increase the price under most demand conditions. This occurs despite the presence of the other generation plant in Tasmania and the capacity of BassLink to import electricity from Victoria. It is important to note that, presently, Hydro Tasmania has a very high degree of discretion over the quantity and characteristics of contracts they negotiate. So if Hydro Tasmania wished to reduce their contract cover to increase the profitability of raising the spot price, they could easily do so.

This result of increased strategic behaviour in the Latent Case is sustained over the entire modelling period, as illustrated in Figure 22. Over time, there is a reduction in the frequency of Nash equilibria found at high prices and large withdrawal volumes in the Latent Case. This is mainly the case at low levels of Tasmanian demand, and is primarily a result of new wind generation in Tasmania. However, despite the effect of new wind generation, Hydro Tasmania has the incentive and ability to withhold capacity to increase the price under a wide range of demand conditions.
Figure 21: Latent Case – Hydro Tasmania equilibria analysis, financial year 2012/13

Source: Frontier Economics
Figure 22: Base Case and Latent Case – Hydro Tasmania equilibria analysis, all financial years

8.5 Conclusion

Our forecast of spot market outcomes indicates that Hydro Tasmania does not presently exercise a significant degree of sustained market power. Given the assumed level of contracting, Hydro Tasmania does not have sufficient incentives to bid strategically, and wholesale outcomes are largely reflective of the economic
cost of supply. This is consistent with our analysis of Hydro Tasmania’s historical bidding.

By contrast, our assessment of latent market power indicates that Hydro Tasmania possesses a significant amount of latent market power. Our assessment indicates that, if it were fully exposed to the spot market, Hydro Tasmania would have the ability and incentive to set prices in excess of the economic cost of supply for the majority of the forecast period. It also shows that Hydro Tasmania’s market power persists across a range of forecast market conditions.

Importantly, we do not consider the forecast of outcomes under the Latent Case to reflect likely market outcomes. It is extremely unlikely that Hydro Tasmania would completely unwind its contract position, and extremely unlikely that Hydro Tasmania would drive up spot prices for the majority of the year. However, the Latent Case does indicate that, if it is exposed to the spot market at certain times during the year, Hydro Tasmania would be in a position to drive up (or down) spot prices even if demand was low. This is consistent with our historical analysis, which indicated that Hydro Tasmania’s bidding behaviour has led to high prices even when demand is low.

Finally, we consider that the Latent Case is useful for assessing the extent to which potential reform options would be likely to mitigate Hydro Tasmania’s market power.
Conclusion on outcomes under Tasmania’s existing electricity industry

Our analysis of historical outcomes and forecast outcomes under existing Tasmanian arrangements points to the same general conclusions:

- The exercise of transient market power is not a significant concern. Our historical analysis of bidding behaviour indicates that there were only a limited number of instances in the period from 2007/08 to 2010/11 when Hydro Tasmania exercised transient market power. Certainly, high price events have tended to be less frequent in Tasmania than in other regions. As a result, allocative and production efficiency losses resulting from transient market power are unlikely to be a significant issue in Tasmania.

- The exercise of sustained market power is also not a significant concern. Our historical analysis indicates that, on average, Hydro Tasmania’s bidding behaviour has tended to be consistent with its fully competitive opportunity cost of water over the period from 2007/08 to 2010/11. Our analysis of observed contract prices supports this conclusion. Our forecasts also support the view that, at its assumed level of hedging contract cover, Hydro Tasmania’s bidding behaviour is consistent with its competitive opportunity cost. In other words, on average, Hydro Tasmania’s bidding behaviour has tended to be consistent with what would be expected in a competitive market. As a result, allocative and production efficiency losses resulting from sustained market power are unlikely to be a significant issue in Tasmania given the external restrictions currently imposed on Hydro Tasmania.

- However, latent market power is a concern. Our historical analysis indicates that Hydro Tasmania is not limited to being able to drive up spot prices only during high demand periods or periods when other generators are not available. Rather, the evidence indicates that Hydro Tasmania is able to drive up spot prices even when demand levels are low and when Tamar Valley is available. Our forecasts of outcomes under the Latent Case also support the view that there are a wide range of demand conditions under which Hydro Tasmania would be able to drive up spot prices if it were not highly contracted. Given this, and given that Hydro Tasmania is ultimately responsible for choosing its contract position (subject, of course, to its risk limits) and, therefore, choosing if and when to be exposed to the spot market, retailers and major energy users are likely to be concerned that they may be subject to Hydro Tasmania’s latent market power in the future. This is likely to act as a deterrent to new entry and investment with potentially significant implications for dynamic efficiency.
PART C –
Reform options
10 Overview of reform options

In preparing its Draft Report, the Panel is considering three potential reform options for the Tasmanian wholesale electricity sector:

- Hydro Tasmania Contract Auction
- Vic-Tas Region
- Hydro Tasmania Trader

This section provides a brief overview of these reform options.

10.1 Hydro Tasmania Contract Auction

**Description**

Under the Hydro Tasmania Contract Auction reform option, Hydro Tasmania would be required to formally auction a defined quantity of hedging contracts. The obligation would define specific contract types to be auctioned – most likely standard swap contracts and cap contracts referenced to the Tasmanian RRN – and the volume of each contract type to be auctioned.

The Hydro Tasmania Contract Auction would be similar to capacity auctions in other markets (most notably EDF’s capacity auctions in France). Experience in other jurisdictions shows that there are a wide variety of ways in which the standard contracts can be designed and in which the auction process can be structured and implemented. Regardless of these implementation issues, however, the basic intent is to provide greater certainty to retailers and major energy users about the availability of competitively-priced contracts.

**Objective**

The objective of the Hydro Tasmania Contract Auction reform option is to ensure that contracts are made available on an ongoing basis to new entrant retailers and new major loads, and to create a competitive process for the sale of these contracts. The auction would be designed to provide new entrants with greater confidence that they would be able to acquire hedging contracts to manage the risk associated with Hydro Tasmania choosing to exercise its hitherto latent market power. In this way, the contract auction would facilitate entry and go some way towards addressing concerns about Hydro Tasmania’s latent market power, which should enhance dynamic efficiency.

Clearly, given the objective of this reform option is to ensure that contracts are available to new entrant retailers and new major loads, this reform option makes most sense as part of a package of reforms to promote downstream entry, including the introduction of full retail contestability (FRC).
To be clear, the objective of this reform option is not to require Hydro Tasmania to remain contracted to a defined level, with the intention of eliminating concerns about latent market power. This would be difficult to achieve simply by introducing a formal auction process because Hydro Tasmania could simply adjust the remainder of its contract book around the auctioned contracts (and subjecting Hydro Tasmania’s complete load to this auction would be unlikely to meet the needs of Hydro Tasmania’s counterparties).

**Likely implications for Tasmanian wholesale electricity sector**

Assuming that the standard contracts that were auctioned were financial contracts (not physical contracts), the Hydro Tasmania Contract Auction reform option would be unlikely to affect spot market outcomes. Hydro Tasmania would be able to adjust its overall contract position around the auctioned contracts and in doing so would be able to continue to make trade-offs between the spot market and contract market.

The contract auction would reduce Hydro Tasmania’s bargaining power relative to those counterparties in the contract market that were able to participate in the contract auction. This is because Hydro Tasmania would not have the option to withdraw from contract negotiations. As a result, the option would likely result in contract terms that were more favourable for these counterparties.

**Implementation issues**

Compared to other possible reform options (including the Vic-Tas Region and the Hydro Tasmania Trader) introducing a Hydro Tasmania Contract Auction is a relatively simple reform. It does not require any re-structuring of the existing businesses, can largely be implemented by Government and would require only relatively minor adjustments to Hydro Tasmania’s systems to ensure compliance.

Nevertheless, if this reform option were to be adopted, it would require further work to design and implement. The key issues to be addressed in order to give effect to this reform option relate to the contracts to be offered through the auction process and the design of the auction process itself.

In relation to the contracts to be offered there are two key questions:

- **What type of contracts should be offered?**

  Wholesale energy contracts between generators and retailers can take a wide variety of different forms. The design of wholesale energy contracts will affect, among other things, the allocation of risks between the counterparties.

  Given that the intention of this reform option is to support FRC, it is likely that the preferred option would be to offer standard financial contracts through the auction. Offering contracts that are similar to those commonly available in other NEM regions likely will be attractive to potential new entrant retailers.
These standard contracts would typically involve a mix of firm swap contracts and firm cap contracts for different periods. It would also be possible to offer a load-following contract – this likely would be attractive to new entrant retailers but would increase risk to Hydro Tasmania.

**What volume of contracts should be offered?**

Retailers will typically try to substantially back their forecast retail load with firm wholesale energy contracts. In order to best support FRC, it would be desirable that new entrants retailers were confident of being able to secure sufficient wholesale contracts to cover the small retail customers that switch away from Aurora Energy. Forecasts of switching levels could therefore provide an indication of the volume of wholesale energy contracts to offer through the contract. However, careful thought will need to be given to the profile of the contract volume over time, and how this will relate to Hydro Tasmania’s existing contract position.

In relation to the design of the auction itself, there are a number of decisions that would need to be made about the auction design that is most appropriate to the reform objectives. Decisions would need to be made about the type of auction to be used, any restrictions to be imposed on participation in the auction, the timing of auctions and how the reserve price is to be determined. In particular, having a robust process for determining the reserve price for the wholesale contracts will be important to ensuring that the auction does not result in an inefficient wholesale energy price.

### 10.2 Vic-Tas Region

**Description**

Under the Vic-Tas Region reform option, the separate Victorian and Tasmanian NEM regions would be combined into a single pricing region. Under this reform option, the spot price in Tasmania would be determined by dispatch outcomes at the Victorian RRN.

The Vic-Tas Region reform option would not require structural reform of Hydro Tasmania or additional regulation of Hydro Tasmania’s pricing or contracting behaviour. However, the reform option would require that BassLink be converted to regulated status, or that a Rule change was made to allow an MNSP to operate within a region. The reform option would also require restructuring of contractual arrangements relating to BassLink, including the System Protection Scheme.

**Objective**

The objective of the Vic-Tas Region reform option is to create competitive tension within the Tasmanian wholesale electricity sector while leaving all
operational and bidding control of Hydro Tasmania’s assets with Hydro Tasmania.

**Likely implications for Tasmanian wholesale electricity sector**

Rather than trying to create firm-specific incentives for, or obligations on, Hydro Tasmania to behave competitively in the wholesale market, the Vic-Tas Region reform option would permanently subject Hydro Tasmania to the spot price outcomes prevailing on the mainland, regardless of physical constraints on BassLink. Hydro Tasmania would lose much of its (latent) market power as it faced the discipline of mainland competitive outcomes in both its spot market bidding and contracting behaviour.

However, under this reform option, constraints within the single region may create issues in the spot market. In particular, it may provide incentives for Hydro Tasmania to engage in ‘disorderly bidding’ in order to:

- Get dispatched if the Victorian regional reference price was high at times of constraint on Basslink, or
- Avoid getting dispatched if the Victorian regional reference price was low at times of constraint on Basslink

As a result, Transend or AEMO would likely need to enter into an agreement for network support with Hydro Tasmania to ensure that Hydro Tasmania would run at times of high Tasmanian demand and low Victorian prices. The prospects for ‘disorderly bidding’ under the Vic-Tas Region are discussed further in Section 11.

Ultimately, combining the Victorian and Tasmanian regions would be expected to improve competition in Tasmania, but is likely to create other inefficiencies (principally associated with price signals in the presence of network constraints and losses). For instance, with a combined region, the signal for new investment in Tasmania, including in response to a period of low hydrological inflows, will be diluted because Tasmanian generators will see the price determined at the Victorian RRP.

**Implementation issues**

Introducing the Vic-Tas Region reform option would require significant reform of the Tasmanian energy sector.

While the Vic-Tas Region reform option does not require structural reform of any of the existing Tasmanian businesses, implementing the combined region would require agreement substantial work. First, implementing the regional boundary change would require major work:

- Substantial analysis would be required to establish the case for the regional boundary change. The regional boundary change would require a change to
the NEM’s market rules, and would therefore need to be reviewed by the Australian Energy Market Commission. The AEMC’s process for considering the abolition of the Snowy Region took in excess of 18 months and involved very detailed analytical work. The abolition of the Snowy region was then implemented only after a further year had passed.

- Substantial work would be required by AEMO to implement the regional boundary change. This would include changes to AEMO’s dispatch engine, and changes to the formulation of network constrain equations and loss factors.
- The regional boundary change would likely require BassLink to be converted to a regulated network asset, which would require the agreement of the asset owners.
- The transmission use of service (TUOS) charges in Victoria and Tasmania would need to be recovered from all customers in the combined region. This would require changes to the existing arrangements for TUOS and likely result in Victorian customers facing higher TUOS charges.

10.3 Hydro Tasmania Trader

_Description_

The Hydro Tasmania Trader reform option would contractually transfer bidding rights over Hydro Tasmania’s capacity to a number of independent Government-owned trading entities. The competing trading entities would become registered participants in the NEM and be responsible for bidding the contracted capacity in the spot market, subject to their rights and obligations under their contract with Hydro Tasmania (including rights to defined capacity, defined inflows and defined water storages). The competing trading entities would also be free to enter into financial contracts with any counterparty.

Ownership and operational control of Hydro Tasmania’s assets would remain with Hydro Tasmania. Hydro Tasmania would remain responsible for the operation and maintenance of generation plant, and would be required to dispatch plant according to instructions from the trading entities. What’s more, Hydro Tasmania would meet its generation obligations to the traders from the common energy pool managed by Hydro Tasmania. Traders would not be given entitlement to the energy available in particular dams, but rather an energy budget determined as a share of Hydro Tasmania’s overall energy budget. This approach overcomes any risk to security of supply and reliability that may otherwise arise from providing access to specific water resources for generation purposes to separate traders.

Under this model the trading entities would make payments to Hydro Tasmania to cover its efficient costs, including its efficient ongoing operating costs and
stay-in-business capital costs. In order to promote efficient outcomes, these payments should be structured to reflect the underlying costs faced by Hydro Tasmania: fixed costs should be recovered through fixed charges and variable costs should be recovered through variable charges. This would ensure that Hydro Tasmania is financially viable on an ongoing basis and also that the independent traders face the costs associated with their bidding decisions.

**Objective**

The objective of the Hydro Tasmania Trader reform option would be to create ongoing competitive tension within the Tasmanian wholesale electricity sector without the need to structurally separate or privatise Hydro Tasmania. By creating durable competitive tension, the reform option would also avoid the need for ongoing regulation of Hydro Tasmania’s behaviour.

**Likely implications for Tasmanian wholesale electricity sector**

Rather than trying to create specific incentives for, or obligations on, Hydro Tasmania to behave competitively in the wholesale market, the Hydro Tasmania Trader reform option would promote competitive behaviour by increasing the number of participants in the Tasmanian region of the NEM. As long as this reform model was implemented effectively, the trading entities would face competitive tension both in bidding into the spot market and in their contracting behaviour.

Ultimately, the intention of this reform option would be to ensure that the independent trading entities have a set of rights and obligations under the contractual arrangements (including rights in regard to bidding Hydro Tasmania’s generation plant and obligations in regard to payments to Hydro Tasmania) that reflect the physical characteristics, capabilities and limitations of Hydro Tasmania’s generation plant. This would promote efficient decisions by the trading entities and efficient outcomes in the wholesale electricity sector.

However, it is important to recognise that Hydro Tasmania’s generation plant operate, to some extent, as part of an integrated system. Given this, there will no doubt be significant complexity in separating the rights to bid the generation plant in this integrated system between separate traders while at the same time preserving the operational efficiencies within the integrated system. Specific issues that may arise could include the allocation of rights and obligations to traders to offer ancillary services and the effective operation of BassLink. At worst, it may be the case that separating the rights to bid the generation plant between traders will result in some loss of efficiency in the operation of Hydro Tasmania’s generation plant or BassLink. If so, this would need to be weighed against the efficiency benefits resulting from a more competitive wholesale electricity sector (as well as the other costs and benefits of the reform option).
Determining the extent of any loss of operating efficiency as a result of the Hydro Tasmania would require a detailed scoping study. It is worth noting, however, that the issue of allocating to independent trading entities the rights and obligations in regard to common infrastructure would not be unique to the case of Hydro Tasmania. Other similar contractual arrangements involve similar issues. For instance, the contractual arrangements designed for the NSW power stations as part of the NSW Energy Reform Strategy involve allocation of rights and obligations in regard to infrastructure that is shared between power stations (including coal handling infrastructure and cooling water infrastructure). These complex issues can be resolved without a significant impact on operational efficiency.

Implementation issues

Introducing the Hydro Tasmania Trader model would involve significant structural reform of the Tasmanian energy sector.

There are two key requirements for the implementation of this reform option: restructuring of the wholesale activities currently performed by Hydro Tasmania and design of the contractual relationships between Hydro Tasmania and the independent traders.

In relation to the restructuring of Hydro Tasmania’s wholesale activities, this reform option would require the creation of a number of independent Government-owned trading entities. Each of these trading entities would be responsible for undertaking wholesale trading activities similar to those currently undertaken by Hydro Tasmania, including making decisions about how energy is to be offered into the NEM and entering into wholesale energy contracts to manage the risk associated with exposure to spot prices in the NEM. This reform option would also require the development of systems and procedures for effective communication between each of the independent Government-owned trading entities and Hydro Tasmania. Clearly, there would be costs associated with creating these independent trading entities, and ongoing costs required to support their activities.

In relation to the design of the contractual arrangements that would govern the relationships between Hydro Tasmania and the independent traders, this would require substantial work, with a number of complex issues to address. These contractual arrangements would need to carefully establish the rights and obligations of each of Hydro Tasmania and the independent traders. Major issues to be addressed in designing these contracts include:

- determining the number of independent traders that are to be established
- specifying the rights that each independent trader would have to capacity and energy from Hydro Tasmania’s generation plant
The allocation of risks under the contract, including the risks associated with power station performance and power station costs.

The resolution of these major issues will need to reflect policy decisions by Government about the future of the Tasmanian electricity supply sector.

### 10.4 Other reform decisions

As well as the three wholesale market reforms discussed in this report, there are a range of other reform options available to Government. Two of these – that would have implications for the Tasmanian wholesale electricity sector – are the arrangements for BassLink and the ownership of Tamar Valley power station.

**BassLink**

BassLink Pty Ltd is currently owned by CitySpring Infrastructure Trust. Hydro Tasmania pays an annual facility fee to CitySpring and, in return, receives the inter-regional revenues (IRRs) associated with BassLink.

In principle, under the Hydro Tasmania Contract Auction reform option or the Hydro Tasmania Trader reform option the IRRs associated with BassLink could be transferred to another entity. Access to the IRRs associated with BassLink may change the financial incentives of an entity, because the IRRs will provide a positive cashflow when flows on BassLink are binding and there is price separate between Tasmania and Victoria. For instance, a new entrant retailer might use IRRs in combination with financial contracts against the Victorian price as a substitute for financial contracts against the Tasmanian price.

For the purpose of our modelling of the Hydro Tasmania Trader reform option we have not made an assumption about how IRRs are allocated to independent traders. Rather, we have assumed that the IRRs remain with Hydro Tasmania. However, this is not to suggest that we would recommend leaving the IRRs with Hydro Tasmania as the preferred option. In practice, the introduction of the Hydro Tasmania Trader reform option, in conjunction with other reforms such as the introduction of FRC, would provide the opportunity for BassLink IRRs to be auctioned to participants. Both new entrant retailers and independent traders may be interested in gaining access to BassLink IRRs as part of their broader contracting strategy. And, indeed, these new entrant retailers and independent traders may place a higher value on the BassLink IRRs than Hydro Tasmania (which, under the Hydro Tasmania Trader reform option, would operate the power stations but not trade the power stations).

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15 Under the Vic-Tas Region reform option, there are no IRRs associated with BassLink because BassLink would operate within a single region. In this case, it is likely that BassLink would need to be converted to a regulated transmission line.
Tamar Valley power station

Tamar Valley power station is currently owned and operated by Aurora Energy. Under any of the reform options considered by the Panel, Tamar Valley power station could be transferred to another entity. However, for the purpose of our modelling we have assumed that Tamar Valley power station remains owned by Aurora Energy.

10.5 Wholesale modelling of reform options

As discussed in the sections above, the Vic-Tas Region reform option and the Hydro Tasmania Trader reform option both have the objective of promoting more competitive outcomes in the spot market. Therefore, in order to assess the likely effects of these reform options, we have undertaken market modelling of these reform options (discussed in Section 11 and Section 12).

However, since the given that the Hydro Tasmania Contract Auction reform option is not intended to affect spot market outcomes, we have not undertaken market modelling of this reform option.
11 Outcomes with combined Vic-Tas Region

As discussed in Section 10.2, the intention of the Vic-Tas Region reform option is to subject Hydro Tasmania to the spot price outcomes prevailing on the mainland, regardless of physical constraints on BassLink.

Clearly the Vic-Tas Region reform option would constitute a substantial change to the performance of the Tasmanian region of the NEM. Consequently, historical outcomes in Tasmania cannot be used as a guide to likely outcomes under this reform option. Instead, the likely effects of this reform option can only be quantified through market modelling. This section sets out our modelling of outcomes under the Vic-Tas Region reform option.

11.1 Methodology

Spot market outcomes under the Vic-Tas Region were modelled in a two-staged process, using WHIRLYGIG and SPARK, as discussed in Section 3.2. This two-stage modelling framework enabled forecast generator costs, physical constraints as well as strategic bidding behaviour to be simultaneously captured in our spot price forecasts.

Under the Vic-Tas Region, the forecasting exercise required two critical modelling inputs. The first was the set of discrete quantity bids that we applied to the market’s major generators. These bids formed the range of quantity strategies that the major generators could play in order to maximise their profits. For Hydro Tasmania, the Vic-Tas Region was modelled using the same range of bidding strategies as were used for the Base Case.

The second key input was the intra-regional network constraints. Including these in the modelling enabled the market model to mimic the physical limits of the NEM transmission network. It is important to incorporate a representation of the physical transmission constraints when modelling a regional boundary change to ensure that the physical limits of the interconnects between regions (e.g. Basslink) were (as accurately as possible) accounted for in the combined region model. These intra-regional constraints were taken from the 2010 ESOO Supply-Demand calculator and were applied to the second stage of the modelling process, SPARK. The constraints were oriented for the existing set of NEM regions, and were applied to all market models presented in this report, including the Vic-Tas Region. The Vic-Tas Region could have been modelled more accurately by applying a set of constraints re-oriented for a Vic-Tas configuration. However, such an exercise would require considerable resources from AEMO and is outside the scope of this project.

The assessment of the Vic-Tas Region reform option required us to model two cases that were closely related to the cases presented in Section 8:
Vic-Tas Case – The Vic-Tas Case was essentially a sensitivity on the Base Case presented in Section 8. Instead of receiving the loss adjusted prices at the Tasmanian RRN, Tasmanian generators received the loss adjusted prices at the Victorian RRN.

Vic-Tas Latent Case – The Vic-Tas Latent Case was a version of the Vic-Tas Case where we assumed that Hydro Tasmania was fully uncontracted. It was the combined region version of the Latent Case presented in Section 8. When compared with the Latent Case presented in Section 8, the Vic-Tas Latent Case provided a measure of the effectiveness of the Vic-Tas Region reform option in containing Hydro Tasmania’s latent market power.

11.2 Vic-Tas Case

Figure 23 shows the annual time-weighted average spot prices for the five NEM regions for the Vic-Tas Case. These prices were compared to the same results from the Base Case and the d-cyphaTrade forward curve (see Section 8.2 for further details on the Base Case). As expected, the spot price outcomes in the Base Case and the Vic-Tas Case were identical for all regions except for Tasmania. In Tasmania, spot prices in the VIC-Tas Case were equal to Victorian spot prices, which is what would be expected.

Generally speaking, our modelling of the Base Case had lower spot prices in Tasmania than in Victoria. As a result, the Vic-Tas Case generally resulted in higher spot prices in Tasmania than the Base Case. However, it is important to recognise that the Base Case modelling results depended, among other things, on the assumed storage levels and inflow levels for Hydro Tasmania. Since the Base Case incorporated relatively high initial storage levels and consistent inflows, spot prices in Tasmania tended to be relatively low (and generally lower than those in Victoria). However, with lower storage levels, or lower inflows, prices in Tasmania in the Base Case would have been higher, reflecting the higher opportunity cost of Hydro Tasmania’s water. In this case, prices in Tasmania would be expected to be lower under the Vic-Tas Region than under the Base Case. This highlights one of the effects of the Vic-Tas Region, as far as Tasmania is concerned: setting the Tasmanian price according to outcomes at the Victorian RRN has the effect of reducing the impact of hydrological outcomes on the Tasmanian spot price.
11.3 Vic-Tas Latent

An analysis of Hydro Tasmania’s bidding behaviour under the Vic-Tas Latent Case illustrates the extent to which the Vic-Tas Region reform option would reduce Hydro Tasmania’s latent market power.

Figure 24 compares the Nash equilibria that comprised the wholesale market outcomes in the Latent Case and the Vic-Tas Latent Case. Similar to Figure 22 from Section 8.4, each sub-plot shows the Tasmanian load duration curve modelled in SPARK, the percentage of available capacity bid by Hydro Tasmania at the Nash equilibria found at each level of demand (the size of each point), and the average price across these Nash equilibria (the colour of each point). Comparing the Latent Case to the Vic-Tas Latent Case, there is a clear and significant reduction in Hydro Tasmania’s ability and incentive to bid up spot prices in the Vic-Tas Latent Case. The reduction in Hydro Tasmania’s latent market power is shown by the increase in the percentage quantity bid at each demand point and by the reduction in the average equilibrium prices at each demand point.

Ultimately, as shown in Figure 25, equilibrium outcomes in the Vic-Tas Latent Case were generally consistent with outcomes in the Base Case and the Vic-Tas Case. This indicates that the sustainability of competitive outcomes under the
Vic-Tas Region reform option do not depend on the level to which Hydro Tasmania is contracted.

Figure 24: Latent Case and Vic-Tas Latent Case – Hydro Tasmania equilibria analysis, all financial years

Source: Frontier Economics
11.4 Disorderly bidding

The results for the Vic-Tas Case and the Vic-Tas Latent Case indicate that the combined Vic-Tas region would significantly increase the competitive constraints faced by Hydro Tasmania. Against that, however, it is necessary to consider the potential for inefficiency to arise as a result of the pricing Tasmanian load and generation at the Victorian price.
As discussed, this reform option may provide incentives for Hydro Tasmania to engage in ‘disorderly bidding’ in order to:

- Get dispatched if the Victorian regional reference price was high at times of northward constraint on Basslink, or
- Avoid getting dispatched if the Victorian regional reference price was low at times of southward constraint on Basslink

**Northward constraint**

When prices are high in Victoria (and Tasmanian prices are equal to the Victoria price) and BassLink flows are binding northwards, generators in Tasmania may have an incentive to compete with one another by bidding negative in order to be dispatched and receive the high price.

Modelling the times when generators in Tasmania would have an incentive to bid negatively would significantly increase the complexity of our modelling. Ultimately, as long as we are using the existing network constraints, rather than a set of constraints re-orientated for a Vic-Tas configuration, this modelling will be indicative of potential outcomes. Given this, we have not undertaken this detailed modelling.

However, we are able to infer from our existing modelling results the extent to which generators are likely to have an incentive to bid negatively. In any case in which the Victorian price is higher than the short-run marginal cost of Tamar Valley power station, and BassLink flows are binding northward, Aurora Energy might have an incentive to bid Tamar Valley power station negatively in order to maximise dispatch. In response, Hydro Tasmania might have an incentive to bid its plant negatively in order to maximise its dispatch. Results from our modelling indicate that there are years in which this combination of outcomes are reasonably common. Figure 26 shows the percentage of the year – for each of the years we have modelled in SPARK – for prices under the Vic-Tas Case are higher than the short run marginal cost of Tamar Valley power station and BassLink flows are binding northward. In 2012/13, 2013/14 and 2015/16, during which there are substantial exports from Tasmania to Victoria, the combination of outcomes occurs from 8% to just under 14% of the year. In other years, when exports from Tasmania are lower, the combination of outcomes is much less common.
However, it is important to note that this behaviour would be unlikely to harm economic efficiency compared to existing arrangements. The reason is that under the existing arrangements, Tasmanian exports would also be at or near their maximum under these conditions. Therefore, disorderly bidding by Tasmanian generators would not significantly increase their dispatch at the expense of Victorian brown coal generators.

The same logic can be applied to infer the extent to which generators in the Latrobe Valley are likely to have an incentive to bid negatively as a result of constraints between the Latrobe Valley and the Victorian RRN. Currently this occurs when there are constraints on the line from Hazelwood to South Morang. Under the current regional definition, constraint of this line can create an incentive for the La Trobe Valley generators to bid negatively in order to maximise dispatch. Again, the aggregate level of production is limited by the constraint and such competition is likely only to result in the displacement of one brown coal generator by another and unlikely to involve significant losses of efficiency. Under the combined Vic-Tas region, in the event that the Hazelwood to South Morang line is binding and there is spare capacity on Basslink for northward flow, Hydro Tasmania and potentially Tamar would also have incentive to bid negatively to displace generation from the La Trobe Valley – i.e. La Trobe Valley and Tasmanian generators would all be on the ‘wrong side’ of the
constraint. Whilst the current modelling indicates that this situation would only arise infrequently (less than 1% of the year), Frontier does not consider this result to be conclusive as this outcome is highly dependent on the formulation of the Hazelwood to South Morang constraints which would in practice be re-oriented under a Vic-Tas region. Such a re-orientation could lead to a significantly different result.

**Southward constraint**

When prices are low in Victoria (and Tasmanian prices are equal to the Victoria price) and BassLink flows are binding southwards, generators in Tasmania may have an incentive to bidding high prices are unavailable in order to avoid being dispatched at the low price.

In these circumstances, AEMO would either need to constrain-on or direct Hydro Tasmania to generate, or Hydro Tasmania would need to agree to generate at these times through some form of contract for network support services. Regardless of the means by which Hydro Tasmania is required to generate under these circumstances, combining the regions would be unlikely to harm the economic efficiency of dispatch. This is because with Basslink constrained, the same amount of Tasmanian generation would need to be dispatched as under the current arrangements. Hence, the resource costs of serving load would be similar with separate or combined regions. It is changes in resource costs that drive economic efficiency effects in dispatch, not the price that generation is paid. However, depending on the arrangements by which Hydro Tasmania is required to generate, there may be distributional effects.

### 11.5 Conclusion

The intention of the Vic-Tas Region reform option is to subject Hydro Tasmania to the spot price outcomes prevailing on the mainland, regardless of physical constraints on BassLink. Our modelling results suggest that the Vic-Tas Region would be very effective in achieving this, and in limiting Hydro Tasmania’s latent market power. In a combined region, Hydro Tasmania would no longer have the same ability or incentive to drive up the Tasmanian price, regardless of its contract level.

For this reason, the Vic-Tas region could result in improvements in production, allocative and dynamic efficiency in Tasmania. Retailers and major energy users would no longer face the same risk of being subject to Hydro Tasmania’s latent market power. Relative to the current market structure and market arrangements in Tasmania, this could promote more efficient investments by retailers and major energy users.
12 Outcomes with Hydro Tasmania Trader

As discussed in Section 10.3, the intention of the Hydro Tasmania Trader reform option is to create competitive tension within the Tasmanian wholesale electricity sector. Because the Tasmanian wholesale electricity sector does not have a history that includes multiple competing generators, the likely effects of this reform option can only be quantified through market modelling. This section sets out our modelling of outcomes under the Hydro Tasmania Trader reform option.

12.1 Methodology

Spot market outcomes under the Hydro Tasmania Trader reform option were modelled in a two stage process, using WHIRLYGIG and SPARK, as discussed in Section 3.2. This two-stage modelling framework enabled forecast generator costs, physical constraints as well as strategic bidding behaviour to be simultaneously captured in our spot price forecasts. Furthermore, within Frontier’s two stage modelling framework, it was possible to accurately capture the key physical and economic characteristics of the Hydro Tasmania Trader reform option.

In the first stage, WHIRLYGIG, we model Hydro Tasmania as an operator of the generation assets rather than a participant in the wholesale electricity market. As an operator, its role is to provide the Traders with a periodic energy budget. This budget is the maximum amount of water the Traders can access for generation over a given period, accounting for the hydrology forecast, existing storage levels and environmental flow requirements. This energy budget is essentially the optimal profile of water use over the forecast period, and it is an output from WHIRLYGIG.

In the second stage, SPARK, we introduce the individual Traders to the market. These Traders are given an energy budget as well as a “must-run” profile, which reflects their share of Hydro Tasmania’s environmental flow requirements. They are allowed to strategically withdraw capacity below their energy budget, as long as they bid at least their must-run profile. This framework allows us to accurately model the Traders as owners of trading rights rather than owners of physical assets.

In modelling the Hydro Tasmania Trader reform option we have assumed that each trader will face the same variable cost of generation as Hydro Tasmania does in the Base Case. This is consistent with the view that any payments from the traders to Hydro Tasmania would reflect the underlying structure of Hydro Tasmania’s costs. While this would likely require that traders faces both variable charges and fixed charges, fixed charges will not affect the bidding behaviour of the traders and therefore need not be incorporated in our modelling.
The assessment of the Hydro Tasmania Trader reform option required us to model eight cases that were closely related to the cases presented in Section 8:

- Four Hydro Tasmania Trader Cases:
  - a Single Trader Case
  - a Two Trader Case
  - a Three Trader Case
  - a Four Trader Case

The Single Trader Case is essentially a sensitivity on the Base Case where a single Trader is the strategic, wholesale market participant in place of Hydro Tasmania. This trader is subject to the same energy budget and financial hedging position as Hydro Tasmania. However, we also assume that the Trader does not receive any Basslink IRRs. In the multiple Trader cases, the set of Traders replace Hydro Tasmania as the wholesale market participants and the energy budget and financial hedges are split equally across the Traders.

- Four Hydro Tasmania Trader Latent Cases:
  - a Single Trader Latent Case
  - a Two Trader Latent Case
  - a Three Trader Latent Case
  - a Four Trader Latent Case

These cases are identical to their counterpart Hydro Tasmania Trader Cases with the exception that one Trader is fully uncontracted. For example, the Single Trader Latent Case is identical to the Single Trader Case except that the Trader is fully uncontracted, and the Four Trader Latent Case is identical to the Four Trader Case except that one of the four Traders is fully uncontracted. These Trader Latent Cases provide a measure of the effectiveness of the Hydro Tasmanian Trader reform option in containing the latent market power of an individual Trader; the cases forecast the extent to which a single Trader exposed to the spot market would, acting unilaterally, have the ability and incentive to increase Tasmanian spot prices through its bidding behaviour.

### 12.2 Outcomes with Hydro Tasmania Trader

Figure 27 shows the annual time-weighted average spot prices for Tasmania across the four Hydro Tasmania Trader Cases, the Base Case and the SRMC Case (see Section 8.2 and 8.3 for further details on the Base Case and SRMC Case respectively).
A couple of things stand out from these results.

First, outcomes under the Base Case and the Single Trader Case are somewhat different. This reflects the fact that it is assumed under the Single Trader Case that the Trader does not receive any IRRs. This absence of IRRs will have an effect on bidding incentives: in some instances it will make it more profitable to increase generation from Hydro Tasmania’s plant and in some instances it will make it more profitable to decrease generation. Ultimately, the effect will depend on demand conditions, supply conditions and the bidding behaviour of other generators. As can be seen in Figure 27, the Trader has an incentive to generate more in 2011/12, before carbon is introduced, and less thereafter.

Second, as expected, spot prices under the four Hydro Tasmania Trader Cases move closer to SRMC spot prices as the number of Traders increases. The results show that a market with three Traders is sufficient to drive the spot price within 1% of the SRMC Case spot price.

Figure 27: Hydro Tasmanian Trader – forecast spot price

Source: Frontier Economics
12.3 Assessment of latent market power with Hydro Tasmania Trader

An analysis of the uncontracted Trader’s bidding behaviour under the four Hydro Tasmania Trader Latent Cases illustrates the extent to which the Hydro Tasmania Trader reform option would reduce latent market power in the Tasmanian wholesale electricity market.

Figure 28 compares the Nash equilibria that comprised the wholesale market outcomes in the Latent Case and the four Hydro Tasmania Trader Latent Cases. Similar to Figure 22 from Section 8.4, each sub-plot shows the Tasmanian load duration curve modelled in SPARK, the percentage of available capacity bid by the sole, fully uncontracted Trader (or Hydro Tasmania in the Latent Case) at the Nash equilibria found at each level of demand (the colour of each point) and the average price across these Nash equilibria (the size of each point). This figure clearly shows a reduction in the uncontracted Trader’s ability to influence spot prices through strategic withdrawals as the number of contracted Traders in the market increases. The modelling also suggests that the greatest reduction in latent market power comes with just two independent Traders. Additional reductions in latent market power with an increase in the number of independent Traders are more modest.
12.4 Conclusion

The intention of the Hydro Tasmanian Trader reform option is to create long-term competitive tension within the Tasmanian wholesale electricity sector. Our modelling results suggest that the Trader model would be very effective in achieving this, and in limiting Hydro Tasmania’s latent market power. Where
there are two or more Traders, no single Trader would have the same ability to drive up the Tasmanian price, regardless of their contract level.

For this reason, the Hydro Tasmanian Trader reform option could result in improvements in production, allocative and dynamic efficiency in Tasmania. Retailers and major energy users would no longer face the same risk of being subject to Hydro Tasmania’s latent market power. Relative to the current market structure and market arrangements in Tasmania, this could promote more efficient investments by retailers and major energy users.
13 Conclusion on outcomes under Reform Options

Our modelling of the Vic-Tas Region reform option and the Hydro Tasmania Trader reform option point to the following general conclusions:

- Both the Vic-Tas Region reform option and the Hydro Tasmania Trader reform option result in substantial reductions in Hydro Tasmania’s latent market power. Under these options, the ability and incentive to exercise market power, even in the absence of hedging contracts, is substantially diminished. Indeed, the ability and incentive to exercise market power is comparable to the Base Case, in which Hydro Tasmania is substantially contracted.

- For the Hydro Tasmania Trader reform option, the greatest reduction in latent market power occurs when moving from a single Trader to two Traders. Thereafter, the additional reductions in latent market power from increasing the number of Traders are much smaller. However, it is worth bearing in mind that the modelling assumes that the individual Traders act unilaterally. Given that the Traders would remain Government-owned, there may remain some concern among retailers and major energy users that two individual Traders may, more easily, act in a coordinated fashion. If this is the case, there may be an argument more than two Traders in order to address these concerns.

Ultimately, given that our analysis of outcomes under the current arrangements in the Tasmanian wholesale electricity sector concluded that transient market power is not a significant concern, and found no evidence of sustained market power, the benefits to be achieved from these reform options are a result of providing retailers and major energy users that they need not be concerned with latent market power.
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