A Assessment of related Rule change proposals

This Appendix presents the Australian Energy Market Commission's (the AEMC's or Commission's) assessment and reasoning of the three Rule change proposals seeking to address congestion in the Snowy region. These proposals are: Snowy Hydro's Abolition of the Snowy Region proposal (Abolition alternative)[39]; Macquarie Generation's Split Snowy Region proposal (Split Snowy Region proposal); and the Southern Generators' Congestion Pricing and Negative Residue Management Arrangements for the Snowy Region proposal (Southern Generators' Congestion Pricing proposal). These proposals are described fully in Section 1 of the respective determinations.

This Appendix briefly outlines the Commission's approach to assessing the proposals, before discussing the Commission's processes and procedures. It then presents the Commission's analysis for each of these proposals against the assessment criteria.

A.1 Approach to assessment

The Commission has assessed each of the proposals against the following criteria:

- Economic efficiency of dispatch;
- Inter-regional trading and risk management;
- Pricing outcomes and participant responses;
- Power system security, supply reliability, and technical issues;
- Good regulatory practice;
- Long term implications and consistency with public policy settings; and
- Implementation.

All three proposals are evaluated against a base case. This provides a common reference point for comparison. The base case chosen represents the market under a "do nothing" approach. It retains the existing Snowy region boundaries, with interconnectors just south of Murray and just north of Tumut. It retains the Snowy regional reference node (RRN) at Murray and allows the expiry of the interim arrangements currently managing congestion in the Snowy region; i.e. the Tumut Constraint Support Pricing/Constraint Support Contract Trial (Tumut CSP/CSC

[39] The Commission made its final Rule determination to accept the Abolition of Snowy Region Rule change proposal on 30 August 2007. For the purposes of this Rule determination, the Abolition proposal is referred to as the "Abolition alternative" to reflect that at the time of the comparison of these alternatives, the Abolition proposal was an alternative, whereas now the Commission has made and commenced the *National Electricity Amendment (Abolition of Snowy Region) Rule 2007 No* 7 to implement the abolition of the Snowy region. For more information see "AEMC 2007, *Abolition of Snowy Region*, Rule Determination, 30 August 2007, Sydney", available on the AEMC website.

Trial) and the Southern Generators Rule. It reinstates NEMMCO's intervention power to manage negative settlement residues on the Victoria-Snowy and Snowy-New South Wales (NSW) interconnectors through "clamping" or "re-orientation".[40] The Commission's quantitative modelling also uses this base case (see Appendix B).

The three Rule change proposals all seek to price the congestion across the Murray-Tumut cutset. They do so using different approaches:

- The Abolition alternative prices congestion by introducing a region boundary across the Murray-Tumut cutset, meaning that this congestion will be reflected in price differences between the Victoria and NSW regions. It also removes the existing Snowy region boundaries north of Tumut and south of Murray as Snowy Hydro argues these region boundaries do not fall across major "pinch-points" of congestion. The removal of the Snowy region relocates Snowy Hydro's Murray generation into Victoria, to be settled at the Victorian regional reference price (RRP) and relocates its Tumut generation into NSW, to be settled at the NSW RRP.

- The Split Snowy Region proposal also prices the congestion across the Murray-Tumut cutset using a new region boundary. However, unlike the Abolition alternative, it retains the existing region boundaries north of Tumut and south of Murray. This proposal replaces the existing Snowy region with two new regions, Murray and Tumut, and the existing two interconnectors between Victoria and NSW with three: Victoria-Murray, Murray-Tumut, and Tumut-NSW. To address the issues of negative settlement residues on the new Victoria-Murray interconnector Dederang is relocated from the Victorian region into the Murray region, and selected as the RRN for the Murray region. The RRN in the Tumut region is located at Lower Tumut, the largest generation node in that new region.

- The Southern Generators' Congestion Pricing proposal prices the congestion between Murray and Tumut, but only when the Murray-Tumut constraint binds. It does this using a congestion pricing mechanism, the Tumut CSP/CSC Trial. Under this proposal when the Murray-Tumut constraint binds Tumut generation is settled at the Tumut node, rather than the Snowy RRP. The Southern Generators Rule component of this proposal replaces National Energy Market Management Company's (NEMMCO's) clamping intervention to manage the accumulation of negative residues between the Victorian and Snowy regions with an alternative funding mechanism.

The Commission presents its analysis for each of these proposals against the specified criteria below. For each criterion, the three Rule change proposals are assessed against the base case and each other.

This assessment enables the Commission to identify the option that the Commission considers best promotes the National Electricity Market Objective (NEM Objective):

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[40] NEMMCO's power to manage the accumulation of negative settlement residues is set out in clause (c) of Part 8 of Chapter 8A of the National Electricity Rules (Rules). NEMMCO's procedure for managing negative residues is set out in its Operating Procedure – Dispatch: SO_OP3705.

"Efficient investment in, and efficient use of, electricity services for the long term interests of consumers of electricity with respect to price, quality, reliability and security of supply of electricity and the reliability, safety and security of the national electricity system."[41]

The Commission's conclusions in this regard are presented in Section 5 of the Rule determination.

A.2 Commission processes and procedures

Since 1 July 2005, the Commission has received six Rule change proposals relating to the management of congestion in the Snowy region. Each of these proposals required consideration by the Commission under the Rule making test. A key issue for the Commission was the approach to evaluating each of these proposals, given constraints on timing and resources. This Section sets out the Commission's processes and procedures in assessing these Rule change proposals.

The Commission considered it logical and reasonable to consider the shorter term proposals, concerned with the management of negative settlement residues, prior to evaluating the longer term options, like region boundary change proposals. The Commission considered analysis, assessment, and implementation of a region boundary change would take time. An interim arrangement, however, could be implemented over a shorter timeframe and could operate in the period leading up to implementation of a more comprehensive solution to the congestion issues in the Snowy region. This approach was consistent with views expressed in the majority of submissions received on the various Rule change proposals.[42]

The Commission published its final Rule determinations on the two short term proposals on:

- 14 September 2006 – on the "Management of Negative Settlement Residues in the Snowy Region".[43] This decision implemented the Southern Generators Rule, which commenced on 1 November 2006; and
- 9 November 2006 – on the "Management of Negative Settlement Residues by Reorientation" alternative proposed by Snowy Hydro and NEMMCO in May 2006.

During that period, the Commission received two of the longer term Rule change proposals, both seeking to change the Snowy region boundaries. Snowy Hydro

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41 Section 7, National Electricity Law (NEL).

42 These views are discussed in AEMC 2006, *Management of Negative Settlement Residues in the Snowy Region*, Final Rule Determination, 14 September 2006, Sydney; and AEMC 2006, *Management of Negative Settlement Residues by Reorientation*, Final Rule Determination, 9 November 2006, Sydney.

43 The "Management of negative settlement residues in the Snowy region" Rule change proposal was proposed by NEMMCO and the "Southern Generators (Loy Yang Marketing Management Company (LYMMCO), Southern Hydro, International Power, TRUenergy, NRG Flinders, Hydro Tasmania). The Commission assumed responsibility for this Rule change proposal from the National Electricity Code Administrator on 1 July 2005.

submitted its Abolition proposal in November 2005, seeking the permanent abolition of the Snowy region. Macquarie Generation's Rule change proposal followed in February 2006. This proposal sought to replace the existing Snowy region with two new load-bearing regions, one in northern Victoria and one in south-west NSW. Following its final decisions on the two interim proposals, the Commission turned its focus to these longer term options.

In December 2006, the Commission decided to release separate draft Rule determinations on the Abolition and Macquarie Generation proposals because the Commission's analysis of the Abolition proposal was well advanced and could be ready for decision earlier than the more analytically complex Macquarie Generation proposal. The Commission considered it would be beneficial to undertake early consultation on the Abolition proposal, pending release of the Macquarie Generation draft decision.

In January 2007, the Commission proceeded to publish its draft Rule determination on the Abolition proposal. In this decision, the Commission stated it would prepare a draft Rule determination on the Macquarie Generation proposal prior to its final Rule determination on the Abolition proposal. This would ensure that the Commission did not make a decision on one option without giving careful consideration to the relevant alternative.

Subsequent to the Commission's draft Rule determination on the Abolition proposal, the Commission received two additional alternative Rule change proposals – the Split Snowy Region proposal on 5 March 2007 and the Southern Generators' Congestion Pricing proposal on 15 March 2007. The former proposal was submitted by Macquarie Generation to replace its earlier February 2006 proposal.

In light of these changed circumstances, the Commission considered it appropriate to provide stakeholders with the opportunity to consider these three competing Rule change proposals simultaneously. Accordingly, it extended consultation on the Abolition draft Rule determination to align with first round consultation on the two new alternatives.

Hydro Tasmania proposed in a submission that the Commission should consider a counter-factual version of the Split Snowy Region where Murray remained the RRN for the Murray region, but proposed the inclusion of a Southern Generators Rule offset type arrangement to manage the negative residues on the Victoria-Murray interconnector.[44] The Commission did not consider this option further for two reasons.

The first was that it was not put forward to the Commission as a formal Rule change proposal. While the Commission considered counter-factuals in its draft Rule determination on the Abolition proposal, the Commission made clear that it considered it was unable to implement a counter-factual without a formal Rule change proposal. As noted above the Commission received two additional Rule change proposals following the Consultation Forum on the Abolition proposal draft

[44] Hydro Tasmania, s.99 submission, Abolition of Snowy Region, Draft Rule Determination (Abolition), p.2-3.

Rule determination. Because these were submitted as formal Rule change proposals the Commission was able to assess them as implementable alternatives to the Abolition proposal. It did not consider it good regulatory practice to undertake the costly and time-intensive process of considering an additional counter-factual that it would not be able to implement in practice.

The second reason was the negative residue management mechanism put forward by Hydro Tasmania did not include any detail on structure of implementation, including specifics such as what interconnector the offsetting residues would come from, or how the mechanism would work. The Commission viewed the purpose and role of such mechanisms in the National Energy Market (NEM) was better undertaken in the context of the Congestion Management Review (CMR), rather than as an additional counter-factual to managing congestion in the Snowy region.

Stakeholder submissions on the Abolition draft Rule determination and the Split Snowy Region and Southern Generators' Congestion Pricing proposals that were critical of the Commission's process focused on its decision to consider long term solutions for the Snowy region prior to finalising the CMR and region boundary process put forward in the Ministerial Council on Energy (MCE) Region Boundary Rule proposal.[45] Other submissions were supportive of the Commission's process, arguing that the Snowy region boundary required an urgent decision to resolve the negative impacts of the current uncertainty.[46] They argued the Commission's approach represented an efficient use of resources, noting that further work was required to develop alternatives to the proposals assessed by the Commission in its draft Abolition determination.[47]

The Commission's timing was informed not only by earlier submissions to these projects, but also the unanimous agreement at the October 2006 Senior Industry Leaders Forum that the Snowy region was unique and required immediate attention prior to finalising the CMR and MCE Region boundary decisions.[48] Moreover, as a consequence of several formal extensions to the process for assessing the various Snowy region boundary proposals, the Commission has been able to have regard to its ongoing work under the CMR in coming to these determinations.

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[45] Electricity Supply Industry Planning Council (ESIPC), s.99 Abolition submission, p.1; Southern Generators, s.99 Abolition submission; s.95 submission, Congestion Pricing and Negative Residue Management Arrangements for the Snowy Region proposal (Southern Generators' Congestion Pricing), p.4, 22-23; Hydro Tasmania, s.99 Abolition submission, p.1-2; ERM Power, s.99 Abolition submission, p.1; and International Power Australia, s.99 Abolition submission, p.2.

[46] Origin Energy, s.99 Abolition submission, p.1; EnergyAustralia, s.99 Abolition submission, p.2; Snowy Hydro, letter to the AEMC chairman, 15 March 2007, p.3; and Macquarie Generation, joint s.99 Abolition, s.95 Southern Generators' Congestion Pricing, and s.95 Split Snowy Region proposal (Split Snowy Region) submission, p.8.

[47] Origin Energy, s.99 Abolition submission, p1-2.; EnergyAustralia, s.99 Abolition submission, p.3.; Eraring Energy, joint s.99 Abolition, s.95 Southern Generators' Congestion Pricing, and s.95 Split Snowy Region submission, p.1; Macquarie Generation, joint s.99 Abolition, s.95 Southern Generators' Congestion Pricing, and s.95 Split Snowy Region submission, p.8.

[48] AEMC 2006, "Industry Leaders Strategy Forum – Summary of Discussion", Congestion Management Review, 17 October 2006. Available: www.aemc.gov.au.

In this Rule determination, the Commission's assessment on the proposed solutions for addressing the issues associated with constraints in the Snowy region has included a comparison of the Southern Generators' Congestion Pricing proposal with the Abolition alternative and Split Snowy Region proposal, thereby addressing concerns raised in several submissions.[49]

For these reasons, the Commission considers that in undertaking its assessment of these Rule change proposals, it has followed appropriate processes to the extent its information and resources permitted.

A.3 Economic efficiency of dispatch

An important component of the overall economic welfare implications of a Rule change proposal is the extent to which it produces efficient dispatch of generation to meet demand, within the constraints of network and system conditions.

All three Rule change proposals change the pricing and settlement arrangements of generators in the NEM. This directly affects generator bidding incentives. If that change in settlement price means that a generator has incentives to bid more cost-reflectively, then the change may well improve on an enduring basis the efficiency of dispatch in the NEM. In its assessment of these Rule change proposals, the Commission has considered which of the different pricing and settlement structures proposed in the three Rule change proposals provides the strongest incentives for generators to bid in a cost-reflective manner, thereby promoting dispatch efficiency.

In assessing the proposals under this criterion, the Commission has considered views put forward in submissions, conceptual analysis prepared by Dr. Darryl Biggar[50], quantitative analysis undertaken by Frontier Economics, and its own analysis.

A.3.1 Congestion and dispatch efficiency

Before considering the impact of a change to the NEM design on the economic efficiency of dispatch it is important to understand the operation of the NEM dispatch engine (NEMDE). The objective of the NEMDE is to minimise the cost of dispatch based on the bids and offers submitted by participants. If the bids and offers submitted are cost reflective, dispatch will be economically efficient within the constraints of network and system conditions. However, there are several situations in which participants' bids and offers may not reflect their resource costs (being, in the case of a generator, the marginal value of its output under competitive market conditions).

First, congestion between a generator and its RRN can result in "mis-pricing". NEMDE effectively determines dispatch by comparing a generator's offer price and

[49] Southern Generators, joint s.99 Abolition and s.95 Southern Generators' Congestion Pricing , p.8-12; and ESIPC, s.99 Abolition submission, p.2-3.

[50] Dr Daryl Biggar, "Snowy Region Boundary Change Proposals – Analytical Assessment of the Options", 1 December 2006; Dr Daryl Biggar, "Snowy Region Boundary Change Proposals – Further Assessment of the Options", 12 December 2006.

its hypothetical (or "shadow") nodal price, which reflects the local demand and supply conditions. Congestion can cause a generator's nodal shadow price (which determines whether a generator is dispatched) and its RRP (which the generator receives for its output) to diverge. This mis-pricing creates dispatch (volume) risk for generators because it can leave a generator at risk of:

- Being dispatched due to its offer price being less than its nodal shadow price but being settled at a RRP that is less than its offer price (i.e. it is "constrained-on"); or
- Not being dispatched even though its offer price is below the RRP (i.e. it is "constrained-off").

As a result of these risks, mis-pricing can distort participant decision-making in both the short- and long-run.

In the short-run, mis-pricing can provide an incentive for generators to engage in non-cost-reflective "disorderly" bidding, such as:

- Bidding "below cost" (down to -$1,000/MWh) or "inflexible"[51] in order to increase its dispatched output, if the price that it expects to receive at settlement is above its resource costs; or
- Bidding "above cost" (up to $10,000/MWh) or inflexible in order to avoid being dispatched, if the price that it expects to receive at settlement is below its resource costs.

This behaviour, which does not rely on generators having any market power, can increase the underlying resource costs of supply if it leads to plant with lower resource costs being displaced by plant with higher resource costs. For example, a generator bidding -$1,000/MWh may be dispatched because it appears to be low cost, when clearly its bid does not reflect underlying resource costs.

Since it is likely to be inefficient to "build out" all constraints, some degree of mis-pricing is inherent in a regional market like the NEM.

Second, to the extent that participants exercise transient market power, their bids and offers will (by definition) not reflect their resource costs. For example, a coal-fired generator may offer its output at $50/MWh when its resource costs are only $15/MWh. Alternatively, it may only offer a proportion of its plant to the market at $15/MWh. This type of behaviour may lead to inefficient dispatch if it also alters the dispatch merit order away from the least-cost order.

Third, market intervention in the dispatch process by NEMMCO is another condition that may incentivise non-cost-reflective bidding by participants. In the NEM, when electricity flows between two regions, settlement residues accrue. These inter-regional settlement residues (IRSRs) equal the price difference between the regions multiplied by the flow between them. When electricity flows from a higher-priced

[51] In respect of a scheduled generating unit, bidding inflexible means that the scheduled generating unit is only able to be dispatched in the trading interval at a fixed loading level specified in accordance with clause 3.8.19(a) of the Rules.

region to a lower-priced region, these settlement residues are negative. Negative settlement residues can accrue on the Victoria-Snowy interconnector when the constraint between Murray and Tumut binds, due to the pricing relationships resulting from the "looped" network configuration around the Snowy region.[52] Until the implementation of the Southern Generators Rule on 1 November 2006, to limit these counter-price flows, and the associated accumulation of negative settlement residues, NEMMCO was able to intervene in market dispatch by:

- Restricting ("clamping") power flows on the Victoria to Snowy interconnector when it expects northward counter-price flows; and
- "Re-orientating" network constraints to Dederang, Victoria when it expects southward counter-price flows between Snowy and Victoria, thereby effectively moving the Snowy RRN to Dederang for that period.

NEMMCO retains its power to clamp power flows on any other interconnectors should flows from a higher-priced region to a lower-priced region arise.[53]

Prior to implementation of the Southern Generators Rule, when NEMMCO clamped Victoria-Snowy interconnector, it provided Snowy Hydro with incentives in some instances to bid in a way that induced clamping. This can affect the efficiency of dispatch.

Having considered the way congestion could affect generator incentives to bid in a cost reflective way, and therefore economic dispatch, the following Sections present the Commission's assessment of the performance of each of the three Rule change proposals against this criterion.

A.3.2 Base case

Under the base case, Snowy Hydro may have incentives to bid in a non-cost-reflective manner.

A.3.2.1 Northward flows

Northward flows between Murray and Tumut would typically occur when demand and prices are relatively high in NSW and/or Queensland. For northward flows, when the Murray-Tumut constraint binds, an increase in Murray generation places the most pressure on the constraint – more pressure than generation from Victoria or the other southern NEM states – due to the positions of the various plant in the network. Under these conditions, Murray generation's nodal shadow price will fall below the Victorian RRP, reflecting the impact that Murray's increased output would have on the constraint. As the Snowy RRN is located at the Murray node, the Snowy RRP will also fall below the Victorian RRP at these times. As the Snowy RRP falls

[52] See Appendix D for further information on this pricing relationship.

[53] Clause (c) of Part 8 of Chapter 8A of the Rules.

below the Victorian RRP, counter-price flows occur on the Victoria-to-Snowy interconnector. This gives rise to negative settlement residues.

To limit the accumulation of negative residues in the base case, NEMMCO restricts (i.e. clamps) flows on the Victoria-Snowy interconnector to a sufficient extent to prevent the continuation of counter-price flows. Once NEMMCO implements clamping, the Murray-Tumut constraint is relieved and the Snowy RRP should rise. If there are no transmission constraints binding north of Tumut, the Snowy RRP will rise towards the NSW RRP. Therefore, Snowy Hydro may be able to effectively earn the (relatively high) NSW RRP on the output of both its Murray and Tumut plant (ignoring losses). This outcome may encourage Snowy Hydro to bid in a way to trigger "clamping". Such bidding is likely to harm dispatch efficiency, because (the energy-constrained) Murray plant will tend to "over-generate" compared to its efficient level at these times.

Even where Snowy Hydro does not bid below its resource costs to instigate clamping, the implementation of clamping may still have a detrimental impact on dispatch efficiency. This is because, as the Commission found in its final Rule determination on the Management of Negative Settlement Residues in the Snowy Region[54], clamping prevents generation from south of Murray from supplying demand north of Murray, even where the southern generation can supply northern demand at a lower cost.

Since southern generation places less pressure on the Murray-Tumut constraint than generation at Murray, more power could potentially enter NSW if it came from the southern regions than if it came from Murray. For this reason, in the absence of clamping, NEMDE would favour southern generation dispatch over Murray generation if both make identically-priced offers (or even if Murray made offers at a somewhat lower price than the southern region generators). There is, therefore, a wider dispatch efficiency impact from Murray "over-generating".

One consequence of clamping southern generation and dispatching Murray instead is that NEMDE may need to dispatch higher merit order generation in NSW or Queensland to compensate for the reduction in flows from the southern regions. To the extent that plant bids and offers reflect their resource costs, clamping may lead to less efficient dispatch than would be the case if the counter-price flows on the Victoria-to-Snowy interconnector had simply been allowed to continue.

Another issue with clamping is the predictability of NEMMCO's intervention. It is difficult for market participants to accurately predict when counter-price flows may arise on the Victoria-Snowy interconnector, and therefore, when NEMMCO may intervene. This is because participants would need to predict how Snowy Hydro will bid. While this is an issue for efficient dispatch, it is more significant when considering risk management implications for inter-regional trading (see Section A.4) and the requirements of good regulatory practice (see Section A.7).

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54 AEMC 2006, *Management of Negative Settlement Residues in the Snowy Region*, Final Rule Determination, 14 September 2006, Sydney.

Tumut generation, on the other hand, helps relieve the Murray-Tumut constraint when it binds. However, in the base case, its output is settled at the Snowy RRP, which is low relative to its nodal shadow price when the Murray-Tumut constraint binds. This low settlement price does not reflect the economic value of Tumut's generation when the Murray-Tumut constraint binds. This mis-pricing of Tumut generation tends to discourage Tumut from generating, even when it may be able to meet NSW demand at relatively low cost.

A.3.2.2 Southward flows

Southward flows between Murray and Tumut typically occur at times of high Victorian and South Australian demand. The bidding incentives for Snowy Hydro under the base case differ for southward flows compared to the incentives at times of northward flows discussed above. When the Murray-Tumut constraint binds, Murray generation is the most effective at alleviating the constraint. Its nodal price, and therefore the Snowy RRP, reflects the value of Murray generation to NEMDE's cost-minimising objective function. In fact, Murray generation has a greater value than even generation in Victoria. This means that the Snowy RRP is above the Victorian RRP, generating counter-price flows on the Snowy-Victoria interconnector. Under the base case to manage these counter-price flows, NEMMCO does not clamp flows; rather, it intervenes by "re-orienting" the binding constraints, effectively relocating the Snowy RRN to the Dederang node, located in Victoria. This effectively aligns the Snowy RRN with the Victorian RRP, which has the effect of slightly mis-pricing (i.e. under-pricing) Murray generation.

For southward flows, Tumut generation places the same pressure on the Murray-Tumut constraint as NSW and Queensland generation. However, Tumut generation is settled at the (relatively) high Snowy RRP, implying that Tumut generation is over-priced. This encourages it to generate even though it provides no greater benefit than NSW or Queensland plant, which receive the relatively lower NSW RRP. Furthermore, Tumut's available generation is greater than the Murray-Tumut line capacity of 1,350 MW. When the Murray-Tumut constraint binds, Tumut's bids cannot affect the Snowy RRP. Therefore, it is constrained-off and incentivised to bid its output below its resource costs, potentially resulting in counter-price flows pushing back into NSW. These counter-price flows can trigger NEMMCO's clamping intervention on the Snowy-to-NSW interconnector, allowing Snowy Hydro to increase Tumut's output and continue to receive a relatively high price on that output. In doing so, once again, Snowy Hydro is incentivised to bid its plant in a manner than is non-cost-reflective. Therefore, dispatch efficiency can once again be compromised by NEMMCO's clamping intervention.

A.3.2.3 Conclusions on base case

The bidding incentives present under the base case do not appear to promote economically efficient dispatch. The Commission's quantitative analysis supports this position, demonstrating that on average over the three years considered all three Rule change proposals would improve dispatch efficiency relative to the base case. These results are discussed further below and in Appendix B.

No submission actively promoted the base case as the preferred market structure going forward. This position was reiterated at the Commission's October 2006 Industry Leaders Strategy Forum. There was general agreement among Forum participants that the material and significant network congestion in the Snowy region required immediate attention.[55] The analysis of the base case suggests returning to this arrangement would be suboptimal and would not promote the NEM Objective.

The Commission considers, therefore, that there is a strong case to take action to address congestion issues in the Snowy region. The question then becomes whether any or all of the three Rule change proposals currently before the Commission represent an improvement on the base case and if so, which is likely to better contribute to the achievement of the NEM Objective.

A.3.3 Rule change proposals

As discussed above, there is no debate that the congestion between Murray and Tumut is material and enduring, and requires a solution. The Commission considers there is a case for change, and presents its considerations on the three formal Rule change proposals put forward to address that congestion.

A.3.3.1 The Abolition alternative

The Abolition alternative prices the material congestion between Murray and Tumut by locating a region boundary across the Murray-Tumut cutset. When these lines constrain, the price separation between NSW and Victoria reflects to the market the cost of that congestion. This proposal also changes the settlement prices for Snowy Hydro's output at its Murray, Tumut and Guthega power stations. This will directly affect Snowy Hydro's bidding incentives for those generators and this will consequently affect dispatch outcomes and the level of congestion around these generators.[56]

Under this proposal, Murray generation will be settled at the Victorian RRN and Tumut generation at the NSW RRN. When the Murray-Tumut constraint binds, and there are no constraints between Tumut and the NSW RRN or Murray and the Victorian RRN, the Abolition alternative will remove the perverse bidding incentives for Snowy Hydro present under the base case. This would in turn be expected to improve the efficiency of dispatch.

However, when constraints bind between Tumut and the NSW RRN or Murray and the Victorian RRN, Tumut or Murray generation, respectively, will be mis-priced. That is, they will be settled at a price that differs from their shadow nodal price. For example, if flows are northward and a constraint binds between Tumut and the NSW RRN at Sydney West, Tumut generation will continue to be settled at the NSW RRP

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[55] Industry Leaders Strategy Forum, "Industry Leaders Strategy Forum Summary Of Discussion", 17 October 2006, available online: http://www.aemc.gov.au/electricity.php?r=20070416.114313.

[56] Guthega power station is such a small percentage of Snowy Hydro's total portfolio that the focus on bidding incentives will be on its Murray and Lower and Upper Tumut power stations.

even though its shadow nodal price will be lower than the NSW RRP. Conversely, if flows are southward and constraints bind between Sydney West and Tumut, Tumut generation will continue to be settled at the NSW RRP even though its shadow nodal price will be higher than the NSW RRP.

Similarly, if flows are southward and a constraint binds between Murray and the Victorian RRN at Thomastown (near Melbourne), Murray generation will continue to be settled at the Victorian RRP even though its shadow nodal price will be lower than the Victorian RRP. Conversely, if flows are northward and constraints bind between Thomastown and Murray, Murray generation will continue to be settled at the Victorian RRP even though its nodal shadow price will be higher than the Victorian RRP.

Such mis-pricing can, in turn, affect Snowy Hydro's bidding incentives. In particular, Snowy Hydro does not face incentives to limit its output in order to avoid constraints on the lines to the south of Murray (when flows are southward) or to the north of Tumut (when flows are northward). In fact, to the extent Snowy Hydro finds itself constrained-off at such times, it may have incentives to bid in a disorderly manner. For example, it may offer its capacity as low as -$1,000/MWh to get dispatched.

Some submissions did not support the Abolition alternative on the grounds that the mis-pricing of Snowy Hydro generation could possibly displace lower cost generation.[57] Others supported these competition benefits and considered they improved Snowy Hydro's incentives to maximise dispatch at its generators' new RRNs.[58]

As discussed below, the other Rule change proposals also introduce non-cost-reflective bidding incentives for Snowy Hydro in particular circumstances. In these proposals, however, Snowy Hydro has a strong incentive to maintain "headroom" on those lines. In other words, Snowy Hydro has incentives to withhold its output to some degree to avoid constraining lines that would cause it settlement price to fall.

As both disorderly bidding and withholding output involve bidding in a non-cost-reflective manner, it is unclear from a conceptual analysis whether the Abolition alternative would lead to more efficient dispatch outcomes than the other options. This is an empirical question that may be informed by quantitative modelling.

The Southern Generators' modelling found that Snowy Hydro's dominant strategy was to withdraw its capacity, particularly its Tumut output. It suggested Abolition would result in higher NEM costs of around $0.7 million per annum.[59]

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[57] Macquarie Generation, joint s.99 Abolition, s.95 Southern Generators' Congestion Pricing, and s.95 Split Snowy Region submission, p.2.

[58] Country Energy, s.99 submission, Abolition, p.2; EnergyAustralia, s.99 Abolition submission, p.1; Origin Energy, s.99 Abolition submission, p.1; Snowy Hydro, joint s.99 Abolition, s.95 Southern Generators' Congestion Pricing, and s.95 Split Snowy Region submission, p.24.

[59] ROAM Consulting, Analysis of the AEMC Draft Rule Determination to Abolish Snowy Region – Appendix A Modelling, Report to Southern Generators' Coalition, 3 April 2007 (ROAM report), p.II and 30.

Conversely, the Commission's quantitative modelling showed production cost savings under the Abolition alternative. This was primarily driven by an increased level of competition, with sustainable bidding patterns involving participants offering almost all their capacity into the market. By pricing Murray and Tumut generation at the Victorian and NSW RRNs, respectively, the Abolition scenario creates incentives for Snowy Hydro to maximise its production by bidding competitively. This suggests Snowy Hydro may not have the incentives to exhibit market power to control flows across the Victoria-NSW interconnector, as suggested in some submissions.[60]

The modelling indicated greater levels of dispatch for Murray, Tumut, Victorian brown coal, and cheaper NSW black coal generators, which displaced more expensive NSW and Queensland black coal and some mid merit gas plant across the NEM. Productive cost savings for the Abolition scenario peaked around $1.5 million per annum (in the 2009 contracted low case).[61]

Under the Abolition alternative, static loss factors for Murray and Tumut generation would replace the existing marginal loss factor equations. Submissions noted that this may introduce inefficiencies.[62] The quantitative modelling accounted for this difference. The consistently positive results described above suggest the overall competition benefits outweigh any potential cost of moving to static loss factors.

Conclusions on the Abolition alternative

The conceptual assessment is unclear on what effect the degree of mis-pricing and non-cost-reflective bidding may have on efficient dispatch. However, the quantitative assessment demonstrates that the Abolition alternative would lead to more competitive bidding, which would improve the economic efficiency dispatch relative to the base case.

A.3.3.2 Split Snowy Region proposal

The Split Snowy Region proposal prices the material congestion between Murray and Tumut, and any congestion that arises on the cutsets just north of Tumut and just south of Dederang. In contrast to the Abolition alternative, this proposal removes most of Snowy Hydro's incentives to engage in the disorderly bidding of Murray and Tumut generation. This is because it removes much of the risk of those plants being mis-priced. All other things being equal, this is likely to improve dispatch efficiency.

However, the Split Snowy Region proposal does introduce strong incentives for Snowy Hydro to maintain "headroom" on all transmission lines between its plant and the Victorian or NSW RRN, depending on the direction of flows.

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[60] Delta Electricity, s.99 Abolition submission, p.4; and ERM Power, s.99 Abolition submission, p.2.

[61] See Appendix B.

[62] Southern Generators, joint s.99 Abolition and s.95 Southern Generators' Congestion Pricing submission, p.15.

For northward flows, if there is a constraint between Lower Tumut and the NSW RRN at Sydney West, the price at the Tumut RRN will fall below to the NSW RRP. All Tumut generation will be settled at this relatively low price. If there are no constraints between the Murray RRN at Dederang and the Tumut RRN, Murray generation will be settled at this similarly low price. If there are constraints between the Murray and Tumut RRNs, the price at which Murray is settled at will fall below the Tumut RRP.

For these reasons, Snowy Hydro is incentivised to withhold output at both Tumut and Murray. Withholding output at Tumut may reduce the risk of constraints binding between the Tumut RRN and NSW RRN during northward flows. This withholding could therefore lead to a higher Tumut RRP than would be the case in the absence of this behaviour. Similarly, Snowy Hydro may be incentivised to withhold some output at Murray to ensure the lines between Murray and Tumut do not bind.

The incentive for Snowy Hydro to withhold some output is also present for southward flows. When the Victorian RRP is high, a constraint between the Victorian RRN and Murray RRN will result in Murray generation being settled at a comparably lower RRP. This means that Snowy Hydro is incentivised to withhold its Murray generation to maintain headroom between the Murray RRN and Victorian RRN.

Similarly, if constraints bind between Murray and Tumut, Tumut output will be settled at a lower price than Murray. Snowy Hydro has a similar incentive to withhold some Tumut output to prevent the Murray-Tumut interconnector from constraining. This behaviour would allow Tumut to import the (higher) Murray RRP. Snowy Hydro stated that the Split Snowy Region proposal did not remove incentives for Tumut and Murray to withhold generation, meaning that it would have the effect of reducing competition and driving up contract prices.[63]

Submissions supportive of this proposal considered that the incentives on Snowy Hydro to maintain headroom in this manner were less detrimental to efficiency than its incentives under the Abolition alternative to engage in disorderly bidding to avoid being constrained-off. Submissions considered that minimising the scope for Snowy Hydro generators to take advantage of those intra-regional constraints would increase dispatch efficiency and avoid counter-price flows.[64] Some submissions commented that the Commission places too much emphasis on the withholding capacity/maintaining headroom argument and its significance on the degree of competition in NSW.[65]

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[63] Snowy Hydro, joint s.99 Abolition, s.95 Southern Generators' Congestion Pricing, and s.95 Split Snowy Region submission, p.25.

[64] Delta Electricity, s.99 Abolition submission, p.1-3; Eraring Energy, joint s.99 Abolition, s.95 Southern Generators' Congestion Pricing, and s.95 Split Snowy Region submission, p.1-2; Macquarie Generation, joint s.99 Abolition, s.95 Southern Generators' Congestion Pricing, and s.95 Split Snowy Region submission, p.3.

[65] Eraring Energy, joint s.99 Abolition, s.95 Southern Generators' Congestion Pricing, and s.95 Split Snowy Region submission, p.1-2.; Macquarie Generation, joint s.99 Abolition, s.95 Southern

The Commission considers, however, that while the increment of output at Murray or Tumut being withheld may be minimal, it may result in more expensive generation being dispatched north or south to meet any incremental increase of demand in NSW/Queensland or Victoria/South Australia/Tasmania, respectively. This may have a material effect on dispatch efficiency, depending on what generator is dispatched to meet any the incremental increase in demand. If the marginal generator dispatched to meet that incremental increase in demand is more expensive than the cost of generation at Murray or Tumut, this is a less efficient outcome than if Murray or Tumut increased their generation by one unit.

Conceptually, it is again unclear whether the Split Snowy Region proposal would lead to more efficient dispatch outcomes compared to the alternative proposals. This is an empirical question, informed by quantitative modelling.

Like the quantitative modelling on the Abolition alternative the production cost savings under the Split Snowy Region proposal were generally positive, peaking at $1.2 million per annum (in the 2008, contracted low case).[66] These savings arise due to the increased likelihood of more competitive bidding by Snowy Hydro and other participants due to reduced system constraints. This effect is not as great compared to the Abolition alternative, and was offset at certain demand levels by production losses. During those times, Snowy Hydro faces incentives that promote high strategic bidding strategies, which are not sustainable in either the base case or Abolition scenarios.

The Southern Generators suggested that the modelling approach used by both themselves and the Commission meant that the increase in dispatch efficiency associated with the use of dynamic inter-regional loss factors rather than static loss factors was unlikely to be observable in the results, meaning the efficiency gains of the Snowy Split Region proposal found in the modelling were likely to be understated.[67] The modelling analysis included in this determination has been updated from earlier analysis to reflect a number of changes, including the incorporation of dynamic inter-regional loss factors for the Split Snowy Region proposal (see Appendix B). Any efficiency gains associated with the use of dynamic loss factors in the Split Snowy Region proposal will therefore be accurately reflected in the quantitative analysis included in this determination.

Conclusions on the Split Snowy Region proposal

The Split Snowy Region proposal virtually removes all mis-pricing for Tumut generation, with Murray generation being potentially mispriced if constraints bind between Murray and the RRN at Dederang. It does, however, introduce incentives for Snowy Hydro to withhold capacity at Murray and Tumut in order to import the high prices from Victoria and NSW, when flows are southward or northward,

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Generators' Congestion Pricing, and s.95 Split Snowy Region submission, p.6; and Southern Generators, joint s.99 Abolition and s.95 Southern Generators' Congestion Pricing submission, p.27.

66 See Appendix B.

67 Southern Generators, joint s.99 Abolition and Southern Generators' Congestion Pricing submission, p.15.

respectively. Conceptually, it is difficult to determine what the net impact on dispatch efficiency would be under these circumstances. The quantitative analysis indicates that the Split Snowy Region proposal is likely to yield less economically efficient dispatch outcomes than those under the Abolition alternative.

A.3.3.3 Southern Generators' Congestion Pricing proposal

The Tumut CSP/CSC Trial component of the Southern Generators' Congestion Pricing proposal focuses on ensuring Tumut generation is settled at its nodal shadow price when the Murray-Tumut constraint binds, as opposed to the Snowy RRP. This produces a similar (but not identical) set of incentives for Snowy Hydro in relation to its Tumut generation as those under the Split Snowy Region proposal, both of which differ substantially from Snowy Hydro's incentives under the base case.

For northward flows, when the Murray-Tumut constraint binds, Tumut generation is no longer mispriced. This is because it receives a price that reflects its own position in the network, rather than the Snowy RRP at the Murray node. Subject to the absence of constraints between Tumut and Sydney West, Tumut effectively receives the NSW RRP. This is consistent with the fact that Tumut generation (like generation in NSW or Queensland, but unlike generation at Murray) relieves the Murray-Tumut constraint. However, as under the Split Snowy Region proposal, if there is a constraint between Tumut and the NSW RRN, the nodal shadow price at Tumut will fall relative to the NSW RRP. This could incentivise Tumut to withhold some output to maintain sufficient headroom to import the higher NSW RRP to its own node.

For southward flows, the Tumut CSP/CSC Trial mechanism operates in the following way. If the Murray-Tumut constraint is not binding, Tumut generation is settled at the Snowy RRP. When it does bind, the Trial provides incentives for Snowy Hydro to prevent it over-generating at Tumut. For its first 550MW of output, Tumut generation is settled at the Snowy RRP. Each additional megawatt from Tumut is settled at its lower nodal shadow price. This prices additional Tumut generation on a similar basis as NSW generation as an additional megawatt from either plant will place similar pressure on the Murray-Tumut constraint. These incentives make Snowy Hydro consider carefully whether it is worth generating more than 550MW at Tumut under these circumstances.

This contrasts sharply with the situation under the base case, in which Snowy Hydro can have incentives to offer Tumut generation below cost to secure the (high) Snowy RRP on all its output and to instigate clamping on the Snowy-NSW interconnector. It also contrasts slightly with the situation under the Split Snowy Region proposal, in which Snowy Hydro risks having its entire Tumut output (rather than just that portion of 550 MW) effectively settled at the (low) NSW RRP if the Murray-Tumut constraint binds. This means that Snowy Hydro may have fewer incentives to withhold Tumut output and leave headroom on the Murray-Tumut lines than it might have under the Split Snowy Region proposal.

The Tumut CSP/CSC Trial component of the Southern Generators' Congestion Pricing proposal therefore reduces the inefficiencies associated with mis-pricing at Tumut as, like the Split Snowy Region proposal, mis-pricing is virtually non-existent when then Murray-Tumut constraint binds. Nevertheless, to the extent that Snowy

Hydro exercises transient market power by withholding output at Tumut, the Southern Generators' Congestion Pricing proposal may not ensure completely efficient Tumut dispatch.

The Southern Generators Rule component of the Southern Generators' Congestion Pricing proposal addresses NEMMCO's intervention on the Victoria-Snowy interconnector to manage negative settlement residues. For northward flows, by eliminating clamping, Snowy Hydro's bidding incentives for Murray generation change, relative to those under the base case. Snowy Hydro no longer has the incentive to bid in a disorderly fashion to instigate clamping. Murray generation no longer has the payoff incentive to "over-generate" compared to its efficient level, relative to the base case.

On the other hand, if the Murray-Tumut constraint does bind, the Snowy RRP (set at the Snowy RRN at Murray) falls below the Victorian RRP, in line with Murray generation's physical position in the network. This provides Snowy Hydro with the strong incentive to withhold some Murray generation to prevent that constraint from binding or from remaining binding.

For southward flows, Murray generation is no longer mis-priced as NEMMCO does not re-orient the Murray-Tumut constraints to the Dederang node to manage negative settlement residues. All other things being equal, these incentives encourage Snowy Hydro to generate more at Murray compared to incentives under the base case or the Snowy Split Region proposal. Under either of the other proposals, Murray generation is effectively settled at the (lower) Victorian RRP instead of its local nodal price, the Snowy RRN.

Due to the multitude of incentives facing Snowy Hydro under all of the proposals, it is not possible to make strong conceptually-based predictions of the relative efficiency of the Southern Generators' Congestion Pricing proposal compared to the other proposals. The Commission has therefore undertaken quantitative modelling to further inform its assessment.

The Southern Generators modelling and submissions commented that there would be dispatch efficiency improvements from the Southern Generators' Congestion Pricing proposal relative to the base case.[68] They stated that their proposal was the least cost option, assuming strategic bidding for Snowy Hydro. In its submission, however, Snowy Hydro commented that its incentive to maintain headroom on the interconnectors would reduce the efficiency of this proposal relative to its Abolition alternative.[69]

The Commission's quantitative modelling produced somewhat different outcomes to those forecast under the Southern Generators' modelling. The production cost savings in the Southern Generators' Congestion Pricing proposal were either positive or very slightly negative. The largest saving of $450,000 per annum was observed in

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[68] See Southern Generators, joint s.99 Abolition and s.95 Southern Generators' Congestion Pricing; submission, p.15.

[69] Snowy Hydro, joint s.99 Abolition, s.95 Southern Generators' Congestion Pricing, and s.95 Split Snowy Region submission, p.14-15.

2008, contracted high case. The production cost savings and losses were due to different bidding incentives being more profitable at various times. However, there does not appear to be a consistent bidding incentive for Snowy Hydro under the Southern Generators' Congestion Pricing proposal like the incentives for more competitive bidding under the Abolition alternative and the Split Snowy Region proposal. Importantly, the magnitude of the production cost savings indicates that on balance the Southern Generators' Congestion Pricing proposal resulted in fewer incentives for cost reflective bidding than under the Abolition alternative and the Split Snowy region proposal.

Conclusions on the Southern Generators' Congestion Pricing proposal

The Southern Generators' Congestion Pricing proposal promotes similar (but not identical) incentives for Snowy Hydro as those under the Split Snowy Region proposal. There appear to be efficiency benefits over the base case. However, the incentives faced by Snowy Hydro to withhold capacity appear to result in less economically efficient dispatch outcomes when compared to the outcomes under the Abolition alternative. The incentives to bid competitively are weaker than either the Split Snowy Region or the Abolition alternative, resulting in a smaller improvements in dispatch efficiency compared to the base case.

A.3.4 Commission's considerations

The Commission considers this to be a case to "do something" rather than supporting a position of "do nothing" and implementing the base case. However, since the Rule change proposals are alternatives, the Commission must consider which proposal will better contribute to the achievement of the NEM Objective. The question then becomes which of the proposals provides the most efficient bidding incentives, and therefore maximises the efficiency of dispatch.

None of the proposals can ensure fully cost-reflective bidding by both Murray and Tumut generation. In each case, it is difficult to conceptually predict the likely net effect on dispatch efficiency of Snowy Hydro's incentives to both: (1) engage in disorderly bidding resulting from mis-pricing; and (2) withhold capacity in order to earn higher settlement prices. The quantitative modelling demonstrates that while all the proposals result in dispatch efficiency improvements relative to the base case, the Abolition alternative produces the most efficient dispatch outcome. Compared to the base case and the alternatives, the Abolition alternative resulted in an increased level of competition, with sustainable bidding patterns involving participants offering almost all their capacity into the market, maximising dispatch efficiency.

Having regard to conceptual and quantitative analysis and submissions, the Commission concludes that the economic efficiency of dispatch benefits resulting from the more competitive environment under the Abolition alternative are greater than those under the Split Snowy Region or Southern Generators' Congestion Pricing proposals.

A.4 Inter-regional trading and risk management

The effect on inter-regional trading and risk management of a change to the region pricing structure in the NEM depends on a number of factors. One key factor is the ability of participants to manage basis (price) risk relative to their ability to manage dispatch (volume) risk. Dispatch risk refers to the uncertainty about whether a participant's plant will be selected to generate, while basis risk refers to the uncertainty about the price a participant will be paid for its output.

Generators typically enter contracts with counter-parties in other locations. Where these counter-parties are located in other regions, generators may face basis risk arising from differences in the price they are paid for their output (their RRN) and the price at which the contract is settled (the counter-party's RRN). Transmission congestion (or losses) can lead to regional price separation.

The three Rule change proposals being assessed all seek to price the material and enduring congestion between Murray and Tumut using different degrees of granular pricing. This can have implications on the ability participants have to manage the basis risk associated with the various proposed pricing structures.

The effect of more granular pricing (either by increasing the number of regions or using congestion pricing mechanisms like CSP/CSCs) on the basis risk of market participants is not straightforward. On one hand, more granular pricing may reduce the basis risk for some participants by providing greater consistency between a generator's offer and the price it receives for its output, reducing the incidence of mis-pricing. Conversely, more granular pricing can increase the level of basis risk for participants to manage.

While generators may use disorderly bidding to manage dispatch risk, this is not an effective strategy to manage basis risk. Generators require access to risk management tools that enable them to hedge for differences between the spot market price at which their output is settled and the strike price at which their contracts are settled.

In the NEM, IRSR units are one tool to help participants manage price separation between regions. These units provide participants with access to a portion of the transmission rentals arising on a particular directional interconnector.[70] IRSR units are sold as non-firm instruments in that they provide a right only to the residues that accrue to physical flows on an interconnector. If flows are reduced for any reason (e.g. transmission constraints or intervention like NEMMCO's clamping), prices can still separate but the holders of the units have a reduced hedge, or no hedge, against those price differences.

Participants have informed the Commission that to manage an inter-regional position, they do not solely rely on IRSR units to manage their basis risk. Some use them as purely a speculative tool, while others stated they may use them as one

[70] A directional interconnector is a reference to a particular direction of flow on an interconnector. For example, the Snowy-to-NSW interconnector comprises of the SN-NSW directional interconnector (for northward flows) and the NSW-SN directional interconnector (for southward flows) (see clause 3.18.1(c) of the Rules).

component of their financial products portfolio to manage their basis risk.[71] Clearly, generators will have less need for basis risk management tools if they have a wide choice of contract counterparties who are located in their region, allowing them to avoid basis risk altogether.

This criterion evaluates which Rule change proposal best supports the efficient management of risk for market participants who wish to trade with parties in other locations. For the each proposal the Commission considers the extent to which the proposal reduces basis risk, and the implications for the firmness of IRSR units used to hedge inter-regional price differences. The Commission has considered views put forward in submissions, conceptual analysis prepared by Darryl Biggar, quantitative analysis undertaken by Frontier Economics, and its own analysis.

A.4.1 Base case

Under the base case, IRSR units between NSW and Victoria for both directions are not firm. As discussed above, when the Murray-Tumut interconnector binds at times of northward flows, negative residues result on the Victoria-Snowy interconnector. This has two effects: (1) NEMMCO intervenes by restricting flows between Victoria and Snowy, also reducing the firmness of those IRSR units - irrespective of the price difference, if the flow is zero across the interconnector, there will be no residues; and (2) the mis-pricing of Tumut means it does not have the incentives to generate, potentially reducing flows on the Snowy-NSW interconnector, reducing the value of those IRSR units. At the extreme, if Tumut does not generate at all due to its low settlement price, only the 1,350MW flowing across the Murray-Tumut cutset will make its way into NSW, compared to around 3,200MW if Tumut were generating at maximum capacity.[72]

For southward flows, when the Murray-Tumut interconnector binds: (1) the pricing incentives on Tumut generation may result in counter-price flows on the Snowy-NSW interconnector, initiating NEMMCO clamping, which reduces the value of those IRSR units; and (2) NEMMCO re-orients the settlement price for Murray generation, and therefore effectively the Snowy RRN so that there is no price difference between the Snowy and Victorian RRPs, therefore reducing the value of IRSR units on the Snowy-Victoria interconnector.

Darryl Biggar's analysis supports the position that under the base case, settlement residues are never firm when the Murray-Tumut constraint (and other relevant constraints limiting flows north or south) bind.[73]

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[71] As part of its work on the Congestion Management Review, the Commission met with a range of market participants to discuss whether they (a) traded inter-regionally, and if they did (b) what approaches and products did they use to manage their basis risk. For confidentiality reasons, the Commission is unable to explicitly list those participants it met with; however, whether participants did or did not trade inter-regionally, not one participant stated that they would manage an inter-regional position using solely IRSR units due to their lack of firmness.

[72] NEMMCO Communication No. 2356, "Change in SNOWY1 Interconnector Transfer Limit", Friday, 5 January 2007, E-mail.

[73] Biggar, 1 December 2006, paras. 73-75.

Snowy Hydro's ability to influence the value of IRSRs on directional interconnectors into the Snowy region (i.e. on the NSW-Snowy and Victoria-Snowy interconnectors) is restricted. Clause 3.18.2(h) of the National Electricity Rules (Rules) places historical restrictions on Snowy Hydro's acquisition of IRSR units for those interconnectors. These restrictions were imposed by the Australian Competition and Consumer Commission (ACCC) because of its concerns about Snowy Hydro's ability to increase the Snowy RRP by exercising market power – given that it is the monopoly generator in the region with no load. Such price increases would increase the value of the IRSR units on directional interconnectors into the Snowy region (i.e. import flows into Snowy) and provide a strong benefits to Snowy Hydro at the expense of other NEM participants and ultimately, end-use customers.

The Rules to permit Snowy Hydro to bid for units on these interconnectors on the condition that it provides NEMMCO with an independent auditor's report that contains a certified statement that sets out the approximate total megawatts of settlement residues required by Snowy Hydro for the relevant period for: (1) its demonstrated pumping needs; and (2) its demonstrated contractual exposures.[74]

A.4.2 Abolition alternative

Snowy Hydro faces lower basis risk under the Abolition alternative relative to the base case. The removal of the existing Snowy region boundaries means Snowy Hydro no longer has to manage price separation between its Murray and Tumut generation settlement price and its contracted volume settled at the Victorian and NSW RRNs, respectively. The reduction in Snowy Hydro's basis risk under the Abolition alternative, combined with the incentives for more competitive bidding discussed in Section A.3, is likely to result in it making more competitive offers for contracts at the NSW and Victorian RRNs compared to the alternatives. This, in turn, will place pressure on other parties to be similarly competitive.

Several submissions agreed that the increased competition from the Abolition alternative would reduce contract prices relative to the base case. They argued that the absence of basis risk for Snowy Hydro would encourage it to lower prices for its contracts, with flow-on benefits for the liquidity of the contract market, inter-regional trade and competition.[75] The Firecone report, commissioned by Snowy Hydro, found that inter-regional trading risk is high and that the instruments available to hedge it are weak, concluding that Abolition would facilitate an increase in contract market competition.[76] Only one submission concluded the Abolition alternative would materially degrade the ability to hedge inter-regionally.[77]

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[74] NEMMCO, "Settlement Residue Auction Information Memorandum", 2 July 2007, p.41-42, available: www.nemmco.com.au.0

[75] Origin Energy, s.99 Abolition submission, p.4; and EnergyAustralia, s.99 Abolition submission, p.1; and Country Energy, s.99 Abolition submission, p.2.

[76] Firecone Ventures, Impacts of changes to the Snowy Region on the Contract Market, April 2007 (Firecone report), p.ii and p.24-26. See also Snowy Hydro, joint s.99 Abolition, s.95 Southern Generators' Congestion Pricing, and s.95 Split Snowy Region submission, p.2.

[77] Westpac, s.99 Abolition submission, p.3.

The effect of the Abolition alternative on the firmness of IRSR units is less clear. While the Abolition alternative explicitly prices the material congestion between Murray and Tumut, it reduces the granularity of pricing in the NEM. This may introduce incentives for Snowy Hydro to bid in a disorderly manner to manage its dispatch risk, making it more difficult for other participants to predict Snowy Hydro's bidding behaviour.

In analysis undertaken for the Commission, Darryl Biggar identified that the new constraint equations representing inter-regional flows between the new Victoria and NSW regions contain terms for both Snowy Hydro generation levels and interconnector flows.[78] Biggar stated this meant that participants would need to predict both Snowy Hydro generation and interconnector flows to determine the value of IRSR units. The difficulty in predicting Snowy Hydro's behaviour may reduce the perceived firmness of IRSRs as an inter-regional hedging instrument relative to the base case.

For example, the nominal limit on the Victoria-NSW interconnector under the Abolition alternative would be equivalent to the current limit between Murray and Tumut of 1,350MW. However, price separation between Victoria and NSW could still occur at times of northward flows if Tumut generation bid in such a way that constraints between Tumut and Sydney West (the location of the NSW RRN) bound before flows on the Victoria-NSW interconnector reached 1,350MW. This analysis suggests that the IRSR units for the proposed Victoria-NSW interconnector may not be the "firmest" in the NEM, as suggested by Snowy Hydro.[79] Westpac agreed, noting in its submission that it considered reducing the number of regions under the current market design would introduce significant mis-pricing of both spot and forward markets, and in absence of a firmer inter-regional hedging instrument, would be detrimental to the NEM.[80]

That being said, the Commission's analysis on binding constraints north of Tumut and south of Murray suggests that while it may occur, it does not appear to be a material problem (see Appendix B).

More particularly, unless it is known which constraints will bind and how often, it is not possible to make definitive statements regarding the effect the Abolition alternative will have on the firmness of IRSR units between Victoria and NSW. It therefore makes it difficult to also make statements regarding the willingness of participants to enter into inter-regional hedges.

The Abolition alternative does address the pricing arrangements that triggered negative residues on the Victoria-Snowy interconnector when the Murray-Tumut constraint bound. It eliminates the problem of negative residues due to loop flows.[81] This greatly reduces the risk of NEMMCO intervention to manage negative residues

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[78] Biggar, 1 December 2006, paras. 97-106.

[79] Snowy Hydro, joint s.99 Abolition, s.95 Southern Generators' Congestion Pricing, and s.95 Split Snowy Region submission, p.40-41.

[80] Westpac, s.99 submission, Abolition draft Rule determination, 30 April 2007, p.1, 3.

[81] Biggar, 1 December 2006, paras. 100-101.

accumulation when the Murray-Tumut constraint binds and, therefore, also reduces the effect that clamping and "re-orientation" under the base case would have on the value of IRSR units.

The Commission expects that the reduction in basis risk for Snowy Hydro under the Abolition alternative will promote incentives for Snowy Hydro to offer more competitively priced contracts at the NSW and Victorian RRNs, introducing greater competitive pressure in the contract markets at those RRNs, and providing competitive benefit for the wider contract market. However, it is not possible to be conclusive on the net effect Abolition would have on the firmness of IRSRs between Victoria and NSW, and the resulting impact that would have on participants' willingness to trade between those regions.

A.4.3 Split Snowy Region proposal

It is possible that increasing the number of regions will increase the basis risk for participants wishing to trade inter-regionally. Several submissions expressed concern about the increase in risk and trading complexity associated with inter-regional contracts.[82]

Under the Split Snowy Region proposal, Snowy Hydro faces greater basis risk than under the Abolition alternative, since its Murray and Tumut generation is located in generation only regions. Every contract it strikes against its Murray and Tumut generation is exposed to price risk between the Murray or Tumut RRN, and the RRN where it strikes the contract. The incentives to manage this basis risk may lead Snowy Hydro to adopt its withholding strategy to reduce the probability of price separation between the Victorian, Murray, Tumut, and NSW regions. It may affect Snowy Hydro's willingness to offer contracts at the NSW and Victorian RRNs. It may also affect the competitiveness of those contracts, given Snowy Hydro would need to price its basis risk accordingly. Snowy Hydro argued in its submission that the more granular pricing, either through more regions or a CSP/CSC arrangement, would reduce contract volume and liquidity and drive up contract prices.[83]

However, participants under the Split Snowy Region proposal may be in a better position to secure a firmer inter-regional hedge than under the base case or the Abolition alternative, since there are fewer unpriced constraints between the Victorian RRN and the NSW RRN. While a participant would need to obtain IRSR units across three interconnectors to hedge a position between NSW and Victoria, as pointed out in several submissions, the Settlement Residue Auction (SRA) linked bid facility may reduce the perceived difficultly or risk of trying to obtain multiple IRSRs across the three interconnectors.[84] The Split Snowy Region proposal also eliminates

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[82] Origin Energy, s.99 Abolition submission, p.2-3; EnergyAustralia, s.99 Abolition submission, p.3.

[83] Snowy Hydro, joint s.99 Abolition, s.95 Southern Generators' Congestion Pricing, and s.95 Split Snowy Region submission, p.39.

[84] Southern Generators, joint s.99 Abolition and s.95 Southern Generators' Congestion Pricing submission, p.30; Delta Electricity, s.99 Abolition submission, p.5; Eraring Energy, joint s.99 Abolition, s.95 Southern Generators' Congestion Pricing, and s.95 Split Snowy Region submission, p.2; Macquarie Generation, joint s.99 Abolition, s.95 Southern Generators' Congestion Pricing, and s.95 Split Snowy Region submission, p.4; Hydro Tasmania s.95 submission, Split Snowy Region, p.3.

the problem of negative residues due to loop flows in the existing Snowy region.[85] One submission argued that the increased data and transparency of the Split Snowy Region proposal would lead to better pricing and risk management.[86]

That being said, the firmness of those IRSR units also depends on the ability of unit holders to predict the incentives for Snowy Hydro's bidding behaviour. As discussed earlier, under the Split Snowy Region proposal, Snowy Hydro has incentives to withhold capacity to maintain headroom to import the higher prices from neighbouring regions. Since IRSRs are a function of both price separation and interconnector flow, the extent to which Snowy Hydro withholds capacity can have a direct affect on the value of IRSRs on those interconnectors. As for the Abolition alternative, the conceptual analysis is inconclusive on what the overall likely affect on participants' ability and willingness to trade inter-regionally would be under the Split Snowy Region proposal. While the combined IRSR units on the three new interconnectors may provide a "firmer" financial hedge than the corresponding units under the Abolition alternative, the incentives Snowy Hydro faces to withhold capacity to manage its own basis risk may offset that firmness.

Snowy Hydro would face greater basis risk under the Split Snowy Region proposal compared to the Abolition alternative, however, and to the extent that this influences the volume and competitiveness of its contracts in the NEM-load bearing regions, it may result in less efficient contract prices relative to the Abolition alternative.

A.4.4 Southern Generators' Congestion Pricing proposal

Under the Southern Generators' Congestion Pricing proposal, when the Murray-Tumut constraint binds, the Tumut CSP/CSC Trial ensures that Tumut output receives its own nodal shadow price, similar to the Split Snowy Region proposal. When the constraint does not bind, Tumut generation is settled at the Snowy RRP, just as it would be under the base case.

The incentives for Snowy Hydro to manage its basis risk under the Southern Generators' Congestion Pricing proposal are fairly similar to those under the Split Snowy Region proposal. While there may be an improvement for Snowy Hydro relative to the base case, its basis risk is more significant under this proposal compared to the Abolition alternative.

Snowy Hydro is likely to have a greater willingness to contract its Tumut generation in NSW under the Southern Generators' Congestion Pricing proposal than under the base case because of its pricing incentives under this proposal. This is because its settlement price is closer to the NSW RRP than under the base case. It may still use its withholding strategy though, to manage any congestion that may arise between it and the NSW RRN. Just as in the Split Snowy Region proposal, any such congestion would lower the Tumut settlement price.

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[85] Biggar, 1 December 2006, para. 122.

[86] Eraring Energy, joint s.99 Abolition, s.95 Southern Generators' Congestion Pricing, and s.95 Split Snowy Region submission, p.5.

Also, as under the Split Snowy Region proposal, Murray generation would still face basis risk on any contracts struck at the NSW RRN. When flows are northward, it would have incentives to withhold capacity to alleviate the constraint to help import the higher NSW RRP. This helps Snowy Hydro manage its exposure from any price difference between its Murray settlement price and the NSW RRP, should it have any contracts there. For southward flows, Murray generation is incentivised to generate to alleviate the Murray-Tumut constraint, therefore assisting Snowy Hydro in meeting its contract position in Victoria using both its Tumut and Murray generation.

The likely effects of these incentives on the IRSR units under the Southern Generators' Congestion Pricing proposal are likely to be a combination of those under the Split Snowy Region proposal and the base case. Accordingly, when the Murray-Tumut constraint binds, the firmness of the Snowy-NSW directional interconnector IRSR units is dependent on the extent to which Snowy Hydro seeks to maintain headroom on that interconnector. Those units are therefore likely to be firmer than under the base case, but inconclusive relative to the Split Snowy Region proposal. For southward flows, should Snowy Hydro's bidding of its Tumut generation result in counter-price flows on the NSW-Snowy directional interconnector, Tumut generation settlements are used to offset the negative residues. This improves the firmness of those units relative to the base case, but it is unclear relative to the Split Snowy Region proposal what the relative firmness may be.

The Southern Generators Rule component of the Southern Generators' Congestion Pricing proposal has its own effect on the IRSR units between Victoria and NSW. As presented in its final Rule determination on the Southern Generators Rule, the Commission considered that the Rule improved the net firmness of IRSR units between Victoria and NSW relative to the base case.[87] This was because the combination of the Victoria-Snowy and Snowy-NSW IRSR units for northward flows was likely to improve the hedging instrument's ability to manage the price difference between the Victorian RRN and NSW RRN relative to the base case. The same was considered true for the combined units for southward flows also. While the Commission considers these IRSR units are more firm than under the base case, it is again unclear what the relative firmness is to those under the Split Snowy Region proposal, or indeed the single IRSR units under the Abolition alternative. It is also unclear what effect the relative firmness of these IRSR units would have on participants' ability to manage any inter-regional basis risk between Victoria and NSW.

Submissions were divided on the likely effect of the Southern Generators' Congestion Pricing proposal on inter-regional trade. Snowy Hydro contended that the Southern Generators' Congestion Pricing proposal was likely to increase transaction costs in the contract market and reduce inter-regional trade.[88] On the other hand, the Southern Generators argued that risks under their Congestion

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87 AEMC 2006, *Management of Negative Settlement Residues in the Snowy Region*, Final Rule Determination, 14 September 2006, Sydney, p.27.

88 Snowy Hydro, joint s.99 Abolition, s.95 Southern Generators' Congestion Pricing, and s.95 Split Snowy Region submission, p.24.

Pricing proposal would be lower than the Base Case due to the "firming up" of interconnector residues.[89]

A.4.5 Commission's considerations

The Abolition alternative results in the lowest basis risk for Snowy Hydro, compared to the alternatives of the Split Snowy Region and the Southern Generators' Congestion Pricing proposals. The Commission expects that the reduction in basis risk for Snowy Hydro under the Abolition alternative will promote incentives for Snowy Hydro to offer more competitively priced contracts at the NSW and Victorian RRNs, introducing greater competitive pressure in the contract markets at those RRNs, providing competitive benefit for the wider contract market.

The positive benefits on IRSR firmness from removing NEMMCO's unpredictable intervention to manage negative residues supports a case for change away from the base case under this criterion. However, the analysis was unable to identify which Rule change proposal promoted IRSR firmness in a way that substantially enhanced market participants' ability to manage basis risk between Victoria and NSW.

The quantitative analysis of risk is also inconclusive on which of the three Rule change proposals better enables participants to manage the risk of trading inter-regionally between Victoria and NSW (both directions) using only IRSR units. Presented in Appendix B, the results suggest the Abolition alternative marginally produced the lowest level of risk for inter-regional positions from NSW into Victoria for all but the 2010 contracted high case. It did not perform as well for trading from Victoria into NSW. There was no risk for Snowy Hydro's Murray and Tumut generation under the Abolition alternative. The base case and Southern Generators' Congestion Pricing proposal produced similar levels of risk for participants trading from NSW into Victoria, with the Split Snowy Region producing marginally higher levels on average. The Split Snowy Region results fell between those of the Abolition alternative and the Southern Generators' Congestion Pricing proposal, but appeared to produce the lowest level of risk in 2010 (contracted high). The results are similarly marginal and inconclusive when considering trading from Victoria into NSW.

That being said, market participants noted in interviews with the Commission that they did not rely solely on IRSRs for managing an inter-regional risk. Some used it as a speculative tool while others used it as part of their portfolio approach for managing inter-regional risk. To the extent participants can access other tools to supplement cover for their inter-regional basis risk, then the overall effect of IRSR firmness is not a strong differentiating factor between the proposals.

The Commission's conclusion that there is likely to be increased competition in the contract market under the Abolition alternative was supported by submissions from a number of parties. As discussed above, they argued that the absence of basis risk for Snowy Hydro would encourage it to lower prices for its contracts, with flow-on

[89] Southern Generators, joint s.99 Abolition and s.95 Southern Generators' Congestion Pricing submission, p.17.

benefits for the liquidity of the contract market, inter-regional trade and competition.[90]

The Commission therefore concludes that the Abolition alternative will result in a material improvement in inter-regional trade and risk management compared to the alternatives.

A.5 Pricing outcomes and participant responses

Although favourable wholesale price impacts are not a distinct component of the Commission's considerations, a greater alignment between costs and prices has desirable efficiency implications. Price outcomes and the related participant responses are informed by the effects the proposals have on dispatch efficiency and inter-regional trading and risk management. More competitive bidding, leading to more efficient dispatch, should lead to more cost-reflective spot prices. If a proposal promotes greater competition in a wholesale market, this may also increase competition in the contract market. This in turn has implications for outcomes and responses in both the short and the long term.

In the short term more cost-reflective prices will enable consumers to make more informed decisions about the timing and level of their consumption, to the extent effective retail competition ensures that end consumers see these more cost-reflective prices. In assessing this criterion the Commission has considered which proposal is most likely to result in wholesale prices that accurately reflect the efficient costs of production, and therefore, promote allocative efficiency. Short term competition improvements can therefore have longer term implications, particularly relating to participant responses to those competitive improvements.

In the longer term, Rule change proposals that change production and pricing (spot and contract) outcomes are likely to affect the timing, location, and type of new investment in load and generation plant. Investors in new plant typically rely on long term contracts to help underwrite their investments. To the extent the changes to region boundaries result in more competitive and, hence, predictable behaviour this is likely to ease entry conditions for investors. In turn, a more predictable market is likely to reduce the risk of ill-timed investment and the costs associated with capacity shortages in the market. The Commission has considered, therefore, which proposal generates the most accurate and reliable long term price signals to inform decisions by existing and prospective generators, loads, and network providers.

This criterion evaluates which of the three Rule change proposals best promotes allocative efficiency in the short term and efficient investment in the longer term. The Commission has considered views put forward in submissions, quantitative analysis undertaken by Frontier Economics, and its own analysis.

[90] Origin Energy, s.99 Abolition submission, p.4.; and EnergyAustralia, s.99 Abolition submission, p.1; and Country Energy, s.99 Abolition submission, p.2.

A.5.1 Short term

NEM spot price outcomes are dependent upon a number of factors, including the level of demand, the availability of generation, network limitations and participant bids and offers. In most circumstances, these factors are inter-related. For example, under the base case, Snowy Hydro's bidding incentives for its Tumut generation can be very different when the Murray-Tumut constraint is binding compared to when it is not binding. As discussed above, these bidding incentives drive dispatch and therefore price outcomes. By considering the effects these Rule change proposals are likely to have on dispatch, the Commission can draw conclusions in relation to the likely short term pricing outcomes.

Unpredictable bidding behaviours and the use of market interventions creates a high risk environment for participants. The dispatch efficiency benefits determined under the three Rule change proposals over those in the base case suggest the market would be better off with any of the proposals compared to the base case. This suggests that the pricing outcomes under the base case would be the least cost-reflective compared to the outcomes under the Rule change proposals. The Commission's modelling supports this assessment (see Appendix B).

The analysis of dispatch efficiency above concluded that the Abolition alternative is most likely to result in efficient dispatch relative to the alternatives, because it encourages the most cost-reflective bidding by participants. Moreover, the Commission's analysis of risk indicated that it expected increased competitive pressure in the contract market under the Abolition alternative as a result of the reduction in Snowy Hydro's basis risk.

The dispatch efficiency benefits from the Abolition alternative stem from a change in bidding incentives for Snowy Hydro's Murray and Tumut generation, in particular, which result in a more competitive set of bidding outcomes. The modelling identified that the more efficient dispatch was driven by Snowy Hydro offering more generation during peak periods at competitive bids. The price results reflect this offsetting behaviour, showing lower average annual prices in NSW over the three years for both the high and low contracted cases.[91] Prices in Victoria also trended downwards over the three years modelled for both the high and low contracted cases; the downward trend was not as substantial as in NSW.[92] The stronger incentives for competitive bidding under the Abolition alternative therefore result in more competitive prices than those in the base case.

Many submissions stated they believed the Abolition alternative would require generators in NSW and Victoria to adopt more competitive strategies, which would lead to more competitive spot, contract, and retail prices.[93] These same stakeholders

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[91] As explained in Appendix B, the higher prices in contracted high and low cases 2008 were directly related to the substantial binding of the South Morang constraint in Victoria. This constraint binds substantially less in 2009 and 2010.

[92] See Appendix B.

[93] EnergyAustralia, s.99 Abolition submission, p.2.; Origin Energy, s.99 Abolition submission, p.3-4; Country Energy, s.99 Abolition submission, p.2; and Snowy Hydro, joint s.99 Abolition, s.95 Southern Generators' Congestion Pricing, and s.95 Split Snowy Region submission, p.15.

commented on the Split Snowy Region proposal stating it was likely to reduce competition, and possibly increase price volatility.[94] The Southern Generators commented that previous modelling by the Commission showed that the Split Snowy Region actually led to substantially lower prices in NSW compared to the Abolition alternative.[95]

As discussed above, the Split Snowy Region and Southern Generators' Congestion Pricing proposals introduce similar bidding incentives for Snowy Hydro's Murray and Tumut generation. These incentives encourage Snowy Hydro to withhold capacity to maintain headroom. Analytically, it is difficult to determine the comparative effect of withholding capacity under these proposals compared to the disorderly bidding incentives under the Abolition alternative. That being said, if more competitive behaviour leads to more competitive pricing (in both the wholesale and contract markets), this suggests prices under the Split Snowy Region and Southern Generators' Congestion Pricing proposals may be less cost-reflective than under the Abolition alternative.

The quantitative modelling results present similar downward pricing trends for the Split Snowy Region proposal, Southern Generators' Congestion Pricing proposal, and base case for both NSW and Victoria annual average prices.[96] In Victoria, all the proposals led to marginally lower prices relative to the results under the base case. In NSW, while the proposed highest prices in 2008 are under the Abolition alternative, in the latter years, the other proposals and base case present fairly similar results. The downward trend in prices over the three years modelled for all the proposals, including the base case, suggests a common change in the underlying assumptions may be driving this trend. The difference in magnitude, however, may be attributed to the different behavioural incentives in each of the proposals compared to the base case. However, the Abolition alternative results in more consistently lower spot prices than the alternatives.

The Commission considers that the improvement in competition in the spot and contract markets under the Abolition alternative is most likely to encourage cost-reflective pricing. The Commission therefore considers that the Abolition alternative promotes wholesale prices that more accurately reflect the efficient costs of production, and therefore, promotes allocative efficiency relative to the base case, Split Snowy Region, and Southern Generators' Congestion Pricing proposal.

A.5.2 Longer term

Contract and wholesale prices provide signals for future generation, load, and network investment. They inform not only location decisions but also the timing of those decisions and best-fit technology, e.g. peak or base load generations. Future

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[94] See for example, EnergyAustralia, s.99 Abolition submission, p.3.

[95] Southern Generators, joint s.99 Abolition submission and s.95 Southern Generators' Congestion Pricing submission, p.28. See Appendix B for an explanation of what is driving the differences between the modelling presented in the Abolition draft Rule determination and the modelling presented in this Rule determination.

[96] See Appendix B.

investors require a level of certainty prior to committing to an investment. Since the beginning of the NEM, there has been considerable uncertainty surrounding the management of congestion in the Snowy region. Such uncertainty can affect investment incentives and decisions. The implementation of one of these three Rule change proposals to address congestion in the Snowy region will not only address concerns about dispatch and pricing efficiency, but will provide greater certainty to potential investors.

Greater price granularity can improve investment location signals. The more prices in a market, the more information investors can obtain about potential network congestion points. Price separation between region prices reflects congestion between those nodes. The Split Snowy Region proposal provides the most explicit pricing signals of the three proposals. In principle, this proposal should provide investors with improved investment signals in and around the Murray and Tumut regions relative to the other proposals.

In practice, it is unlikely that this will improve future investment signals in those pricing regions. The Murray and Tumut regions are still physically located in national park. Regardless of how explicit the pricing signals may be under the Split Snowy Region proposal, environmental restrictions make investment in the area highly unlikely. From the perspective of informing future investment, the increased price granularity in the Split Snowy Region proposal is therefore not a differentiating characteristic between it and the Abolition alternative and the Southern Generators' Congestion Pricing proposals.

Investment decisions also require information on the competitive environment and likely trends in participant behaviour. The assessments above indicate that the Abolition alternative is most likely to promote cost-reflective pricing compared to the alternatives. While the Commission's modelling only considers a three-year outlook, it indicates a positive trend in more cost-reflective pricing over time relative to the base case and alternatives. ESPIC noted in its submission that while that the productivity gains from a region boundary change were likely to be modest, efficient prices were likely to emerge in the longer term.[97]

A.5.3 Commission's considerations

More efficient dispatch as a result of more cost-reflective bidding by participants is likely to be reflected in more cost-reflective spot prices. Similarly, a reduction in basis risk in the contract market is likely to increase competitive pressure, with benefits for allocative efficiency in the short term and dynamic efficiency in the long term. Discussion in previous Sections noted the Commission's conclusion that the Abolition alternative is most likely to improve economic dispatch efficiency and inter-regional trading risk management when compared to the Split Snowy Region and Southern Generators' Congestion Pricing proposals. This should in turn result in more cost-reflective prices.

[97] ESIPC, s.99 Abolition submission, p.2.

The Commission considers that because the Abolition alternative is more likely to promote cost-reflective pricing compared to the alternatives, it is therefore more likely to promote allocative efficiency in the short term and the signals for efficient investment in the longer term.

A.6 Power system security, supply reliability, and technical issues

This assessment criterion considers whether any of the Rule change proposals detract from NEMMCO's ability to operate a secure and reliable network in the short or longer term. Conceptually, it is unlikely that a Rule change proposal that adversely affects supply reliability or NEMMCO's ability to maintain power system security would promote the NEM Objective. The Commission's evidence base for the assessment of the proposals against this criterion includes information put forward in submissions and advice from NEMMCO.

A.6.1 Assessment of relevant issues

The Commission's starting point for its assessment of the proposals against this criterion is that a change to region boundaries should only affect pricing and settlement, and the associated changes to bidding incentives, rather than the mechanics of the dispatch process. NEMMCO will continue to have an overriding responsibility to maintain power system security and the power to make directions if necessary. This responsibility would also apply under the Southern Generators' Congestion Pricing proposal.

The Commission forwarded stakeholder comments on this criterion to NEMMCO as the market and system operator. In response to Hydro Tasmania's concern regarding adequate resources to manage operational changes[98], NEMMCO set out its intended approach to demonstrate that it could deal with operational changes during the implementation period. NEMMCO confirmed that an implementation date of July 2008 for the Abolition alternative provided sufficient time to both implement the proposal and meet operational requirements.

NEMMCO stated that constraint equations and other measures are designed to manage the technical issues of the power system. Although a region boundary change would require changes to manage the power system under the new region structure, NEMMCO did not consider that the either the Abolition alternative or the Split Snowy Region proposal would increase the risks to power system security. In the Commission's view, this statement addressed the Southern Generators' suggestion that any region change would create some risk to system security from unforeseen behavioural outcomes, implementation errors, or manual, operator errors.[99]

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[98] Hydro Tasmania, s.99 Abolition submission, p.3.

[99] Southern Generators, joint s.99 Abolition and s.95 Southern Generators' Congestion Pricing submission, p.18.

NEMMCO also commented that it had not identified any circumstances where intervention to manage power system security had been necessary as a result of the operation of the Southern Generators Rule. To this extent, NEMMCO concluded that power system security has not been compromised. In the Commission's view, this conclusion addressed Snowy Hydro's concerns on potential system security problems arising from operation of the Southern Generators Rule and indicated that no such problem would arise if the Southern Generators' Congestion Pricing proposal were implemented.[100]

A.6.2 Commission's considerations

The Commission has taken into account issues raised by submissions, advice from NEMMCO, and its own analysis in making its assessment of the likely power system security and supply reliability implications of these three Rule change proposals. The Commission considers that none of the proposals will have significant direct impacts on system security, supply reliability or the technical functioning of the NEM. The application of this criterion, therefore, does not provide a basis for distinguishing between the Abolition alternative, the Split Snowy Region, and the Southern Generators' Congestion Pricing proposals.

A.7 Good regulatory practice

The Commission considers that good regulatory practice is a key criterion when considering whether a Rule change proposal is likely to promote the long term interests of consumers. Good regulatory practice refers to the transparency and predictability of regulatory action.

The Commission's understanding and application of good regulatory practice has been informed by a review of relevant Australian and international standards as well as consideration of views put forward by stakeholders in submissions. The Commission has consulted the Australian Government's Office of Best Practice Regulation, "Principles and Guidelines for National Standard Setting and Regulatory Action by Ministerial Councils and Standard-Setting Bodies",[101] APEC's "Good Regulatory Practice Guidelines",[102] and the New Zealand's Ministry of Economic Development, "Code of Good Regulatory Practice"[103].

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[100] Snowy Hydro, Supplementary Submission, 26 March 2007, p.13.

[101] Council of Australian Governments, "Principles and Guidelines for National Standard Setting and Regulatory Action by Ministerial Councils and Standard-Setting Bodies", June 2004.

[102] APEC, "Information Notes on Good Regulatory Practice for Technical Regulation", September 2000, available: http://www.apec.org/apec/documents_reports/sub-committee_standards_conformance/2006.html.

[103] Ministry of Economic Development, "Code of Good Regulatory Practice", 15 November 1997, available: http://www.med.govt.nz/templates/MultipageDocumentTOC___22149.aspx.

A.7.1 Assessment of the Rule change proposals

The application of the good regulatory practice criterion to Rule change proposals requires consideration of whether their implementation would promote the transparent and predictable operation of the market. On this basis, Rule change proposals ought to:

- Promote transparency in the operation of the NEM;
- Promote regulatory benefits that outweigh costs;
- Promote a proportionate response to an identified problem; and
- Promote changes that are robust in the longer term.

The three Rule change proposals are assessed below against each of these good regulatory practice principles.

A.7.2 Transparency in the operation of the NEM

To promote transparency, a Rule change proposal may seek to improve aspects of NEM operation like cost-reflective pricing, non-power system security interventions, predictability, and risk management mechanisms.

As set out above, all three Rule change proposals improve transparency in NEM operations compared to the base case by pricing the congestion between the Murray and Tumut power stations. One potential point of difference, however, is that the Abolition alternative and the Split Snowy Region proposals are less complicated and therefore more transparent in their operation compared to the Southern Generators' Congestion Pricing proposal.

All the proposals reduce the need for regular NEMMCO non-system security intervention to manage negative residue accumulation on the existing Victoria-Snowy interconnector compared to the base case. Snowy Hydro argue in their submission that the Southern Generators' Congestion Pricing proposal would result in a requirement for continued NEMMCO intervention to manage negative residues on the South Australia to Victoria interconnector.[104] The Southern Generators contended that the Abolition alternative represents an operational intervention by the Commission.[105]

In its Rule change proposal, Snowy Hydro suggested that the Abolition alternative would improve transparency because it removes Snowy Hydro's incentives to maintain headroom on the lines north of Tumut at times of northward flows,

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[104] Snowy Hydro, joint s.99 Abolition, s.95 Southern Generators' Congestion Pricing, and s.95 Split Snowy Region submission, p.28.

[105] Southern Generators, joint s.99 Abolition and s.95 Southern Generators' Congestion Pricing submission, p.24.

revealing the full extent of potential congestion on those lines.[106] This would give Transmission Network Service Providers (TNSPs) clearer incentives to assess whether action to relieve these constraints is warranted under the Regulatory Test. However, the Commission does not find this argument convincing, since it is possible that region boundary change may introduce other incentives for distorted bidding, as discussed in Section A.2, which would not necessarily lead to efficient augmentation. Moreover, market modelling using strategic bidding strategies provides TNSPs with the tools to determine the extent of benefit from augmenting the lines north of Tumut, whether they can observe substantial constraints binding north of Tumut or not.

A.7.3 Regulatory benefits that outweigh costs

The market has been seeking for a solution to the congestion problems in the Snowy region for many years. As discussed in Appendix D, multiple incremental fixes have been introduced to manage the problem until the implementation of a longer term solution. This constant short term change and the ambiguity around which of the potential longer term solutions (including region boundary change) may be implemented and at what time, has promulgated a degree of uncertainty in the NEM.

As discussed further in Section A.9, the Commission considers that the costs of implementing one of these Rule change proposals is minimal relative to the market benefit of providing certainty around a permanent solution manage the material and enduring congestion in the Snowy region.

A.7.4 Proportionate response

A proportionate response to the issues arising from the congestion in the Snowy region would need to address the problem, therefore addressing a major legacy congestion issue, but without pre-empting possible market-based responses to future congestion problems in the NEM.

As discussed in Appendix D, the congestion in the Snowy region has been, and unless addressed is likely to continue to be, a source of material and enduring congestion, which has material implications for the efficient operation of the NEM. The MCE's policy, as set out in the CMR Terms of Reference, specifies that material and enduring constraint issues should ultimately be "addressed through investment or regional boundary change".[107]

The congestion in the Snowy region is unlikely to be addressed by either network augmentation or load or generation investment. TransGrid, as the relevant TNSP, provided the Commission with advice to the effect that augmentation would be unlikely to satisfy the Regulatory Test. For example, upgrades to the Murray-Tumut

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[106] Snowy Hydro, *Rule Change Proposal for the Snowy Region: Revision of Transmission Connection Nodes*, 11 November 2005, Appendix B, p.9.

[107] Ministerial Council on Energy, "Terms of Reference for Australian Energy Market Commission – Congestion Management Review", 5 October 2005, p.4.

lines, such as raising the height of transmission towers, would require extensive outages over many months. This would be likely to exacerbate the congestion problem in the interim, imposing significant market costs. Further, generation or load responses are also unlikely to occur given the restrictions on developing such investments in a national park.[108]

The Southern Generators' Congestion Pricing proposal prices this Snowy region congestion, using a mechanism other than region boundary change. It provides incentives for Snowy Hydro to offer its Murray and Tumut generation into the market in a more cost-reflective manner than it would do under the base case. It is, however, a long term extension to what was intended to be an interim pricing mechanism.[109] Moreover, as a mechanism implemented directly through the Rules like the Southern Generators' Congestion Pricing proposal would be open to further change under a new Rule change proposal. Should the Southern Generators' Congestion Pricing proposal be implemented, it is possible that additional region boundary change option or new Rule change proposals could lodged with the Commission in the short term.

In contrast, region boundary change in the Snowy provides a more stable, permanent mechanism to price congestion, consistent with the MCE's suggested approach for addressing material and enduring congestion where that congestion is unlikely to be resolved by investment.

The Commission, therefore, considers that the Abolition alternative and the Split Snowy Region proposals perform better than the Southern Generators' Congestion Pricing proposal against this criterion. While the Commission does not consider that the Southern Generators' Congestion Pricing proposal is the best long term mechanism for addressing congestion in the Snowy region, it does consider it would be beneficial to retain this interim mechanism (currently in Part 8 of Chapter 8A of the Rules) until implementation of a region boundary change.

Having identified that a region boundary change is the best approach to addressing the legacy congestion issues in the Snowy region, the question then arises as to which of the two such proposals is the most appropriate response.

The Split Snowy Region proposal retains the existing region boundaries north of Tumut and south of Murray, while the then Abolition proposal removes these boundaries. If the Commission observed significant increases of congestion at the present boundaries in its forward-looking quantitative analysis, this may support implementation of the Split Snowy Region proposal. In this case this proposal would avoid the market uncertainty of removing region boundaries only to reintroduce

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[108] See Appendix D for further information.

[109] See "History of the current Part 8 derogation for implementing the Tumut CSP/CSC Trial and NEMMCO's power to manage negative residues" Section in AEMC 2007, *Decision Report - Determination By The AEMC On The Expiry Date Of The Participant Derogation In Part 8 Of Chapter 8A Of The National Electricity Rules - Network Constraint Formulation*, Determination, 3 May 2007, Sydney.

them in a few years time. Some stakeholders cited this argument in their submissions.[110]

While the Commission's conceptual analysis indicates that congestion may increase north of Tumut and south of Murray power stations under the then Abolition proposal, it is uncertain to what extent and what precise location any such increase may arise. Material and enduring congestion does not appear in the historical analysis. Where material congestion does arise, for example, around the South Morang transformers, network upgrades are currently underway to address that congestion (see Appendix G). More importantly, material and enduring congestion is not evident in the forward-looking analysis (see Appendix B). Some stakeholders made this observation in their submissions.[111]

Even if congestion were to appear, there is not necessarily a case for retaining the present region boundaries just north of Tumut and just south of Murray (or Dederang in the case of the Split Snowy Region proposal). The MCE's policy intent in its staged approach to congestion management places strong emphasis on allowing scope for investment responses prior to considering a region boundary change.[112] For instance, the Last Resort Planning Power (LRPP) gives the AEMC the power to direct certain market participants to take the Regulatory Test for transmission investment under certain circumstances, including where the Commission considers an investment response has not been investigated to address material network congestion.

This good regulatory practice principle of a proportionate response to a problem is concerned with identifying a permanent mechanism to address the material and enduring congestion between Murray and Tumut power stations in the Snowy region, without pre-empting other possible market responses to any future congestion problems. On balance, the Commission considers the Abolition alternative is the most appropriate and proportionate response to address congestion in the Snowy region when compared to the Split Snowy Region and Southern Generators' Congestion Pricing proposals.

A.7.5 Robust longer term changes

Addressing the Snowy region legacy issue will provide a sensible starting point from which to apply the future congestion management regime. In this regime, a region boundary change is intended to price congestion that would not otherwise be addressed by the activities of market participants or network service providers; MCE policy has identified it is the last stage for managing material and enduring congestion. For the reasons discussed above, the Commission considers that between the three Rule change proposals assessed the Abolition alternative would

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110 Eraring Energy, joint s.99 Abolition, s.95 Southern Generators' Congestion Pricing, and s.95 Split Snowy Region submission, p.5; and Macquarie Generation, joint s.99 Abolition, s.95 Southern Generators' Congestion Pricing, and s.95 Split Snowy Region submission, p.6.

111 See for example, Origin Energy, s.99 Abolition submission, p.3.

112 MCE, "Terms of Reference for Australian Energy Market Commission – Congestion Management Review", p.4.

provide the most robust starting point for the longer term congestion management regime.

A.7.6 Commission's considerations

The Commission considers that any of these Snowy region related Rule change proposals would offer an improvement in terms of the transparency and predictability of market operation compared with the base case. They all improve the operation of the NEM relative to the base case by reducing the likely incidence of NEMMCO's intervention to manage negative residues, and they all price the material and enduring congestion between Murray and Tumut.

As discussed further in Section A.9, the Commission considers that the costs of implementing one of the Rule change proposals is minimal relative to the market benefit of providing certainty around a permanent solution manage the material and enduring congestion in the Snowy region.

The Commission considers, however, that the Abolition alternative is the most appropriate proportionate response to the material and enduring congestion problem in the Snowy region. Moreover, the Commission considers that the Abolition alternative provides the most appropriate starting point from which to apply the future congestion management regime.

The Commission, therefore, considers the Abolition alternative to be, on balance, the most appropriate response with respect to the principles of good regulatory practice compared to the Split Snowy Region and Southern Generators' Congestion Pricing proposals.

A.8 Long term implications and consistency with public policy settings

At this stage of the NEM's development, radical changes to the market design and operation are unlikely to be either necessary or desirable in terms of promoting the NEM Objective. The Commission, therefore, regards that most Rule change proposals submitted to the Commission will focus on smaller incremental improvements compared to the overall costs of operating the power system. In this regard, the NEM Objective provides the Commission with guidance on what is meant by incremental improvement to the market.

The NEM Objective is oriented towards an efficiently operating market and power system for the long term benefits of consumers. In its assessment of the three Rule change proposals, the Commission considers it important that the effect of the proposals on economic efficiency, reliable supply, and power system security in the short to medium term is consistent with the provision of appropriate longer term investment decisions and hence contribute to the achievement of benefits for consumers in the longer term.

In considering Rule change proposals, the Commission must also have regard to the broader public policy settings. For example, in assessing these Rule change proposals, the Commission has considered the policy position put forward by the

MCE regarding the management of congestion and the long term options for addressing material and enduring congestion.

A.8.1 Long term implications

As discussed above, the Commission considers that relative to the base case, the three proposals are likely to promote more efficient dispatch and, proportionately, more competitive pricing outcomes. Quantitatively, these economic efficiency improvements suggested incremental benefits to the market rather than substantial economic gains. That being said, these proposals address the most material and enduring congestion problem currently in the NEM. By pricing this congestion, these proposals will not only provide incremental economic benefits, but will also promote greater market certainty by addressing this legacy problem. Improving longer term market certainty is in the long term interest of consumers as it creates a more stable and transparent environment for future investment decisions.

As discussed in Section A.5, the Commission expects that the increased competition under the Abolition alternative is most likely to promote allocative and dynamic efficiency in the NEM over the longer term, is therefore most likely to provide longer term benefits for end-use customers.

A.8.2 Consistency with public policy

Stakeholders' views on the consistency of the various proposals with public policy settings were divided. Several considered the legacy problem in the Snowy Region required a tailored solution and that a decision to change the Snowy region boundary was consistent with MCE policy.[113] They indicated the current market uncertainty was negatively impacting on competitiveness and the quality of contracts in the NEM.[114]

Others expressed concern over the Commission's approach to review a one-off region boundary change while finalising the process and criteria for determining future region boundary changes. They stated that an *ad hoc* approach could lead to regulatory uncertainty and could pre-empt decisions on the related processes. Some submissions stated that the processes to be set out in the CMR and MCE Process for Region Change were the appropriate processes to assess the problems in the Snowy Region.[115]

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[113] Macquarie Generation, joint s.99 Abolition, s.95 Southern Generators' Congestion Pricing, and s.95 Split Snowy Region submission, p.8; and Snowy Hydro, joint s.99 Abolition, s.95 Southern Generators' Congestion Pricing, and s.95 Split Snowy Region submission, p.16-17.

[114] See for example, EnergyAustralia, s.99 Abolition submission, p.2; Origin Energy, s.99 Abolition submission, p.1; and Snowy Hydro, letter to the AEMC chairman, 15 March 2007, p.3.

[115] Southern Generators, joint s.99 Abolition and s.95 Southern Generators' Congestion Pricing submission, p.4; South Australian Minister for Energy, s.99 Abolition submission, p.1.; ESIPC, s.99 Abolition submission, p.1; ERM Power, s.99 Abolition submission, p.1; International Power Australia, s.99 Abolition submission, p.2; and Hydro Tasmania, s.99 Abolition submission, p.1-2.

In assessing the Abolition alternative and the Split Snowy Region, and the Southern Generators' Congestion Pricing proposals, the Commission has ensured its consideration and decision-making process has had regard to the MCE's public policy settings for managing congestion and region boundary change.

As discussed above in Section A.7, the MCE set out in its CMR Terms of Reference that material and enduring congestion should ultimately be addressed through either investment or region boundary change. In October 2005, the MCE also proposed a Rule change proposal on the process for region change. In its proposal, the MCE confirmed this position stating that:

> "A stable [NEM] regional structure is envisaged in which a regional boundary change is justified by the lack its investment response to material and ongoing congestion."[116]

The congestion in the Snowy region is not likely to be addressed by an investment response in the short to medium term. In the absence of investment, a region boundary change that prices the material and enduring congestion is consistent with the public policy position of the MCE.

The Commission therefore considers that its decision to implement a region boundary change to address this legacy issue is consistent with the MCE's public policy settings as set out in its CMR Terms of Reference and its proposal on the process for region change. Waiting until the conclusion of the CMR or the final Rule determination on the MCE proposal would unnecessarily extend the market uncertainty around managing congestion in the Snowy region; it would only delay what the Commission's considers to be the inevitable consideration and implementation of a change to the Snowy region boundaries.

A.8.3 Commission's considerations

While all three proposals are likely to improve economic efficiency in the market, for the reasons discussed in earlier Sections, the Abolition alternative is more likely to promote a more stable and transparent longer term environment compared to the Split Snowy Region and Southern Generators' Congestion Pricing proposals. The Commission considers that consumers would be expected to gain from these efficiency improvements in the longer term, through the creation of a more stable and transparent environment for future investment decisions. The Commission also considers that region boundary change resulting from to the Abolition alternative is consistent with the policy settings as set out by the MCE.

A.9 Implementation

A change to the existing Snowy region boundaries would be the first such change to region boundaries since the start of the NEM in 1998.[117] It is also worth noting that

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[116] Ministerial Council on Energy, "Reform of Regional Boundaries", Rule change request, 5 October 2005, p.8.

this change would be given effect through a change to the Rules, rather than through the review mechanism currently provided for in the Rules (clauses 3.5.2 and 3.5.3). This review mechanism is currently suspended. Since the making of the initial Rules on 1 July 2005, clauses 3.5.2 and 3.5.3 have not commenced. Consequently, the Commission has sought advice from NEMMCO and input from market participants on the steps required to implement both the Abolition alternative and the Split Snowy Region proposals.

The implementation issues surrounding the Abolition alternative, the Split Snowy Region, and the Southern Generators' Congestion Pricing proposals are important considerations for the Commission. In particular, the benefits of making a change to the Rules should exceed the costs of that change. In reaching its decision, the Commission has considered the relative costs and benefits of implementing the proposals.

The Commission understands that the Southern Generators' Congestion Pricing proposal has minimal implementation costs. The only implementation step for the Southern Generators' Congestion Pricing proposal would be to incorporate into the body of Chapter 3 of the Rules the current CSP/CSC trial at Tumut and the Southern Generators Rule (to manage negative settlement residues in the Snowy Region), rather than have them operate as a temporary arrangement under the derogation in Part 8 of Chapter 8A of the Rules.

Both the region boundary proposals have similar implementation processes, although the Abolition alternative could be implemented more quickly and at a lower cost than the Split Snowy Region proposal. There are a number of common steps required to implement the Abolition alternative and the Split Snowy region proposal. However, from NEMMCO advice and stakeholder submissions it appears that that the Abolition alternative would be simpler to implement than the Split Snowy Region proposal because:

1. It involves the abolition of a region and one interconnector (in net terms); and

2. It is likely to involve smaller adjustments to the contract portfolios, IRSR unit holdings, and risk positions of a smaller number of market participants than the Split Snowy Region proposal.

Based on advice from NEMMCO and subsequent input from market participants, both proposals would require changes to: data used in dispatch; market information and dispatch systems; and, most significantly for market participants, financial hedging and risk management arrangements. These changes are outlined below. The Commission then considers the risks and costs of implementation.

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[117] Excluding: a) the addition of Tasmania to the NEM in 2005, which did not require any change in boundaries, but involved the addition of a region previously electrically separated from the other parts of the NEM; and b) reassignment of load at the Terranora node from the Queensland region to the NSW region as part of the conversion of Directlink to a prescribed network service.

A.9.1 NEMMCO advice

NEMMCO provided a series of letters advising the Commission on the changes required to implement region boundary change, and the likely time required to implement these changes. This advice is discussed below.

NEMMCO's letters were published on the Commission's website and interested parties were invited to make submissions regarding issues relating to implementation of a change to the Snowy region boundaries.

A.9.1.1 NEMMCO's August 2006 advice

On 12 July 2006, the AEMC wrote to NEMMCO seeking its advice on the steps and timeframes required to implement a region boundary change, in particular the (then) two boundary change proposals for the Snowy region.[118] After conducting an internal assessment process, NEMMCO wrote to the Commission on 25 August 2006.[119]

Changes required

NEMMCO advised that implementation of either region boundary change proposal would be likely to require changes to:

1. Physical systems and data used to manage the market:
    (a) NEMMCO's market management systems (MMS);
    (b) Participant computer systems interfacing with NEMMCO's systems;
    (c) Marginal loss factors – static and dynamic;
    (d) Transmission constraints and limits;
    (e) Energy and demand projections for new regions;
    (f) Minimum Reserve Requirements of each region; and
    (g) SRA arrangements;
2. Financial risk management arrangements of market participants:
    (a) Prudential limits calculated by NEMMCO for market participants;
    (b) Credit-support arrangements of market participants;
    (c) Financial hedge contracts; and

[118] The Abolition proposal and the original May 2006 Macquarie Generation proposal.

[119] NEMMCO, Letter to Dr John Tamblyn, Implementation of a region boundary change, 25 August 2006.

(d) Inter-regional settlement residue unit holdings;

3. Information concerning:

   (a) The Statement of Opportunities (SOO)/Annual National Transmission Statement (ANTS); and

   (b) Mapping National Metering Identifiers, generator and load connection points to new regions; and

4. Metering. A change in the Snowy region boundary may require the installation of revenue metering on the new boundaries so that the distribution of settlement residues to Auction Participants could be calculated to a very high degree of accuracy. Two types of metering are used in the NEM — operational (or "SCADA") metering and revenue metering.[120] At present, there is both revenue metering and operational metering installed at various points along the existing Snowy region's boundaries, but it is not apparent to NEMMCO whether revenue metering must be used for the purpose of calculating settlement residue distributions. NEMMCO stated that the question of revenue metering was more relevant to the May 2006 Macquarie Generation proposal than the Abolition alternative, with existing metering likely to be adequate for the Abolition alternative. However, in both cases, as a transitional step, lower accuracy SCADA metering could be used prior to the installation of revenue metering at the new regional boundaries.

NEMMCO's implementation timeframe

NEMMCO stated that if a Rule determination recommending a change to the Snowy region boundaries were made by December 2006, it estimated that it could implement the Abolition alternative by November 2007. [121] This implementation timeframe would:

- Align with its procedure and cycle for implementing changes to its MMS; and
- Allow time for market participants to modify and test their Information Technology (IT) systems and inter-faces with the MMS.

NEMMCO highlighted that there were a number of uncertainties relating to its estimated timeframe, in particular the need to install revenue metering and sourcing new data on transmission limits from TNSPs for inclusion in NEMMCO's dispatch constraints. However, NEMMCO noted that there was potential for these risks to be managed through:

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[120] Operational metering requirements, which relate to monitoring power flows between transmission the ends of each transmission line (i.e. between nodes), are set out in clauses 4.11.1 and 4.11.2 of the Rules. Revenue metering requirements, which relate to connection points, are set out in rule 7.9 and Item 1 of Table S7.2.3.2 of Schedule 7.2.

[121] NEMMCO also stated it could implement this discontinued Macquarie Generation proposal, which at that time, the Commission was still considering.

1. Using lower accuracy SCADA data on interconnector flows in place of revenue metering to calculate settlement residue distribution;

2. Permitting NEMMCO to substitute estimated limit equations where it is not practicable for TNSPs to deliver within NEMMCO's timeframes; and

3. Using estimates of reserve margin levels for the new regions prior to the completion of a formal review of these levels, which would take at least nine months to complete.

NEMMCO stated that making these compromises could enable an even shorter implementation timeframe.

NEMMCO also noted that delaying TNSPs' delivery of 10-year regional energy and demand projections beyond the regular time of May might delay the publication of the SOO/ANTS beyond its Rule requirement deadline of 31 October. NEMMCO stated that the Commission's determination on a new region boundary would need to provide further technical detail on the exact placement of the boundary change, so that NEMMCO and TNSPs could initiate detailed technical work on implementation. In particular, NEMMCO needed details of:

- "cutsets that form the interconnectors, including specification of the line end; and

- substations that form the regional reference node."[122]

Without these details, the implementation of the boundary change may be delayed because NEMMCO may need to conduct a consultation "to determine the placement of a regional reference node and the transmission lines and line ends constituting an interconnector".[123]

A number of submissions commented that NEMMCO's proposed start date was conservative, and could be advanced if additional resources were made available.[124]

A.9.1.2 NEMMCO's revised 5 March 2007 advice

On 5 March 2007, the Commission received a letter from NEMMCO advising that the proposed 1 November 2007 implementation date was not feasible. This letter suggested a revised implementation date of 1 July 2008. Reasons for the revised timeframe included NEMMCO's:[125]

- Underestimation of the amount of work involved in converting approximately 2,500 constraint equations. This work is expected to take a total of 8 months;

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[122] NEMMCO, Letter on implementation, p.9.

[123] NEMMCO, Letter on implementation, p.9.

[124] EnergyAustralia, s.99 Abolition submission, p.2.; TransGrid, joint s.99 Abolition, s.95 Southern Generators' Congestion Pricing, and s.95 Split Snowy Region submission, p.3; and Snowy Hydro, Supplementary submission, 26 March 2007, p.5, 42.

[125] NEMMCO, Letter on revised implementation, 5 March 2007, p.1-2.

- Requirement for a new method to test constraint equations in pre-production; and

- Proposed trialling time prior to before introducing the new region structure into a production environment to minimise market risk.

NEMMCO also noted that commencing the region boundary change on 1 July 2008 would smooth the transition in two key ways:[126]

- It would avoid the need for supplementary loss factor equations, making a transition from the current 2007/08 loss factors to the new 2008/09 loss factors smoother; and

- It would align with the start of the Q3 SRA process avoiding the complication of having some SRA units apply for only part of a quarter.

A.9.2 Implementation risks

Region boundary change raises a number of implementation risks for both NEMMCO and market participants. While NEMMCO needs to manage the risks associated with making changes to the market systems, participants have to manage their portfolio risks. These include reassessing their hedging portfolios to determine whether and how a change to the region boundaries is likely to affect any of their spot and contract positions. To the extent it does, a participant may need to renegotiate its position or otherwise alter its wholesale market strategy.

More specifically, shorter implementation timeframes may increase the cost and risks for market participants of unwinding their contractual positions. Shorter timeframes may therefore result in participants bearing a greater loss than would be the case if the transition period were longer. That being said, the current degree of uncertainty in the market is arguably causing its own problems regarding participants' willingness to contract.

Some submissions contended that the proposed start date of 4 November 2007 for the Abolition alternative did not provide participants with adequate time to adjust their positions.[127] Other participants suggested a shorter time frame should be possible, as participants have already commenced transitioning their portfolios.[128]

In either case, a shorter implementation timeframe than three years for the Abolition alternative is less of a problem than it would be for the Split Snowy Region proposal, as there are fewer contracts that would be affected by the removal of the Snowy RRN than the creation of two new regions between Victoria and NSW.

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[126] NEMMCO, Letter on revised implementation, p.3.

[127] Country Energy, s.99 Abolition submission, p.7; Southern Generators, joint s.99 Abolition and s.95 Southern Generators' Congestion Pricing submission, p.19.

[128] EnergyAustralia, s.99 Abolition submission, pp.2-3.

A.9.3 Implementation costs

Several submissions expressed concern at the Commission's failure to quantify the costs of implementing the Abolition alternative in the draft determination.[129] Accordingly, the Commission has attempted a clearer quantification of the implementation costs, which can then be assessed against the estimated benefits identified earlier in this Appendix. However, despite participant comments about the lack of information on implementation costs, very few participants provided information to assist the Commission's analysis.

As noted above, the costs of implementing the Southern Generators' Congestion Pricing proposal are likely to be minimal.

NEMMCO provided the Commission with a very rough estimate of what it would cost to implement the Abolition alternative. This estimate was approximately $160,000. Relevant costs included:

- Market system changes;
- Modification and testing of constraint equations;
- Modification of loss factors;
- Amendments to the SRA auction;
- Updates for the SOO/ANTS;
- Updates for metering and settlement;
- Adjustments to reserve margins;
- Changes to operating procedures;
- Updates to the medium term Projected Assessment of System Adequacy (PASA);
- Updates for the Energy Management System (EMS);
- Setup and running of the pre-production trials; and
- Project management oversight.

Only two submissions provided estimates of participants' implementation costs. EnergyAustralia commented that it would cost them around $5,000 to implement the Abolition alternative and around $15,000 to implement the Split Snowy Region

[129] ESIPC, s.99 Abolition submission, p.3; Hydro Tasmania, s.99 Abolition submission, p.3; Hydro Tasmania, s.95 Split Snowy Region submission, p.3-5; and Southern Generators, joint s.99 Abolition and s.95 Southern Generators' Congestion Pricing submission, p.19.

proposal.[130] Snowy Hydro stated implementation of the Abolition alternative would cost them about $10,000.[131]

As of 17 July 2007, NEMMCO's registration list identified: 31 Scheduled Market Generators; 17 Non-Market Scheduled generators; 44 Market Customers; and 5 Traders. The following tables present a rough estimate for the market as a whole of the implementation costs of these region boundary changes. For these purposes, it is assumed both Scheduled and Non-Market Scheduled Generators have the same implementation costs, as do Market Customers and Traders.

Table A.1: Estimated implementation costs for Abolition proposal

Participant type	Individual cost ($)	No. participants	Total
Generator	$10,000	48	$480,000
Retailer/Market Customer	$5,000	44	$220,000
Trader	$5,000	5	$25,000
TOTAL			**$725,000**

Data source: NEMMCO advice to the Commission; NEMMCO Registration List, 17 July 2007; participant submissions.

For the purposes of costing the implementation of the Split Snowy Region proposal, the number of retailers and market customers was arbitrarily split to reflect the likely range in the costs of implementing this region boundary change. The implementation cost for generators was assumed to be $15,000 consistent with the Abolition alternative, as no generators provided any advice on the likely costs of implementing the Split Snowy Region proposal.

Table A.2: Estimated implementation costs for Split Snowy Region proposal

Participant type	Individual cost ($)	No. participants	Total
Generator	$15,000	48	$720,000
Retailer/Market Customer - Small	$5,000	22	$110,000
Retailer/Market Customer - Large	$15,000	22	$330,000
Trader	$15,000	5	$75,000
Total			**$1,235,000**

Data source: NEMMCO advice to the Commission; NEMMCO Registration List, 17 July 2007; participant submissions.

[130] EnergyAustralia, s.99 Abolition submission, p.2.

[131] Snowy Hydro, joint s.99 Abolition, s.95 Southern Generators' Congestion Pricing, and s.95 Split Snowy Region submission, p.44-45. Note that this cost estimate refers to both Snowy Hydro Generator and Red Energy Retailer, meaning that the Commission's cost estimate is likely to be conservative.

Additional implementation costs under the Split Snowy Region proposal include the provision of adequate revenue metering at Dederang (either new meters or an alternative estimation mechanism). There would also be additional costs if implementation was not aligned with the start of the financial year. For example, this would include the recalculation of loss factors.

A.9.4 Commission's consideration

The implementation issues surrounding each of these Rule change proposals are important considerations for the Commission. In particular, the benefits of making a change to the Rules should exceed the costs of that change. The Commission's analysis indicates that each of the proposals is likely to result in net benefits to the market.

The Commission notes that all three Rule change proposals are capable of being implemented in a reasonable timeframe and at relatively low cost. The Commission also notes the NEMMCO advice that the Abolition alternative could be implemented sooner than the Split Snowy Region proposal.

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B Modelling

This Appendix describes the approach, assumptions, and data sources used in the revised modelling undertaken by the Commission's consultants (Frontier Economics or Frontier) of the various Rule change proposals submitted by participants in relation to the Snowy region of the NEM. The analysis considered several alternative proposals:

- The Abolition of Snowy region proposal (Abolition proposal)[132] submitted by Snowy Hydro, in which Tumut generation is located in the NSW region and Murray and Guthega generation are located in the Victorian region;

- The Snowy Split Region proposal formally put forward by Macquarie Generation, in which the existing Snowy region is split into separate Tumut and Murray regions with the Murray regional reference node (RRN) located at Dederang; and

- The Congestion Pricing and Negative Residue Management Arrangements for the Snowy Region proposal put forward by the "Southern Generators" (Loy Yang Marketing Management Company Pty. Ltd., AGL Hydro Pty. Ltd., International Power (Hazelwood, Synergen, Pelican Point and Loy Yang B), TRUenergy Pty. Ltd., Flinders Power, and Hydro Tasmania) which is based on the existing arrangements of the Tumut CSP/CSC Trial and the Southern Generators Rule. This is referred to as the Southern Generators' Congestion Pricing or "SG" scenario.

Each of the above proposals was compared to a base case similar to that used in the Commission's quantitative modelling for the draft Rule determination on the Abolition proposal, published on 19 January 2007 (Abolition proposal draft Rule determination). The base case included the Abolition proposal draft Rule determination existing Snowy region boundaries with no Tumut CSP/CSC Trial mechanism and no Southern Generators Rule

To the maximum extent possible, Frontier sought to maintain consistency between the modelling approach adopted for this Rule determination and the analysis presented in the Abolition proposal draft Rule determination. However, there have been several changes to the modelling assumptions and the scenarios considered from the Abolition proposal draft Rule determination. These changes are clearly highlighted in this Appendix.

The Appendix begins by discussing the Commission's consultation approach then outlines the modelling framework. It then discusses the methodology, assumptions,

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[132] The Commission made its final Rule determination to accept the Abolition of Snowy Region Rule change proposal on 30 August 2007. For the purposes of this Rule determination, the Abolition proposal is referred to as the "Abolition alternative" to reflect that at the time of the comparison of these alternatives, the Abolition proposal was a proposal, whereas now the Commission has made and commenced the *National Electricity Amendment (Abolition of Snowy Region) Rule 2007 No 7* to implement the abolition of the Snowy region. For more information see "AEMC 2007, Abolition of Snowy Region, Rule Determination, 30 August 2007, Sydney", available on the AEMC website.

results, and conclusions for the forward-looking investment analysis, the dispatch and price modelling, and the risk modelling in turn.

B.1 Modelling framework and approach

The modelling framework is oriented towards the decision-making criteria to be applied by the Commission. These criteria, in turn, are guided by the nature of the issue the proposed Rule change is seeking to address and the NEM Objective. The modelling framework for these three Rule change proposals aims to answer the following key questions:

- How do the proposals affect the **economic efficiency of dispatch**? The economic efficiency of dispatch is concerned with the costs of producing electricity to meet customer demand. The economic efficiency of dispatch will be *maximised* where the generation resource costs of supplying customer load are *minimised* over a given time period. In particular, the Commission is interested in testing whether the avoidable generation costs of meeting load are likely to be reduced by any of the Rule change proposals being considered, and if so, by what degree. As hydro plant have insignificant variable fuel and operating costs, from a dispatch efficiency perspective, they should be run at those times when they can displace the plant with the highest avoidable costs. By considering the pattern of dispatch under each of these Rule change proposals, it is possible to assess changes to the efficiency of dispatch; and

- How do the proposals affect the **risk associated with inter-regional trade**? This is a function of both the price differences between regions and the firmness of IRSR units that can be used to hedge inter-regional price differences. In particular, we are interested in testing whether inter-regional price differences converge and/or IRSR units are "firmed up" by the three Rule change proposals, which will have the implications for inter-regional trade. This is important since the functionality of the hedging market potentially affects both future wholesale and retail prices and participants' future investment decisions. In the medium to longer term, these impacts could affect the achievement of the NEM Objective.

These three Rule change proposals potentially give rise to complex behavioural changes in the market, which means that it is not possible to draw conclusions as to their likely effect purely from analysis of historical data or by reference to a conceptual model. Forward-looking empirical modelling was therefore undertaken to test the effect of each of the proposals on the economic efficiency of dispatch and the firmness of IRSRs. There are three key parts to the forward-looking modelling analysis:

- **Investment modelling** to determine a sensible pattern of new plant entry in the NEM. New investment needs to meet both reliability requirements and the range of greenhouse gas abatement schemes active in the NEM;

- **Dispatch/price modelling** to examine market outcomes in terms of generator output and revenues and spot market prices, which involves participants being allowed to engage in strategic bidding to maximise their operating margins under different market conditions. This modelling aims to test the behavioural

changes to market participants resulting from implementation of each of the proposals and the differences in dispatch, price and revenue outcomes relative to the base case; and

- **Risk modelling** to consider the risk management implications for market participants. In particular, this aims to examine whether any of the proposals are likely to increase or decrease the risk of inter-regional trading, either by making prices more volatile and hence more difficult and costly to hedge, and/or by making inter-regional hedging more or less valuable.

The investment modelling was undertaken to determine an optimal investment profile, and a pattern of dispatch for non-strategic hydro plant (this terminology is discussed in more detail below), which was then used as an input to the dispatch/price modelling.

Both the forward-looking dispatch and the risk modelling analysis were undertaken for four key scenarios:

- **A business-as-usual scenario (Base)**. In this case, it was assumed that NEMMCO managed counter price flows on all interconnectors by clamping, with the exception of southward flows on the Victoria-Snowy interconnector where negative residues were managed by re-orientating relevant Snowy constraints to Dederang. Neither the Tumut CSP/CSC instrument nor Southern Generators Rule arrangements were assumed to be in place. This case is referred to as the "Base" scenario;

- **The Abolition of Snowy Region proposal scenario (Abolition)**. This scenario, referred to as the "Abolition" scenario, reflected the Snowy Hydro Rule change proposal.[133] In this case, Murray was included in the Victorian region while Tumut was included in NSW. The existing Victoria-Snowy and Snowy-NSW interconnectors are replaced with a single Victoria-NSW interconnector. Unlike in the analysis for the Abolition proposal draft Rule determination, in this analysis, bi-directional flows on all interconnectors are restricted (i.e. "clamped") to manage the accumulation of negative settlement residues. Neither the Tumut CSP/CSC Trial nor the Southern Generators Rule arrangements are included;

- **The Split Snowy Region proposal scenario (SSR)**. This scenario reflected the revised proposal put forward by Macquarie Generation.[134] And is referred to as the "SSR" scenario. It involved splitting the Snowy region, with Murray and Tumut becoming standalone NEM regions. The new Murray region included Dederang as the RRN with the RRN for the Tumut region located at Lower Tumut. The existing Victoria-Snowy and Snowy-NSW interconnectors were replaced with three new interconnectors: Victoria-Murray, Murray-Tumut and Tumut-NSW. NEMMCO was assumed to clamp flows on all interconnectors to manage negative settlement residues. Neither the Tumut CSP/CSC Trial or Southern Generators Rule arrangements were assumed to be in place; and

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[133] Available on the AEMC website at: http://www.aemc.gov.au/electricity.php?cat=rc.

[134] Macquarie Generation, Rule Change proposal to establish new Snowy regions, 5 March 2007.

- **The Southern Generators' Congestion Pricing proposal scenario (SG)**. This scenario was based on the Southern Generators' Congestion Pricing proposal.[135] This incorporated the existing Tumut CSP/CSC Trial arrangements for Tumut generation and the Southern Generators Rule, which requires the positive inter-regional settlement residues on the Snowy-NSW interconnector to offset negative inter-regional settlement residues on the Snowy-Victoria interconnector (after adjusting for CSP/CSC allocations). This case is referred to as "SG" scenario.

The first three scenarios are reasonably consistent with those presented in the Abolition proposal draft Rule determination. The SG scenario was considered in light of the Southern Generators' Congestion Pricing proposal to inform this Rule determination.

The approach to each of these types of modelling, including a brief description of the models used, is discussed in Sections B.2 and B.4 below. Those Sections also present the modelling assumptions, results, and conclusions for each of the scenarios.

B.2 Forward-looking investment and dispatch/price modelling

This Section discusses the approach, assumptions, results, and conclusions for the forward-looking investment and dispatch and price modelling analysis.

B.2.1 Approach

The investment modelling was undertaken using Frontier Economics' least cost investment model, *WHIRLYGIG*. Using this pattern of investment, the dispatch/price modelling was undertaken using Frontier Economics' game-theoretic wholesale market model, *SPARK*. It is worth describing some of the key features of these models before discussing the methodology used to calculate the dispatch and pricing implications of the Abolition and SSR proposals.

B.2.1.1 Key features of WHIRLYGIG

WHIRLYGIG incorporates a representation of the physical system and is purpose built to determine optimal, least-cost investment patterns in a wholesale electricity market subject to reliability constraints, greenhouse schemes and so on. The model contains the following features:

- A realistic treatment of plant characteristics, including for example minimum generation levels, variable operation costs, etc;
- A realistic treatment of the network and losses, including inter-regional quadratic loss curves, and constraints within and between regions;
- The ability to model systems from a single region down to full nodal pricing;

[135] Southern Generators, Rule change request: move Snowy CSP/CSC trial into Chapter 3, 15 March 2007.

- The capability to optimise the operation of fuel constrained plant (e.g. hydro plant), and pumped storage plant over some period of time; and

- The ability to include a range of constraints that represent limitations on the market, such as capacity reserve constraints or greenhouse gas emissions schemes.

Given this representation of the market, the current stock of committed plant and a "menu" of new investment options, *WHIRLYGIG* determines the least cost optimal investment and dispatch pattern over the modelling period including the timing, type, location and size of new generating capacity. This capacity reflects the system reliability constraints that the market must meet and other policy factors that influence investment (predominantly greenhouse measures).

B.2.1.2 Key features of SPARK

Much like WHIRLYGIG, SPARK incorporates a representation of the physical system. Furthermore the model is purpose built to examine strategic behaviour in a wholesale electricity market. The model contains the following features:

- A realistic treatment of plant characteristics, including for example minimum generation levels, variable operation costs, etc;

- A realistic treatment of the network and losses, including inter-regional quadratic loss curves, and power system security constraints within and between regions;

- The ability to model systems from a single region down to full nodal pricing, including the incorporation of intra-regional constraints (such as the ANTS constraints); and

- The capability to optimise the operation of fuel constrained plant (e.g. hydro plant), and pumped storage plant over some period of time.

In addition, *SPARK* uses game theory to determine equilibrium generator bidding patterns in an environment of imperfect competition. Game theory provides a systematic tool for determining generator bids in such an environment, obviating the need for subjective judgements on bidding behaviour. This effectively makes generator bids an output of the model rather than an input. This allows an investigation of the changes in pricing and output behaviour resulting from changes in market rules or structure.

These features allow generator bidding strategies to be automatically reformulated in response to them facing different settlement prices when region boundaries are changed.

SPARK applies game-theoretic techniques by allowing selected strategic players to choose from a set of quantity change strategies (Cournot competition) and/or price change strategies (Bertrand competition) for each set of market conditions having regard to the market rules, power system conditions and the extent of intervention. In addition, *SPARK* is capable of modelling portfolios of generators within and

across region boundaries, thereby allowing generators to test, create and exploit transmission constraints to their profit.

Once each participant is provided with a set of bidding choices, *SPARK* tests the potentially millions of bidding combinations for their sustainability. Sustainability in this context refers to the application of the Nash Equilibrium solution concept. A Nash Equilibrium is a set of strategies for all generators in which no individual generator has an incentive to unilaterally deviate from its bidding strategy. *SPARK* finds the Nash Equilibrium by assessing the "payoffs" of each generator in response to the bidding behaviour of every other generator in the NEM. The "payoff" relates to the difference between each generator's $/MWh pool revenue and its assumed $/MWh variable cost as well as any contract difference payments the generator may make or receive. If a generator can increase its payoff by changing its bids, that means that its original bid was not consistent with a Nash Equilibrium.

SPARK uses the Nash Equilibria bidding strategies to produce a range of results. The outputs produced by *SPARK* for each level of demand modelled include:

- Generator bids;
- Generator dispatch/outputs;
- Regional prices; and
- Interconnector directions and MW flows.

B.2.1.3 Methodology

WHIRLYGIG was used to determine an optimal investment pattern in new generating capacity which incorporates system reliability limits, greenhouse schemes and other factors that effect investment in the NEM. This pattern of investment is then used as an input to the dispatch/price modelling.

As noted above, *SPARK* can be used to determine optimal bids, market prices, and generator outputs under a given set of market assumptions. As these assumptions change, so too does the model-determined optimal set of bids and, hence, market prices and generator outputs. This enables *SPARK* to be used to calculate the dispatch and pricing impacts of changes to the market design such as an alteration to the region boundary structure of the NEM.

The first step in the dispatch/price modelling is to describe the base case scenario against which market design changes can be compared. This allows comparison of the Base scenario to the Abolition, SSR and SG proposals. Each of these scenarios is briefly outlined below. Detailed modelling assumptions are discussed in the following Section.

Base scenario:

Features of the Base scenario

- **Existing region boundary structure** – the structure of the NEM regions represented the current configuration;

- **Tumut CSP/CSC Trial excluded** – the derogation in Part 8 of Chapter 8A of the National Electricity Rules (Rules) states that the Tumut CSP/CSC Trial is due to expire on: 31 October 2008 or as otherwise determined by the AEMC.. While the modelling focused on three financial years – 2007/08 to 2009/10 inclusive, which overlap with the expiry of that derogation, the Tumut CSP/CSC Trial was excluded from the Base, Abolition and Split Snowy Region scenarios in the analysis because a region boundary change (or a decision not to change) would supersede the Tumut CSP/CSC Trial;;

- **Southern Generators Rule excluded** – the Southern Generators Rule is included in the Part 8 of Chapter 8A derogation. It was excluded therefore from all scenarios except the SG scenario for the same reasons as the Tumut CSP/CSC Trial; and

- **NEMMCO clamping** – the effect of the introduction of a region boundary change in the presence of clamping was the focus of the modelling analysis. As such, clamping to manage negative settlement residues was assumed to occur bi-directionally on all interconnectors. The only exception was in the base case for southward flows on the Victoria-Snowy interconnector, where the re-orientation of the constraints to Dederang ensured that no negative residues arose. Unlike the case in the Abolition proposal draft Rule determination modelling, clamping was modelled assuming a $6,000 per hour threshold for negative settlement residues and perfect foresight - That is, if a given combination of market participant bids and offers resulted in negative settlement residues in excess of the threshold arising on a particular interconnector then the set of bids was re-dispatched with flow on the interconnector constrained to zero. As noted above, the Abolition proposal draft Rule determination utilised a zero threshold for clamping on the basis that this was consistent with the wording of the Rules, although not with NEMMCO's actual practice. The use of a $6,000 per hour threshold was intended to better reflect NEMMCO's actual practice, even though NEMMCO applies a $6,000 threshold over the duration of a negative settlement residue event as determined by pre-dispatch modelling rather than on a "per hour" basis. As Frontiers modelling approach does not involve model outcomes across consecutive trading intervals, it was necessary to settle on a threshold that could be applied on an hourly basis. Another change in the modelling assumptions for this Rule determination applied where two parallel regulated interconnectors exist (i.e., NSW-Queensland (QNI and DirectLink) and Victoria-South Australia (Heywood and MurrayLink)). In these cases clamping was only implemented in the case that the *net* negative residues across *both* interconnectors was greater than the threshold.[136]

[136] For example, if negative settlement residues of $X arose on DirectLink and positive residues of $Y arose on QNI then DirectLink would not be clamped if X<Y and would be clamped if X > Y + threshold.

Abolition of Snowy region proposal scenario

Features of the Abolition scenario:

- **Alternate region boundary structure –** Murray and Guthega were included in the Victorian region while Tumut was included in NSW. The existing Victoria-Snowy and Snowy-NSW interconnectors were replaced with a single Victoria-NSW interconnector;

- **Tumut CSP/CSC Trial excluded –** as for the Base scenario;

- **Southern Generators Rule excluded –** as for the Base scenario; and

- **NEMMCO clamping –** clamping was effected on all interconnectors.

Split Snowy Region proposal scenario:

Features of the SSR scenario

- **Alternate region boundary structure –** the Snowy region was split with Murray and Tumut becoming standalone NEM regions. The new Murray region has Dederang as its RRN and Lower Tumut as the RRN for the Tumut region. The existing Victoria-Snowy and Snowy-NSW interconnectors were replaced with three new interconnectors: Victoria-Murray, Murray-Tumut and Tumut-NSW;

- **Tumut CSP/CSC Trial excluded –** as for the Base scenario;

- **Southern Generators Rule excluded –** as for the Base scenario; and

- **NEMMCO clamping –** clamping was effected on all interconnectors.

Southern Generators' Congestion Pricing proposal scenario

Features of the SG scenario:

- **Existing region boundary structure –** the structure of the NEM regions represented the current configuration;

- **Tumut CSP/CSC Trial included –** as this was part of the Southern Generators' Congestion Pricing proposal;

- **Southern Generators Rule included –** as this was part of the Southern Generators' Congestion Pricing proposal; and

- **NEMMCO clamping –** clamping was effected on all interconnectors except bi-directional flows on the Victoria-Snowy interconnector (as in the Base scenario). Negative residues on this interconnector would not accrue due to the implementation of the Southern Generators Rule. The SG scenario removes the requirement for clamping or re-orientation of constraints on the Victoria-Snowy interconnector. Clamping of bi-directional flows on the Snowy-NSW interconnector only occurs in the event that they are not triggered by a binding

constraint that is included in the nominated set of constraints for the Tumut CSP/CSC Trial. If the negative residues on the Snowy-NSW interconnector relate to a constraint in the Tumut CSP/CSC trial there is no clamping and the negative residues are funded as part of the CSP/CSC arrangements.

Required steps

After establishing each of the scenarios for examination (Base, Abolition, SSR and SG scenarios), the dispatch modelling analysis was progressed in three main steps:

- First, *WHIRLYGIG* was used to model a short run marginal cost (SRMC) bidding scenario to determine the optimal pattern of dispatch for all *non-strategic hydro plant* (see the discussion of modelling assumptions below for a discussion of this terminology). In the SRMC scenario, all (non-run-of-river) hydro plant (e.g. McKay Creek) were dispatched at those times and in those quantities that minimised the variable dispatch cost of all thermal plant in the system. However, while strategic hydro plant (such as Snowy Hydro) were not restricted to this pattern of dispatch in future scenarios, the pattern of dispatch for all non-strategic hydro plant were not altered for the remainder of the analysis;

- Second, *SPARK* was used to model the dispatch and pricing outcomes of a strategic bidding scenario. Snowy Hydro and key thermal generators in other regions were allowed to bid strategically. The modelling focused on a number of key demand levels when significantly different market outcomes as a results of boundary change were most likely to occur – i.e. extreme peak demand times in summer and winter; and

- Finally, a number of demand levels representing the remainder of the year were modelled under the assumption of competitive dispatch, where the output of the strategic hydro generators was energy-constrained to ensure that their output over the year reflected assumed energy limitations.

The detailed assumptions and sensitivities used for the dispatch/pricing modelling are discussed in more detail below.

B.2.2 Modelling assumptions

As previously discussed, to the maximum extent possible, Frontier sought to maintain consistency between the assumptions adopted in the modelling for this Rule determination and the analysis presented in the Abolition proposal draft Rule determination. Accordingly, the assumptions are the same as those presented in the Abolition proposal draft Rule determination with the exception of the change in clamping assumptions, as outlined above, changes to the static loss factors and dynamic loss equations for the Abolition and SSR scenarios and the addition of the SG scenario. (See Section B.3 for explanation of key differences). The specific modelling assumptions used for the analysis of the Abolition, SSR and SG proposals in comparison to the base case are set out below. We then discuss the differences from the assumptions used in the Abolition proposal draft Rule determination in more detail.

B.2.2.1 Generation capacity

Existing and committed[137] generation capacities for scheduled generators were taken from *NEMMCO, Statement of Opportunities for the National Electricity Market, October 2006* (the SOO). The portfolio structure of existing generation was based on *NEMMCO, List of Scheduled Generators and Loads, 21 February 2006* adjusted for those portfolios where dispatch rights have recently been transferred under contract or via sale.

B.2.2.2 Generator bids

Abolition proposal draft Rule determination

Game theory analysis in a market such as the NEM with multiple pricing zones, transmission constraints and a significant number of players is computationally demanding. The number of combinations of bids to be evaluated increases exponentially with the number of strategic players, as well as the number of available bidding strategies available to each strategic player. There are an infinite number of bidding strategies and it is obviously not possible to model all of these.

Therefore, a number of methods can be adopted to ensure the modelling problem is manageable, including:

- The types and ranges of bidding strategies can be limited. In *SPARK*, bidding strategies can involve bidding the available capacity at different prices, or making more or less capacity available to the market, or a combination of both. Within these choices, the price range over which generators are allowed to bid, and the increments within this range, can be limited. Similarly, the extent of capacity withdrawal choices can be contained to a level that is plausible, and again the number of discrete choices within this range can be restricted to make the computational problem more tractable;

- The number of strategic players can be limited. Players can be categorised as either "strategic" or "non-strategic":

  – *Non-strategic* players are given fixed bids (i.e. their bids remain constant no matter how other players bid – fixed bids can be in any form or level, just as so long as they are fixed); and

  – *Strategic* players are given a set of potential bids to choose from and will respond to changes in other players' bids in order to maximise their payoff by choosing the most profitable bid from those available; and

- The set of potential bids available to strategic players can be limited to decrease the number of bidding combinations to be evaluated.

[137] For example, Kogan Creek in Queensland from 2007/08.

The strategic participants and their strategic power stations used in this analysis are shown in Table B.1. To limit the number of strategic participants, only the largest generation portfolios in each region of the NEM were assumed to behave strategically. They were given options to alter the *quantities* they offered into the market using a number of strategies (i.e. Cournot competition). For instance a strategy of 75% shown in the table corresponds to a participant bidding 75% of the combined capacity of its strategic power stations at or near SRMC and the remainder at VoLL.

Given the importance of understanding the effect of the proposals on the incentives for Snowy Hydro, Snowy Hydro was allowed a relatively large number of bidding strategies. Snowy Hydro was given options to offer from 0% to 100% of its capacity in 12.5% increments. Murray and Tumut Power Stations were assumed to be able to separately engage in these bidding strategies. This allowed for nine strategies for each of Murray and Tumut Power Stations, or a total of 81 combinations for Snowy Hydro. Snowy Hydro capacity that was offered into the market was bid at $1/MWh. This allowed Snowy Hydro to engage in behaviour that has been anecdotally observed, such as bidding Murray at close to $0/MWh. Note that Snowy Hydro *was not* energy constrained at times when it, and other participants, were allowed to bid strategically. The modelling was set up such that if Snowy Hydro generated at full capacity at these strategic times it would not exhaust its annual energy budget.[138]

Major generators in other regions of the NEM were assumed to be able to offer 80% or 90% of capacity at or close to SRMC (with the remainder at VoLL). The largest players in NSW and Victoria – Macquarie Generation and International Power, respectively – were also given the option to offer only 70% of capacity at or close to SRMC.

[138] An annual energy budget is the volume of electricity, in MWh, that a generation plant can produce in a year if it utilised all of its available fuel. In the case of a hydro-storage plant, the annual available "fuel" (ie stored water) has been based on typical annual hydrological conditions rather than the recent drought conditions that have prevailed. See Section B.2.2.12.

Table B.1: Strategic Participants

Strategic participant	Strategic stations	Bidding strategies (proportion of capacity offered at or close to SRMC)
Snowy Hydro	Tumut (i.e. Lower Tumut, Upper Tumut), Murray (i.e. Murray 1 & 2 stations, plus Guthega)	0%, 12.5%, 25%, 37.5%, 50%, 62.5%, 75%, 87.5%, 100% (Murray and Tumut given flexibility to bid separately)
Delta	Mt. Piper, Munmorah, Vales Pt, Wallerawang C	90%, 80%
International Power	Hazelwood, Loy Yang B	90%, 80%, 70%
LYMMCO	Loy Yang A	90%, 80%
Macquarie Generation	Liddell, Bayswater, Hunter Valley GT	90%, 80%, 70%
QPTC (Enertrade)	Gladstone, Collinsville, Mt Stuart GT	90%, 70%
TRU Energy	Yallourn	90%, 80%

Hydro Tasmania was not modelled as a strategic player due to its present high level of vesting and other contract cover. This level of contract cover is expected to remain relatively high throughout the modelling period. All of Hydro Tasmania's discretionary capacity was bid into the market during high demand times (the summer and winter peak times when other players were allowed to bid strategically) at an SRMC of $1/MWh to reflect this high contract level and the fact that the plant would not be energy constrained at such times. For the remainder of the year, Hydro Tasmania was energy constrained such that its assumed annual energy budget was met. This ensured that Tasmanian spot prices reflected the opportunity cost of Hydro Tasmania's water across the year correctly.

All non-strategic thermal generators were assumed to bid into the market at SRMC. For the demand levels where generators were allowed to behave strategically, non-strategic thermal baseload units were bid in at SRMC for 100% of capacity and peaking units were bid in at five times marginal cost, resulting in bids of $100-1,500/MWh. The demand levels comprising the rest of the year were dispatched with all plant (strategic and non-strategic) bid in at SRMC. For strategic and peaking plant, only 90% of capacity was bid at SRMC, with the remainder at VoLL.

Given these bidding choices, over all demand points modelled, SPARK computed regional reference prices, generator outputs, interconnector flows, and so on for nearly 500,000 bidding combinations for each year modelled. The Nash Equilibria were found from the results of these model runs.

Thermal generation SRMC and new entrant plant SRMC and fixed costs were drawn from the ACIL document: *SRMC and LRMC of Generators in the NEM, February 2005*. As noted above, non-strategic hydro plant were assumed to generate in the same manner as in the SRMC scenario.

B.2.2.3 Game theory and multiple equilibria

Using the Nash Equilibrium solution concept of game theory, it is possible for more than one equilibrium set of bids to be found for a representative demand point. In theory, each equilibrium is just as likely as another. Given that an equilibrium outcome is more likely than an outcome that is not an equilibrium, it is possible to think of the collection of multiple equilibria as a collection of "likely" outcomes. By assuming a weighting for each equilibrium, we allow for distributions of these equilibrium outcomes to be generated. Frontier explicitly assumed that a given Nash Equilibrium was as likely as any other – that is, all equilibria were assumed to be equally likely.

Presentation of modelling outcomes in the presence of multiple equilibria is challenging and a number of approaches are possible:

- Present the full distributions of results for all key variables;
- Present a simple summary statistic that embodies the distribution of underlying results (i.e. distribution means); and
- Select a specific equilibrium using some kind of heuristic selection process.

Ideally, the full distributions would be presented for the key variables of interest in the analysis. However, due to the sheer volume of information involved, this was not practical. In practice, given the number of different scenarios and cases that needed to be compared against each other, presentation of the full distributions would actually hinder interpretation of the results.

Using a heuristic selection criterion, for example selecting the equilibrium with the lowest production cost for each demand point and ignoring all other sustainable outcomes, was also deemed an unsuitable approach to the analysis. The major benefit of using a framework like game theory to analyse incentives is that it is systematic and objective. Selecting one outcome in preference to all others would weaken the analysis and ignore the remainder of the distribution of likely outcomes.

As a compromise, Frontier presented the results using the average values of the distributions for all key variables assuming that all equilibria are equally likely. Additional analysis was undertaken by Frontier to ensure that these average values did not misrepresent the outcomes of the modelling.[139]

B.2.2.4 Contract levels and sensitivities

The level of contract cover can be an important determinant of bidding behaviour because some generators manage the risks of unfunded difference payments by bidding their contracted capacity at their SRMC. This approach to risk management can dampen spot prices in the short term.

[139] The additional analysis found that the relativities between the averaged outcomes of the modelling were consistent with the relativities at other points on the distributions. That is, the distributions were generally smooth.

Therefore, a number of different assumptions on contracting levels were modelled for each of the scenarios. In constructing the various contracting cases, four key aspects of contracting in the NEM were considered:

1. **Overall levels of contracts in the market –** strategic players were assumed to sell contracts equal to "high" and "low" percentages of their installed capacity (see Table B.2 below). These were similar to the levels used in assessing the Southern Generators Rule change;[140]

2. **Volume of IRSR units Snowy Hydro holds with respect to the contracts it has struck in Victoria and NSW –** Snowy Hydro was assumed to hold IRSRs *equal* to its inter-regional contracting volume;

3. **Split of Snowy Hydro's aggregate contract volume between the Victorian and NSW nodes –** Snowy Hydro was assumed to split the total volume of inter-regional contracts it sold between the Victorian and NSW nodes. Only the case where contracts were split equally between the Victorian and NSW nodes is presented. This 50/50 split was the base case used in the modelling for the Southern Generators Rule change.[141] The increased complexity and size of the modelling problem in this analysis meant that some limit on the number of scenarios and sensitivities had to be observed. As such, only this 50/50 split was considered; and

4. **Type of contracts held by Snowy Hydro –** Snowy Hydro was assumed to hold all cap contracts with $300/MWh strike prices. This reflects the fact Snowy Hydro essentially offers insurance products into the market.

Table B.2 summarises the combinations arising from the first two contracting cases considered. NSW strategic generators were assumed to contract to a lower level than players in other regions initially to account for the effect of the Electricity Tariff Equalisation Fund (ETEF) arrangement. These levels increased through the modelling period to reflect the ETEF roll-off. The percentage of NSW regulated retail load supported by ETEF is planned to reduce as follows:

- From September 2008 (100% to 80%);
- From March 2009 (80% to 60%);
- From September 2009 (60% to 40%);
- From March 2010 (40% to 20%); and
- From June 2010 (20% to 0%).[142]

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140 AEMC, Final Rule Determination, National Electricity Amendment (Management of Negative Settlement Residues in the Snowy Region) Rule 2006, Appendix C, pp.C20-C21.

141 AEMC, Final Rule Determination, National Electricity Amendment (Management of Negative Settlement Residues in the Snowy Region) Rule 2006, Appendix C, pp.C20-C21.

142 See Office of Financial Management, Payment rules for the Electricity Tariff Equalisation Fund, April 2006, p.3.

Table B.2: Contracting cases

Contracting case	Snowy Hydro contract level	Snowy Hydro IRSR units	NSW players	Other players
High	60% of capacity	Equal to contract level	Initially 65% of capacity, rising to 75% by 2009/10 to account for ETEF roll-off	75% of capacity
Low	50% of capacity	Equal to contract level	Initially 55% of capacity, rising to 65% by 2009/10 to account for ETEF roll-off	65% of capacity

B.2.2.5 Modelling period

The modelling was conducted for the three financial years 2007/08 to 2009/10 inclusive.

B.2.2.6 Greenhouse schemes

Multiple greenhouse gas abatement schemes are active during the modelling period. The *WHIRLYGIG* modelling included the following schemes:

- NSW GGAS; [143]
- Queensland 13% gas; [144]
- Mandatory Renewable Energy Target (MRET); [145]
- Victorian Renewable Energy Target (VRET); [146] and
- The NSW Renewable Energy Target (NRET). [147]

These schemes ultimately affect the mix of plant present in the system and the way it is dispatched. The dispatch/price modelling incorporated these effects by assuming the determined investment pattern and the dispatch of "green" generators.

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[143] Greenhouse Gas Reduction Scheme Administrator, Introduction To The Greenhouse Gas Reduction Scheme (GGAS), June 2006.

[144] See http://www.energy.qld.gov.au/13percentgas.cfm for details regarding the scheme.

[145] Office of the Renewable Energy Regulator, Mandatory Renewable Energy Target Overview, March 2006.

[146] See http://www.esc.vic.gov.au/public/VRET/Overview.htm for details regarding the scheme.

[147] NSW Government, NSW Renewable Energy Target Explanatory Paper, November 2006.

NEMMCO nets out the demand met by embedded generation from its demand forecasts. As a large component of these schemes is met by embedded generation, this demand was added back into the models and explicitly modelled. It should be noted that intermittent generation technologies, such as wind, only contribute a percentage of their capacity towards meeting the reliability constraints in the model (in the case of wind, this amounts to 8% of installed capacity being assumed operational at times of peak demand in line with NEMMCO's assumptions).[148]

B.2.2.7 Demand

To streamline the modelling, the analysis focused on 62 representative demand points per year rather than a chronological modelling of each half hour, or hour, in each year. The time saved by modelling fewer demand points allowed a larger number of strategic players and strategies to be modelled. Each demand point was weighted by its expected frequency of occurrence during the year (in hours) so that yearly average results could be determined by adding up the frequency-weighted outcomes for each demand point. This meant that points of low and average demand, which occur frequently throughout the year, received a higher weighting than the peak demand points, which occur infrequently.

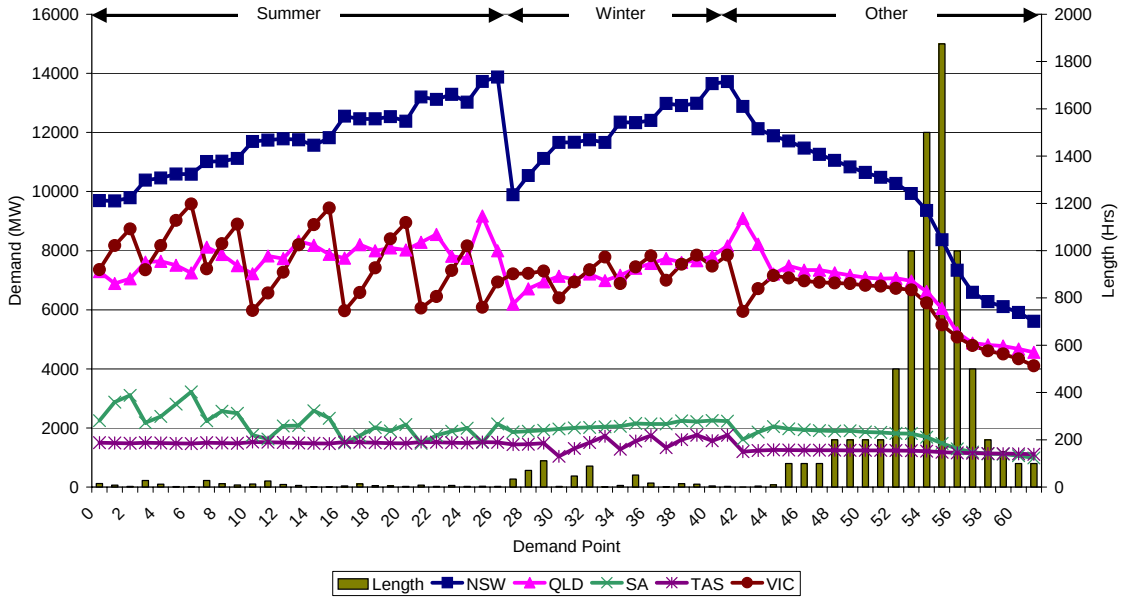
The electricity demand in each year was based on the medium growth, 50% probability of exceedance (POE) forecasts from NEMMCO's 2006 Statement of Opportunities (SOO) and was characterised using the 62 representative demand points. The demand profile was based on the 2004/05 actual load profile.

The first 27 points focused on levels of NSW and Victorian demand that led to clamping (as informed by the previous Southern Generators Rule analysis) during *extreme* summer peak hours. These points accounted for 250 hours of the year. Another 15 points were allocated to *extreme* winter peak hours in a similar manner, corresponding to a further 470 hours. The remainder of the year, 8040 hours, was represented by a final 20 demand points. This is shown for 2007/08 in Figure B.1 below where the level of demand is shown on the left vertical axis and the length of each point is shown on the right vertical axis. It is important to note that the definition used here does not correspond to the summer and winter peak periods normally used in the NEM (e.g. AFMA summer and winter peaks).

Demand side bids were included, with the volume taken from the SOO at an assumed bid price of $500/MWh. No additional demand elasticity was assumed at any given demand point.

[148] NEMMCO, 2005 Energy and Demand Projections, July 2005, p.17.

Figure B.1 Level and duration of demand points (2007/08)



B.2.2.8 Loss factors and equations

The modelling was conducted on a zonal pricing and settlements basis. Six regions (i.e. zones) were modelled: NSW, Queensland, Victoria, South Australia, Tasmania and Snowy (regions changed in the Abolition and SSR scenarios). Within each region static losses where accounted for by incorporating each generating unit's Static Loss Factor (SLF) as published by NEMMCO. Inter-regional losses where incorporated dynamically in the modelling using loss factor equations provided by NEMMCO. Static marginal loss factors and dynamic marginal loss factor equations were taken from a pre-release draft version of NEMMCO's document, List of Regional Boundaries and Marginal Loss Factors for the 2006/07 Financial Year, March 2006.

The revised region boundary structures under the Abolition and SSR scenarios meant that new static loss factors were required for the new regions and new dynamic marginal loss factor equations were required for the new interconnectors. NEMMCO provided the specific static loss factors and dynamic marginal loss factor equations for each of these scenarios. For example, for the Abolition scenario a new Upper Tumut static loss factor relative to the NSW RRN and a dynamic loss equation for the new Victoria to NSW interconnector were provided.

B.2.2.9 Constraint equations

The constraints that are included in the Tumut CSP/CSC Trial for the Snowy region were taken from NEMMCO's document, *Constraint List for the Tumut CSP/CSC trial, March 2006*. This document lists the constraints for which Snowy Hydro receives CSP payments, including re-oriented formulations if applicable.

In the Base and SG scenarios, the constraint equations for all other constraints were taken from the Constraint Spreadsheet provided with the *Annual Transmission Statement (ANTS)* data attached to the NEMMCO 2005 SOO. The full list of system normal, national transmission flow path (NTFP) constraints was included in the modelling. These ANTS-zone constraints incorporate the principal transmission limits on the underlying physical network that affect power flows across the major transmission flow paths in the NEM. These flow limits incorporate:

1. Pure intra-regional limits;

2. Limits that impact on a combination of generators within a region and one or more interconnectors; and

3. Constraints that involve the interaction of flows on two (or more) interconnectors (e.g. QNI and DirectLink).

For the Abolition and SSR scenarios, NEMMCO provided altered versions of the 2005 ANTS constraint set which reflected the relevant change to region boundaries in each scenario. These constraints were implemented dynamically in the modelling for all scenarios in fully co-optimised form.

These constraint equations incorporated the effect of likely transmission network upgrades via changes in line ratings over time. The constraints also incorporate the impact of committed/likely new generation capacity by assigning each new generator a co-efficient in the constraint equations.

B.2.2.10 Interconnectors

For the Base and SG scenarios, the analysis used a six region representation of the NEM: Queensland, NSW, Snowy, Victoria, South Australia and Tasmania. As discussed earlier, boundaries between the Victorian, Snowy and NSW regions were altered under the Abolition and SSR scenarios and new interconnectors replaced the existing ones. The interconnector transfer capabilities were limited by the network constraints represented in the ANTS and the Snowy constraint list under system normal conditions. Basslink was assumed to be fully commissioned from the commencement of the modelling period, with limits of 590MW north or 300MW south, consistent with the detailed information provided with the 2006 SOO. MurrayLink, DirectLink and Basslink were dispatched as regulated interconnectors. For Basslink, this was justified on the basis that Hydro Tasmania was not nominated as a strategic generator for the reasons given above.

B.2.2.11 Outages

The modelling was conducted on a system normal basis, meaning it did not include any transmission outages (scheduled or random). This was done to increase flexibility for the gaming analysis and is consistent with the assumption that significant generator outages are unlikely to be scheduled during the peak summer and winter months, which were the focus of the modelling analysis. Random or forced generator outages were excluded from the analysis for simplicity. While this would tend to understate dispatch costs, the comparison between the Base scenario

and the other scenarios should not have been significantly influenced by this simplification, as the pattern of outages should not be any different between the three scenarios.

B.2.2.12 Energy constrained plant

Hydro plant were modelled to reflect long-term average energy limitations, rather than the recent drought conditions that have become more apparent over the last 12-18 months. Run-of-river plants were assumed to operate at the same level across all demand periods and other hydro plant were assumed to run to meet annual energy budgets, based on the assumption that water would be used at times it was most valuable. The modelling also incorporated pumping units (Wivenhoe, Shoalhaven and Tumut), which were assumed to have a 70% pumping efficiency and be dispatched when optimal (i.e. most valuable).

Snowy Hydro had previously indicated that it had the ability to manage its water reserves between years.[149] To the extent that any of the proposals increased Snowy Hydro's output over the entire year relative to the Base scenario, we would observe higher production cost savings due to increased hydro output displacing thermal plant. However, for the purposes of this modelling exercise, Snowy Hydro was assumed to have an energy budget of 4.9 TWh p.a. as reported in NEMMCO's 2005 ANTS report. As discussed, Snowy Hydro was not assumed to be energy constrained during the "super-peak" times of the year when generators are assumed to bid strategically. The length of time represented by these strategic demand points meant that Snowy Hydro could not exhaust its energy budget even if it was fully dispatched at these super-peak times.

B.2.2.13 Treatment of VoLL prices

Under some market conditions, *SPARK* finds it profitable for generators to set the spot price at the Value of Lost Load (VoLL = $10,000/MWh). In practice, the spot price occasionally rises to VoLL, but generally not as often as *SPARK* finds it is profitable to do so.

The key difference between the modelling results and actual behaviour is the observed tendency towards "self regulation" by generators. Typically, generators do not necessarily exploit every opportunity to set the market price at VoLL when they can. This self regulation could be due to generator concerns about the risk of not being able to meet contract payments triggered by high spot prices (the costs of which are taken into account in the *SPARK* modelling) or concerns that high spot prices will attract unwanted regulatory attention. Instead of setting VoLL prices under these circumstances, generators often set spot prices substantially less than the VoLL – but nevertheless at high levels compared to average prices.

It is difficult to conceive of a systematic approach for incorporating this self regulation into market modelling. There are two key choices for managing this issue:

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[149] See Snowy Hydro Limited, first round submission, Management of Negative Settlement Residues by re-orientation Rule change proposal, 7 July 2006, p.19.

explain that this behaviour exists and take no account of its effects, or accept its reality and adjust for its effects. In the present modelling exercise, it was agreed to reflect the reality of self regulation through a systematic and consistent adjustment of VoLL pricing events across all scenarios. More specifically, prices were effectively capped by a notional generator with a bid equal to the recent historical average of high price events ($2,500/MWh), which were classified as any price over $300/MWh (the marginal costs of the most expensive generator).[150] The same adjustment approach was used for all modelling scenarios and therefore ought not significantly distort the comparison of the results.

B.3 Key assumption changes since Abolition proposal draft Rule determination in January 2007

Since the Abolition proposal draft Rule determination, several key assumption changes have been made with regards to how negative settlement residues on interconnectors are managed via clamping. These changes are summarised in Table B.3. Note that the Abolition proposal draft Rule determination work did not include a scenario analogous to the SG scenario.

Table B.3: Key assumption changes since Abolition proposal draft Rule determination modelling

Assumption	Abolition proposal Draft Rule Determination	August Determination
Which interconnectors are subject to clamping	Snowy region interconnectors only except where V_SN is reoriented to Dederang for southward flows in the Base scenario.	All interconnectors except where V_SN is reoriented for southward flows or for the V_SN interconnector in either direction in the SG scenario.
Clamping threshold	$0	$6,000/hour
Net clamping	N/A	Net clamping implemented for QNI/DirectLink and Heywood/MurrayLink ie flows only clamped if *net* residues across both interconnectors are negative in excess of the threshold.

As clamping can effectively segment the market, its effect on market outcomes is relatively large. The adoption of these assumptions brings the modelling of clamping closer to how it is implemented in practice. However, some differences still remain:

[150] This average price was derived from the Southern Generators Rule determination: AEMC, Final Rule Determination, National Electricity Amendment (Management of Negative Settlement Residues in the Snowy Region) Rule 2006, Appendix C, p.C24-C25.

- NEMMCO's threshold applies for the duration of the negative residue event as determined via pre-dispatch modelling; and

- NEMMCO implements clamping in a staged manner. That is, flows on the affected interconnector are stepped down over a number of dispatch periods eventually being constrained to zero flow if the negative residues persist.

Due to the demand point representation used in SPARK (rather than time sequential modelling of each half hour) and the partly discretionary nature of clamping implementation it is not possible to precisely capture these two features. Frontier believes that the current set of assumptions represent the closest practicable approximation to NEMMCO's actual implementation of clamping.

Static loss factors and interconnector dynamic loss factor equations for Abolition and SSR scenarios

In the modelling undertaken for the Abolition proposal draft Rule determination, revised static marginal loss factors for the Abolition scenario were derived by NEMMCO using the revised 2005 ANTS constraints for that scenario and made available for the analysis. For the (then) Split Region Option scenario, which is comparable to the current Split Snowy Region option, NEMMCO provided estimates of static loss factors that reflected the region boundary change and an approximate model of dynamic losses on the new interconnectors was assumed.

For the modelling undertaken for this Rule determination, NEMMCO provided fully derived static loss factors and dynamic loss factor equations for the SSR scenario, which could be expected to improve the accuracy of the results. NEMMCO used the 2007 ANTS constraints to perform this derivation. The same data for the Abolition scenario has been used as was used in the Abolition draft Rule determination.

SG Scenario

The SG scenario is an additional scenario not previously considered in the Abolition proposal draft Rule determination.

B.3.1 Investment pattern results

As discussed above, the investment pattern results are derived under the assumption of competitive bidding, and are then applied to each of the scenarios considered in the dispatch/price modelling (Base, Abolition, SSR and SG).

Figure B.2 to B.5 show the new investment pattern for the NSW, Victoria, Queensland and SA regions respectively. In all regions, we observe a significant amount of "green" generating capacity being built, including technologies such as hydro, biomass and wind. This capacity was predicted to be built to meet the growing demand for low emissions generation brought about by the greenhouse gas abatement schemes active in the NEM as well as to ensure system reliability.

Beyond green investment, some additional peaking and mid-merit generation capacity was needed in each region for reliability purposes over the modelling

period. The Tallawarra power station fulfilled this role in NSW, while generic new capacity was required in the other regions.

In NSW and Victoria, peaking capacity was the only additional capacity that was required. In South Australia, mid-merit capacity was the most cost effective way to meet load growth and reliability constraints. In Queensland, new mid-merit capacity was needed, predominantly to meet the Queensland 13% gas target. Note that the capacity shown in Figure B.4 for Queensland is in addition to the commissioning of projects listed as "committed" in the SOO, such as Kogan Creek from financial year 2007/08.

Figure B.2 NSW new investment

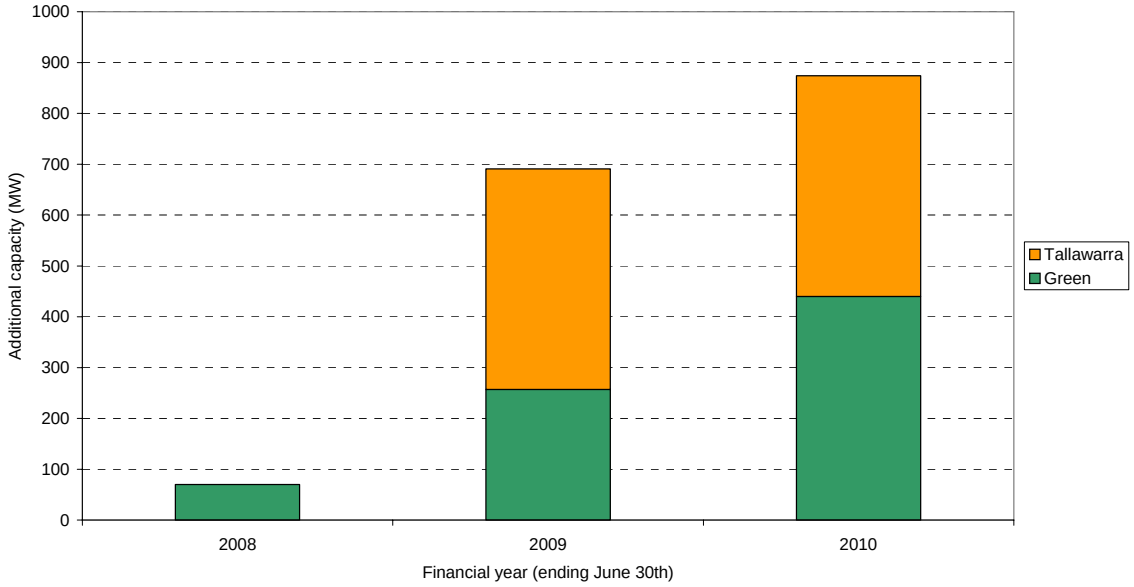


Figure B.3 Victoria new investment

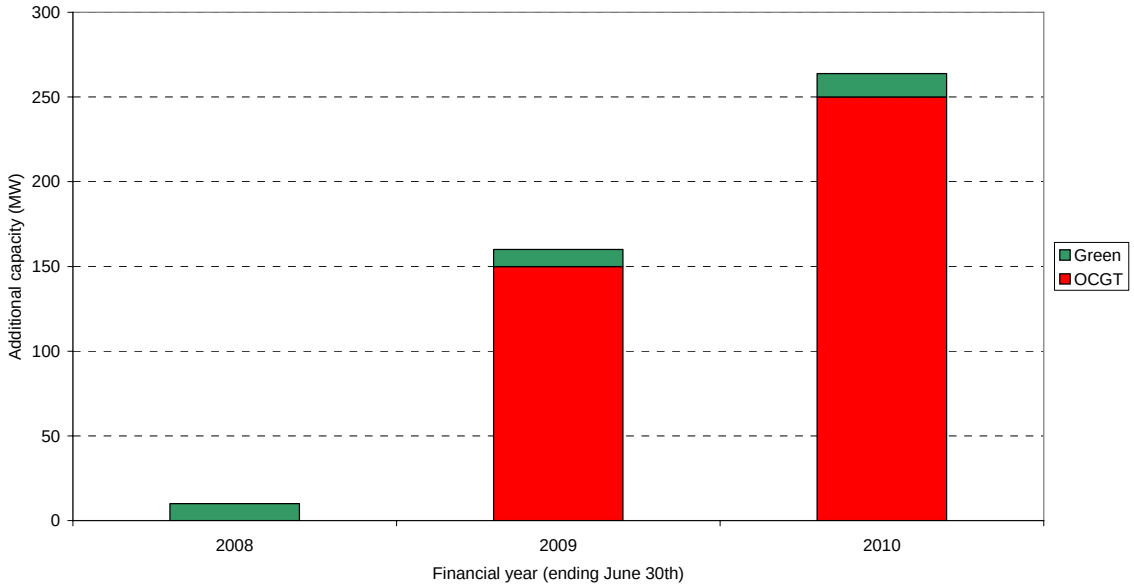


Figure B.4 Queensland new investment

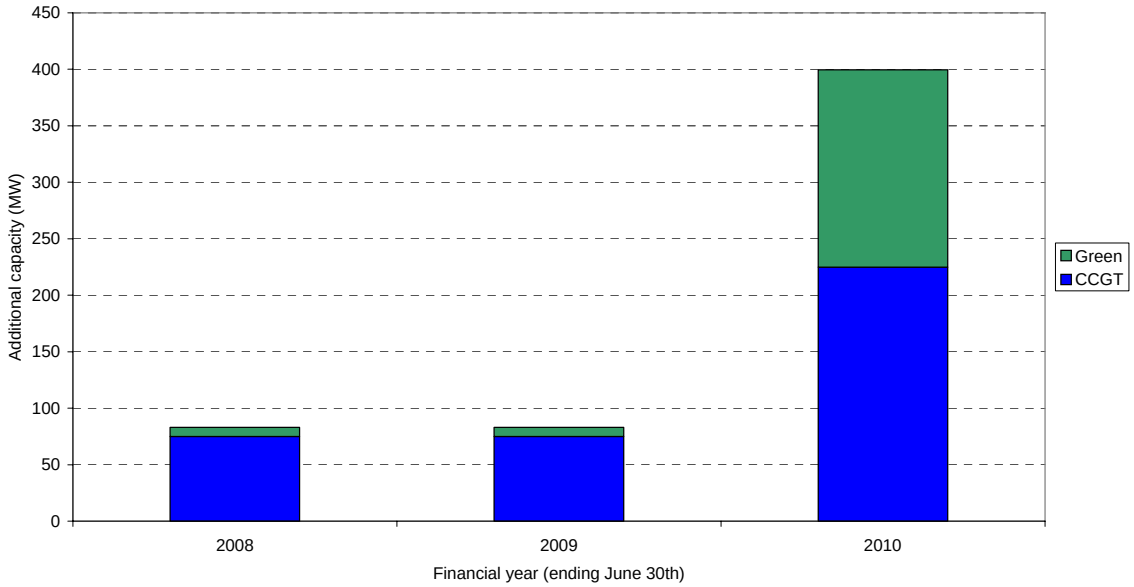
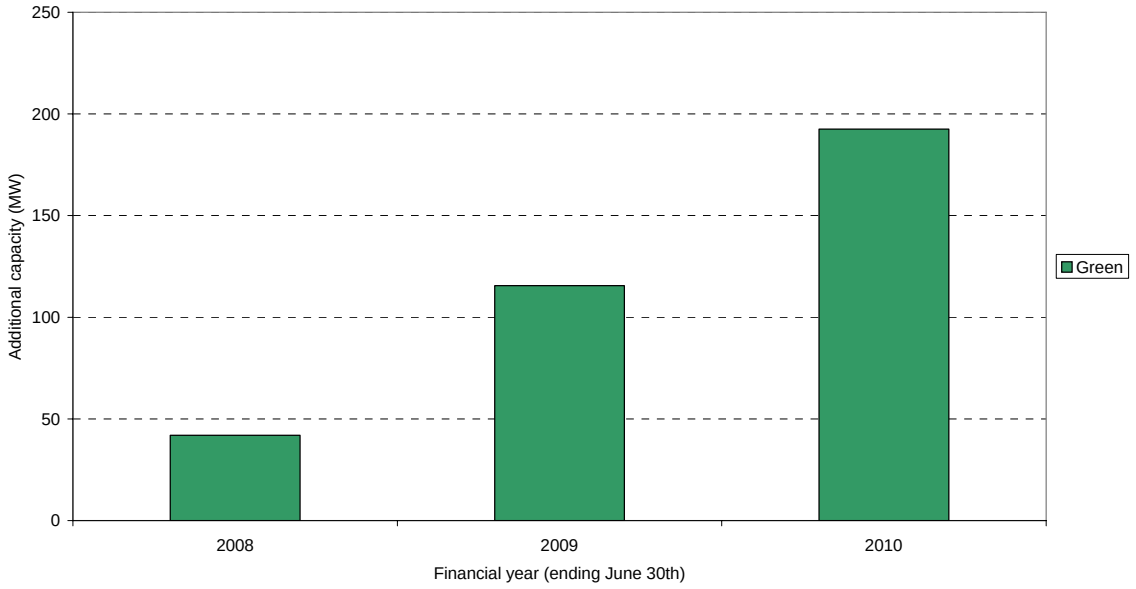


Figure B.5 SA new investment



The modelling approach assumed that the pattern of new generation investment as detailed above would not change under the different regional pricing and settlement arrangements modelled. This assumption was made to simplify comparisons between the scenarios and was considered to be, on balance, a conservative assumption to the extent that the modelling did not capture any dynamic efficiency gains due to an option leading to more efficient investment in the NEM. In any case, given that the modelling was only conducted over a three year period, any potential welfare gains due to more efficient investment would most likely have been small.

B.3.2 Dispatch/price modelling results

This Section discusses the dispatch and pricing modelling results obtained for each of the scenarios described above. The results of interest included:

- Production costs – annual NEM-wide variable electricity production costs in the summer peak period, winter peak period and remaining ("other") times of the year;
- The output of Snowy Hydro;
- Interconnector flows into NSW;
- Annual Regional (time-weighted) prices for Queensland, NSW, Snowy, Victoria, South Australian, and Tasmania;
- Instances of intra-regional constraint; and
- The frequency of clamping in the various scenarios.

Each of these results is discussed in turn below.

B.3.2.1 Broad conclusions of the modelling

In summary, both the Abolition and SSR scenarios led to production cost savings and price reductions against the Base scenario, while the results for the SG scenario are less conclusive. The primary reason for the desirable outcomes from the boundary change proposals was an increased level of competition due to freer interconnector flows arising from the:

- New region boundary configuration and reformulated system constraints;
- Resultant change in network congestion between the scenarios, most prominently in a reduction of constraints around the Snowy region; and
- Altered incentives created for Snowy Hydro and other market participants under this new structure.

Specifically, the modelling shows that in the Abolition scenario, additional patterns of bidding that involved participants offering almost all their capacity into the market became sustainable (i.e. were Nash Equilibria). These "competitive" bidding equilibria were not sustainable (i.e. not Nash Equilibria) in the Base and SG scenarios due to altered patterns of congestion brought about by differences in region boundary reconfiguration, the implementation of clamping and the increased ability of participants to increase their profits by unilaterally withdrawing capacity. This was primarily due to a significantly different formulation of system constraints under the new region boundary configuration. This reformulation led to a reduction in system congestion and altered participants' incentives accordingly.

Savings in the SSR scenario arose for similar reasons as in the Abolition scenario. However, the magnitude of the savings was lower. Significant production cost *increases* (i.e. productive efficiency losses) at key demand points were also observed in the SSR scenario in certain years and contracting cases, which offset some of the production cost savings. These outcomes were fundamentally driven by Snowy Hydro being incentivised to withdraw large amounts of capacity in the SSR scenario compared to some other scenarios.

Results in the SG scenario followed a different pattern. The altered revenues received by Snowy Hydro changed its equilibrium bidding incentives. This meant that at certain times more capacity was offered into the market whilst at other times more was withdrawn relative to the Base scenario. The magnitude of the differences relative to the Base scenario was smaller than for the Abolition and SSR scenarios as would be expected given that the underlying set of system constraints was identical to that used in the Base scenario. Benefits in the SG scenario arise solely from the altered financial incentives of Snowy Hydro.. Conversely, in the Abolition and SSR scenarios, the reformulation of system constraints led to a significantly different and more efficient pattern of congestion across the NEM relative to the Base scenario.

These points are elaborated upon and supported by the modelling results presented below.

B.3.2.2 Caveats and limitations of the modelling

When interpreting the following results, it must be kept in mind that the modelling exercise was conducted to investigate the potential relative effects of different options for managing congestion in the Snowy region, with particular emphasis on the change in Snowy Hydro's bidding incentives. It was not the intention to predict actual market outcomes (particularly prices) for a given scenario, but rather, to investigate the relative changes that arise between the scenarios. For this reason, the results for a given scenario should not be considered as forecasts of actual market outcomes.

The key assumptions, which were constant across the scenarios, and which should be kept in mind when interpreting the results were as follows:

- The majority of the year was dispatched assuming competitive bidding in order to ensure Snowy Hydro does not exceed its energy budget. This resulted in lower pool price outcomes than may arise in reality, to the extent that strategic behaviour actually occurs at these times;

- Long term hydrology levels have been assumed contrary to actual drought conditions currently affecting the market. This led to lower price levels than are observed currently; and

- New entrant plant were assumed to be standalone and non-strategic in the absence of more accurate information. Again, this assumption would tend to depress pool prices towards the end of the modelling period, as greater amounts of capacity enter the market, to the extent that new entrant plant would be built by incumbent generators and/or withheld from the market more aggressively (or offered above short run marginal cost (SRMC)).

B.3.2.3 Production costs

As discussed above, savings in variable production costs represent the dispatch efficiency benefits of a change in the market design. Figure B.6 shows the annual production cost savings for both the Abolition (red bars) SSR (blue bars) and SG (orange bars) scenarios. Savings are presented relative to the Base scenario for both the high and low contracting cases. Positive values denote a saving relative to the base scenario.

The Abolition scenario produced savings in all years and contract cases relative to the Base scenario. Savings peaked at $1.5m for the 2009, contracted low case. These savings were driven by the finding that the boundary change led to more competitive bidding strategies for Snowy Hydro and other participants being sustainable due to a reduction in the frequency of network constraint around the Snowy region. This led to greater levels of dispatch for Murray, Tumut, Victorian brown coal plant and cheaper NSW black coal plant displacing more expensive NSW and Queensland black coal and some mid merit gas plant across the NEM. The result was that production cost savings accrued (later results will also quantify the price effect this displacement causes). This effect was also observed in the analysis performed for the Abolition proposal draft Rule determination, the results of which are reproduced here in Figure B.7.

It should be noted that the modelling for the Abolition proposal draft Rule determination is not directly comparable to the results presented in this round of analysis due to the assumption of nonzero-threshold clamping on *all* interconnectors applied in that earlier work. Clamping in this manner, across all scenarios, significantly changed the incentives of market participants and had the net effect of dampening the magnitude of the production cost savings, particularly due to the assumption of a non-zero clamping threshold. This is consistent with the work performed for the Abolition proposal draft Rule determination, where the presence of clamping in only the Base scenario was identified as one of the drivers of the savings reported at that time. In the present modelling, given that less clamping occurs on the key Snowy region interconnectors occurs, differences (and source of production cost savings) between the scenarios have been reduced. This has resulted in reduced cost savings.

Production cost savings under the SSR scenario were generally positive and peaked at $1.2m relative to the SG scenario in the 2008, contracted low case. As with the Abolition scenario, these production cost savings arose due to the increased likelihood of more competitive bidding by Snowy Hydro and other participants due to reduced system constraint. The effect was not quite as great as that seen for the Abolition scenario and was also offset at certain demand levels where production cost losses were observed relative to the Base scenario.

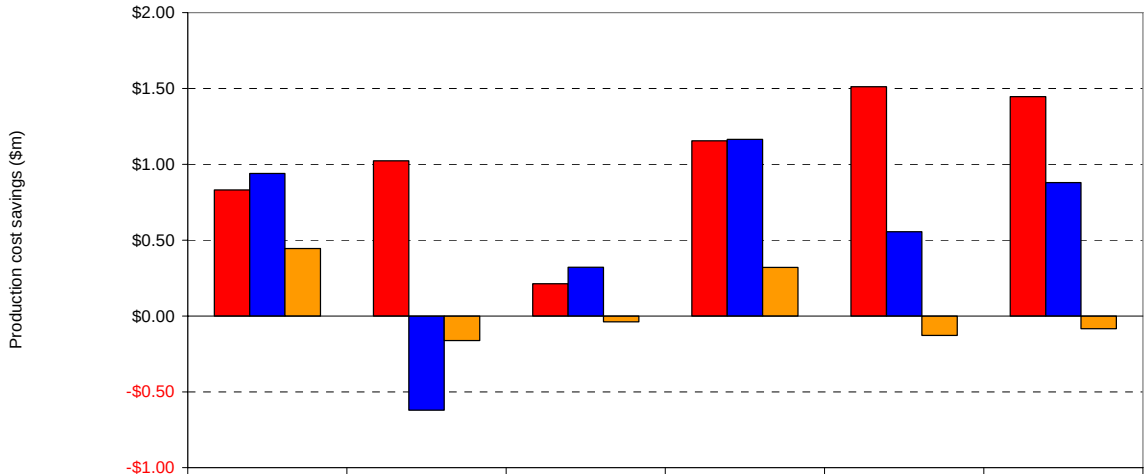
At these times, Snowy Hydro in particular was incentivised to pursue highly strategic bidding strategies in the SSR scenario that were not as profitable in either the Base or Abolition scenarios due to the different region configurations and constraint forms. Specifically, the fact that both Murray and Tumut generation were settled at their own respective regional prices tended to encourage greater withholding of capacity than under the Abolition or even the Base scenarios. Prices in the SSR scenario drove this outcome.[151] Specifically, the fact that the prices that were set in the Murray and Tumut regions incorporated the dynamic losses on the Victoria to Murray and Tumut to NSW interconnectors led to different pricing outcomes than in the Abolition case (even for the dispatch of identical bidding combinations). These different prices created different incentives for Snowy Hydro which, at times, led to production cost losses. This will be discussed in greater detail below.

Production cost savings in the SG scenario were either positive or very slightly negative (approaching the noise limits of the modelling), with the largest saving of $450K observed for the 2008, contracted high case. Production cost savings and losses in the SG scenario relative to the Base scenario were caused solely by the different incentives that Snowy Hydro had due under the SG arrangements. This lead to different bidding strategies being more profitable, coupled with the reaction of other participants to this change. This explanation is discussed in greater detail below. The differences between the SG and Base scenarios were less than those between the Abolition and Base and SSR and Base scenarios. This reflects the fact

[151] The RRPs for Tumut and Murray generation are the nodal prices at Lower Tumut and Dederang. This means that nearly all generation in the Snowy Mountains area is settled at (or very close to) its nodal price, with the exceptions being Murray, Upper Tumut and Guthega power stations which are respectively settled at the Dederang, Lower Tumut and Dederang nodal prices.

that the only difference between the Base and SG scenarios was Snowy Hydro's financial incentives rather than a fundamentally different constraint formulation, as was the case with the region boundary change scenarios.

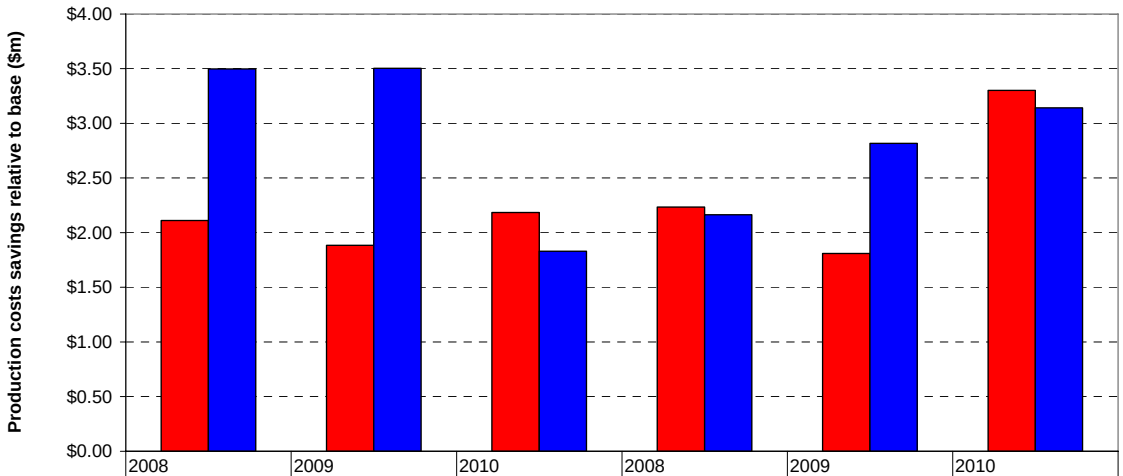
Figure B.6 Annual production cost savings – current analysis ($m)



	2008	2009	2010	2008	2009	2010
	Contracted High			Contracted Low		
Abolition vs Base	$0.83	$1.02	$0.21	$1.15	$1.51	$1.45
SSR vs Base	$0.94	-$0.62	$0.32	$1.16	$0.56	$0.88
SG vs Base	$0.45	-$0.16	-$0.04	$0.32	-$0.13	-$0.08

Contract case, financial year (ending June 30th)

Figure B.7 Annual production cost savings – from Abolition proposal draft Rule determination ($m)



	2008	2009	2010	2008	2009	2010
	Contracted High			Contracted Low		
Snowy	$2.11	$1.89	$2.19	$2.23	$1.81	$3.30
Split RO	$3.50	$3.50	$1.83	$2.16	$2.82	$3.14

Contracting case, financial year (ending June 30th)

B.3.2.4 Production cost savings under the assumption of competitive bidding by all participants

Figure B.8 shows the annual production cost savings if it is assumed that all market participants bid all capacity at SRMC (competitive bidding). Under this assumption, the level of contracting is immaterial. We observe that both the Abolition and SSR scenarios yielded annual production cost savings of between $0.5m and $1.5m. The savings were positive in all years for these two scenarios and the Abolition scenario delivered at least $0.5m of additional savings over the SSR scenario.

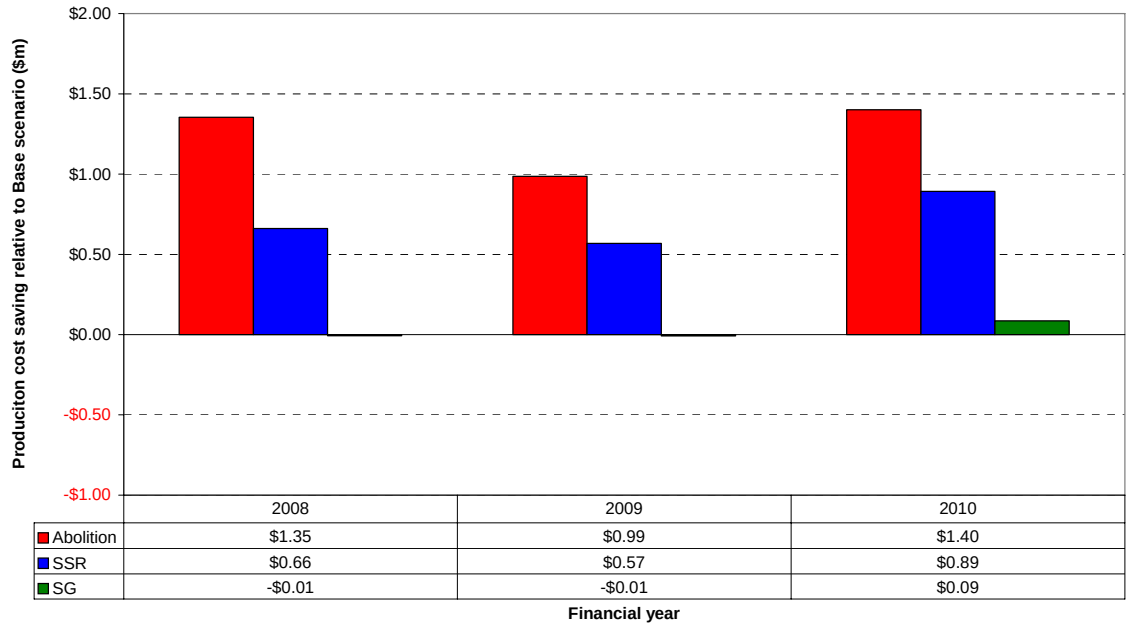
The SG scenario production costs were almost identical to the Base scenario outcomes in all three years. In the first two years, differences of less than $10,000 can be seen between the two scenarios (on an annual production cost of approximately $1.8bn). In the final year, a small saving of $90,000 can be observed, but this is potentially within the tolerance of the model and could comprise modelling "noise". The SG outcomes are not surprising given that:

- Under the assumption of competitive bidding, very little system constraint occurs across the NEM and both the SG and Base scenarios share the same constraint formulation; and

- The major difference between the scenarios – Snowy Hydro financial incentives – does not lead to a change in the assumed bidding pattern of Snowy Hydro (i.e. competitive).

The Commission published technical advice from Frontier on these SRMC results on 8 November 2007. The advice is available on the AEMC website, www.aemc.gov.au.

Figure B.8 Annual production cost savings – assuming competitive, SRMC bidding by all participants ($m)



	2008	2009	2010
Abolition	$1.35	$0.99	$1.40
SSR	$0.66	$0.57	$0.89
SG	-$0.01	-$0.01	$0.09

B.3.2.5 Timing of the production cost savings

Figure B.9 shows the break down of the production cost by category - summer peak, winter peak and other times. Note that the summer and winter peak times do not correspond to conventional market definition of peak but rather the "super-peak" times noted above.

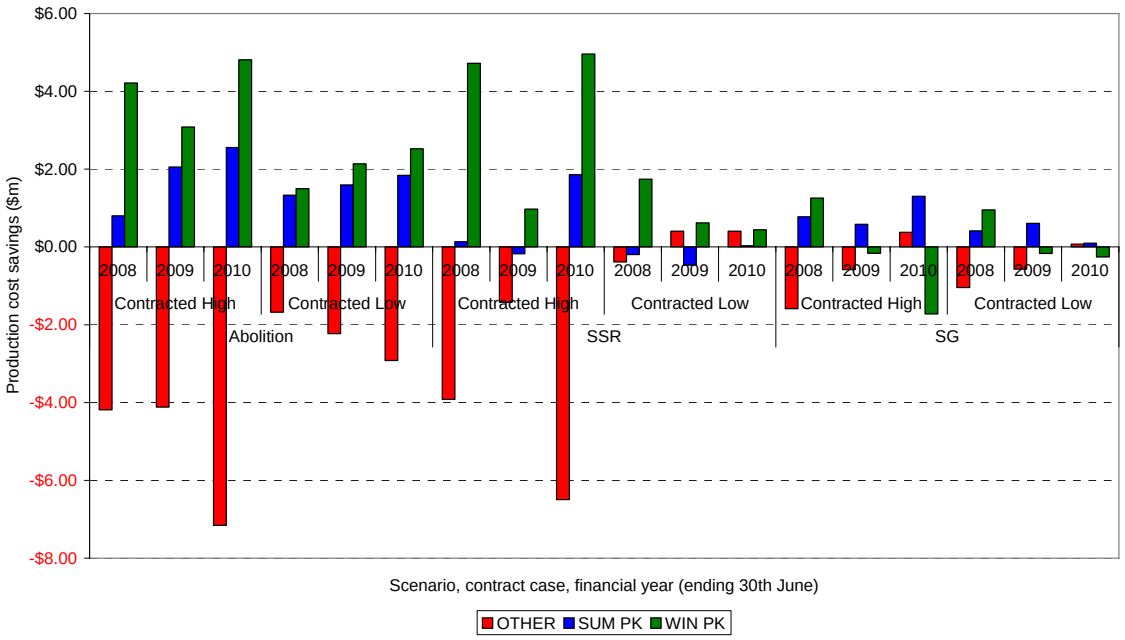
The production cost savings in the Abolition scenario occurred consistently during the extreme summer and winter peak times of the year when generators were allowed to bid strategically. During these periods, Snowy Hydro's hydro plant tended to run more than they did in the Base scenario. This caused a displacement of relatively expensive thermal generation in the Abolition case and hence a reduction in production costs at those times. However, due to Snowy Hydro's limited annual energy budget, it was forced to generate less at *other* times of the year in the Abolition scenario compared to the Base scenario. This meant that more relatively cheap thermal generation was required to run at those times in the Abolition scenario. Nevertheless, the net effect of the switching of timing of hydro production was lower overall costs in the Abolition case, as higher-cost thermal generation was displaced at peak times and more lower-cost thermal generation was required at other times.

With respect to the timing of production cost savings in the SSR scenario, we observe a similar pattern of savings to what was seen in the Abolition scenario in the contracted high case. Savings were not as consistent as in the Abolition scenario, particularly in the summer peak times. This reflected the occasions where production cost losses occurred in the SSR scenario relative to the Base scenario. For the contracted low case, a different pattern emerged. The magnitude of savings was far lower and generally occurred only during the winter peak times, with outcomes during the summer peak and other times following no clear pattern. In the

contracted low case a greater range of equilibrium outcomes arose, with lower contracting levels making a greater range of bidding options feasible. On the average, this tended to produce similar outcomes for the SSR scenario as under the Base scenario, meaning that as such no significant savings (or losses) were observed. Note that this result differed from the Abolition scenario where greater number of equilibrium outcomes in the contracted low case resulted in production cost savings relative to the Base scenario.

Timing of the production cost changes in the SG scenario followed no obvious pattern. In addition, the magnitude of the savings was relatively low, as would be expected given the similarities between the SG and Base Case scenarios in terms of system constraint formulation. Having high or low levels of contracting in the SG scenario makes little difference to the production cost changes relative to the Base case.

Figure B.9 Annual production cost savings by time of year ($m)



B.3.2.6 Production cost changes by demand point

The drivers of the production cost results discussed above occurred to a greater or lesser extent across all of the demand points (29 and 30) modelled. Two demand points in particular serve well to illustrate exactly what lead to the differences in production cost outcomes-both in terms of savings and losses, between the scenarios. Both these points represent relatively high winter demand across the NEM, particularly in Victoria and SA. The levels of demand characterised by these points occur relatively frequently across the year (70.5 and 111.5 hours respectively) resulting in these demand points making up a large component of the annual production cost outcomes. Demand point 29 was given particular attention in the Abolition proposal draft Rule determination.

The impact of these points can be seen in Figure B.10 and Figure B.11. These figures show the production cost savings by scenario relative to the Base scenario by strategic demand point for the contract high and low cases respectively. It is clear that the greatest production cost savings and losses occurred for demand points 29 and 30 respectively. Further investigation of these two demand points, presented in detail below, serve to illustrate the driver of the differences across the scenarios for all demand points.

Figure B.10 Production cost savings relative to the Base scenario by strategic demand point, contracted high

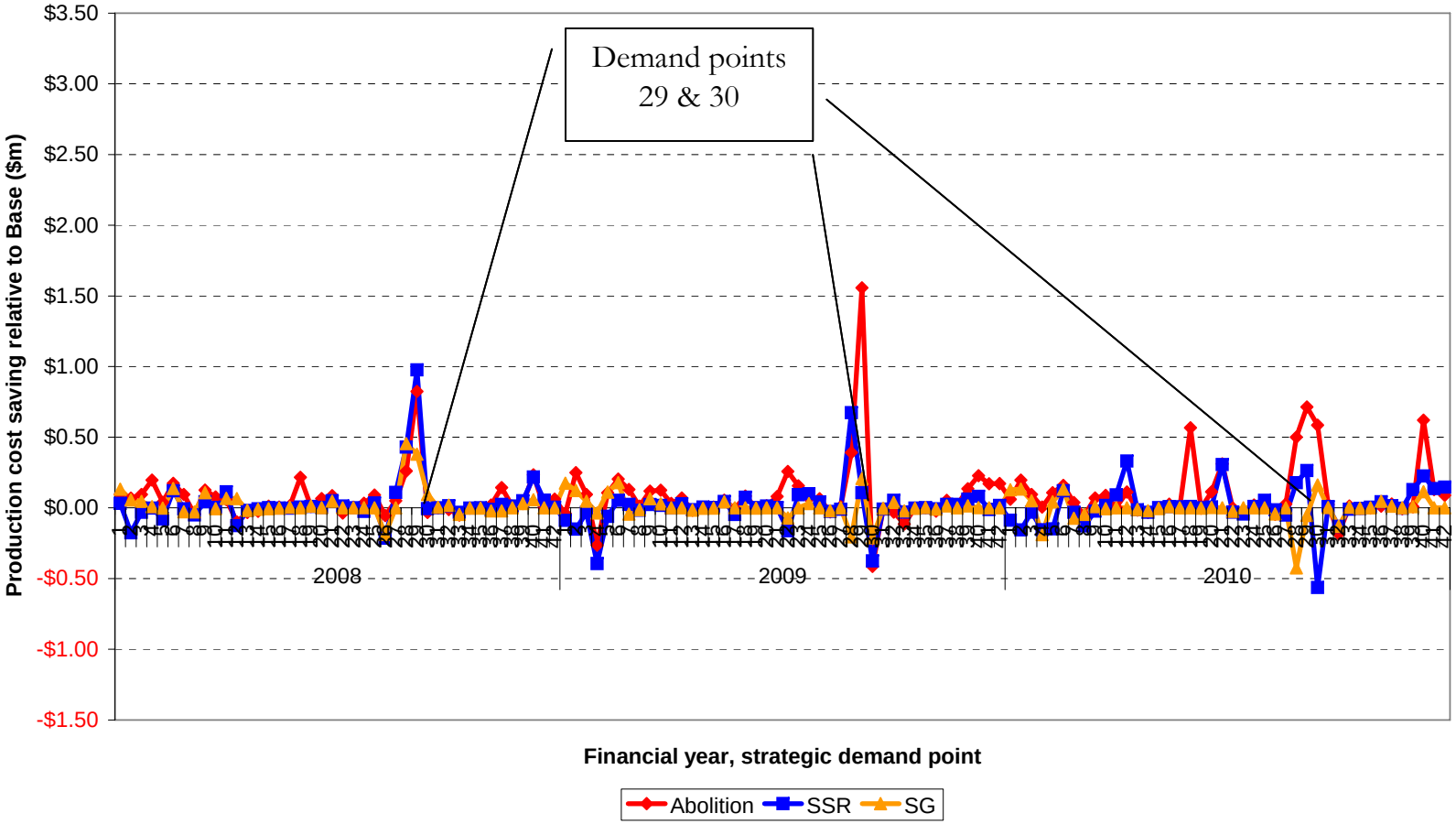
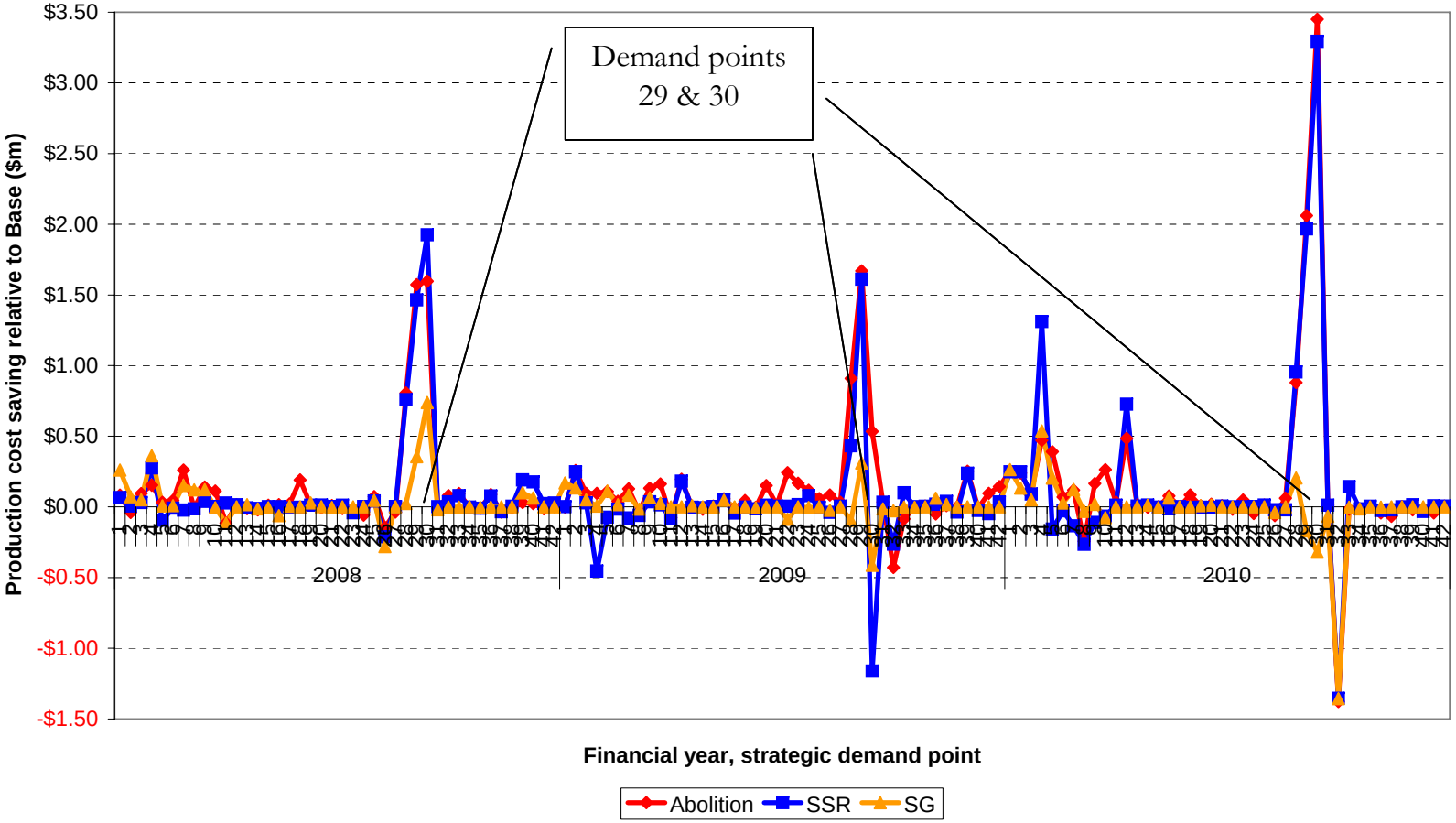


Figure B.11 Production cost savings relative to the Base scenario by strategic demand point, contracted low



B.3.2.7 Hourly production cost changes by demand point

Demand points 29 and 30 represent periods where significant production cost savings accrued. They serve well to illustrate the drivers of the different outcomes between the scenarios. This is partly due to these points representing a relatively large number of hours compared to the other strategic demand points that were modelled. This high weighting reflects the historical analysis undertaken by Frontier to identify levels of demand where constraint issues around the Snowy Region may arise. Before beginning a detailed discussion of the drivers behind these two demand points, it is valuable to present and discuss the production cost savings results on a per hour basis. These results are presented in Figure B.12 and Figure B.13 for the high and low contracting cases, respectively.

Whilst the largest contribution to annual production cost changes was made by points 29, 30 and several others, we see that on an hourly basis, other demand points dominated the results. This result is unsurprising for the following reason: The largest hourly production cost changes occurred for demand points that represented extreme market conditions in terms of high levels of demand. Based on Frontier's historical market analysis, it was observed that such events occurred relatively infrequently and hence, these points were given a correspondingly low weighting in the modelling. On the other hand, hourly outcomes for demand points 29 and 30 were not as extreme, but these levels of demand were observed much more frequently. Consequently, the outcomes relating to these points were given a larger weighting and their contribution to annual outcomes was highly significant.

Figure B.12 Hourly production cost savings relative to the Base scenario by strategic demand point, contracted high

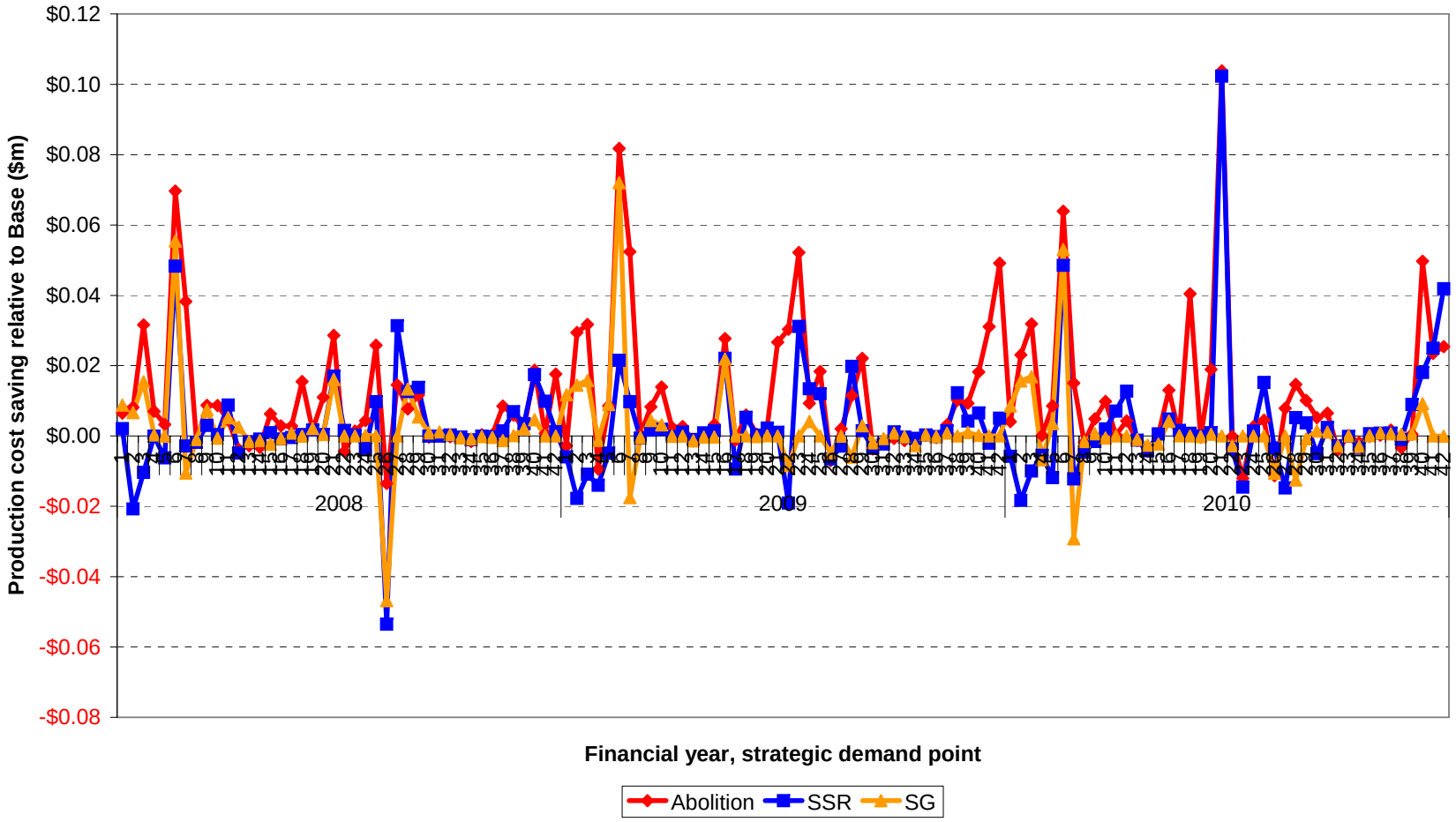
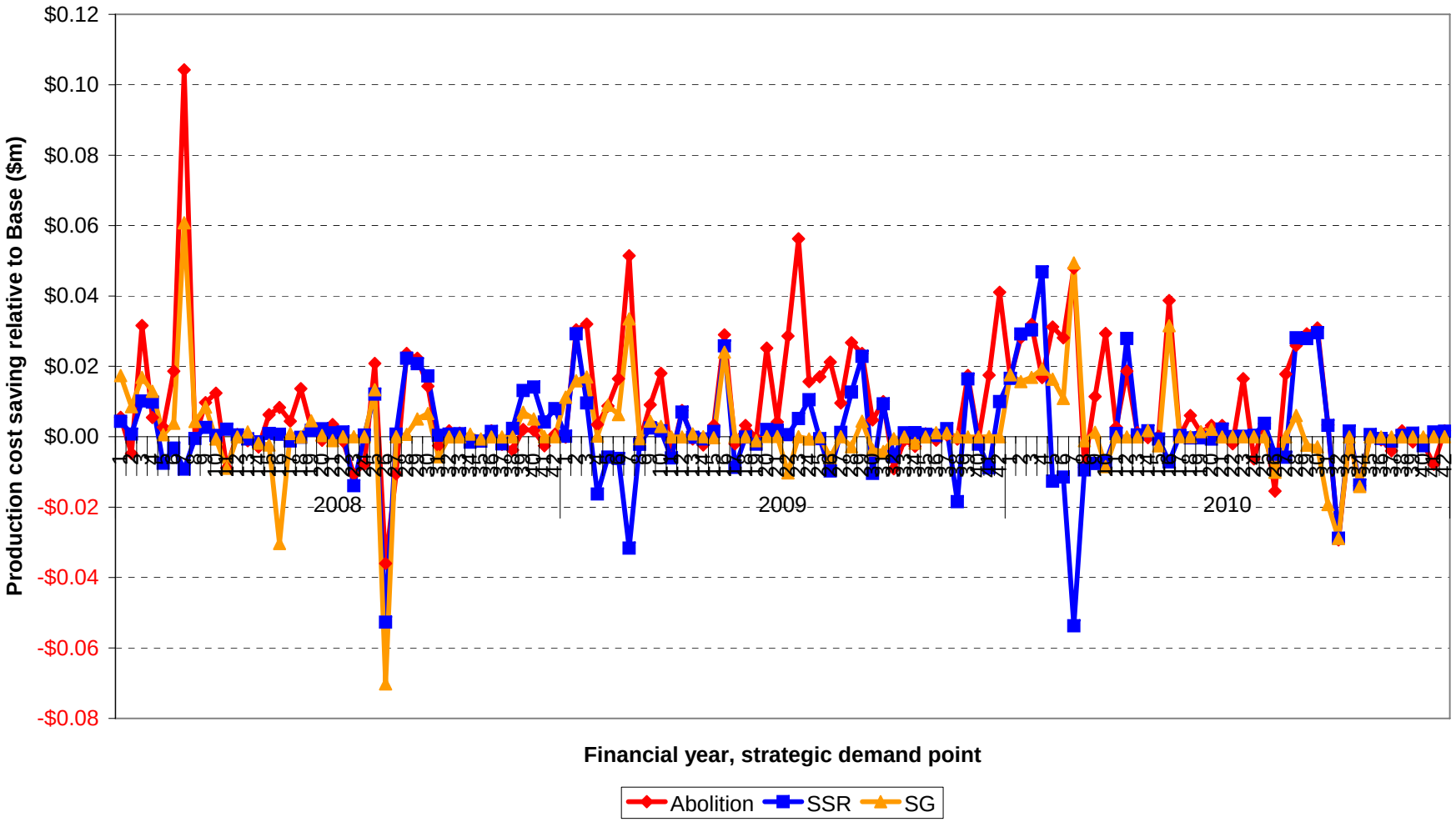


Figure B.13 Hourly production cost savings relative to the Base scenario by strategic demand point, contracted low



B.3.2.8 Drivers of the production cost savings

Figure B.14 shows a scatter plot of Nash Equilibrium outcomes for demand point 29 for the 2007/08, contracted high outcomes. The horizontal axis shows the combined amount of capacity offered into the market by Guthega, Murray and Tumut plant, while the vertical axis shows the payoff (profit) received by Snowy Hydro (including revenue from Laverton, Valley Power and Blowering and contract difference payments).

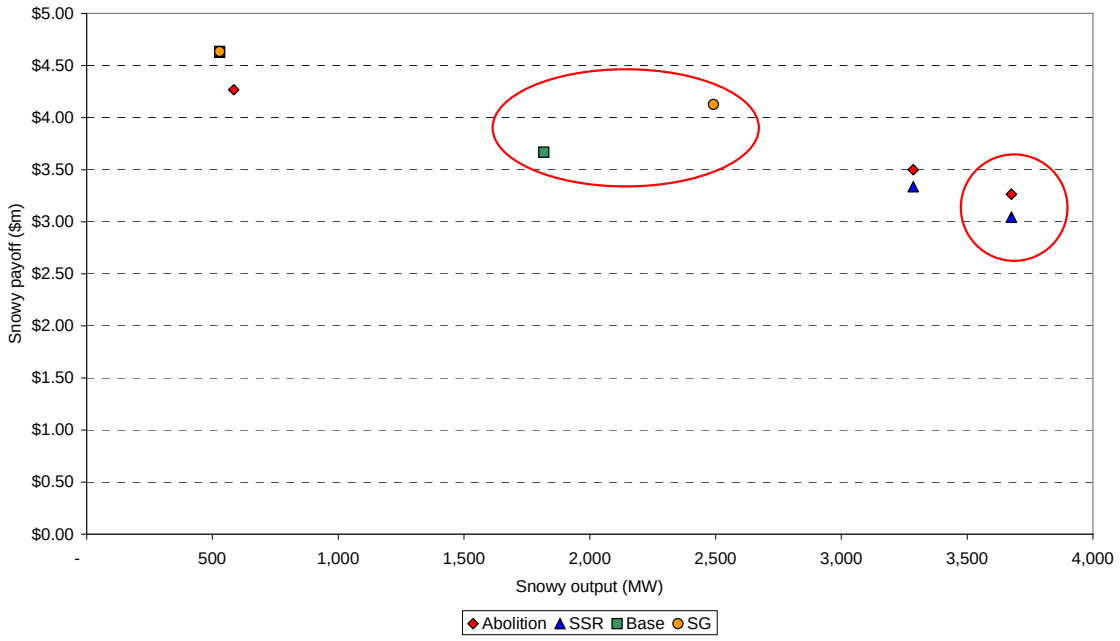
It can be observed that a single equilibrium in each scenario occurred on the left side of the graph where Snowy Hydro offered approximately 500MW into the market (note that the data point for the SSR scenario is partially obscured by the Base and SG data points). These equilibria also involved the withdrawal of capacity by other market participants. As similar outcomes occurred in all four scenarios the production cost differences relating to these four equilibria were small.

In addition to these "strategic" equilibria (on the left side of the graph), a number of "competitive" equilibria (where more capacity was offered into the market) occurred under all scenarios. For the Base and SG scenarios a total of 1,800MW and 2,500MW respectively were offered into the market by Snowy Hydro's Tumut and Murray generation. This was still short of the Snowy region's full generating capacity (3,126MW[150]). For the Abolition and SSR scenarios even more competitive equilibria arose, including outcomes where Snowy bid all of its capacity into the market (circled in red on the right-most side of the graph).

Because equilibria where Snowy Hydro offered a relatively large amount of capacity into the market dominated the outcomes in the Abolition and SSR scenarios we observed significant production cost savings for this demand point in both of these scenarios. While more capacity was offered in the SG scenario relative to the Base scenario, it was not as much as in the Abolition and SSR scenarios. This explains why the production cost savings, while significant for the SG scenario, were not as great as in the Abolition and SSR scenarios for this demand point.

[150] NEMMCO, List of Generators and Scheduled Loads in the National Electricity Market, NEMMCO, Brisbane, 6 August 2007.

Figure B.14 Snowy Hydro equilibrium outcomes, demand point 29, 2007/08 contracted high



Understanding exactly why these different Nash equilibrium outcomes were sustainable in the different scenarios requires an analysis of market participants bidding incentives, particularly Snowy Hydro's, and information about the level of system constraint that existed for the different bidding combinations. Four particular equilibria have been chosen to aid this analysis (circled in red in Figure B.14). These particular equilibria were chosen because they involved a fixed set of bids for all market participants other than Snowy hydro making diagrammatic comparison far easier.

Figure B.15 shows Snowy Hydro's payoff curve for four circled equilibria in Figure B.14. The modelling assumed 81 potential different combinations of capacity bids between Murray and Tumut. These are shown along the horizontal axis of Figure B.15, in increasing order of aggregate capacity (bid combination 1 corresponds to no capacity being offered into the market and bid 81 represents 100% of Murray and Tumut being offered into the market). The vertical axis shows the payoff received on the offered level of output. These curves represent a cross section through the strategic space considered in the modelling with other participants' bids held fixed at their equilibrium values. The "spikes" and "dips" in the payoff curves reflect the presence of system constraint or clamping in the market (which typically leads to price separation between regions, impacting on Snowy Hydro's payoffs).

In the Abolition and SSR scenarios, the highest payoff (in this case, Nash Equilibrium outcomes) occurred where Snowy Hydro offered all of its capacity into the market, as marked on the far right section of the payoff curves for these scenarios. The Base and SG equilibria occurred as shown. The higher payoffs received by Snowy Hydro for these bidding combinations were due to system constraints binding which led to large inter-regional price differentials and increased payoffs. The same constraints

did not bind in the Abolition and SSR scenarios, enabling more competitive bidding strategies to be sustainable as Nash equilibria.

Figure B.15 Snowy Hydro payoff curve for demand point 29, 2007/08 contracted high

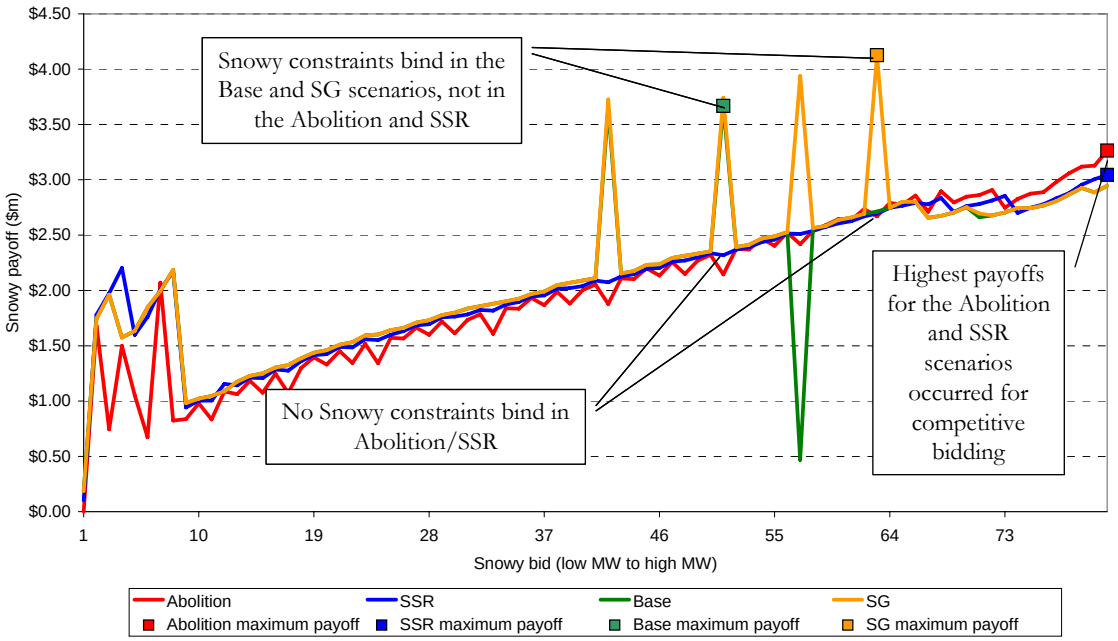


Figure B.16 depicts which constraints were binding in each of the four scenarios for demand point 29 when the equilibrium bidding combination for the Base scenario was dispatched in each scenario. The vertical axis is purely illustrative and indicates whether the constraint was binding for each of the equilibria chosen in the different scenarios. The ”hard” limits on both the Heywood (VS_460) and MurrayLink (VSML_210) interconnectors bound in all four scenarios (the VS_460 and VSML_210 constraints shown in the Figure). In the Base and SG scenarios a handful of other constraints also bound:

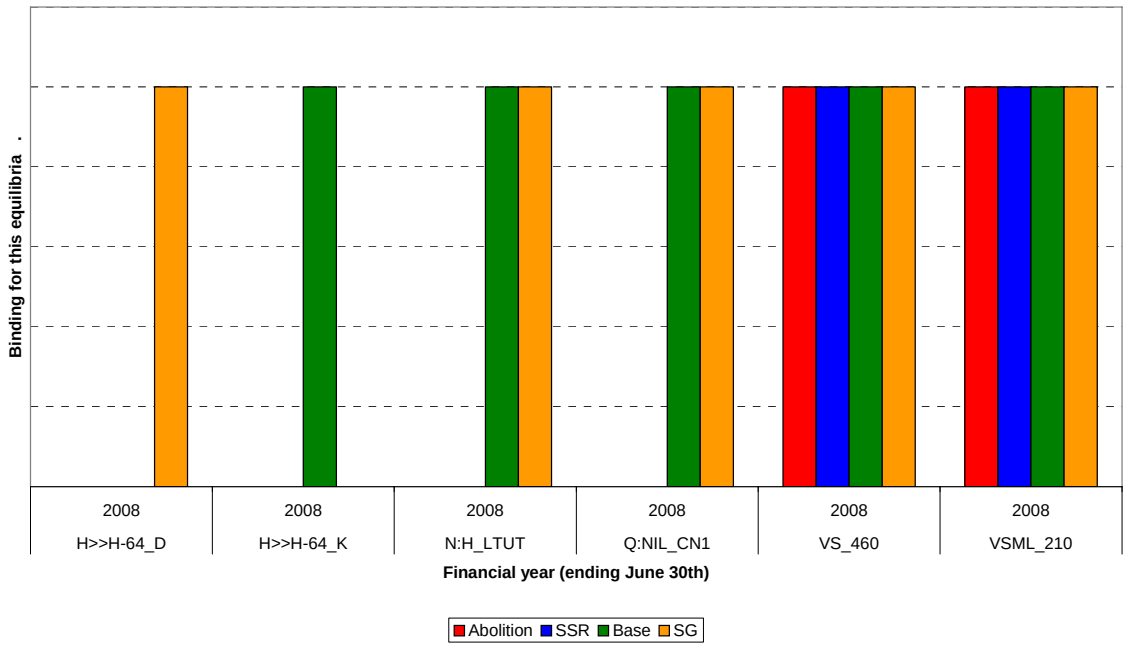
- “H>>H” Snowy intra-regional constraints on the Murray to Tumut lines which were reformulated to reflect the altered region boundaries;
- “N:H_LTUT” Snowy to NSW inter-regional constraints which includes Snowy-NSW, NSW-Queensland and Victoria-SA interconnector flow terms and is also reformulated to reflect the altered region boundaries; and
- “Q:NIL_CN1” Queensland intra-regional constraint between the central and northern Queensland subregions which bound due to the above constraints binding which altered the amount of generation needed in Queensland.

The binding of these constraints was what makes certain, less competitive bidding strategies into Nash Equilibria in the Base and SG scenarios. When reformulated to reflect the altered region boundaries of the Abolition and SSR scenarios the

constraints did not bind for the same set of market participant bids. The absence of any associated price spikes made it more profitable for Snowy Hydro to bid competitively, in these cases by offering all of its capacity into the market. This behaviour, in turn, drove the production cost savings in the Abolition and SSR scenarios relative to the Base scenario. These outcomes occurred for many of the modelled levels of demand and were most prominent for demand points 29 and 30.

For the SG scenario, Figure B.15 shows that the extra revenues that Snowy Hydro receives via the Tumut CSP/CSC Trial resulted in bidding strategies where more capacity was offered relative to the Base scenario. This led to production cost savings relative to the Base scenario. However, as the strategies were not as competitive as those seen in the Abolition and SSR scenarios, the magnitude of the savings was also less in the SG scenario.

Figure B.16 Binding constraints for equilibrium bidding combinations, for demand point 29, by region boundary scenario, 2007/08, contracted high case.



Similar outcomes can be observed in other years and contract cases. Figure B.17 to Figure B.20 show the equilibrium outcomes and payoff curves for demand point 29, in 2008/09 for the contracted high and low cases, respectively. Once again, specific equilibria where all other market participant bids were the same were selected, to aid comparison.

We observe that similar outcomes occurred in each of these cases. That is, the absence of binding constraints in the Abolition and SSR scenarios due to the new region boundary structure, led to more competitive equilibrium bidding strategies for Snowy Hydro and other participants. This resulted in production cost savings

relative to the Base case. Similar effects can be seen for many other modelled demand levels.

Figure B.17 Snowy Hydro equilibrium outcomes, demand point 29, 2008/09 contracted high

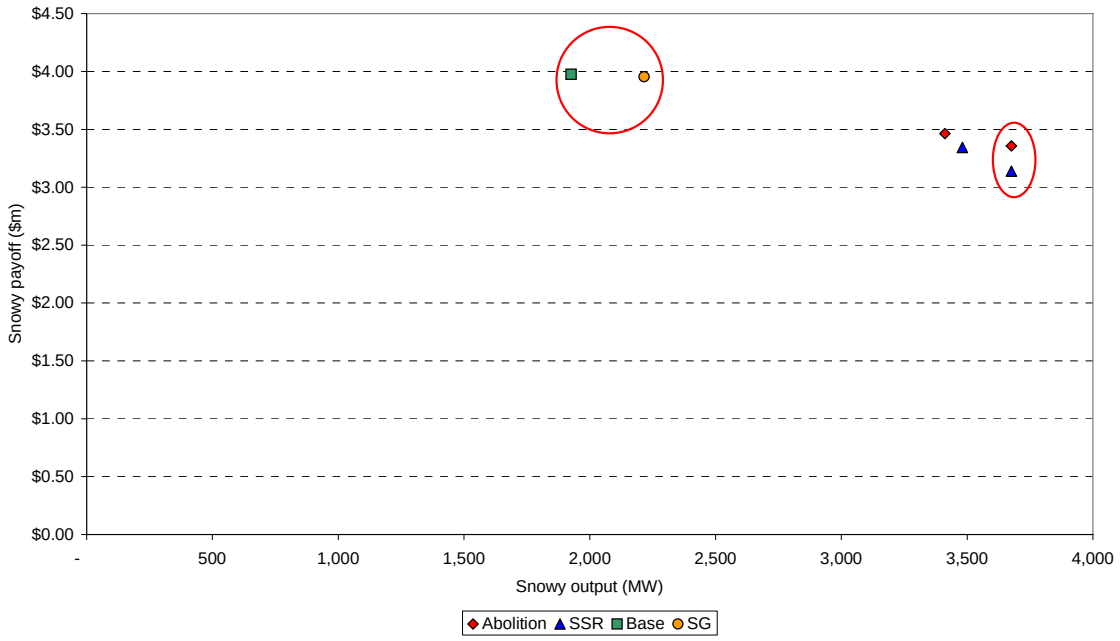


Figure B.18 Snowy Hydro payoff curve for demand point 29, 2008/09 contracted high

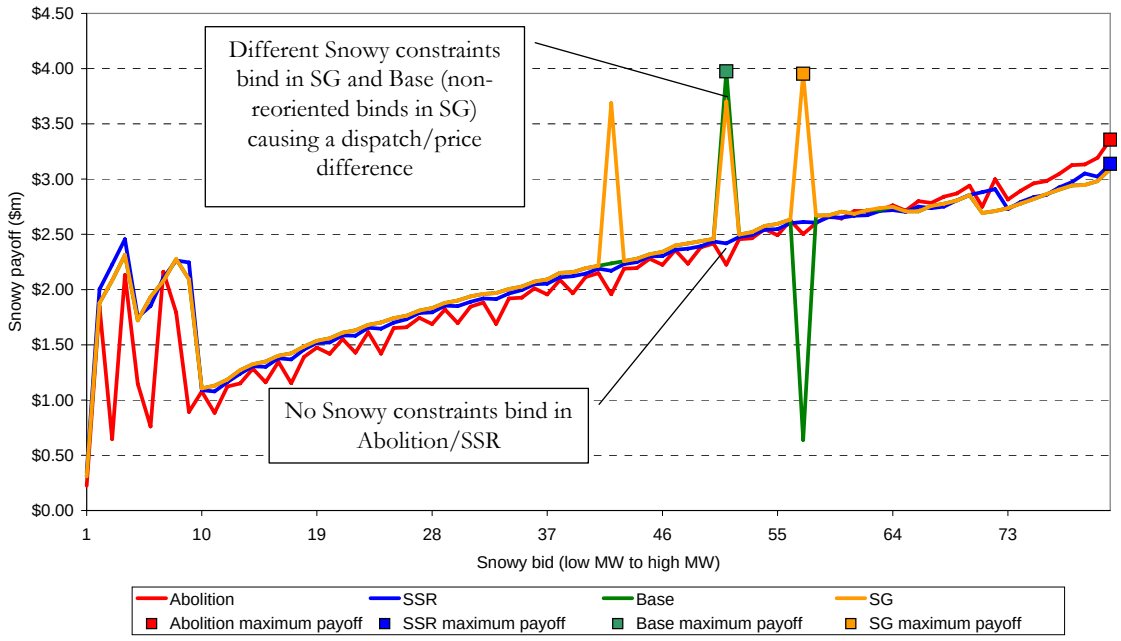


Figure B.19 Snowy Hydro equilibrium outcomes, demand point 29, 2008/09 contracted low

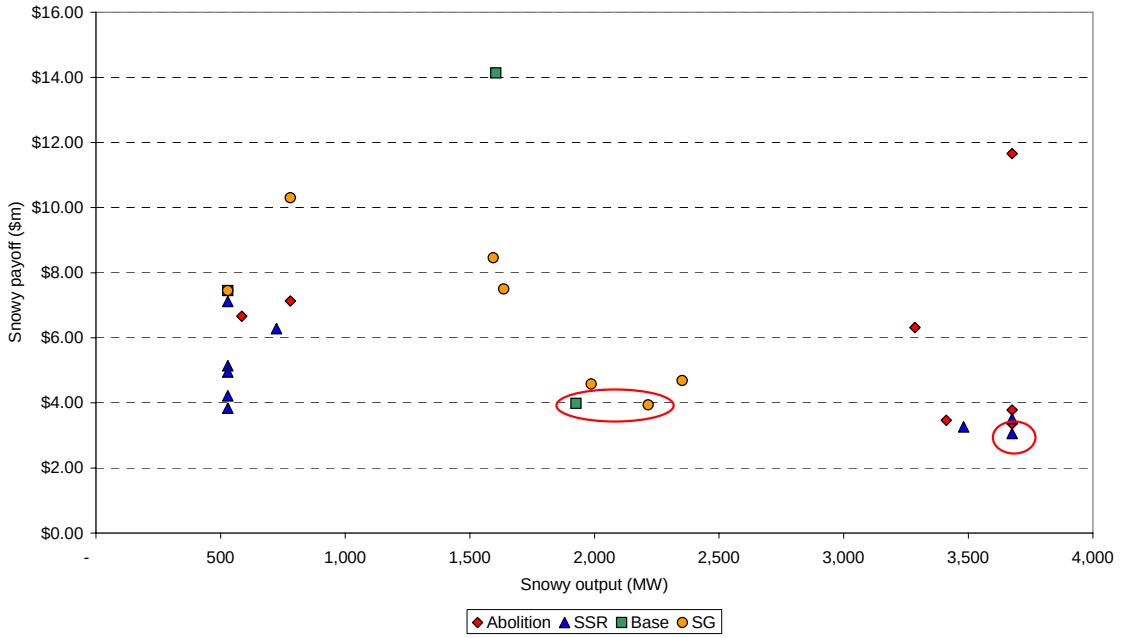
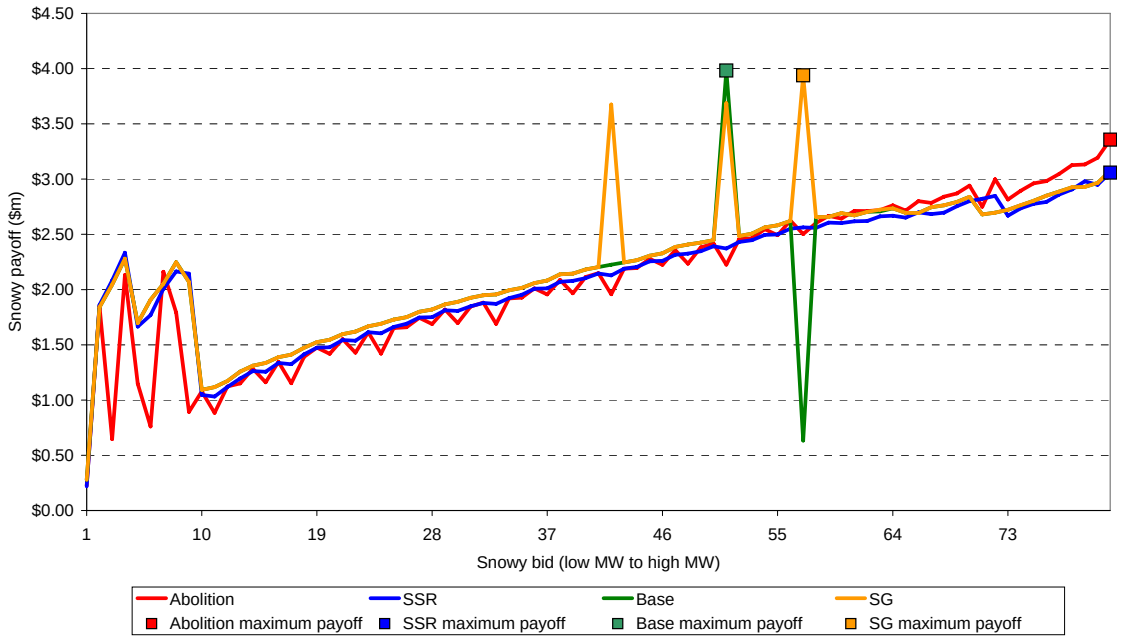


Figure B.20 Snowy Hydro payoff curve for demand point 29, 2008/09 contracted low



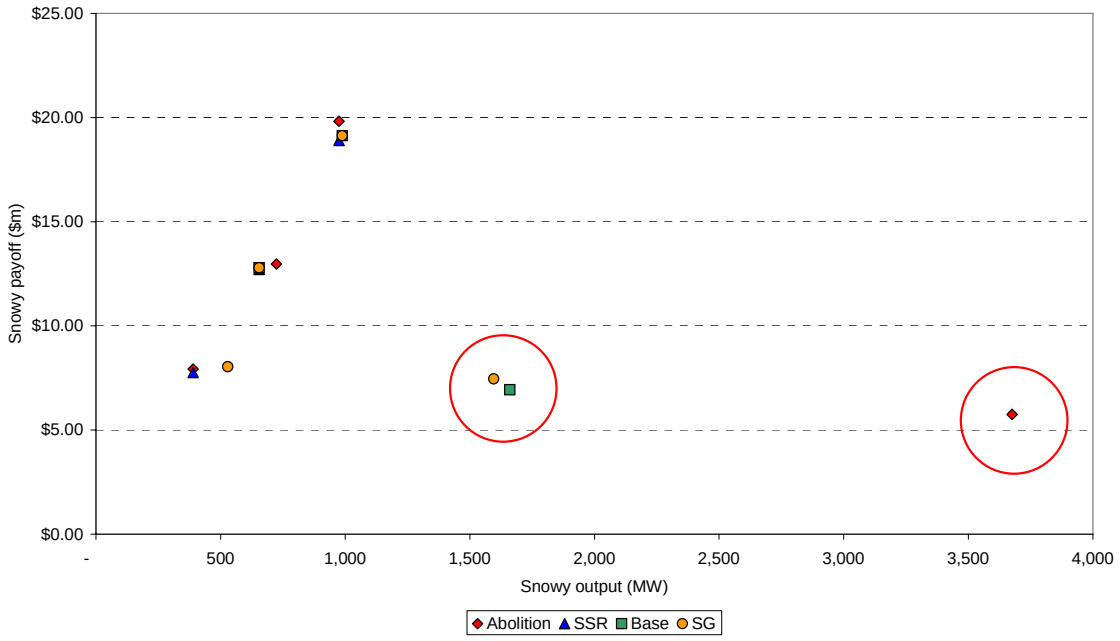
B.3.2.9 Drivers of the production cost losses

Net annual production cost losses relative to the Base scenario occurred for some years and contract cases in the SG and, more notably, SSR scenarios. For the SSR scenario this is most pronounced for the 2008/09 contracted high case. Examining Figure B.10 shows that the biggest single loss occurred for demand point 30, Figure B.21 shows the equilibrium level payoffs for this demand point.

We observe an equal number of strategies in all four scenarios where Snowy Hydro only offered 400MW to 1,000MW into the market. However, in each of the Base and SG scenarios, an additional more competitive equilibrium per scenario arose in which Snowy Hydro offered approximately 1,600MW into the market. As no corresponding competitive equilibrium arose in the SSR scenario, we found that, on average, the SSR scenario accrued production cost losses relative to the Base scenario. Conversely, a fully competitive equilibrium, in which Snowy Hydro offered all its capacity to the market, arose in the Abolition scenario. This resulted in production cost savings relative to the Base scenario. Such an outcome did not arise in the SSR scenario because such competitive strategies were dominated by strategies where Snowy Hydro withdrew significant amounts of capacity. This happened as a direct consequence of the different pricing outcomes that Snowy Hydro could achieve in the SSR regional configuration. This will be discussed in more detail below.

For demand point 30, we also observed production cost losses in the SG scenario, as less capacity was offered relative to the Base scenario. This arose due to a slightly different pattern of congestion and its effect on Snowy Hydro via the SG mechanism making it more profitable to withdraw slightly more capacity.

Figure B.21 Snowy Hydro equilibrium outcomes, demand point 30, 2008/09 contracted high



Once again, we considered Snowy Hydro's payoff curves to explain why these competitive equilibria did not arise in the SSR scenario. Note that in this instance, the circled equilibria *did not* involve the same bidding pattern for all market participants other than Snowy Hydro. In particular, the bidding pattern for the Base and SG scenarios were the same whilst the Abolition scenario equilibrium bidding combination was different.

Figure B.22 shows the payoff curves corresponding to the Base and SG scenarios equilibrium strategies for all other players. Figure B.23 shows the payoff curves where all other participants were fixed with the Abolition scenario equilibrium strategies. In both graphs the reason why a more competitive equilibria did not arise in the SSR scenario was that it was more profitable for Snowy Hydro to withdraw significant amounts of capacity and increase pool prices. This occurred for a number of key demand points in all years and contract cases for the SSR scenario and in some cases led to net annual production cost losses.

Two features of the payoff curves drive this outcome:

- When Snowy Hydro withdraws more capacity (left-most side of Figure B.23) it consistently earns an equivalent or greater payoff in the SSR scenario than it earns under the Abolition scenario – this made withdrawal strategies relatively more profitable in the SSR scenario; and

- When Snowy Hydro offers all or most of its capacity into the market (right-most side of Figure B.23) it consistently earns a lower payoff than that which arises under the Abolition scenario – this made competitive strategies relatively less profitable.

The effect of these two features was that at certain times and for certain demand levels, it was more profitable for Snowy Hydro to withdraw significant amounts of capacity in the SSR scenario. This was an effect that was not observed in the Abolition scenario. This result was purely driven by the different pricing implications of the two scenarios. In the Abolition scenario, Murray generation receives the Victorian price and generation at Tumut receives the NSW price. However, in the SSR scenario, both Murray and Tumut generation receive an imported price *that is adjusted for losses on the new interconnectors*. Also, slightly different amounts of dynamic losses occurred in the SSR scenario. Typically, greater losses occurred in the SSR scenario than in the Abolition scenario, as the dynamic losses were being calculated on a greater number of interconnectors. This resulted in additional overall generation in the SSR scenario to cover the shortfall.

These two factors resulted in non-trivial price differences in the SSR scenario compared to the other scenarios. This, in turn, resulted in the different payoff curve discussed above. For the more uncompetitive bidding combination that resulted in the maximum payoff in the SSR scenario (left side of Figure B.23), the additional losses required the dispatch of additional generation. The dispatch of this more expensive additional generation resulted higher prices across the entire NEM including the Murray and Tumut regions. The result was that significant withdrawal was the most profitable strategy in the SSR scenario.

Conversely, the fully competitive strategy, which yielded an equilibrium for the Abolition scenario (right-most side of Figure B.23), was not as profitable in the SSR scenario. For this bidding combination, power flowed from Murray to Victoria and Tumut to NSW. In the Abolition scenario, Snowy Hydro received the Victorian and NSW regional references prices, as discussed above. In the SSR scenario, Snowy Hydro received the lower, dynamically loss-adjusted Victorian price at Murray and the lower, dynamically loss-adjusted NSW price at Tumut. This made this bidding combination less profitable in the SSR scenario than in the Abolition scenario.

Figure B.22 Snowy Hydro payoff curve for demand point 30, 2008/09 contracted high – Base and SG equilibrium strategies for other market participants

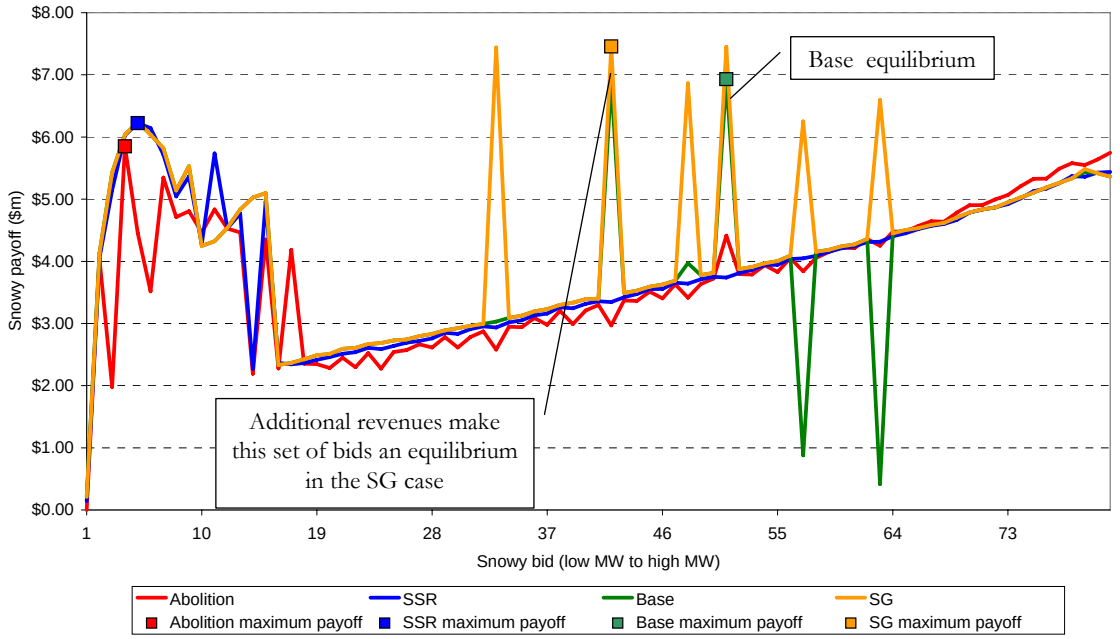
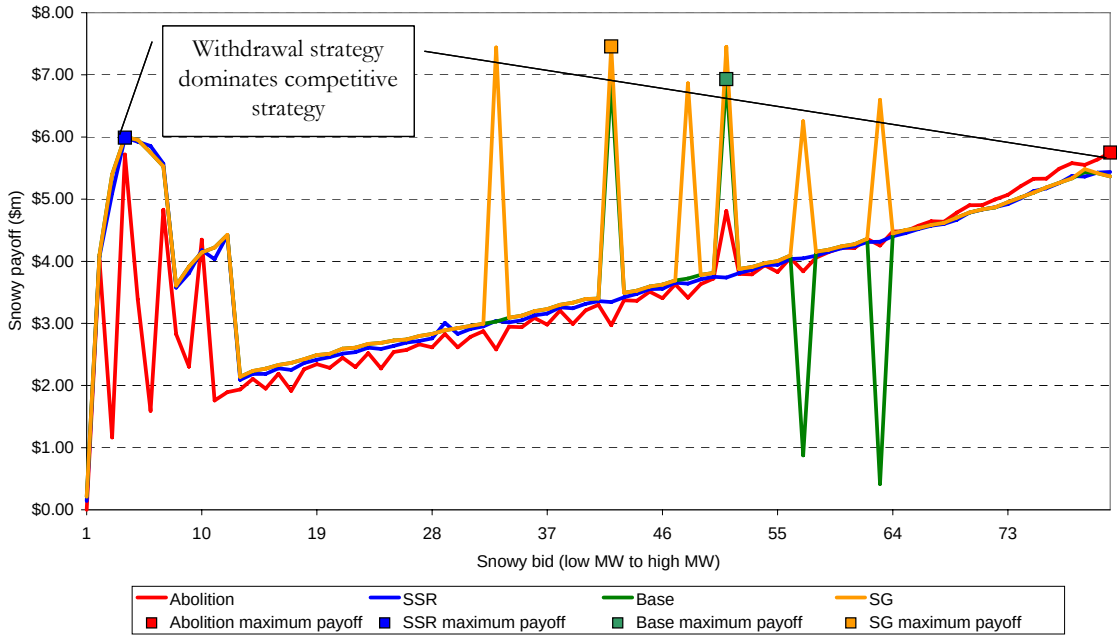


Figure B.23 Snowy Hydro payoff curve for demand point 30, 2008/09 contracted high – Abolition equilibrium strategies for other market participants



B.3.2.10 Production cost changes by plant type

The analysis presented above shows that production cost savings across the modelled scenarios arose when market participants, particularly Snowy Hydro, bid more competitively and when expensive generation was displaced by cheaper generation. Figure B.24 to Figure B.26 show the production cost savings by cost-band relative to the Base scenario for the Abolition, SSR, and SG scenarios respectively. A positive value represents less generation, and hence a production cost savings, in any given cost band.

In the Abolition scenario we consistently saw production cost savings arise due to mid-merit and peaking plant being displaced by black coal. Mid-merit plant was also generally displaced in most years in the SSR scenario, particularly in those years in which the net annual production cost savings was positive. A similar, but dampened effect was observed in the SG scenario for those years where savings were positive.

Figure B.24 Production cost savings relative to Base by cost band - Abolition

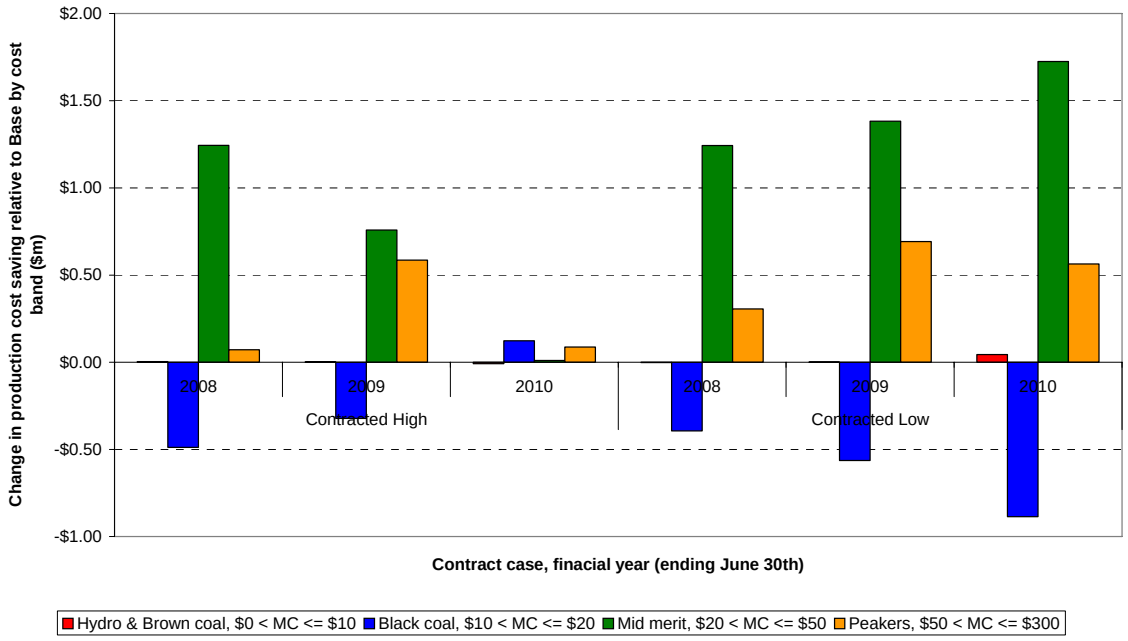


Figure B.25 Production cost savings relative to Base by cost band - SSR

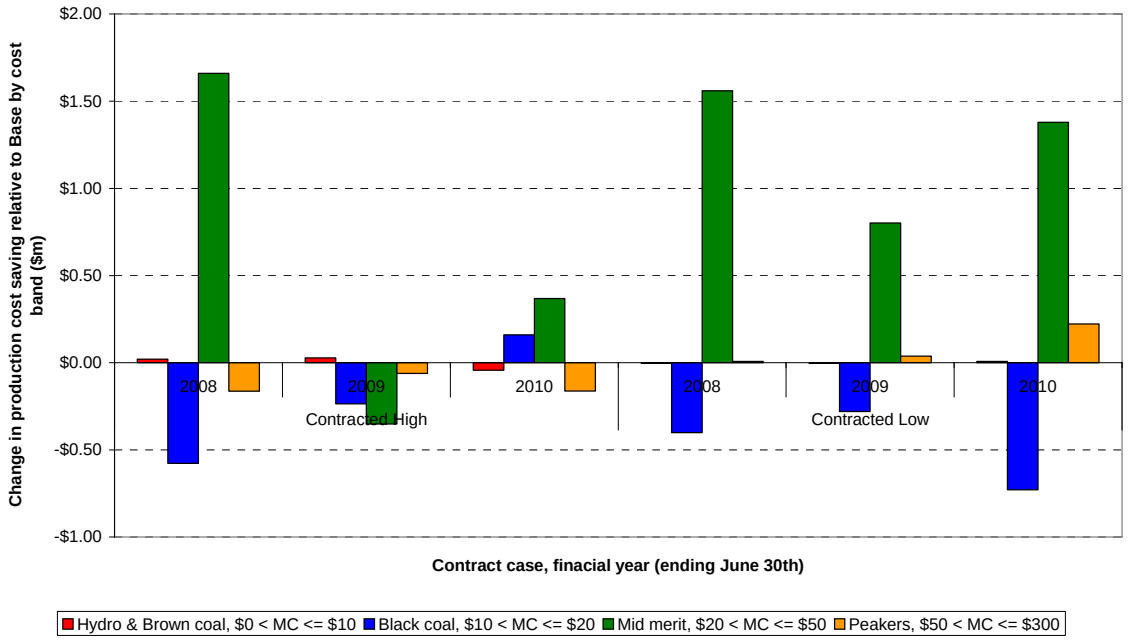
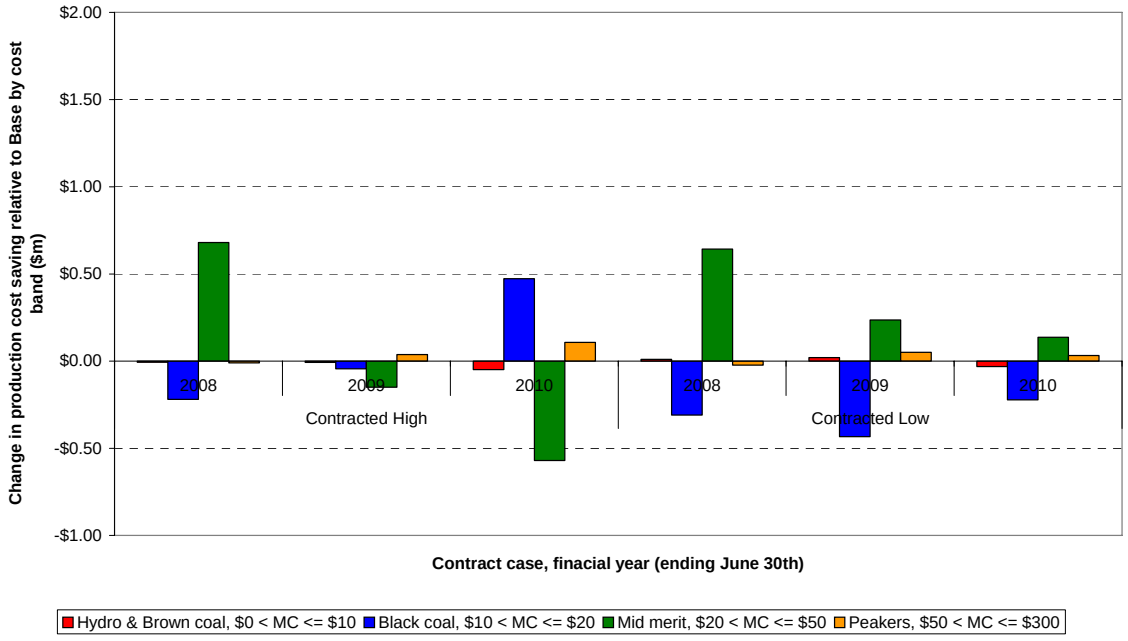


Figure B.26 Production cost savings relative to Base by cost band - SG



B.3.2.11 Changes in dispatch

Figure B.27 to Figure B.29 show the changes in output levels for Snowy Hydro at Murray and Tumut by time of year for the Abolition, SSR and SG scenarios respectively relative to the Base scenario. In the Abolition scenario (Figure B.27), Murray consistently generated more during peak times while Tumut generated less with the net effect being an increase in Snowy Hydro generation during peak times. This outcome was in keeping with the increased likelihood of more competitive bidding discussed above. Due to Snowy Hydro's annual energy budget, the increased output at peak times necessitated a reduction in output during the other times of the year.

Snowy output levels followed a similar pattern in the SSR scenario, particularly in the contracted high case as was seen for the production cost results. In the contracted low case, we observed a smaller increase in Murray generation during peak times and a larger reduction in Tumut generation. The overall effect was closer to a switching of Snowy Hydro generation from Tumut to Murray rather than a significant net increase in output at peak times. Again, this outcome is consistent with the production cost results and bidding analysis outlined for this contracting case.

Changes in output in the SG scenario relative to the Base scenario were of a smaller magnitude than in the other scenarios, as would be expected due to the identical constraint representation. In 2007/08, when production cost savings were positive for both the contracted high and low cases, we observe an increase in Tumut generation at peak times.

Figure B.27 Change in Murray and Tumut output relative to Base - Abolition

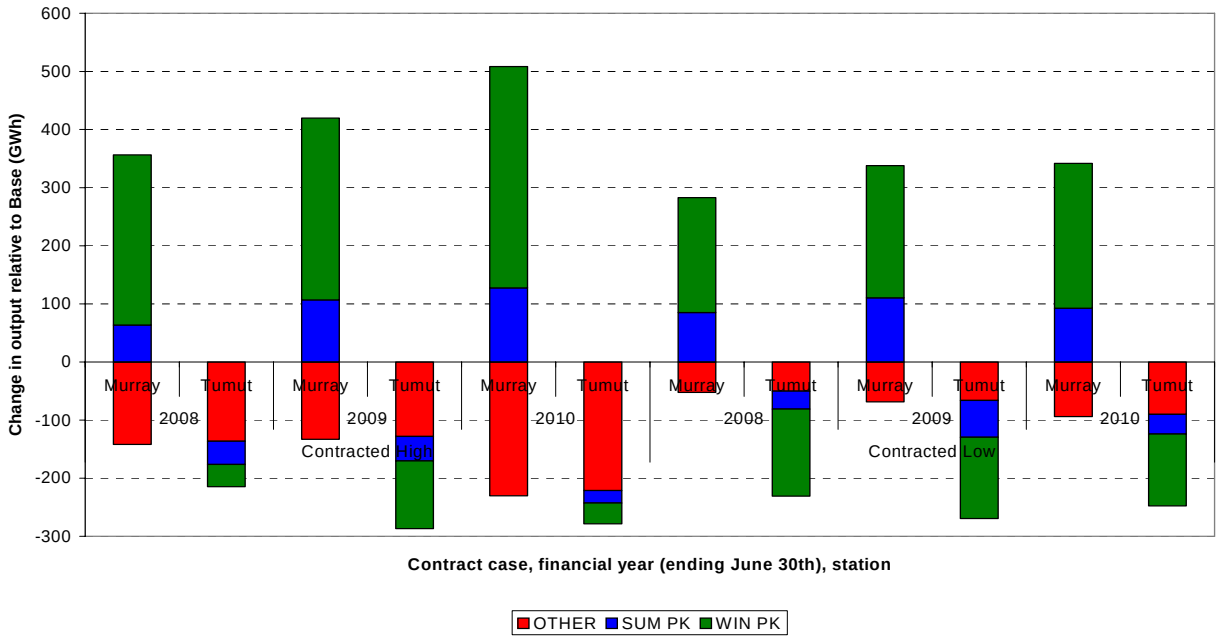


Figure B.28 Change in Murray and Tumut output relative to Base - SSR

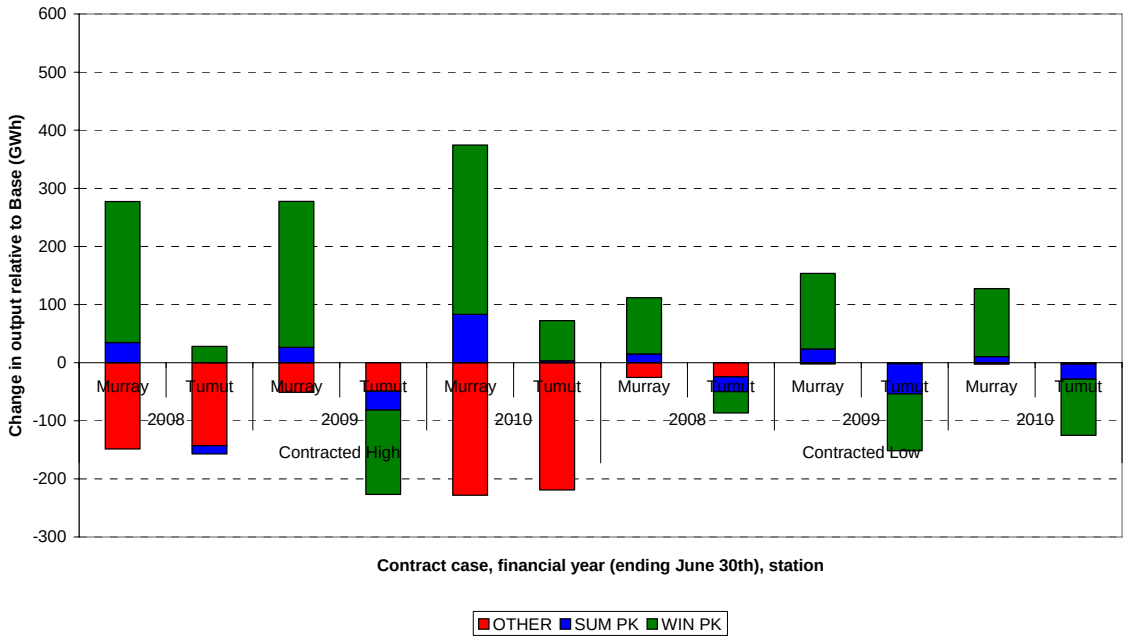
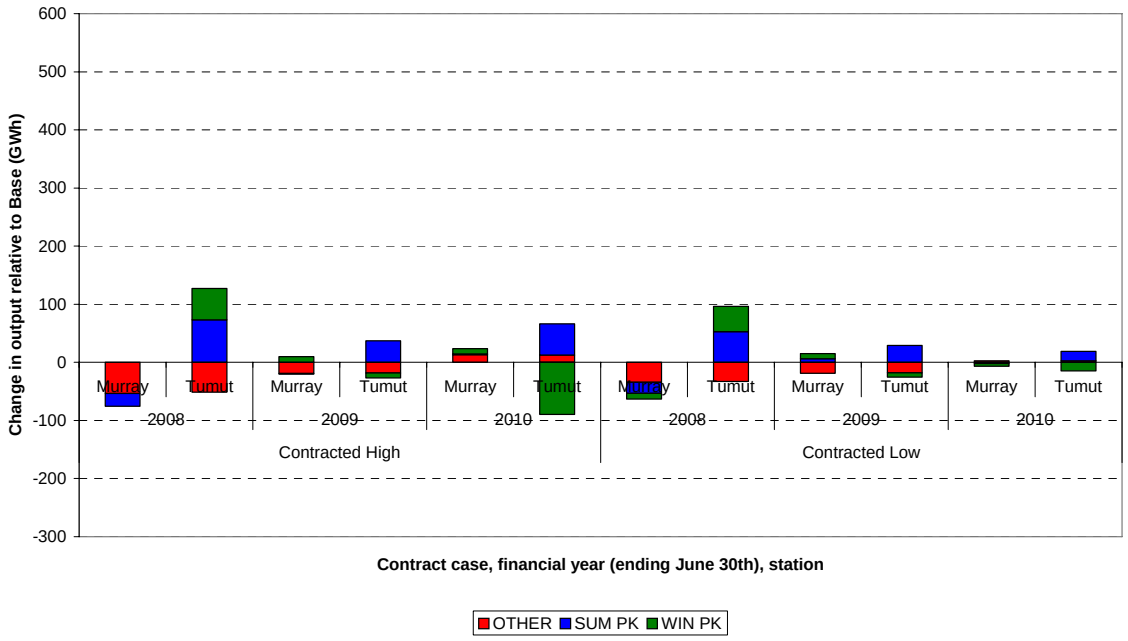


Figure B.29 Change in Murray and Tumut output relative to Base – SG scenario



Some slight changes in annual production between the Northern and Southern generators across the year were observed in the results. The differences between the Base scenario and a given proposal did not exceed roughly 50GWh across the year

(out of an annual production level of at least 212TWh). These changes did not follow any particular pattern across the years and contract cases modelled.

B.3.2.12 Changes in flows

Figure B.30 show the change in net energy transfers from Victoria to Murray and from Tumut to NSW, when the Abolition scenario is completed to the Base Case. The changes in net energy transfers are split into summer and winter "super peak" periods. Figure B.31 and Figure B.32 show the same figure for the SSR and SG scenarios respectively. In all figures, positive Murray to Victoria values represent an increase in power transferred in a southward direction under the relevant scenario, while positive Tumut to NSW values represent an increase in power transferred northwards.

Increases in flows out of the Snowy region can be observed for both the Abolition and SG scenarios, particularly during winter peak times (which represent a greater number of hours than the summer peak times). This was attributable to Snowy Hydro being incentivised to offer more capacity into the market as a result of reduced system congestion, resulting in greater levels of dispatch. Only minor variations in the SG scenario were observed, as would be expected given that there is no change in the constraint representations between the SG and Base scenarios.

Figure B.30 Changes in net flows relative to the Base scenario – Abolition scenario

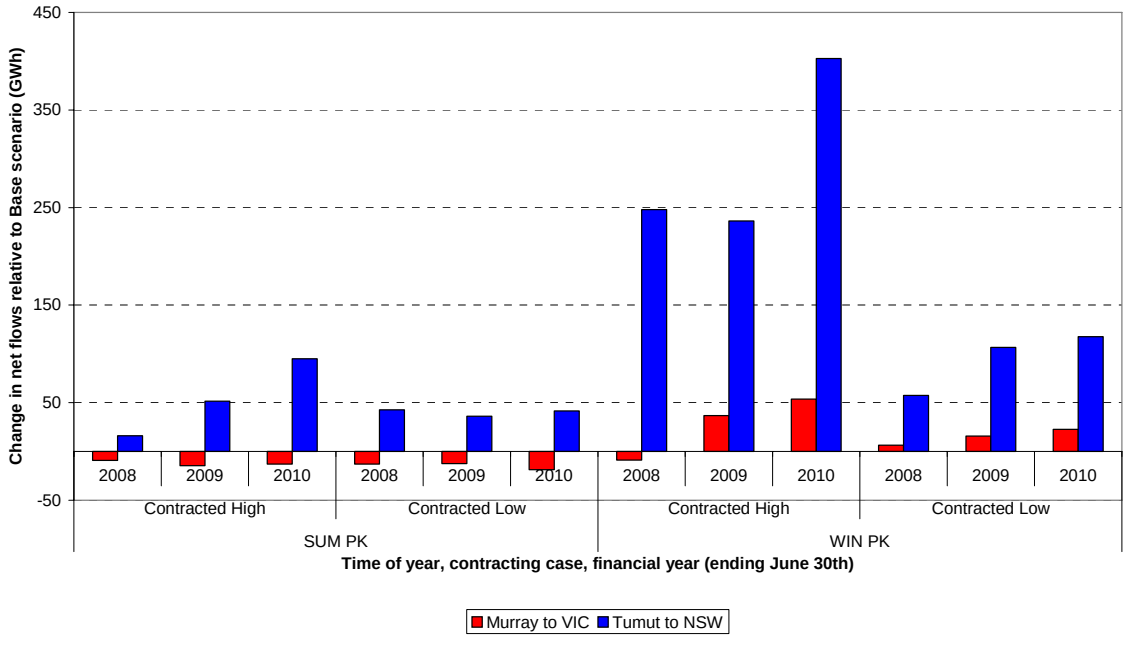


Figure B.31 Changes in net flows relative to the Base scenario – SSR scenario

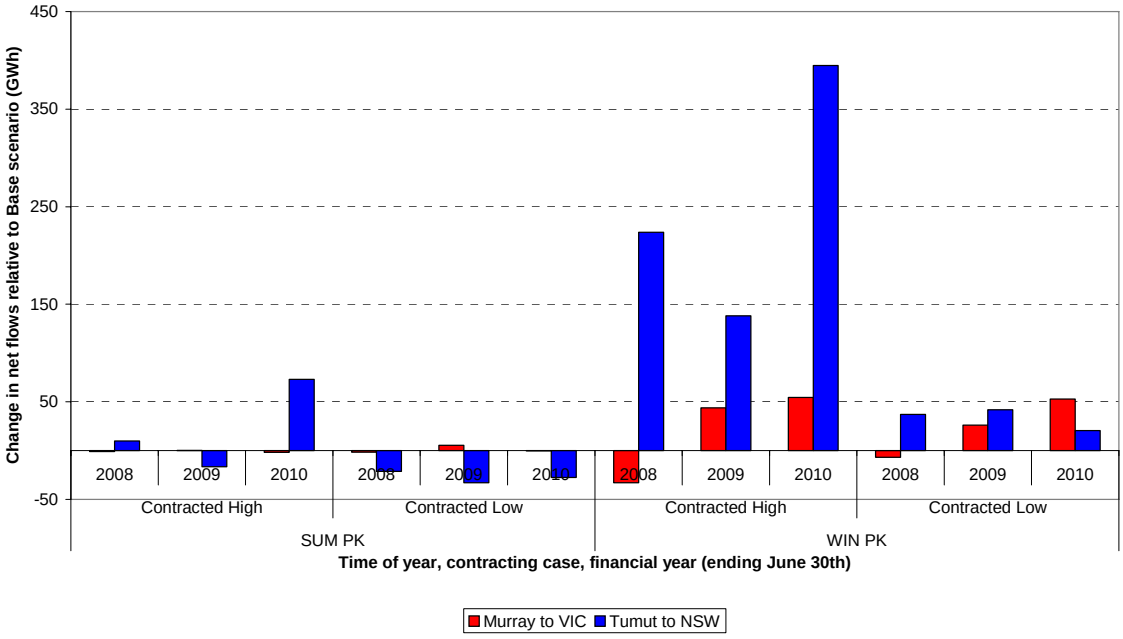
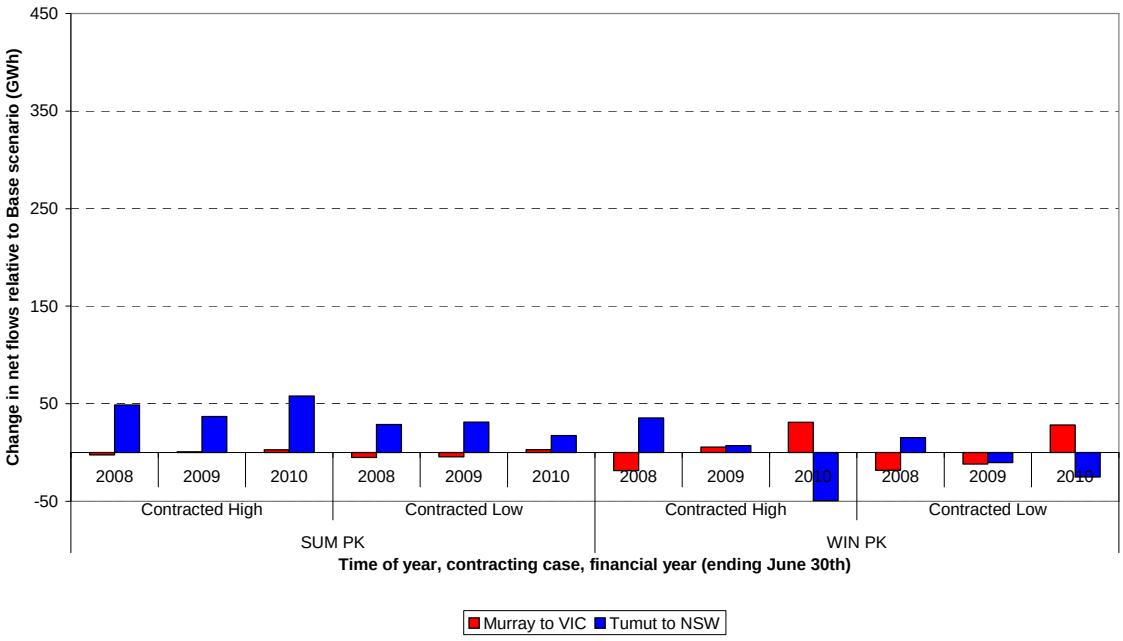


Figure B.32 Changes in net flows relative to the Base scenario – SG scenario



B.3.2.13 Price effects

Figure B.33 and Figure B.34 show the results for the time-weighted average annual prices for NSW and Victoria, respectively. The peak summer demand points (when high volatility is typically observed) predominantly drove differences in prices between the scenarios. Changes to region boundaries generally led to a reduction in prices due to baseload plant displacing relatively expensive plant, as discussed above. Small decreases were also observed in the SG scenario.

The Base scenario generally resulted in the highest prices of all four scenarios for each year and contract case in both NSW and Victoria. The Abolition scenario resulted in the lowest price outcomes for the majority of years and contract cases. This is consistent with the production cost savings results presented earlier, particularly where it was shown that significant amounts of mid merit and/or peaking generation is displaced by cheaper baseload generation.

The South Morang constraint[151] played a significant role in the price outcomes of the modelling. In all instances where a significantly reduced price was observed relative to the Base scenario we observed the South Morang constraint binding less frequently. This outcome conforms with observed market outcomes, which reveal a coincidence of the South Morang constraint binding and high regional prices. The results of the next Section show that this constraint bound least frequently in the Abolition scenario and the SSR scenario relative to the Base scenario. The majority of price changes occurred during the summer peak times, and to a lesser extent during the winter peak times. Differences in pricing outcomes during the other times of the year were immaterial between the scenarios. These outcomes were consistent with the modelling undertaken for the Abolition proposal draft Rule determination.

[151] In the 2005 ANTS the South Morang constraint on the F2 transformer was referred to as VH>V3NIL. In later years this constraint has also be referred to as V>>H_NIL_2_R, V>>H_NIL_3_R and V>>V_NIL_3B_R.

Figure B.33 Average annual prices – NSW

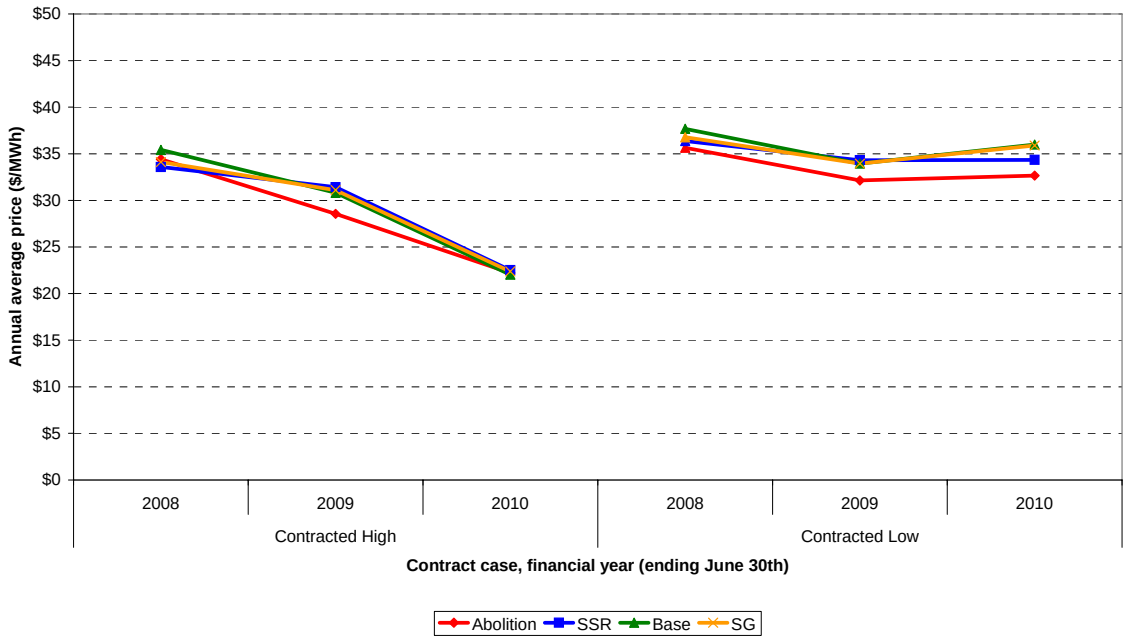
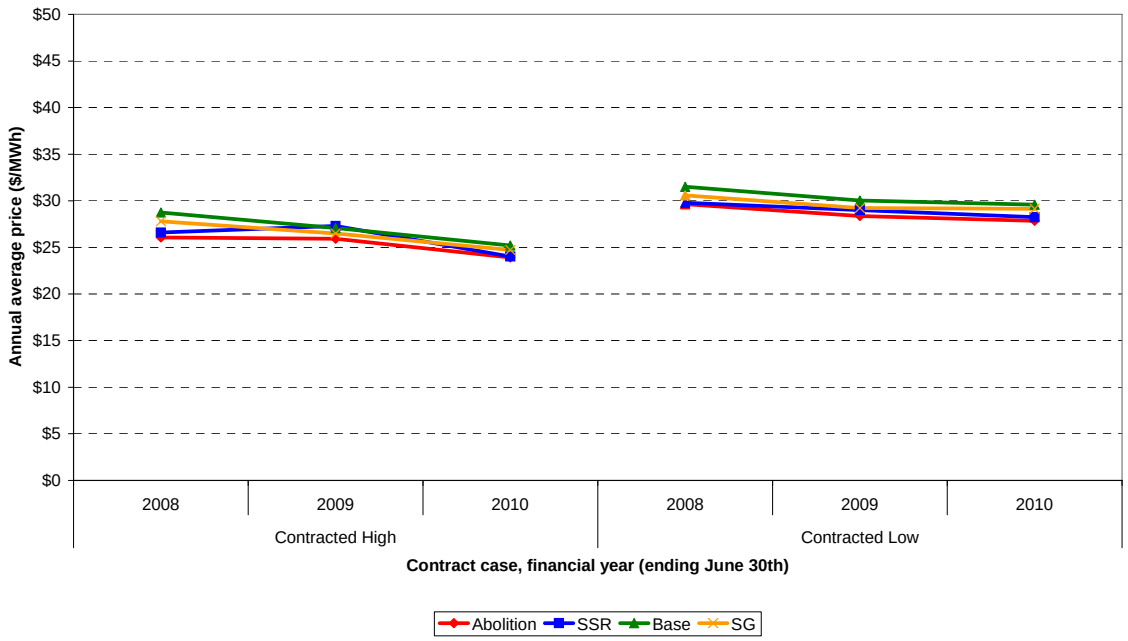


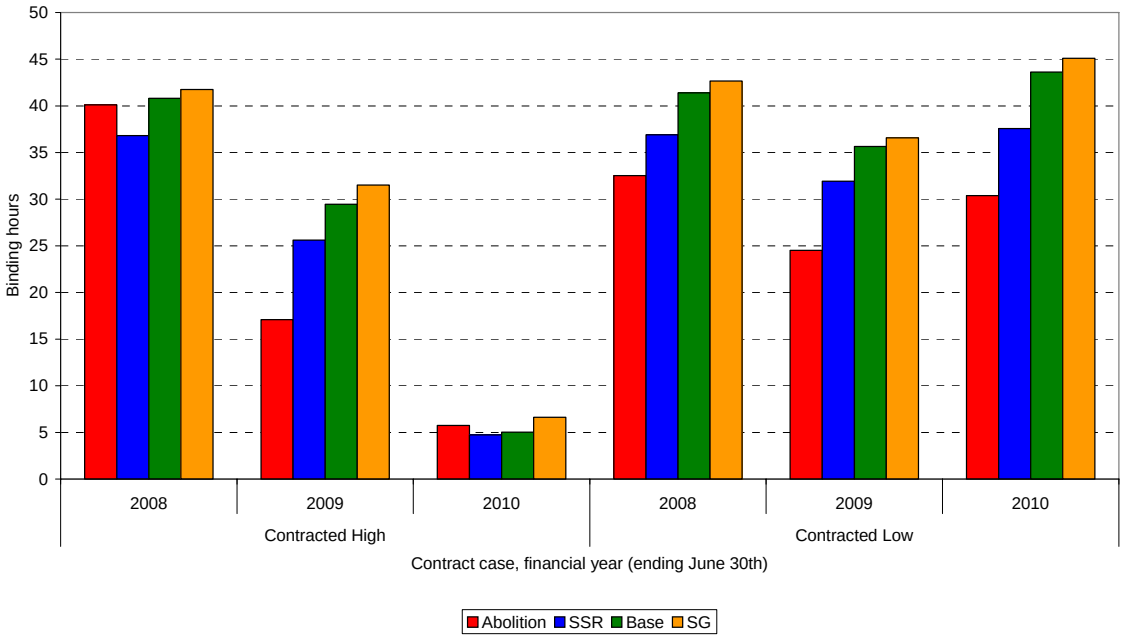
Figure B.34 Average annual prices - Victoria



B.3.2.14 Incidence of constraints

The previous Section noted the effect of the South Morang constraint on wholesale spot prices. The South Morang constraint is imposed to avoid overloading the F2 transformer at South Morang. Figure B.35 shows the frequency with which the South Morang constraint bound across the four scenarios. We observe that the Abolition scenario resulted in the lowest level of congestion on this constraint, followed by the SSR, Base, and SG scenarios in increasing frequency of constrained hours for the majority of years and contracting cases.

Figure B.35 South Morang constraint – frequency of occurrence



Numerous other constraints also bound in the modelling across the various years and scenarios. Figure B.36 and Figure B.37 show the hours of binding constraint by category for the contracted high and low cases respectively. The categories have been chosen to reflect cutsets relevant to the analysis, with particular focus on the Snowy region and the immediately surrounding area. Data were also included for other regions of the NEM where congestion could arise as a follow-on effect of a Snowy region boundary change – Victoria NSW and transfers from NSW to Queensland. Voltage and stability constraints were also included, as was a discretionary constraint category. This category consisted of essentially the Victoria to Snowy interconnector 1,900MW hard limit on southern flows.

Data for northern Queensland and for flows from Victoria to South Australia are not shown in the figures. The northern Queensland data were not considered relevant to the analysis. Similarly, the constraints that set the hard flow limits on the Victoria to South Australia and MurrayLink interconnectors bound for almost all of the demand points that were modelled competitively (+8,000 hours). It should come as no

surprise that bidding all Victorian brown coal into the market at SRMC at these times would result in significant flows of power from Victoria to South Australia.

The figures show that constraints were observed primarily around the NSW to Queensland border, internally throughout NSW, on the western ring[152] within NSW (grouped as "Liddell-Tom") and on the Murray-Tumut lines. Stability constraints also bound relatively frequently. Lesser congestion arose north of Tumut and around South Morang. The South Morang constraint, although it bound for a relatively small number of hours, was a significant driver of pricing outcomes in the modelling.

Relative to Base scenario, the two region boundary change proposals led to a substantial change to the location of congestion. Constraints on the Murray-Tumut lines effectively ceased to bind and there was a marked reduction in the frequency of stability constraints and NSW to Queensland transfer limit constraints binding. The South Morang constraint also bound less frequently, as discussed above. These reductions were offset, to some extent, by an increase in congestion elsewhere in the network. The internal NSW constraints reflected transfers of power from baseload generation in NSW to Queensland and could potentially lead to any of the NSW baseload generators being either constrained-on or -off.

These constraints bound with greater frequency in the region boundary change scenarios relative to the Base case, in line with the fact that more power flowed northwards from the Snowy region. Similarly, we also observed a slight increase in congestion north of Tumut. An increase in the discretionary constraints (essentially the 1900MW hard limit on southward flows from Snowy to Victoria) bounds more frequently. Again, this reflected increased production at Snowy Hydro at certain times.

The SG scenario produced outcomes that were generally similar to those seen in the Base scenario given that the constraint formulation between the scenarios was essentially identical. The major difference was in the incidence of Murray-Tumut congestion, where lower levels were observed in the SG scenario. This reflected Snowy Hydro's altered incentives and the resultant sustainable bidding patterns.

In terms of production cost drivers, the most significant change in the pattern of congestion was that the Murray-Tumut constraints ceased to bind in the Abolition and SSR scenarios (as discussed in detail above). The reduction in the frequency of the South Morang constraint binding was the primary driver of the observed price effects in the modelling.

[152] The "western ring" constraint is discussed in Appendix D.

Figure B.36 Binding constraints by category – contracted high

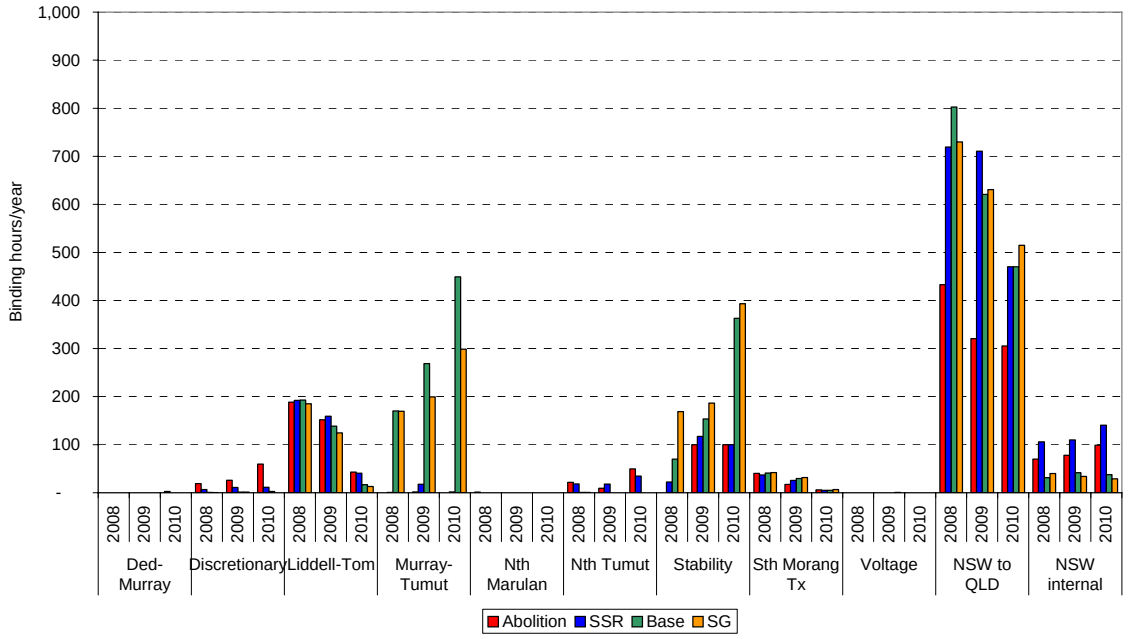


Figure B.37 Binding constraints by category – contracted low

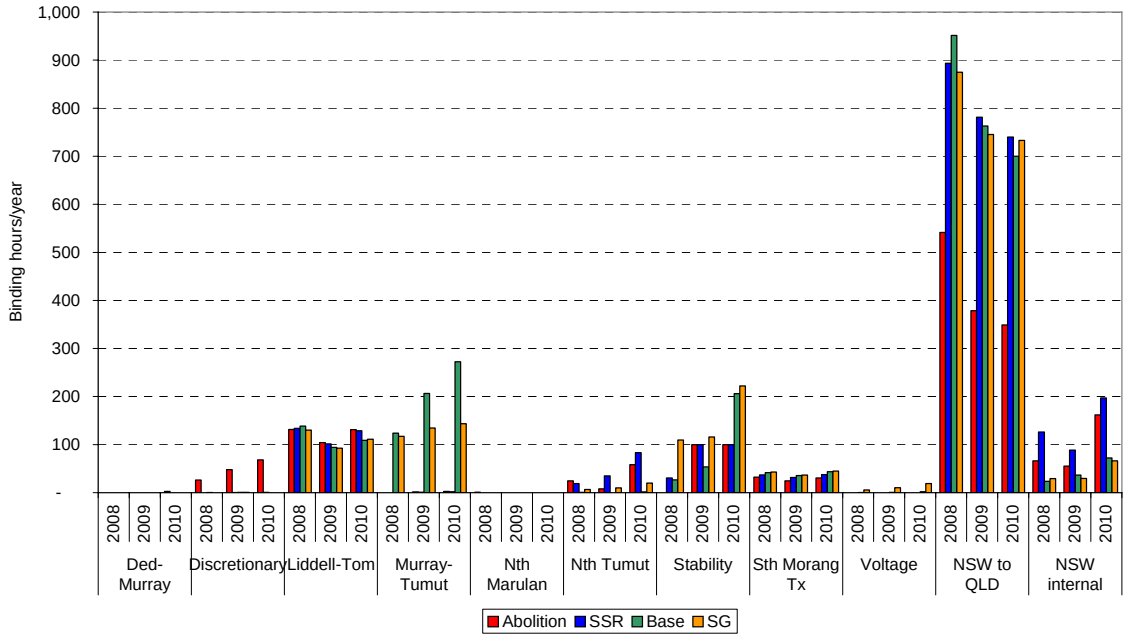


Figure B.38 and Figure B.39 show the average dual price when particular groups of constraints bound. The dual price of a constraint in an optimisation problem for the dispatch of an electricity market reflects the change in total system cost if the right hand side of the constraint were increased by one unit. For example, the dispatch problem includes a constraint stating that supply must equal demand. By increasing

the value of demand by one unit and looking the change in the total system cost (objective function), the dual price of the constraint can be determined. In the case of a supply must equal demand constraint, this dual is usually identified as the system marginal price, as it reflects the marginal cost of meeting an extra unit of demand.

For the grouped constraints represented below, the averaged dual prices *do not* have an obvious economic interpretation. This mostly reflects the fact that the constraints were not normalised relative to each other – the right hand sides of the constraints reflect line ratings on different lines. Effectively, we averaged over "apples and oranges". They do, however, reflect the extent to which the given set of constraints would alter dispatch patterns when they bound. As such, the results presented in Figure B.38 and Figure B.39 should be used as an indicative measure of the severity of constraint in NEM, rather than as an absolute measure.

Using these duals as an indicator of the severity of constraints, the greatest effect by far was for the internal NSW constraints, followed by the NSW to Queensland transfer constraints. Both of these groupings involve terms for the large NSW baseload generators and set flow limits on DirectLink and QNI. When these constraints bind, they lead to price separation between NSW and Queensland and also potentially between NSW and the Southern regions (to the extent that changes in baseload output across NSW can bind the southern interconnectors). The result is that when these constraints bind, the duals associated with them are relatively high reflecting interregional price separation.

The Western ring (Liddell-Tom) and South Morang constraints also have non-trivial constraint duals, reflecting their impact on dispatch.

Figure B.38 Average dual prices by category – contracted high

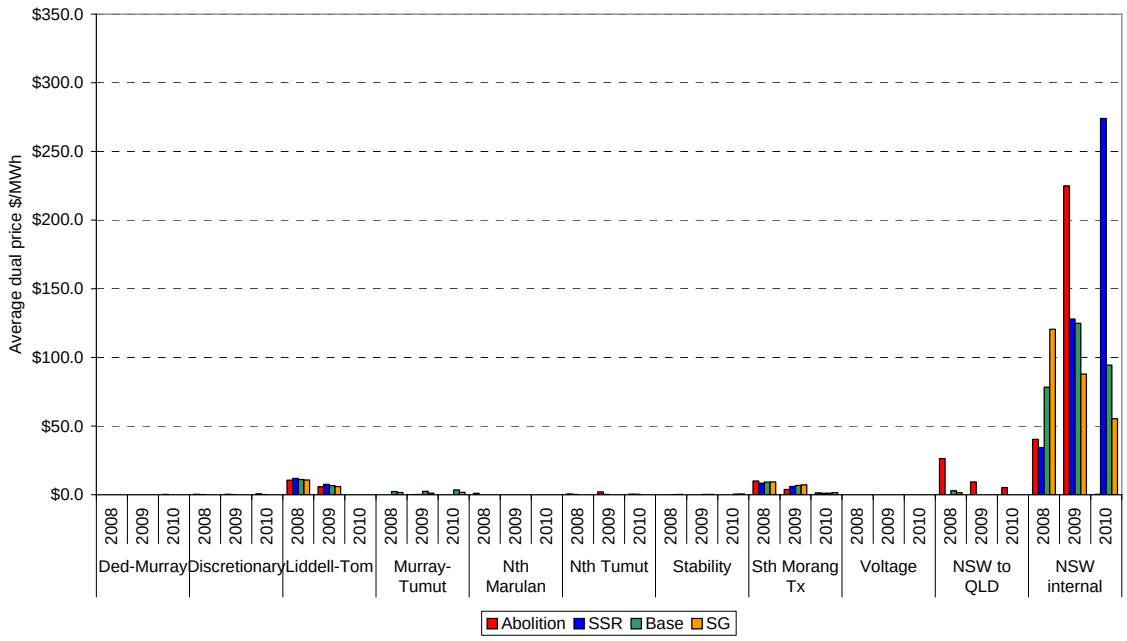
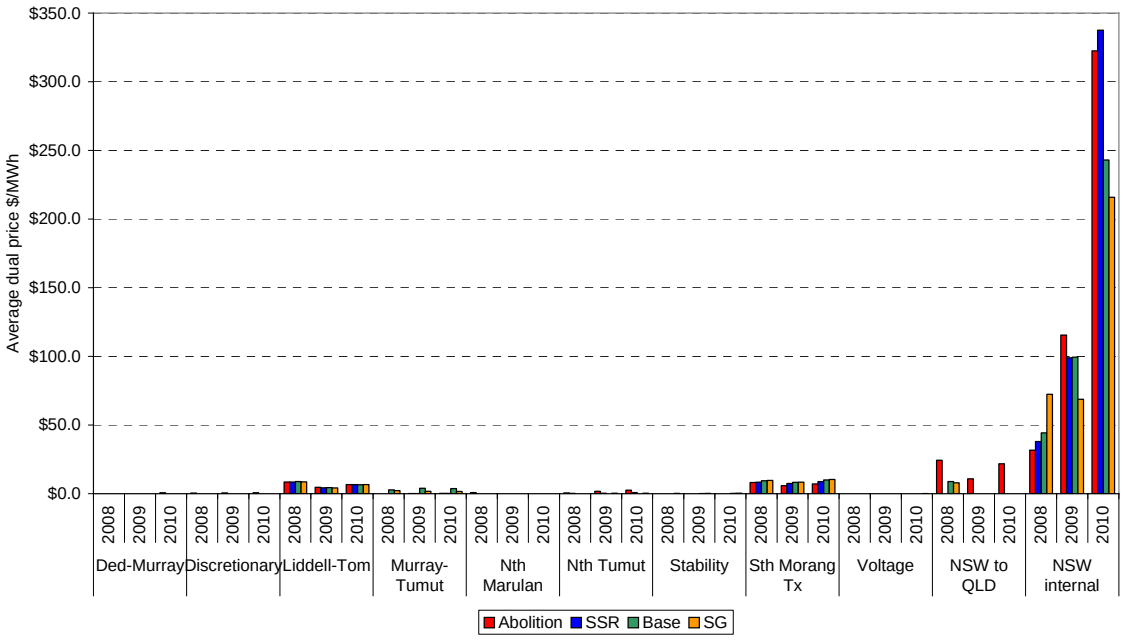


Figure B.39 Average dual prices by category – contracted low



B.3.2.15 Incidence of clamping to manage negative settlement residues

As discussed previously in this Appendix, for this modelling undertaken to inform this Rule determination, NEMMCO was assumed to manage negative settlement residues on all interconnectors, except southward flows on the Victoria to Snowy interconnector in the Base scenario and Victoria to Snowy interconnector flows in either direction in the SG scenarios. Clamping was assumed to be activated with a $6,000/per hour threshold, meaning that the flow on a given interconnector would be set to zero if the residue would otherwise exceed this threshold. Clamping on QNI/DirectLink and Heywood/MurrayLink only occurred when the *net* residue across both interconnectors was less than the clamping threshold, in line with NEMMCO's implementation for these interconnectors.[153]

Although a greater number of interconnectors were subject to clamping in the modelling for this Rule determination, the assumption of a $6,000 threshold and the use of a net clamping approach on some interconnectors resulted in a reduced incidence of clamping relative to the Abolition proposal draft Rule determination results. This approach more accurately reflects the policy towards clamping that NEMMCO currently applies than the approach previously modelled.

Figure B.40 and Figure B.41 show hours of clamping on the Snowy region and other inter-regional interconnectors, respectively. Where a given interconnector is not shown on the graph, e.g. the Victoria to NSW or Murray to Tumut interconnectors in Figure B.40, it should be inferred that no clamping was observed. Of the two interconnectors that connect to the Snowy region, in the Base scenario the greatest incidence of clamping was for the Snowy-NSW interconnector. Clamping on this interconnector was in the order of 1% of the year. Some minor clamping also occurred on the Victoria-Murray and Tumut-NSW interconnectors in the SSR scenario. No clamping was observed in the Abolition and SG scenarios for the relevant interconnectors around the Snowy region.

Figure B.41 shows the incidence of clamping on other interconnectors in the system. Relatively low levels of clamping (less than 0.1% of the year) were observed on these interconnectors.

[153] See NEMMCO, *Operating Procedure, Dispatch*, doc no: SO_OP3705, Rev 46, 16/03/07.

Figure B.40 Hours of clamping, Snowy region interconnectors

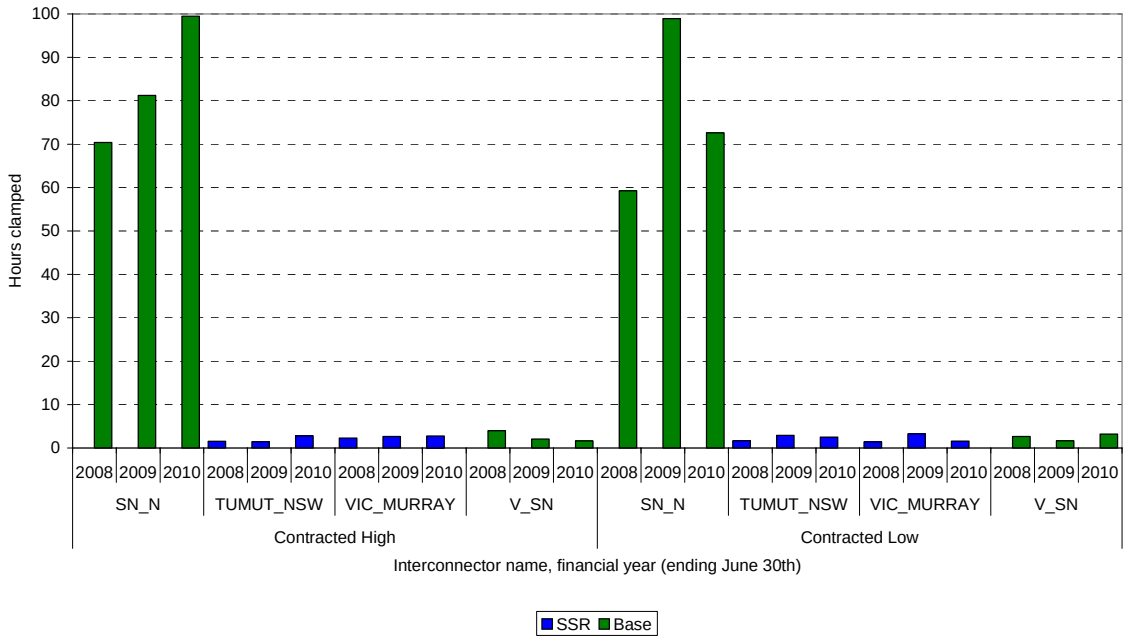
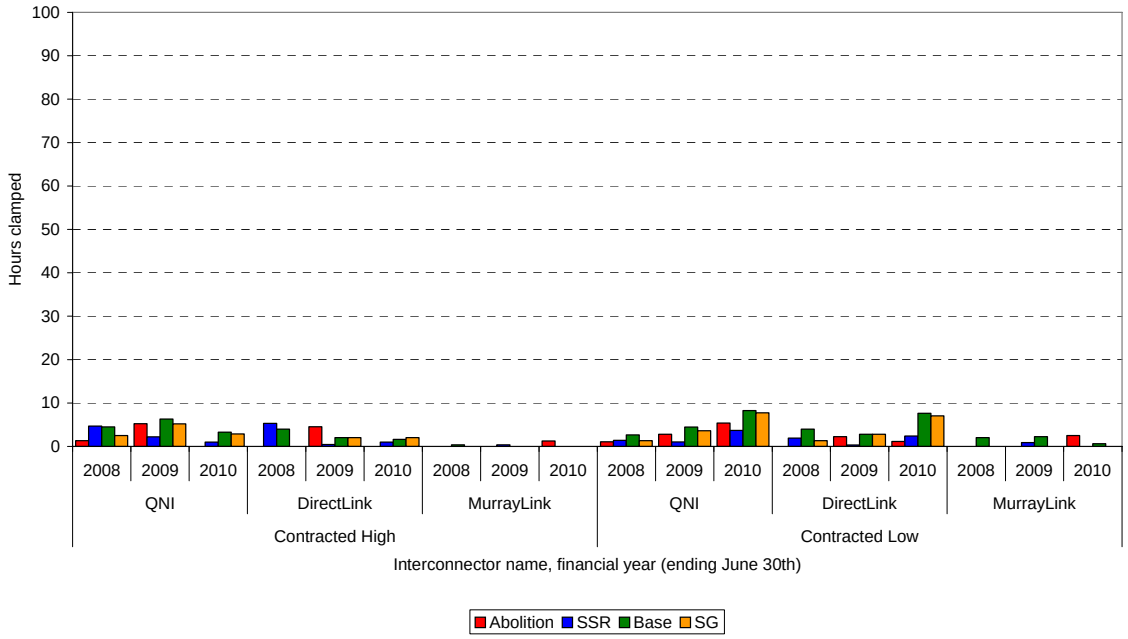


Figure B.41 Hours of clamping, other interconnectors



B.4 Risk modelling

This Section discusses the approach, assumptions, results, and conclusions for the forward-looking risk modelling analysis.

B.4.1 Approach

The risk modelling was undertaken using Frontier Economics' portfolio optimisation model, *STRIKE*. This discussion begins by describing some of the key features of this model before discussing the methodology used to calculate the risk implications of the Abolition, SSR, SG, and Base scenarios.

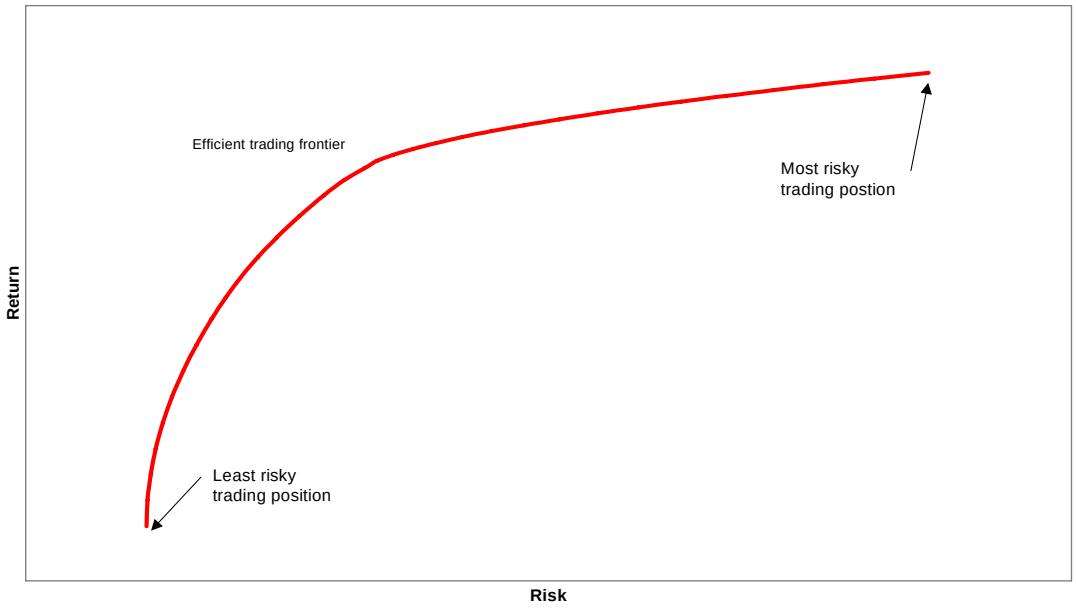
B.4.1.1 Key features of *STRIKE*

The *STRIKE* financial model uses portfolio theory to determine an efficient mix of energy purchasing instruments from a suite of options (spot, physical and financial) for a range of risk levels. Each efficient combination of instruments is represented as a point on a frontier, against which other portfolios can be compared.

Portfolio theory sets out how rational investors would use diversification to optimise their portfolios and how an asset should be priced given its risk relative to the market as a whole. More specifically, portfolio theory estimates the return of an asset as a random variable and a portfolio as a weighted combination of assets. The return of a portfolio is therefore a random variable and consequently has an expected value and a variance. Risk in this economic model is usually identified with the standard deviation of portfolio return (although other measures of risk can be used). For a given expected return, a rational investor would choose the least risk portfolio. In portfolio theory this relationship between risk and reward is represented by an efficient frontier (see Figure B.42).

The efficient frontier describes the outer edge of every possible portfolio of assets that could be plotted in risk-return space. Portfolios of assets along this line deliver lowest risk for a given level of expected return. Conversely, for a given amount of risk, the portfolio lying on the efficient frontier represents the combination of assets offering the best possible expected return. Any portfolio that lies below and/or to the right of the efficient frontier is sub-optimal, delivering either a lower expected return and/or higher level of risk than a portfolio lying on the frontier. It is not possible to construct a portfolio that lies above and/or to the left of the efficient frontier. The model calculates the outer edge (frontier) of every possible portfolio using an advanced quadratic mixed integer programming technique.

Figure B.42 A generalised efficient frontier for hedging energy trading risks



B.4.1.2 Methodology

As market conditions change, so does the efficient frontier. This enables the impact of changes in spot price volatility and IRSR firmness arising from the various options to be compared.

The risk modelling was undertaken for several key scenarios:

- A Victorian generator hedging at the NSW node;
- A NSW generator hedging at the Victorian node; and
- A Snowy Hydro generator hedging at both the Victorian and NSW nodes concurrently.

Each of the options affect the existence and/or magnitude of settlement residues accruing between Victoria, Murray, Tumut and NSW. The above cases cover the range of likely risk-management applications using combinations of the relevant residues.

In each case, *STRIKE* was run to calculate the efficient frontier for the given set of price duration curves and IRSR units.

The precise effect of a region boundary change on risk will depend on where participants choose to locate on the efficient frontier – that is, their risk preferences. Given that the analysis is primarily concerned with the *relative* effects of the alternative proposals, for simplicity the results are presented for the most conservative risk position on the efficient frontier (that is, the bottom left point of the efficient frontier).

The analysis assumes a generator in a given region has a fixed inter-regional position and determines the minimum risk (measured in $/MWh standard deviation in return) associated with that same position under each of the Base, SG, SSR, and Abolition scenarios. It is the level of risk associated with the minimum risk position for each scenario that is presented in the results Section below.

B.4.1.3 Assumptions

The risk modelling was based on the spot prices and IRSRs produced by the dispatch modelling for the Base case, SG, SSR, and Abolition scenarios described above.

For each of the spot price series and associated IRSR units, the analysis compared the efficient frontiers for each of the following hypothetical generators with an inter-regional position using the relevant IRSR units between Victoria, Murray, Tumut and NSW:

- Victoria into NSW: A 100MW Victorian generator with a 100MW position in NSW and able to purchase a mix of relevant northward IRSR units;
- NSW into Victoria: A 100MW NSW generator with a 100MW position in Victoria and able to purchase a mix of relevant southward IRSR units; and
- Murray/Tumut into Victoria/NSW: A 100MW Snowy Hydro generator (50MW at Murray and 50MW at Tumut) with a 50MW position in Victoria and a 50MW position in NSW and able to purchase a mix of relevant IRSR units.

For the purposes of comparison, the generation and inter-regional position were assumed to be consistent in each case. IRSR units were assumed to be available to the generator at actuarially fair cost (i.e. the cost of the unit was equal to the expected return of the residues[154]).

B.4.1.4 Results

The *STRIKE* results are presented below in Figure B.43 and show the level of risk associated with the risk-minimising inter-regional position (including a risk-minimising mix of relevant IRSR units). Risk is expressed in terms of the standard deviation of returns for the optimised portfolio, in terms of $ per MWh covered by the inter-regional position.

The minimum risk results are a combination of two key factors, the underlying level of basis risk (uncertainty of price differentials between regions) and the effectiveness of the various IRSR units in offsetting that basis risk. The underlying basis risk may differ between the region boundary options modelled due to the impact that changes in the regional structure and constraints have on prices and hence price differentials,

[154] Note that the assumed cost of the IRSR units is inconsequential to this particular analysis. This is because the analysis focuses on determining the portfolio with minimum risk, and hence has no regard to cost. The minimum risk portfolio would be the same no matter what the assumed cost of the IRSR units.

but also due the behavioural effects the various change options have on participant bids. Similarly, the effectiveness if IRSR units to offset the basis risk may change between the options for similar reasons.

For inter-regional positions from NSW into Victoria and Murray/Tumut into Victoria/NSW, the analysis found that the Abolition scenario produced the lowest levels of risk, over all years and contracting cases, except for contracted high 2010 that exhibits significantly lower levels of underlying basis risk compared to earlier years. The Base scenario tended to produce the highest levels of risk, followed closely by the SG scenario and then the SSR scenario. For hedging from Murray/Tumut into Victoria/NSW, the analysis indicated that the Abolition scenario produces the lowest risk outcome.

This is intuitively obvious, as there is no inter-regional price risk for Snowy Hydro's generators under its proposal – Murray earns the Victorian price and Tumut earns the NSW price. These results were driven by the changes in underlying basis risk between the options, which happen to follow the level of prices in NSW and Victoria under each option. The implications is that lower prices correspond to lower inter-regional price risk. Whilst the effectiveness of relevant IRSR units may differ between the cases, the impact of this is not material enough to alter the ranking of options based on the underlying basis-risk.

For inter-regional positions from Victoria into NSW, the results differed somewhat. The SG scenario generally produced the lowest levels of risk, which is not surprising given that the Southern Generators Rule act to firm up the Victoria to NSW IRSRs. The SG scenario risk results were followed fairly closely by the Abolition scenario. Again, this is not surprising as the Abolition scenario produced the lowest, and hence least volatile, prices. It is important to note that the impact on contract competition in NSW at these times is somewhat ambiguous, because lower hedging by Victorian generators at the NSW RRN may be (more than) offset by greater hedging by Tumut at the NSW RRN. The Base and SSR scenario produced the highest levels of risk, interchanging between years and contracting cases with SSR scenario generally worse in risk terms than the Base scenario.

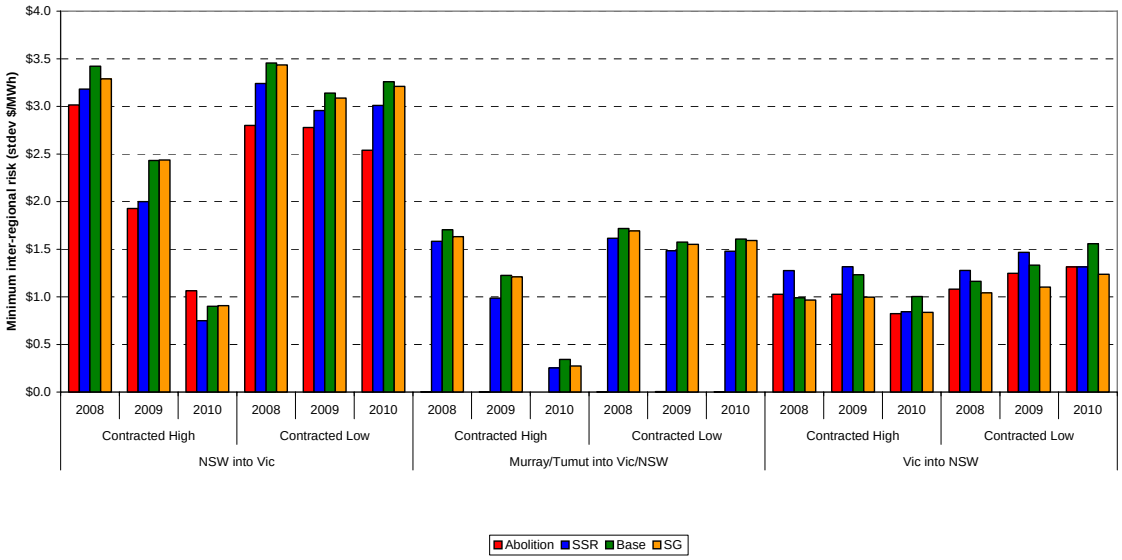
Importantly, the STRIKE modelling makes several assumptions that may not be borne out in reality – it assumes that:

- Participants can obtain as many IRSR units on whichever directional interconnectors they wish – that is, they bear no execution risk;

- Participants incur no material transactions costs in determining how many and what kind of IRSR units they need to best hedge their contract positions.

To the extent that these assumptions depart from reality, the STRIKE results may not provide an accurate reflection of the risk impacts of changes to the market structure. Note also that the STRIKE modelling does not consider the risks faced by generators within a given region contracting at their own RRN.

Figure B.43 Inter-regional risk results



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C Submission summary

This Appendix has three parts. Part 1 presents a summary of the submissions received on the single draft Rule determination on both the Split Snowy Region and Southern Generators' Congestion Pricing and Negative Residue Arrangements for the Snowy Region (Southern Generators' Congestion Pricing) proposals. Part 2 presents a summary of the submissions received on the Abolition of the Snowy Region proposal (Abolition proposal) draft Rule determination and first round submissions on the Split Snowy Region and Southern Generators' Congestion Pricing proposals. Part 3 presents a summary of submissions received during the Commission's first round consultation on the Abolition proposal. All submissions are available on the Commission's website.

The views presented in the submissions, and summarised in this Appendix, is an important input to the analysis of these three Rule change proposals presented in Appendix A.

Part 1 – Submissions on the single draft Rule determination on both the Split Snowy Region proposal and Southern Generators' Congestion Pricing proposal

Submissions on the single draft Rule determination on both the Split Snowy Region proposal and Southern Generators' Congestion Pricing proposal closed on 16 October 2007. The Commission received two submissions, one from Snowy Hydro and one from Origin Energy.

Snowy Hydro stated that it believed the Commission had taken "an appropriate integrated approach to assessing the competing alternatives."[155] It also noted that the Commission had taken an appropriate modelling approach to assess the competing proposals. Snowy Hydro supported the Commission's conclusions, stating that the decision was consistent with the NEM's region-designed market and, when compared to the other proposals, was more transparent and less complex.

Origin Energy noted that the Commission accepted the Abolition proposal because that proposal addressed congestion in the Snowy region in a manner that most appropriately balanced dispatch efficiency and inter-regional trading risks. In contrast, Origin Energy considered that the Split Snowy Region proposal focussed on dispatch efficiency at the exclusion of trading risk. Origin Energy noted that given this reason and the recent final Rule determination on the Abolition proposal, that

[155] Snowy Hydro, s.99 submission, Split Snowy Region and Congestion Pricing and Negative Residue Management Arrangements for the Snowy Region (Southern Generators' Congestion Pricing), Draft Rule Determination, 12 October 2007, p.1.

the Commission should not accept the Split Snowy region proposal.[156] The submission did not consider the Southern Generators' Congestion Pricing proposal.

Part 2 – Submissions on Abolition proposal draft Rule determination

C.1 Introduction

This Part summarises the submissions on the Abolition proposal draft Rule determination, the Split Snowy Region proposal and Southern Generators' Congestion Pricing proposal. Submissions on these proposals closed on 30 April 2007.

A total of 17 organisations made submissions on the consultations on the Abolition proposal, the Split Snowy Region proposal and the Southern Generators' Congestion Pricing proposal in 27 separate submissions. The table below shows the organisations that submitted submissions, the Rule change to which the submission related and whether multiple submissions were made.

Table C.1: Submissions reviewed

Organisation	Nature of Submission	Rule changes commented on in submission		
		Abolition proposal (s.99)	Split Snowy Region proposal (s.95)	SG Congestion Pricing proposal (s.95)
Country Energy	Single submission on 1 Rule change	✓	×	×
Delta Electricity	Single submission on 1 Rule change	✓	×	×
Electricity Supply Industry Planning Council (ESIPC)	Single submission on 1 Rule change	✓	×	×
EnergyAustralia	Single submission on 3 Rule changes	✓	✓	✓
Eraring Energy	Single submission on 3 Rule changes	✓	✓	✓

[156] Origin Energy, s.99 submission, Split Snowy Region and Southern Generators' Congestion Pricing, Draft Rule Determination submission, 16 October 2007.

Organisation	Nature of Submission	Rule changes commented on in submission		
		Abolition proposal (s.99)	Split Snowy Region proposal (s.95)	SG Congestion Pricing proposal (s.95)
ERM Power	Single submission on 1 Rule change	✓	×	×
Hydro Tasmania	Separate submissions on 2 Rule changes	✓	✓	×
International Power Australia	Single submission on 1 Rule change	✓	×	×
Macquarie Generation	Single submission on 3 Rule changes	✓	✓	✓
NEMMCO	Separate submissions on 3 Rule changes	✓	✓	✓
Origin Energy	Two submissions on 1 Rule change	✓	×	×
Snowy Hydro	Single submission(s) on 3 Rule changes	✓	✓	✓
South Australian Minister for Energy	Single submission on 1 Rule change	✓	×	×
Southern Generators[157]	Separate submission(s) on 2 Rule changes	✓	×	✓
TransGrid	Single submission on 3 Rule changes	✓	✓	✓
VENCorp	Single submission on 2 Rule changes	✓	✓	×
Westpac	Single submission on 2 Rule changes	✓	×	✓

This Section summarises the submissions primarily according to the assessment criteria used in the draft Rule determination, i.e.:

[157] The Southern Generators were: Loy Yang Marketing Management Company, AGL Hydro, International Power, TRUenergy, Flinders Power and Hydro Tasmania.

- economic efficiency of dispatch;
- pricing outcomes and participant responses;
- inter-regional trading and risk management;
- power system security, supply reliability, and technical issues;
- good regulatory practice;
- long term implications and consistency with public policy settings; and
- implementation.

Given the overlapping nature of the submissions on the Abolition proposal, the Split Snowy Region proposal and the Southern Generators' Congestion Pricing proposal, the summary below includes comments on all of these consultations against the Commission's assessment criteria. The discussion begins with comments from submissions on the Commissions approach and a separate section has been included to record specific comments on the modelling analysis.

C.2 The Commission's approach

A number of submissions were critical of the Commission's approach to the review.

Hydro Tasmania was not convinced that the Commission had adequately developed a range of alternative NEM regional structures. Rather, Hydro Tasmania suggested that the Commission responded to a series of ad hoc proposals, which was not the best way to respond.[158]

The Southern Generators suggested that the Commission had adopted a poor approach by creating and examining alternative options rather than considering the main arguments made by the proponent for the Rule change proposal. The Southern Generators' contended that the Commission failed to consider the current arrangements (including the CSP/CSC Trial and Southern Generators Rule change) in its assessment of the alternatives, was inconsistent in its approach throughout the Rule change process and examined a base case that was extremely unlikely to occur (the business as usual case).[159]

ESIPC suggested that the Commission's analysis was between two flawed options.[160] They indicated that they were interested in seeing an effective boundary and

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[158] Hydro Tasmania, s.99 submission, Abolition of Snowy Region, Draft Rule Determination (Abolition), p.2.

[159] Southern Generators, s.99 submission, Abolition of Snowy Region, Draft Rule Determination (Abolition); s.95 submission, Congestion Pricing and Negative Residue Management Arrangements for the Snowy Region (Southern Generators' Congestion Pricing), pp.5-12, 18.

[160] Electricity Supply Industry Planning Council (ESIPC), s.99 submission, Abolition of Snowy Region, Draft Rule Determination (Abolition) p.2.

constraint management regime emerge from the broader work program of the Commission.[161]

Views were mixed as to the appropriateness of the alternatives considered by the Commission.

Origin Energy contended that the key alternatives to the Abolition proposal – the Split Snowy Region proposal and Southern Generators' Congestion Pricing proposal – were dismissed by the Commission for sound economic and legal reasons. Origin was of the view that re-examining these options would involve unnecessary duplication and inappropriate use of the regulatory process.[162]

Other participants suggested that the Commission's analysis should be expanded to include an assessment of the current CSP/CSC arrangements together with the Southern Generators' Congestion Pricing proposal as an alternative. The Southern Generators' contended that the Commission's failure to consider the current arrangements as an alternative was a major oversight in the analysis.[163] The ESIPC recommended that the Commission's analysis of the appropriate solution to address the problems in the Snowy region should consider the alternative of retaining the current CSP/CSC arrangements.[164]

Origin Energy noted that CSP/CSC arrangements could be a useful way to impose price signals while maintaining competitive neutrality. However, Origin Energy also suggested that CSP/CSCs are at an early stage of their development and are therefore not presently a viable alternative.[165]

Similarly, EnergyAustralia stated that the CSP/CSC arrangements require further assessment and development. EnergyAustralia noted difficulties with the CSP/CSC Trial to date, including reduced market liquidity at the NSW node and ongoing uncertainty in relation to SRA payouts.[166] Eraring Energy and Macquarie Generation noted that CSPs and CSCs were only intended to be developed as interim arrangements.[167] Snowy Hydro opposed the extension of the Southern Generators

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[161] ESIPC, s.99 Abolition submission, p2.

[162] Origin Energy, s.99 submission, Abolition of Snowy Region, Draft Rule Determination (Abolition), p1.

[163] Southern Generators, s.99 Abolition submission; s.95 Southern Generators' Congestion Pricing submission, pp.8-12.

[164] ESIPC, s.99 Abolition submission, pp.2-3.

[165] Origin Energy, s.99 Abolition submission, p.2.

[166] EnergyAustralia, s.99 submission, Abolition of Snowy Region, Draft Rule Determination (Abolition), p.3.

[167] Eraring Energy, joint s.99 submission, Abolition of Snowy Region, Draft Rule Determination (Abolition); s.95 submission, Congestion Pricing and Negative Residue Management Arrangements for the Snowy Region (Southern Generators' Congestion Pricing); and s.95 submission, Split Snowy Region, p.1; Macquarie Generation, joint s.99 submission, Abolition of Snowy Region, Draft Rule Determination (Abolition); s.95 submission, Congestion Pricing and Negative Residue Management Arrangements for the Snowy Region (Southern Generators' Congestion Pricing); and s.95 submission, Split Snowy Region, p.8.

Rule, and stated that it is resulting in serious mis-pricing for the La Trobe Valley, which is likely to require additional management over the summer.[168] Snowy Hydro supported the Commission's adoption of the business as usual case as an alternative, assuming the expiry of the partial CSP/CSC Trial.[169]

Hydro Tasmania preferred the maintenance of the existing market arrangements, but offered a variation on the Split Snowy Region as its second-preferred option. This variation involved Murray power station being used as the regional reference node (RRN) for the new Murray region and Dederang remaining in Victoria.[170] Hydro Tasmania suggested that negative settlement residues arising under this variation could be managed with a mechanism Southern Generator Rule. Meanwhile, Snowy Hydro contended that this would represent an additional patch.[171]

The Commission considers that in undertaking its assessment of these three Rule change proposals it has followed appropriate processes, to the extent its information and resources permitted. The Commission's timing was consistent with the unanimous agreement at the October 2006 Senior Industry Leaders Forum that the Snowy region was unique and required immediate attention prior to finalising the CMR and MCE Region boundary decisions. The Commission's approach to assessing these three Rule change proposals is discussed in more detail in Appendix A.

C.3 Economic efficiency of dispatch

Many submissions commended the extent of the Commission's analysis on the economic efficiency of dispatch in the Draft Rule Determination.[172] However, opinion was divided as to whether the Commission had reached the appropriate conclusions on the basis of that analysis in light of the other options available.

C.3.1 Efficiency of dispatch under abolition of Snowy region

Several participants were supportive of the Commission's analysis and the conclusion that abolition of the Snowy region was likely to improve the economic efficiency of dispatch compared to the base case (of status quo regional boundaries and NEMMCO intervention to manage counter-price flows). Country Energy, EnergyAustralia, Origin Energy and Snowy Hydro all supported the Commission's conclusions that the Abolition proposal would promote greater competition and improve the efficiency of dispatch, as well as improve the efficiency of pricing and

168 Snowy Hydro, letter to AEMC chairman, 15 March 2007, p.2.

169 Snowy Hydro, joint s.99 submission, Abolition of Snowy Region, Draft Rule Determination (Abolition); s.95 submission, Congestion Pricing and Negative Residue Management Arrangements for the Snowy Region (Southern Generators' Congestion Pricing); and s.95 submission, Split Snowy Region; 30 April 2007, pp.17-19.

170 Hydro Tasmania, s.99 Abolition submission, pp.2-3.

171 Hydro Tasmania, ibid, p.3; Snowy Hydro, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.21.

172 See for example Delta Electricity, s.99 submission, Abolition of Snowy Region, Draft Rule Determination (Abolition), p.2.

inter-regional trading.[173] Origin argued that the Abolition proposal would strengthen the incentives for Snowy Hydro to maximise its dispatch at the going price in each region, thereby improving dispatch efficiency.[174]

Some submissions expressed concerns over the likely efficiency of dispatch under the Abolition proposal. Most notably, Macquarie Generation suggested that because the Abolition proposal treats congestion between Tumut and the NSW RRN and between Murray and the Victorian RRN as intra-regional constraints, Snowy Hydro would face incentives to maximise generation during periods of binding intra-regional congestion, displacing lower cost generation.[175]

Three submissions commented on the Commission's concern that Snowy Hydro faced incentives to maintain "headroom" on the Snowy to NSW interconnector, reducing dispatch efficiency. Eraring Energy suggested that the Commission had given more weight to the maintaining headroom issue than the bidding-below-cost issue, without demonstrating a more detrimental impact for economic efficiency.[176] Similarly, Macquarie Generation did not consider that an incentive to keep 20-30MW of capacity of headroom during periods of high NSW and Queensland prices would significantly influence the degree of competition in NSW or the overall efficiency of dispatch.[177] The Southern Generators expressed scepticism about the potential impact of maintaining headroom on the Snowy to NSW interconnector.[178]

Snowy Hydro and Origin Energy noted that there was limited difference in terms of efficiency of dispatch between the alternatives considered, but stated that the Abolition proposal would have the greatest (positive) impact on the contract market.[179]

C.3.2 Efficiency of dispatch under the Split Snowy Region proposal

Some participants drew on the Commission's modelling and analysis to conclude that the Split Snowy Region proposal was likely to result in greater efficiency improvements than abolition of the Snowy region. Delta Electricity, Eraring Energy

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[173] Country Energy, s.99 submission, Abolition of Snowy Region, Draft Rule Determination (Abolition), p.2; EnergyAustralia, s.99 Abolition submission, p.1; Origin Energy, s.99 Abolition submission, p.1; Snowy Hydro, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.24.

[174] Origin Energy, s.99 Abolition submission, p.4.

[175] Macquarie Generation, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.2.

[176] Eraring Energy, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, pp.1-2.

[177] Macquarie Generation, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.6.

[178] Southern Generators, s.99 Abolition submission; s.95 Southern Generators' Congestion Pricing submission, p.27.

[179] Snowy Hydro, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.1; Origin Energy, s.99 Abolition submission, p.1.

and Macquarie Generation contended that by avoiding the creation of a remote intra-regional generator in both NSW and Victoria, the Split Snowy Region proposal would minimise the scope for generators to take advantage of intra-regional constraints. This would improve the efficiency of dispatch while avoiding counter price flows and a resulting reduction in IRSR firmness.[180] These participants referred to the modelling analysis in the draft Rule determination indicating that the Split Snowy Region proposal could deliver greater production cost savings than the Abolition proposal.

The Southern Generators referred to the Commission's and their own modelling analysis to show that dispatch efficiency was likely to be highest under the Split Snowy Region proposal. They noted that the modelling approach used meant that the increase in dispatch efficiency associated with the use of dynamic inter-regional loss factors rather than static loss factors was unlikely to be observable in the results, meaning the efficiency gains of the Snowy Split Region proposal found in the modelling were likely to be understated.[181]

Hydro Tasmania noted that by using Dederang as the RRN for the proposed new Murray region in the Split Snowy Region proposal, the option would lead to a dispatch outcome that was less optimal than under the current arrangements (with existing regional boundaries, a CSP/CSC regime at Tumut and the Southern Generators Rule in place).[182]

C.3.3 Efficiency of dispatch under the Southern Generators' Congestion Pricing proposal

The Southern Generators submitted[183] modelling analysis by ROAM Consulting to demonstrate that the current arrangements (with existing regional boundaries, a CSP/CSC regime at Tumut and the Southern Generators Rule in place) would result in an improvement in dispatch efficiency compared to the business as usual case, and that the Abolition proposal would decrease rather than improve dispatch efficiency compared to the current arrangements.[184] The ROAM report ranked the current arrangements as the least-cost dispatch option under Snowy Hydro strategic bidding assumptions but as the second-most expensive option under 'typical' Snowy Hydro bidding assumptions.[185]

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[180] Delta Electricity, s.99 Abolition submission, p.1-3; Eraring Energy, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.1-2; Macquarie Generation, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.3.

[181] Southern Generators, s.99 Abolition submission; s.95 Southern Generators' Congestion Pricing submission, p.15.

[182] Hydro Tasmania, s.95 Split Snowy Region submission, p.3.

[183] See Southern Generators, s.99 Abolition submission; s.95 Southern Generators' Congestion Pricing; submission p15.

[184] ROAM Consulting, *Analysis of the AEMC Draft Rule Determination to Abolish Snowy Region – Appendix A Modelling, Report to Southern Generators' Coalition*, 3 April 2007 (ROAM report).

[185] ROAM report, pp.I-II and pp13-18.

On the other hand, Snowy Hydro expressed serious concerns about the economic efficiency of dispatch under the Southern Generators' Congestion Pricing proposal. Snowy Hydro suggested that the (presently implemented) Southern Generators Rule was leading to inefficient pricing in Victoria, reduced flows across the (Victoria to Snowy) interconnector, negative settlement residues and increased uncertainty, with detrimental implications for the contract market.[186] In particular, Snowy Hydro stated that under the current arrangements, when the Murray-Tumut constraint binds, the offers of generators in Victoria, South Australia and Tasmania do not directly influence the Victorian price.[187] Rather, the Victorian price is set by a combination of the NSW RRP and the offers of Murray generation. This provides generators in the southern part of the NEM with incentives to maximise volume against the Victorian price, worsening the South Morang constraint.[188] In its submission, Snowy Hydro made specific reference to the events of 12th and 30th January 2007 as providing examples of the types of outcomes it described.[189]

In response, the Southern Generators contended that the market outcomes of 12 January 2007 were not the result of the implementation of the Southern Generators Rule. Rather, these outcomes were the result of a constraint at South Morang substation binding.[190] The Southern Generators stated that although constraints between Murray-Tumut also bound at this time, the outcomes described by Snowy Hydro would have occurred even if constraints between Murray and Tumut had not bound.[191] Further, the Southern Generators suggested that committed augmentation works would relieve constraints at South Morang over the next 12-18 months.[192]

C.4 Inter-regional trading and risk management

C.4.1 Inter-regional trade and risk management under the Abolition proposal

Snowy Hydro suggested that under its Abolition proposal, the NSW-Victorian interconnector would be the firmest interconnector in the NEM. It would provide 'full SRA access' for Victorian generators wishing to contract in NSW and 'reasonable access' for NSW generators wishing to contract in Victoria.[193] Country Energy agreed, noting that the Abolition proposal would impose the least disruption to

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186 Snowy Hydro, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, pp.14-15.

187 Snowy Hydro, s.99 supplementary submission, 26 March 2007, p.2 and Attachment A, pp.7-12.

188 Ibid.

189 Ibid, pp.1-2 and Attachment A, p.7, 9, 10 and 14.

190 Southern Generators letter to the AEMC, 8 March 2007, pp.1-3; Southern Generators, s.99 Abolition submission; s.95 Southern Generators' Congestion Pricing submission, p.16.

191 Southern Generators, s.99 Abolition submission; s.95 Southern Generators' Congestion Pricing submission, p.16.

192 Ibid.

193 Snowy Hydro, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, pp.40-41.

financial risk management and future investment, while enhancing inter-regional contracting.[194]

Several participants expressed concern regarding the potential for Snowy Hydro to exercise 'market power' over the new Victoria to NSW interconnector in the event of the abolition of the Snowy region. Delta Electricity noted that Snowy Hydro's Victorian gas turbine capacity together with its Murray plant could provide Snowy Hydro with market power on the new NSW-Victoria interconnector in both directions.[195] ERM Power contended that the draft Rule determination would institutionalise Snowy Hydro's market power, by legitimising its capability to constrain generation flows between the two regions. This would reduce the effective hedging products available in Victoria and NSW.[196]

Three participants supported the Commission's view that the Split Snowy Region proposal was likely to result in an increase in transaction costs and complexity detrimental to inter-regional trade compared to the Abolition proposal:

- Origin Energy stated that the Abolition proposal would reduce Snowy Hydro's incentives to influence settlement residue auctions (SRAs), thus lowering consequential inter-regional risks for participants.[197] Origin believed that the absence of basis risk for Snowy Hydro would encourage it to lower prices for its contracts, with flow-on benefits for the liquidity of the contract market, inter-regional trade and competition.[198] Origin Energy suggested that under the Split Snowy Region proposal, Snowy Hydro would have very strong incentives to purchase SRAs on these constrained links, which could in turn increase the complexity and associated risks of pricing inter-regional contracts;[199]

- EnergyAustralia was similarly concerned about an increase in risk and complexity of trading between Victoria and NSW under the Split Snowy Region proposal.[200] It noted that its implementation costs under a Split Snowy Region arrangement were likely to be $15,000, compared to $5,000 for the abolition of the Snowy Region;[201]

- Snowy Hydro commissioned consultants, Firecone Ventures (Firecone), to assess the impact of changes to the Snowy region on the contract market.[202] The Firecone report concluded that inter-regional trading risk is high and that the

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194 Country Energy, s.99 Abolition submission, p.2.

195 Delta Electricity, s.99 Abolition submission, p.4.

196 ERM Power, s.99 submission, Abolition of Snowy Region, Draft Rule Determination (Abolition), p.2.

197 Origin Energy, s.99 Abolition submission, p.4.

198 Ibid.

199 Ibid, pp.2-3.

200 EnergyAustralia, s.99 Abolition submission, p.3.

201 Ibid, pp.2-3.

202 Snowy Hydro, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.2.

instruments available to hedge it are weak.[203] The report discussed how the abolition of the Snowy Region would facilitate an increase in contract market competition.[204] Snowy Hydro suggested that the Commission's risk modelling underestimated the difficulty of trading under the Split Region option.[205] Snowy Hydro contended that both the Split Snowy Region proposal and the Southern Generators' Congestion Pricing proposal would substantially increase the complexity of assessing, pricing and managing inter-regional risk for Snowy Hydro.[206] Snowy Hydro concluded that the more granular pricing, either through more regions or a CSP/CSC arrangement, would reduce contract volume and liquidity and drive up contract prices.[207]

Westpac contended that the abolition of the Snowy region would result in significant mis-pricing in the spot and forward markets.[208] Westpac presented analysis to demonstrate that as the number of regions decrease, the ability to arbitrage the price differential between the remaining regions is reduced (rather than improved as assumed by the Commission) and transactions costs may increase.[209] Westpac concluded that the abolition of the Snowy region would materially degrade the ability to hedge inter-regionally.[210]

C.4.2 Inter-regional trade and risk management under the Split Snowy Region proposal

Several participants disagreed with the Commission's conclusions on the likely effect of the Split Region Option on inter-regional trading and risk management compared with the likely effect of the abolition of the Snowy region. These participants suggested that the additional risk and complexity associated with the Split Snowy Region proposal was unlikely to be material.

Hydro Tasmania noted that if there was no need for a region boundary at the existing boundaries to the Snowy region, any increase in inter-regional trading risk under the Split Snowy Region proposal was likely to be minimal.[211] The Southern Generators, Delta Electricity, Eraring Energy, Macquarie Generation and Hydro

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[203] Firecone Ventures, Impacts of changes to the Snowy Region on the Contract Market, April 2007 (Firecone report), p.ii and p.24. See also Snowy Hydro, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.2.

[204] Firecone report, pp.25-26. See also Snowy Hydro, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.2.

[205] Snowy Hydro, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, pp.25-26.

[206] Ibid, pp.26 and 28.

[207] Ibid, p.39.

[208] Westpac Institutional Bank (Westpac), s.99 submission, Abolition of Snowy Region, Draft Rule Determination (Abolition), p.1.

[209] Ibid, p.2.

[210] Ibid, p.3.

[211] Hydro Tasmania, s.95 Split Snowy Region submission, p.3.

Tasmania referred to the current linked-bid facility in SRAs, and suggested that it would enable basis risk to be managed under the Split Snowy Region proposal without greater difficulty than under the abolition of the Snowy region.[212] Macquarie Generation suggested that IRSRs would actually be made firmer, since Snowy Hydro would not have incentives to maximise output in a way that artificially limited inter-regional flows.[213] The Southern Generators suggested that the basis risk of trading between Victoria and NSW would decrease, because the number of material intra-regional constraints would be reduced.[214] They also considered that the Commission was conservative in interpreting the modelling results, given the material increase in risk under the Abolition proposal compared to the Split Snowy Region proposal.[215]

Eraring contended that the increased data and transparency of the Split Snowy Region proposal would lead to better pricing and risk management for inter-regional trading between the NSW and Victorian nodes.[216] Delta Electricity proposed arrangements for the holders of SRA units to be given the right to exchange their current holdings and acquire additional rights on new interconnectors under the Split Snowy Region proposal.[217]

Three submissions commented on the current restrictions on Snowy Hydro's participation in SRAs. Eraring Energy agreed with the Commission's view that the existing restrictions on Snowy Hydro would need to continue if the Abolition proposal were implemented.[218] By contrast, Snowy Hydro stated that the restriction on it purchasing inward IRSRs should be abolished with the Snowy region.[219] Snowy Hydro suggested that such restrictions would no longer be required since its generation would no longer be located in a region with no load.[220] NEMMCO stated that the Snowy restricted bidder clause (cl 3.18.2(h) of the Rules) needed to be either deleted or amended to reflect the new interconnectors.[221]

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212 Southern Generators, s.99 Abolition submission; s.95 Southern Generators' Congestion Pricing submission, p.30; Delta Electricity, s.99 Abolition submission, p.5; Eraring Energy, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.2; Macquarie Generation, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.4; Hydro Tasmania s.95 submission, Split Snowy Region, p.3.

213 Macquarie Generation, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.4.

214 Southern Generators, s.99 Abolition submission; s.95 Southern Generators' Congestion Pricing submission, p.30

215 Ibid, p.29.

216 Eraring Energy, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.5.

217 Delta Electricity, s.99 Abolition submission, p.5.

218 Eraring Energy, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.5.

219 Snowy Hydro, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.35.

220 Ibid.

221 NEMMCO, s.99 Abolition submission, p.4.

C.4.3 Inter-regional trade and risk management under the Southern Generators' Congestion Pricing proposal

Snowy Hydro contended that the current arrangements (based on the existing regional boundaries, the Tumut CSP/CSC and the Southern Generators Rule) were resulting in significant disruption and uncertainty. This implied that the Southern Generators' Congestion Pricing proposal was similarly likely to increase transaction costs in the contract market and reduce inter-regional trade.[222]

On the other hand, the Southern Generators stated that risks under their Congestion Pricing proposal would be lower than the business as usual, since:

- The Tumut CSP/CSC Trial arrangements have the effect of "firming up" residues on the Snowy-NSW interconnectors; and
- The Southern Generators Rule means NEMMCO does not need to clamp the Victoria-Snowy interconnector, increasing the firmness of residues on that interconnector.[223]

C.5 Pricing outcomes and participant responses

C.5.1 Pricing outcomes and participant responses under the Snowy proposal

Origin Energy and EnergyAustralia supported the Commission's findings that the Abolition proposal could have a beneficial effect on pricing outcomes and participant responses. EnergyAustralia believed that the Abolition proposal would require generators in adjacent regions to adopt a more competitive contracting and bidding strategy, resulting in more competitive spot, contract and retail prices.[224] Origin Energy suggested that greater competition around each RRN in Victoria and NSW would reduce Snowy Hydro's ability and incentives to influence the market price.[225] Origin also suggested that the Abolition proposal would lead to a more competitive contract market, encouraging generators to increase their level of contract cover and, as a result, bid more competitively into the spot market.[226]

In general, participants did not comment on the longer-term implications of the Abolition proposal for investment in the NEM. ESIPC suggested that the productivity gains from a region boundary change were likely to be modest, with the most material benefits – including improved price discovery and efficient pricing

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[222] Snowy Hydro, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.24.

[223] Southern Generators, s.99 Abolition submission; s.95 Southern Generators' Congestion Pricing submission, p.17.

[224] EnergyAustralia, s.99 Abolition submission, p.2.

[225] Origin Energy, s.99 Abolition submission, p.3.

[226] Ibid, pp.3-4.

and investment drivers – emerging in the longer term.[227] ESIPC expressed concern that using boundary change as an interim solution may result in perverse investment incentives.[228]

C.5.2 Pricing outcomes and participant responses under the Split Snowy Region proposal

Submissions were divided on the likely effect of the Split Snowy Region proposal on pricing outcomes and participant responses. The Southern Generators referred to the modelling in the draft Rule determination, which found that the Split Region Option was likely to lead to substantially lower prices in NSW than the Abolition proposal.[229] In contrast, EnergyAustralia stated that the Split Snowy Region proposal would increase price volatility and reduce competition in the NEM.[230]

Snowy Hydro contended that the Split Snowy Region proposal would impose nodal pricing on Snowy Hydro generation while preserving regional prices for other generators.[231] Origin Energy agreed that applying nodal prices to some generators and not others without an appropriate hedging mechanism would be inconsistent with market design and competitive neutrality.[232]

Snowy Hydro claimed that the support, from some generators, for the Split Snowy Region proposal (as well as the Southern Generators' Congestion Pricing proposal) was to limit competition in those generators' respective "home" region spot and contract markets.[233] Snowy Hydro stated that the Split Snowy Region proposal did not remove incentives for Tumut and Murray to withhold generation, meaning that it would have the effect of reducing competition and driving up contract prices.[234]

As with the Abolition proposal, submissions tended not to comment on the longer term implications for investment in the NEM.

C.5.3 Pricing outcomes and participant responses under the Southern Generators' Congestion Pricing proposal

Snowy Hydro contended that the presently-implemented Southern Generators Rule encouraged generators to bid in a way that did not reflect their costs, resulting in a

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227 ESIPC, s.99 Abolition submission, p.2.

228 Ibid.

229 Southern Generators, s.99 Abolition submission; s.95 Southern Generators' Congestion Pricing submission, p.28.

230 EnergyAustralia, s.99 Abolition submission, p.3.

231 Snowy Hydro, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.21.

232 Origin Energy, s.99 Abolition submission, p.2.

233 Snowy Hydro, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.3 and pp20-22.

234 Ibid, p.25.

less competitive and efficient price.[235] As with the Split Snowy Region proposal, Snowy Hydro suggested that the Southern Generators' Congestion Pricing proposal did not remove incentives for Tumut and Murray to withhold generation, reducing competition and driving up contract prices.[236] Further, Snowy Hydro again claimed the Southern Generators' Congestion Pricing proposal would impose nodal pricing on Snowy Hydro generation while preserving regional prices for other generators.[237]

The Southern Generators drew on their commissioned modelling analysis to conclude that the proposed changes would not have any significant implications for allocative efficiency.[238]

C.6 Power system security, supply reliability and technical issues

Many submissions did not comment on power system security and supply reliability issues. A number of technical issues were raised in submissions from NEMMCO, VENCorp and TransGrid and are discussed below in Section C.9 (Implementation).

Snowy Hydro supported the Commission's assessment that the Abolition proposal did not impede power system security.[239] Snowy Hydro also concluded that the Split Region option was unlikely to impede power system security.[240]

Hydro Tasmania expressed concern that diverting NEMMCO resources to make changes to constraint equations required to support region boundary change meant that those resources would not be available to deal with operational changes.[241]

The Southern Generators stated that any region change creates some risk to system security from unforeseen behavioural outcomes, implementation errors or manual operator errors.[242]

VENCorp noted the importance of securing reactive and reliability support for the Snowy region. It suggested that the ability to procure dispatch and reactive reserve should be assessed, and if necessary, made a condition of acceptance.[243] VENCorp also noted that activities associated with transmission planning and the Victorian

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[235] Ibid, p.22.

[236] Ibid, p.27.

[237] Ibid, p.21.

[238] Southern Generators, s.99 Abolition submission; s.95 Southern Generators' Congestion Pricing submission, p.17.

[239] Snowy Hydro, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.24.

[240] Ibid, p.26.

[241] Hydro Tasmania, s.99 Abolition submission, p.3.

[242] Southern Generators, s.99 Abolition submission; s.95 Southern Generators' Congestion Pricing submission, p.18.

[243] VENCorp, joint s.99 submission, Abolition of Snowy Region, Draft Rule Determination (Abolition); and s.95 submission, Split Snowy Region, p.2.

Jurisdictional System Security Coordinator, such as matters associated with the additional length of line and Murray switching station, would require interaction with TransGrid.[244]

TransGrid does not expect the technical limits applicable to flows through critical sets of transmission lines internal to NSW to require any changes to account for the region boundary change.[245] Further, TransGrid did not expect NSW system security constraints to be affected.[246]

Snowy Hydro raised concerns in relation to ramping capability under the Southern Generators' Congestion Pricing proposal, given the incentive for participants to bid low and potentially lock ramp rates.[247] Snowy Hydro recommended NEMMCO reviewed any system security issues that arose in this regard.[248]

C.7 Good regulatory practice

A number of submissions commented on good regulatory practice in the context of the requirement for future Rule changes and the Commission's assessment of the overall net benefit of the change. Macquarie Generation noted its agreement with the good regulatory practice criterion developed by the Commission.[249]

C.7.1 Requirement for future Rule changes

There was a range of views on the likely requirement for future Rule changes following the implementation of the Abolition proposal.

Snowy Hydro contended that maintaining the current arrangements (based on present regional boundaries, the Tumut CSP/CSC Trial and the Southern Generators Rule) would promote uncertainty and would be inconsistent with good regulatory practice.[250] Snowy Hydro submitted that the Abolition proposal would address legacy issues while providing a long term solution by creating an evolutionary platform for the Congestion Management Review (CMR).[251] Snowy Hydro

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[244] Ibid, p.3.

[245] TransGrid, joint s.99 submission, Abolition of Snowy Region, Draft Rule Determination (Abolition); s.95 submission, Congestion Pricing and Negative Residue Management Arrangements for the Snowy Region (Southern Generators' Congestion Pricing); s.95 submission, Split Snowy Region, p.3.

[246] Ibid, p.3.

[247] Snowy Hydro, Supplementary submission, 26 March 2007, p.13.

[248] Ibid.

[249] Macquarie Generation, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.5.

[250] Snowy Hydro, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, pp.24-25.

[251] Snowy Hydro, letter to AEMC, 15 March 2007, p.2.

suggested that, from a good regulatory practice perspective, the Tumut CSP/CSC trial was always treated as a temporary arrangement.[252]

The Southern Generators submitted that maintenance of the current arrangements would not pre-empt or prejudge any future decisions about long-term solutions to Snowy congestion.[253]

Eraring Energy noted that there is no guarantee that constraints would not arise in the future at the current regional boundaries, meaning that there is a possibility those regional boundaries would need to be reintroduced, creating unnecessary market disruption.[254]

On the other hand, Origin suggested that the modelling analysis showed that these constraints were expected to bind infrequently.[255] In the longer term, if and when these constraints started to bind, they could be addressed using the mechanisms developed in the CMR.[256]

Macquarie Generation submitted that the Split Snowy Region proposal has the benefit of maintaining existing interconnectors and creating a new interconnector so that there is a region boundary across all potential areas of congestion.[257] By contrast, Snowy Hydro contended that the Split Snowy Region proposal is unnecessary, since historical data and the Commission's modelling analysis indicated few constraints. Therefore, the option would pre-empt potential network upgrades.[258]

C.7.2 Assessment of net benefits

Three submissions expressed concern at the Commission's failure to quantify the costs of implementing the Abolition proposal. ESIPC submitted that the draft Rule determination did not make the case that the proposed Rule change would deliver benefits in excess of the costs.[259] Hydro Tasmania expressed concern that there was no proper assessment of the implementation costs associated with the proposed

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252 Snowy Hydro, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.2.

253 Southern Generators, s.99 Abolition submission; s.95 Southern Generators' Congestion Pricing submission, p.19.

254 Eraring Energy, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.5.

255 Origin Energy, s.99 Abolition submission, p.3.

256 Ibid, pp.3-4.

257 Macquarie Generation, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.6.

258 Snowy Hydro, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.20.

259 ESIPC, s.99 Abolition submission, p.3.

Snowy region boundary change.[260] The extent and cost of NEMMCO work needed to be known before participants could properly assess the cost-benefit ratio.[261] The Southern Generators suggested that the Commission was remiss in not attempting to quantify the costs of the Abolition proposal in its draft Rule determination.[262]

Other submissions made comments on the likely cost-benefit ratio based on their own assessment of costs, reaching a range of conclusions:

- The South Australian Minister for Energy noted that abolition of the Snowy region was likely to result in significant financial and implementation costs for NEMMCO and participants, and may not be the most efficient long-term solution;[263]

- EnergyAustralia submitted that the benefits from more competitive contract prices under the Abolition proposal would far outweigh overall implementation costs.[264] It estimated its own costs associated with the implementation of the proposal at $5,000;[265]

- Snowy Hydro submitted that the overall costs for the Abolition proposal would be relatively small and immaterial in comparison to the benefits estimated by the Commission.[266] It estimated its implementation costs for both Snowy Hydro Generator and Red Energy Retailer as likely to be less than $10,000.[267] Snowy Hydro notes that the costs, complexity and required system changes for both the Southern Generators Rule and the Tumut CSP/CSC trial were greater for participants than the proposed Snowy Hydro boundary change;[268]

- Westpac indicated that the Southern Generators' Congestion Pricing proposal was preferable because it would require minimal change to NEMMCO and participant systems;[269]

- Macquarie Generation did not consider that the additional costs and risks of the Split Snowy Region proposal would outweigh the benefits of more robust dispatch signals, particularly during outage conditions;[270] and

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260 Hydro Tasmania, s.99 Abolition submission, p.3; Hydro Tasmania, s.95 Split Snowy Region submission, pp.4-5.

261 Hydro Tasmania, s.99 Abolition submission, p.3.

262 Southern Generators, s.99 Abolition submission; s.95 Southern Generators' Congestion Pricing submission, p.19.

263 South Australian Minister for Energy (SA Minister for Energy, s.99 submission, Abolition of Snowy Region, Draft Rule Determination (Abolition), p.1.

264 EnergyAustralia, s.99 Abolition submission, p.2.

265 Ibid.

266 Snowy Hydro, Supplementary submission, 26 March 2007, p.4.

267 Snowy Hydro, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, pp.44-45.

268 Snowy Hydro, Supplementary submission, 26 March 2007, p.4.

269 Westpac, s.99 Abolition submission, p.3.

- The Southern Generators stated that the implementation costs of their Congestion Pricing proposal were sunk, while the costs of implementing region change were likely to be many millions of dollars.[271] They concluded that the Split Snowy Region proposal would be simpler to implement than the Abolition proposal.[272]

C.7.3 Ongoing intervention

Snowy Hydro submitted that the Southern Generators' Congestion Pricing proposal would result in a requirement for continued NEMMCO intervention to manage negative residues on the South Australia to Victoria interconnector.[273]

The Southern Generators contended that the Abolition proposal represents an operational intervention by the Commission, since it:

- Would apply only to specific connection points in the NEM rather than to the NEM as a whole; and

- Specifies an implementation date,

rather than defining regions through operational processes consistent with the approach to date.[274] They submitted that the Commission confused regulatory stability with operational stability by adopting this approach.[275]

C.8 Long term implications and consistency with public policy settings

C.8.1 Imminent Rule change versus longer term processes

Submissions were divided on the Commission's view that it was appropriate to deal with Snowy legacy issues in advance of related reviews and Rule changes.

Snowy Hydro supported the Commission's congestion management work program, with the final determination on the Abolition proposal in August 2007 in coordination with the release of determinations on related Rule changes and reviews.[276] It submitted that the use of the Rule change process to change the Snowy

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[270] Macquarie Generation, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.5.

[271] Southern Generators, s.99 Abolition submission; s.95 Southern Generators' Congestion Pricing submission, p.19.

[272] Ibid, p.35.

[273] Snowy Hydro, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.28.

[274] Southern Generators, s.99 Abolition submission; s.95 Southern Generators' Congestion Pricing submission, p.24.

[275] Ibid, pp.25-26.

[276] Snowy Hydro, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.9.

region boundary was consistent with MCE policy to address material and enduring constraints.[277] Macquarie Generation agreed that the Snowy region represents a unique problem that demands a tailored solution through a restructure of the regional boundaries.[278]

However, a number of submissions considered that the Commission should not make a boundary change in advance of the MCE's Rule change and the CMR:

- The Southern Generators believed that the longer term solution to Snowy region congestion would be identified as part of the congestion management regime and consideration of the MCE's Rule change.[279] They submitted that the draft Rule determination was inconsistent with MCE policy.[280] They also considered that the Commission did not satisfactorily explain its decision to consider the Abolition proposal in terms of long term solutions, and that it was inconsistent in adopting a short term focus in its draft Rule determination;[281]

- The South Australian Minister for Energy stated that the outcomes of the MCE region boundary Rule change and CMR should not be pre-empted by ad hoc Rule change proposals;[282]

- ESIPC considered that the MCE's Rule change proposal on the reform of regional boundaries and the CMR were the appropriate processes to assess long term solutions to the problems in the Snowy region;[283]

- ERM Power similarly suggested that it would be inappropriate for the Commission to make a one-off boundary change prior to developing a sound boundary review framework, particularly given that the options being considered by the Commission were inconsistent with this framework;[284]

- International Power expressed the strong view that region boundary change should not be contemplated until the completion of these related processes.[285] They contended that the ad hoc approach adopted by the Commission was alarming, created regulatory uncertainty and had the potential to harm current assets and the future investment climate;[286] and

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277 Ibid, pp.16-17.

278 Macquarie Generation, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.8.

279 Southern Generators, s.99 Abolition submission; s.95 Southern Generators' Congestion Pricing submission, p.4.

280 Ibid, pp.22-23.

281 Ibid, pp.4-6.

282 SA Minister for Energy, s.99 Abolition submission, p.1.

283 ESIPC, s.99 Abolition submission, p.1.

284 ERM Power, s.99 Abolition submission, p.1.

285 International Power Australia, s.99 submission, Abolition of Snowy Region, Draft Rule Determination (Abolition), p.2.

286 Ibid.

- Hydro Tasmania submitted that there is no need to make a change to the NEM regional structure while higher level processes are underway, because there is a working mechanism in place.[287] Hydro Tasmania considered that responding to ad hoc region change proposals is not the best approach and suggested seeking clarification from the MCE as to the conflict between the three year delay proposed in the MCE boundary Rule change proposal and the perception that there is a current need for change to address Snowy region congestion.[288]

By contrast, a number of submissions commented on the effect of the current uncertainty over the Snowy region boundary on market outcomes, urging the Commission to resolve the uncertainty by making an urgent decision:

- EnergyAustralia and Origin Energy submitted that the current uncertainty of the Snowy region boundary is negatively impacting the competitiveness and quantity of contracts in the NEM, and urged the Commission to quickly resolve the issue rather than waiting for the outcome of the MCE Rule proposal and the CMR; [289]

- Snowy Hydro indicated that it has been withholding significant volumes of contracts in the forward hedging market as a result of the uncertainty over the region boundary, with the effect of reducing liquidity and competition in the contract market.[290] Snowy Hydro suggested that other participants were unreasonably delaying the process by submitting revised or new proposals;[291]

- NEMMCO stated that participants had raised concerns with NEMMCO over the suspension of SRA units involving the Snowy region boundary due to the impact of suspension on the financial contract market.[292] International Power supported this view, noting that the suspension of the SRAs pending the outcome of the Rule change process had increased inter-regional trading risk and potentially harmed interstate trade.[293]

Snowy Hydro submitted that the Split Snowy Region proposal could not be implemented because:

- The proposed RRN would be at a point that had no material load or generation, which would be at odds with the NEM market design; and

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[287] Hydro Tasmania, s.99 Abolition submission, pp.1-2.

[288] Hydro Tasmania, s.99 Abolition submission, p.2; Hydro Tasmania, s.95 Split Snowy Region submission, p.2.

[289] See for example, EnergyAustralia, s.99 Abolition submission, p.2 and Origin Energy, s.99 Abolition submission, p.1.

[290] Snowy Hydro, letter to the AEMC chairman, 15 March 2007, p.3.

[291] Ibid, p.1.

[292] NEMMCO, s.95 Southern Generators' Congestion Pricing submission, p.1.

[293] International Power Australia, s.99 Abolition submission, p.2.

- The proposed regional boundaries cross locations with neither material nor enduring constraints in direct contradiction of MCE policy.[294]

C.8.2 Considerations for Congestion Management Review and MCE Rule change

A number of submissions raised issues for consideration in the CMR and MCE boundary Rule change process.

Westpac submitted that the real issue in the Snowy region, and other areas in the NEM, is that option 4 constraints were introduced without an effective hedging mechanism.[295] Westpac considered that the constraint-based residue (CBR) scheme proposed by Dr Daryl Biggar looked promising, and suggested a working group be formed with stakeholders from the Commission, NEMMCO, generators, retailers and the financial market with the aim of developing the CBR (and/or competing proposals) into a package to be implemented in the NEM.[296]

VENCorp noted the AER's work on developing incentives within the regulatory regime and highlighted the importance of ensuring consistency with the Commission's review of congestion management in the NEM.[297]

NEMMCO noted and supported the Commission's consideration of constraint formulation and the management of settlement residues in the CMR.[298] It suggested clauses (a), (b) and (c) of the derogation in Part 8 of Chapter 8A of the Rules should be changed to have continued operation until otherwise determined by the Commission – pending the outcomes of the Commission's determinations – rather than expiring on 31 July 2007.[299] [300]

C.9 Implementation

C.9.1 Technical matters

Both NEMMCO and TransGrid noted that they did not see any issues in terms of practical implementation.

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[294] Snowy Hydro, Supplementary submission, 26 March 2007, pp.3-4.

[295] Westpac, s.99 Abolition submission, p.3.

[296] Ibid.

[297] VENCorp, joint s.99 Abolition; and s.95 Split Snowy Region submission, p.2.

[298] NEMMCO, s.95 Southern Generators' Congestion Pricing submission, p.1.

[299] Ibid, pp.1-2.

[300] On 3 May 2007, the Commission determined to extend the derogation in Part 8 of Chapter 8A of the Rules to 31 October 2008 with the option to expire the whole derogation, the Tumut CSP/CSC Trial and/or Southern Generators Rule on a date other than 31 October 2008 or a specified event.

C.9.1.1 Location of Jindabyne pumps and Guthega Power Station

Snowy Hydro submitted that the Jindabyne Pumps ought to be located in Victoria, since they are hydraulically coupled to Murray generation, while Guthega Power Station can only effectively supply NSW load and should therefore be located in NSW.[301]

Three other submissions commented on the location of the Jindabyne Pumps and Guthega Power Station, agreeing that they should be in the Victorian region, rather than split between Victoria and NSW as proposed by Snowy Hydro. Delta Electricity suggested that there was some confusion over the physical nature of the system that could be resolved by asking TransGrid to provide independent expert advice.[302] TransGrid noted that the suggested location would leave Guthega on the Victorian side of an open breaker – isolated from its region. TransGrid would need to monitor whether there would be any threat to transmission equipment from these operating arrangements.[303] NEMMCO recommended that since both the Guthega power station and the Jindabyne pumping station are effectively connected to the Murray switching station, they should both be located in the new Victoria region.[304]

However, in a joint supplementary submission with Snowy Hydro, NEMMCO indicated that it were open to a boundary location that was consistent with the Abolition proposal on the understanding that TransGrid and Snowy Hydro were planning to change the normal switching arrangement for the lines.[305] Shortly after, NEMMCO advised the Commission that its constraint modification work for the Snowy abolition proposal would now proceed on the assumption that Guthega will be in the new NSW region and Jindabyne will be located in the new Victorian region.[306]

C.9.1.2 Revenue metering

TransGrid considered that there is sufficient installed revenue class NEM metering at Guthega, Jindera, Lower Tumut, Murray and Upper Tumut to cater for the proposed region boundary changes, provided energy transfers remain within the Type 2 or 3

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[301] Snowy Hydro, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, pp.34-35.

[302] In particular Delta Electricity suggested that the current arrangements are at odds with the presentation given by Snowy Hydro at the public forum. See Delta Electricity, s.99 Abolition submission, pp.6-7.

[303] TransGrid, s.99 submission, Abolition of Snowy Region, Draft Rule Determination; s.95 submission, Congestion Pricing and Negative Residue Management Arrangements for the Snowy Region; s.95 submission, Split Snowy Region, p.2.

[304] NEMMCO, s.99 submission, Abolition of Snowy Region, Draft Rule Determination, p.2.

[305] Joint Snowy Hydro and NEMMCO, Supplementary Submission, Abolition of Snowy Region, 6 July 2007, p.1.

[306] NEMMCO, Letter re: draft National Electricity Amendment (Abolition of Snowy Region) Rule 2007, 20 July 2007, p.1.

metering categories for which the installations are registered.[307] TransGrid thought it possible that the load on some interconnectors would increase to Type 1 energy levels, requiring additional work to upgrade metering, regardless of whether the Abolition proposal or the Split Snowy Region proposal was implemented.[308] TransGrid offered to work with the Commission, NEMMCO and the relevant Metering Data Providers to identify and upgrade affected installations.[309] TransGrid also noted that upgrading an installation is a lengthy process, requiring a minimum of 10 to 12 months and up to 3 years to complete. TransGrid proposed that the Commission provide a transitional provision in the Rules to allow up to 3 years to upgrade any metering installations required as a result of a boundary change.[310]

NEMMCO understood that the Murray to Tumut lines have revenue quality metering at both ends, and that the other lines forming the new interconnection also have existing revenue metering. NEMMCO also noted that the load from the Snowy to NSW regions exceeded the threshold for upgrading the revenue metering from type 2 to type 1. This issue does not arise out of the Abolition proposal but is something TransGrid and NEMMCO will have to manage in parallel.[311]

In contrast to TransGrid's views, NEMMCO considered that the relevant lines in the Split Snowy Region proposal do not have revenue quality metering and considerable time and expense is likely to be involved in upgrading the existing infrastructure.[312] NEMMCO noted there may be potential to use SCADA data as a substitute, but this would raise a number of issues, including the need to develop appropriate policies and procedures.[313]

C.9.1.3 Region boundary

Snowy Hydro proposed that the Victoria-NSW region boundary be located at the Guthega 132kV busbar, yielding closed regions and no islanding.[314] TransGrid proposed that the Commission chooses the region boundary to minimise the extent of transmission assets assigned across a boundary into a different region.[315] TransGrid proposed the location of the region boundary should be at the Murray switching station, at the end of lines 65 and 66.[316] NEMMCO also recommended the boundary on the Murray to Tumut lines be located closer to the Victorian (Murray)

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[307] TransGrid, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.2.

[308] Ibid.

[309] Ibid.

[310] Ibid.

[311] NEMMCO, s.99 Abolition submission, p.2-3.

[312] NEMMCO, s.95 Split Snowy Region submission, p.1.

[313] Ibid, p.2.

[314] Snowy Hydro, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.35.

[315] TransGrid, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.2.

[316] Ibid.

end, to achieve consistency with nearby lines. In its submission, NEMMCO specifically provided definitions for the revised boundaries that would form the basis for the constraint development work should a final decision not be available at that time.[317] In a joint submission with Snowy Hydro, NEMMCO indicated that it was open to a boundary location that was consistent with the Abolition proposal.[318] NEMMCO consequently wrote to the Commission indicating that it would proceed with the process for constraint building on the assumption that the Guthega power station would be in the NSW region and the Jindabyne pumps would be in the Victoria region.[319]

C.9.1.4 Loop flows and load

Snowy Hydro contended that the Split Snowy region proposal could not be practically implemented because a loop flow, which NEMDE cannot support, would be created between Victoria and NSW through Redcliffs.[320] Snowy Hydro also commented that the Wodonga load would be redefined into NSW.

C.9.1.5 Demand forecasts

VENCorp noted that a change in regional structure may necessitate adjustments to the calculation of Victorian regional demand (including the Jindabyne pump and losses on the Murray to Dederang transmission lines).[321] TransGrid expressed the view that any modification to the Snowy line will have little, if any, impacts on the current load forecasting requirements and practices of the organisation.[322]

C.9.2 Start date

Views of participants were mixed on the appropriate start date for the Snowy Hydro Rule change proposal, with some contending that any further delay would be problematic and others suggesting that the Commission's proposed start date was unrealistically early.

Delta Electricity believed that the proposed start date, 04 November 2007, may not provide sufficient time for market participants to prepare for the major change to the NEM. Delta Electricity recommended that the Commission consult market participants for a more realistic start date.[323] The Southern Generators agreed, saying that a notice period of at least one year would be required to allow

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317 NEMMCO, s.99 Abolition submission, p.2.

318 Joint Snowy Hydro and NEMMCO, supplementary Abolition submission, p.1.

319 NEMMCO, letter to the AEMC, 20 July 2007, p.1.

320 Snowy Hydro, Supplementary submission, 26 March 2007, p.3.

321 VENCorp, joint s.99 Abolition; and s.95 Split Snowy Region submission, p.3.

322 TransGrid, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.3.

323 Country Energy, s.99 Abolition submission, p.7.

participants to adjust their positions, and that the Commission's proposed start date would cause substantial additional disruption to contract markets.[324] The Southern Generators also questioned the Commission's decision to set a start date that falls within a quarter, given the quarterly frequency of SRAs, and suggested that the Commission consider the costs and benefits of alternative start dates.[325]

EnergyAustralia suggested a shorter time frame should be possible, as participants have already commenced transitioning their portfolios.[326]

Snowy Hydro strongly opposed any form of extension of the Southern Generators Rule beyond 31 July 2007, contending that the derogations are resulting in significant market stress.[327]

NEMMCO advised that its proposed start date of 1 July 2008 was based on the assumption that a final determination on the Abolition proposal would be issued by the end of June 2007, and that any delays beyond this time in publication of the final determination would put at risk NEMMCO's ability to meet the proposed 1 July 2008 start date.[328] NEMMCO noted that the extension of the timetable reduced the importance of the savings and transitional arrangements the Commission incorporated, but recommended that these be maintained to facilitate transition.[329] In order to implement the Abolition proposal by July 2008, NEMMCO stated it would commence constraint building on the basis of the boundary definitions as set out in its submission, and consequently amended in its July 2007 letter.[330]

NEMMCO expected that the implementation effort and elapsed time to implement the Split Snowy Region proposal would be similar to that required for the Abolition proposal, and noted that the 1 July 2008 start date was dependent on commencing work by the end of June 2007.[331]

EnergyAustralia expressed the view that the start date could be advanced if NEMMCO outsourced some work to third party contractors, and urged the Commission to make this enquiry to NEMMCO.[332] TransGrid and Snowy Hydro both offered resources to assist NEMMCO in the reorientation of constraints to accommodate the region boundary change.[333] Snowy Hydro further contended that NEMMCO's work program was conservative, for example, by failing to allow for

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[324] Southern Generators, s.99 Abolition submission; s.95 Southern Generators' Congestion Pricing submission, p.19.

[325] Ibid, pp.19-20.

[326] EnergyAustralia, s.99 Abolition submission, pp.2-3.

[327] Snowy Hydro, letter to AEMC chairman, 15 March 2007, p.2.

[328] NEMMCO, s.99 Abolition submission, p.1.

[329] Ibid, p.3.

[330] NEMMCO, letter to the AEMC, 20 July 2007, p.1.

[331] NEMMCO, s.95 Split Snowy Region submission, p.1.

[332] EnergyAustralia, s.99 Abolition submission, p.2.

[333] TransGrid, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.3; Snowy Hydro, Supplementary submission, 26 March 2007, p.5.

work streams to be conducted in parallel where possible.[334] Snowy Hydro suggested a number of areas where time could be saved in NEMMCO's project plan.[335] Snowy Hydro concluded, based on NEMMCO advice, that a start date of 4 November or 30 December at the very latest would be achievable.[336]

C.9.3 TNSP issues

VENCorp and TransGrid raised a number of implementation issues relating to the regulatory regime for TNSPs:

- Revenue determinations are based on the physical location of assets within jurisdictional boundaries, rather than NEM regional boundaries. Recovery of approved revenue is jurisdictional based. Where there are multiple TNSPs within a region, a Coordinating Network Service Provider (cl 6A.29.1(a) of the Rules) must be appointed to set prices for connection points within the region and make payments to other TNSPs with assets in the region.[337] TransGrid suggested this could be addressed by relocating the region boundary to Murray switching station;

- It is possible that there will be disparities in TransGrid's jurisdictional licence or operational policies that will have implications for a key line in the region; [338] and

- TransGrid noted that the Commission's analysis indicated prices between NSW and Victoria were likely to converge, which would reduce the IRSRs payable to TransGrid, in turn resulting in a material increase in transmission charges paid by NSW customers.[339] However, TransGrid noted that this increase was likely to be offset by more competitive energy prices.[340]

C.9.4 Rule changes

The only submission to comment on the wording of the proposed Rule change was from NEMMCO:[341]

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[334] Snowy Hydro, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.42.

[335] Including, for example, testing system normal constraints while system not-normal constraints are under development and allowing excessive time for changes to be made to SRA arrangements. Snowy Hydro joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, pp.42-44.

[336] Ibid, p.44.

[337] VENCorp, joint s.99 Abolition; and s.95 Split Snowy Region submission, p.2.

[338] Ibid.

[339] TransGrid, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.3.

[340] Ibid.

[341] NEMMCO, s.99 Abolition submission, p.1.

- A reference should be made to "the *regional reference node* located in the Snowy *region*", rather than naming specific location names, since the name of each regional reference node is not a defined term in the Rules;

- The current definition of "Sydney Time" should be retained since NEMMCO uses this for settlements purposes; and

- Terms that were defined for the transitional provisions were highlighted in such a way that they would not become defined terms under the Rules.

C.10 Modelling

In general, participants were supportive of the level of modelling analysis adopted by the Commission in its Draft Rule Determination. However, several submissions suggested additional modelling analysis was required.

C.10.1 Limitations of modelling assumptions

ESIPC noted that the modelling undertaken for the Commission was extensive and included a range of assumptions about the portfolios of different market participants and their costs, contract levels and commercial strategies. These strategies, in particular, were likely to change over time. However, ESIPC did not make any suggestions as to how the Commission's analysis could be improved in this regard.[342]

Hydro Tasmania considered that the modelling undertaken to date did not weight the periods of peak demand appropriately.[343] Hydro Tasmania also stated that ignoring market responses to the occurrence and risk of planned and unplanned network outages would have understated the impact of the selected regional structures.[344]

Macquarie Generation supported the modelling approach, but expressed concern over two aspects of the modelling:

- The impact of system outage conditions.[345] Macquarie Generation suggested that the assumption of system normal conditions favoured the Abolition proposal. This was because even if Snowy Hydro were bidding strategically to take advantage of an intra-regional constraint, the modelling would not reveal any costs from this behaviour and there was no possibility of counter price flows occurring.[346] Consequently, Macquarie Generation recommended that the Commission model the impact of non-normal conditions on the incentives for

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342 ESIPC, s.99 Abolition submission, p.2.

343 Hydro Tasmania, s.95 Split Snowy Region submission, p.3.

344 Ibid.

345 Macquarie Generation, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.3.

346 Ibid, p.6.

Snowy Hydro under both the Abolition proposal and Split Snowy Region proposal.[347] It suggested the possibility of applying an interconnector constraint duration curve based on historic transmission flows;[348] and

- The use of simplified constraint equations from the Annual National Transmission Statement.[349] Macquarie Generation are concerned this may overstate the likely level of inter-regional flows between Victoria and NSW. They suggest the Commission ask NEMMCO to conduct detailed load flow analysis to estimate maximum possible interconnector flows under various scenarios.[350]

Delta Electricity referred to comments by the AEMC's consultant, Danny Price from Frontier Economics, at the public forum on the draft Rule Determination, in which Mr Price highlighted the risks of a single generator exercising market power during non-system normal conditions.[351] Delta Electricity suggested that additional modelling, drawing on assumptions suggested by market participants in submissions and at the public forum, was required to validate the robustness of the Split Snowy Region proposal as an alternative to the abolition of the Snowy Region.[352]

C.10.2 Additional modelling to assess alternatives

NEMMCO suggested analysis could be undertaken to assess whether the inefficient market outcomes referred to by Snowy Hydro, when both the Murray/Tumut and South Morang or La Trobe Valley constraints bind, arise principally because of CSP/CSC arrangements together with the Southern Generators Rule or because suitable congestion management has not been put in place for these other constraints.[353]

The Southern Generators believed that the Commission's modelling analysis needed to be extended to cover the current arrangements prior to a final determination.[354]

C.10.3 Southern Generators' modelling

Snowy Hydro rejected the appropriateness of the ROAM modelling commissioned by the Southern Generators, stating that it was not comparable with, and was inferior

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[347] Ibid, p.3.

[348] Ibid.

[349] Ibid, p.8.

[350] Ibid.

[351] Delta Electricity, s.99 Abolition submission, p.4.

[352] Ibid, p.7.

[353] NEMMCO, s.95 Southern Generators' Congestion Pricing submission, p.2.

[354] Southern Generators, s.99 Abolition submission; s.95 Southern Generators' Congestion Pricing submission, p.17.

to, the Commission's modelling. Snowy Hydro concluded that it was not possible to draw any conclusion from this work.[355] In particular they noted:

- ROAM did not use any game theoretic modelling, allowing only Snowy Hydro's plant to bid strategically and make volume/price trade-offs. Snowy Hydro suggested that this inappropriate assumptions were used for Snowy Hydro bidding;
- There was no allowance for the contract level of participants, which was likely to affect participant bidding; and
- The Snowy Hydro energy level was not kept constant throughout the modelling.[356]

Part 3 – First round submissions on the Abolition proposal

Part 2 of this Appendix presents a summary of submissions received before 19 January 2007 as part of the consultation process on the Abolition proposal and related alternatives.

The alternative considered in these submissions was Macquarie Generation's February 2006 "Alternative Snowy Region Boundary" Rule change proposal. This proposal sought to replace the existing Snowy region with two new load-bearing regions, one in northern Victoria and one in south-west NSW. On 22 March 2007, the Commission published a notice of its decision to discontinue the Rule making process for the Rule change proposal. Its reasons for this decision and the notice are available on the AEMC website. This proposal is referred to as the "discontinued Macquarie Generation proposal" in this Part of the Appendix.

C.11 First round consultation

On 12 January 2006, the Commission commenced first round consultation under section 95 of the NEL on the Abolition proposal. Submissions on the proposal were to close on 10 March 2006. Snowy Hydro gave a presentation to the Commission on its proposal on 10 February 2006.

On 16 February 2006, the Commission published a section 107 notice to extend consultation on the proposal from 10 March 2006 to 24 March 2006. Its reasoning for this extension was to allow consideration of the Abolition proposal and the alternative discontinued Macquarie Generation proposal as it commenced first round consultation on the latter proposal on the 16 February 2006. Aligning the consultation periods enabled the co-ordination of submissions on both proposals.

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[355] Snowy Hydro, joint s.99 Abolition; s.95 Southern Generators' Congestion Pricing; and s.95 Split Snowy Region submission, p.11.

[356] Ibid, pp.10-11.

The Commission received ten submissions that combined comments on both the Abolition and discontinued Macquarie Generation proposals from: Delta Electricity, Eraring Energy, National Electricity Market Management Company (NEMMCO), Origin Energy, Westpac Institutional Bank, the Australian Energy Regulator (AER), Ergon Energy, Energy Users Association of Australia (EUAA), and the Southern Generators. Four submissions from CS Energy, the Energy Retailers Association of Australia (ERAA), Snowy Hydro Ltd, and TransGrid submitted submissions on the Abolition proposal. Four submissions from CS Energy, the ERAA, Snowy Hydro Ltd., and Wambo Power Ventures were received on the discontinued Macquarie Generation proposal. Five supplementary submissions from the Southern Generators, Wambo Power Ventures, Hydro Tasmania, Macquarie Generation, and Snowy Hydro were also received.

Origin Energy and Snowy Hydro supported the Abolition proposal and did not support the discontinued Macquarie Generation proposal. CS Energy supported the Abolition proposal as a short-term solution and considered the discontinued Macquarie Generation proposal may be considered as part of a longer-term option. The EUAA supported the discontinued Macquarie Generation proposal as the best long-term solution but thought its consideration should wait until the Congestion Management Review concluded. TransGrid's submission responded to statements presented in the Abolition proposal document. The remaining submissions did not support either proposal.

C.12 Preparation of Draft Rule Determination

In preparing the Draft Rule Determination, the Commission sought comment from stakeholders on the modelling approach to be used to assess the Snowy region boundary change proposals. It also asked NEMMCO for advice regarding the process for implementing a region boundary change. Stakeholders submitted comments on the modelling approach and NEMMCO's implementation advice.

C.12.1 Information Disclosure Statement – 15 June 2006

In preparing the Draft Rule Determination, the Commission published an Information Disclosure Statement on 15 June 2006 seeking comments on the modelling inputs and approach being adopted for the Snowy region boundary Rule change proposals. Submissions on this public consultation closed on 23 June 2006. Hydro Tasmania and Snowy Hydro Ltd. submitted comments on the Information Disclosure Statement.

C.12.2 Implementation of a region boundary change

The Commission wrote to NEMMCO on 12 July 2006 requesting advice and clarification on understanding what process must be undertaken in order to implement a region boundary change and how long that process would take. NEMMCO responded on 25 August 2006. The Commission asked for stakeholder comments on NEMMCO's response by 13 October 2006. Six submissions on

implementation were received from: the ERAA, Snowy Hydro Ltd., Macquarie Generation, Country Energy, Delta Electricity, and Ergon Energy.

C.13 Submissions related to the Snowy region boundary change proposals

Due to the overlapping content of submissions to the above consultations, the summary below reflects comments related to the Commission's assessment criteria. Comments specifically related to the modelling approach are presented in Appendix A.

C.13.1 Timing of consideration (including on alternatives)

Twelve submissions commented on the interactions between the Abolition and discontinued Macquarie Generation proposals, the proposed MCE Reform of Regional Boundaries Rule change proposal, (MCE boundary criteria proposal) and the Congestion Management Review (CMR).

C.13.1.1 Consider Snowy region boundary change proposals now

Five submissions preferred to see the Abolition and discontinued Macquarie Generation proposals progressed prior to considering the MCE boundary criteria proposal and CMR.

- Delta Electricity suggested both proposals could be used as test cases for developing criteria for congestion management and regional boundaries;[357]
- NEMMCO did not oppose fast-tracking but stated that the proposals should demonstrate the economic benefit characteristics outlined in the MCE proposal;[358]
- Eraring Energy suggested that a robust process for assessing alternative boundary proposals would be an outcome from considering the Snowy boundary Rule change proposals;[359]
- The numerous interim measures to deal with the congestion problems in the Snowy region convinced CS Energy that the Commission should consider these proposals now rather than waiting until the region boundary change process was finalised;[360] and

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[357] Delta Electricity, s.95 submission, Abolition and discontinued Macquarie Generation proposals, 23 March 2006, p.2.

[358] NEMMCO, s.95 submission, Abolition and discontinued Macquarie Generation proposals, 7 March 2006, p.1.

[359] Eraring Energy, s.95 submission, Abolition and discontinued Macquarie Generation proposals, 22 March 2006, p.1.

[360] CS Energy, s.95 submission, Abolition proposal, 24 March 2006, p.1.

- Snowy Hydro stated that while the process proposed in the MCE boundary criteria proposal was sound, existing problems, like that in the Snowy region, should be corrected prior to implementing the new arrangements.[361]

Hydro Tasmania noted that the Commission was considering the Snowy boundary change proposals prior to determining a general region boundary criteria. It considered, however, that "in the interest of consistency", lessons from the proposed modelling exercises should inform the more general criteria.[362] In a supplementary submission, Hydro Tasmania stated that the Southern Generators Rule "appears to have resolved all the known dispatch and pricing issues in relation to the constraint within the Snowy region" so the assessment of a boundary changes should now focus on the consequences of loss modelling.[363]

C.13.1.2 Consider Snowy region boundary change proposals, Congestion Management Review, and proposed MCE boundary change criteria together

The AER supported an approach considering the proposals and Congestion Management Review (CMR) in parallel. It considered an holistic review process would allow consideration of all the possible options rather than a narrow approach focussed on considering Rule change proposals.[364] The Southern Generators supported consideration of these boundary change proposals within the CMR so propose a "sensible and co-ordinated [congestion management] regime", which would put forward, if necessary, a single optimal change.[365]

C.13.1.3 Consider the CMR and proposed MCE boundary change criteria first

Origin Energy stated that it saw the Abolition and discontinued Macquarie Generation proposals as alternatives, addressing the same issue. The proposals should therefore be considered together, it stated. Origin Energy commented, though, that the CMR, including details on economic criteria for analysing boundary changes, should be finalised first. Once the criteria were settled, Origin Energy proposed consideration of these Snowy boundary change proposals should be fast-tracked.[366]

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[361] Snowy Hydro, s.95 submission, Abolition proposal, p.14.

[362] Hydro Tasmania, Submission on Information Disclosure Statement June 2006, 23 June 2006, p.2.

[363] Hydro Tasmania, Supplementary s.95 submission, Abolition and discontinued Macquarie Generation proposals, 5 October 2006, p.1-2.

[364] AER, s.95 submission, Abolition and discontinued Macquarie Generation proposals, 24 March 2006, p.1.

[365] Southern Generators, s.95 submission, Abolition and discontinued Macquarie Generation proposals, 24 March 2006, p.2.

[366] Origin Energy, s.95 submission, Abolition and discontinued Macquarie Generation proposals, 4 April 2006, p.1-2.

The ERAA expressed support for a formal boundary change process. Its view was to expedite consideration on the MCE proposal then use those findings to consider these proposals on the Snowy region boundary. The ERAA was concerned with fast-tracking a solution without comprehensive economic analysis to ensure it was the most efficient long-term solution.[367]

Wambo Power Ventures stated it was "inappropriate" to agree to a one-off change to the region boundary structure pending the development of a general framework.[368]

C.13.2 Economic efficiency of dispatch

C.13.2.1 Positive affect on dispatch efficiency

Origin Energy considered that by increasing the number of generators observing the same price signals, the Abolition proposal would enhance competitive neutrality, decrease bidding distortions, and lower the ability for each generator to influence its price for output.[369]

Snowy Hydro stated its proposal would increase generation from Tumut into NSW because it would no longer need to keep the lines into NSW unconstrained. It calculated that the net economic benefit of placing Tumut generation in NSW was around $3.34 million.[370] The discontinued Macquarie Generation proposal, Snowy Hydro argued, would not eliminate Tumut generation's incentives to maintain headroom on the transmission lines into NSW.[371]

On the other hand, the EUAA considered the discontinued Macquarie Generation proposal provided the best means to align regional boundaries and financial transactions with transmission constraints and to minimise the need for special arrangements to manage intra-regional constraints.[372]

C.13.2.2 Adverse affect on dispatch efficiency

The Southern Generators stated that a proposal should be rejected if it reduced dispatch efficiency.[373] The discontinued Macquarie Generation proposal, they stated, moved transparent pricing through the existing inter-regional constraints to intra-regional constraints.

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[367] ERAA, s.95 submission, Abolition proposal, 23 March 2006, p.2.

[368] Wambo Power Ventures, s.95 submission, Abolition and discontinued Macquarie Generation proposals, 24 March 2006, p.1.

[369] Origin Energy, s.95 submission, p.1.

[370] Snowy Hydro, s.95 submission, Abolition proposal, p.8-9.

[371] Snowy Hydro, Submission, June 2006 Information Disclosure Statement, 21 June 2006, p.4.

[372] EUAA, Attachment to s.95 submission, Abolition and discontinued Macquarie Generation proposals, 24 March 2006, p.6.

[373] Southern Generators, s.95 submission, p.6.

Eraring Energy stated it opposed both proposals because they moved from explicitly pricing congestion on existing interconnectors to not pricing congestion because the existing interconnectors would become intra-regional transmission lines. In its view, both proposals would "fix one problem and create two new problems."[374] The Southern Generators concurred with the concern of moving away from explicitly pricing the inter-regional congestion on the "Dederang-Murray" southward constraint. They expressed a similar concern with the constraints north of Tumut generation.[375]

Westpac stated that the Abolition proposal created incentives for Tumut generation capacity to be offered at very low prices, yet would be "immune" to the shadow price at the Tumut node. It considered under this proposal, Snowy Hydro's ability to act as a "gate keeper" was not reduced; if anything it was more likely to increase it. Westpac continued, stating this would disadvantage the Victorian generators by shutting them out of the NSW market, even if there were no counter-price flows.[376] The EUAA considered the Abolition proposal was unlikely to stand as a long-term solution because other intra-regional transmission constraints north and south of the Snowy region would require congestion management mechanisms, like CSP/CSC in the future.[377]

Snowy Hydro stated that the discontinued Macquarie Generation proposal was "technically incorrect". It commented that Upper Tumut was "firmly connected" to Canberra and Yass, and it would therefore be "incorrect to place a boundary between these locations".[378]

TransGrid noted that in its Rule change proposal, Snowy Hydro commented that the current Snowy region boundary may create perverse incentives to invest in a 500kV ring upgrade as a way to increase supply from north NSW into the Sydney area. TransGrid responded to this claim by stating that any potential transmission investment needed to pass the Regulatory Test, and that it was "questionable" to argue that Snowy Hydro's proposed region boundary change provided exactly the same benefits as TransGrid's 500kV upgrade."[379]

In its technical supplementary submission, the Southern Generators commented their analysis of constraint locations relative to the proposed Snowy region boundaries indicated the discontinued Macquarie Generation proposal would provide a more accurate representation than existing regions, but that in others, it would be less accurate. They concluded for all constraints, the Abolition proposal,

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[374] Eraring Energy, s.95 submission, p.2, 5.

[375] Southern Generators, s.95 submission, p.7-8.

[376] Westpac, s.95 submission, Abolition and discontinued Macquarie Generation proposals, 24 March 2006, para 8-10.

[377] EUAA, Attachment to s.95 submission, p.6.

[378] Snowy Hydro, s.95 submission, discontinued Macquarie Generation proposal, 23 March 2003, p.7.

[379] TransGrid, s.95 submission, Abolition proposal, 27 March 2006, p.2-3.

would have been "equal to or worse than the existing regions with the Tumut [CSP/CSC] trial in place."[380]

The Southern Generators proposed that the problems in the Snowy region could be better addressed by the permanent application of a CSP/CSC arrangement for both Murray and Tumut power stations. The allocation of CSC would follow a similar logic to that currently used to determine Tumut's allocation.[381]

C.13.2.3 Introduction of region loop flows

Several submissions expressed concern that the discontinued Macquarie Generation proposal introduced an inter-regional loop flow between South Australia, Victoria, and the new Northern Victoria region. The Southern Generators, Westpac, Eraring Energy, Snowy Hydro, and NEMMCO all raised this concern in various submissions.[382]

Macquarie Generation submitted a supplementary submission stating its proposal intended to "preserve the linear structure of the NEM". This, it stated, would "mitigate the need to implement a network model representation" so did not require fundamental changes to the NEM dispatch engine.[383]

Delta Electricity noted that when considering these boundary changes, the AEMC should "ensure the changed region does not have a generator or a [regional reference node (RRN)] in the loop."[384]

C.13.2.4 Loss factors

In its supplementary submission, Hydro Tasmania raised a concern of the impact on dispatch efficiency and pricing implications from moving Murray and Tumut generation from dynamic loss factors to static loss factors. At the moment, the impact on dispatch efficiency due to the Murray-Tumut constraint is only during the short period that the constraint binds. A change in loss factor accuracy resulting from the move to static loss factors would affect dispatch efficiency all the time.[385]

Snowy Hydro addressed Hydro Tasmania's concerns in its own supplementary submission. Snowy Hydro stated that under its boundary change proposal, the marginal loss factors for Murray and Tumut generation were no different from loss factors in other locations in the NEM. It considered the impact of marginal loss

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380 Southern Generators, Supplementary s.95 submission, Abolition and discontinued Macquarie Generation proposals, 31 March 2006, p.3.

381 Southern Generators, s.95 submission, p.11.

382 Southern Generators, s.95 submission, p.8; Westpac, s.95 submission, para 13; Eraring Energy, s.95 submission, p.4; NEMMCO, Letter to Dr John Tamblyn, Implementation of a region boundary change, 25 August 2006, p.9-10; Snowy Hydro, Submission on implementation, 12 October 2006, p.3.

383 Macquarie Generation, Supplementary submission, discontinued Macquarie Generation proposal, 21 April 2006.

384 Delta Electricity, s.95 submission, p.3.

385 Hydro Tasmania, Supplementary s.95 submission on Abolition proposal, p.2.

factors to be immaterial as they "are only an issue in the case of dynamic efficiency when due to dynamic loss factors one plant is dispatched in preference to another."[386]

C.13.3 Pricing outcomes and participant responses

Origin Energy stated that it preferred the Abolition proposal since prices tended to be less volatile in larger regions because more generators observed the same price signals and there is more trade around prices that reflect a higher concentration of generation and load.[387]

ERAA stated it supported regional boundaries that promoted efficient pricing as that provided appropriate investment signals to both generation and load.[388] The Southern Generators noted though, it was important to consider if implementing a region boundary change caused any new mispricing.[389]

Both the Southern Generators and Westpac suggested that new regional reference nodes should be located near generation (e.g. Murray or Tumut) since load was not as responsive to price signals as generation.[390]

In its submission to the June 2006 Information Disclosure Statement, Snowy Hydro commented that because the current Snowy region had no consumers, measuring the impact of the proposals on prices in the Snowy region was not necessary. It stated there would be no efficiency gains from cost reflective pricing. Rather, it continued, the impact of the proposals on prices in NSW and Victoria should be an important consideration.[391]

Under the Abolition proposal, TransGrid raised that the total settlement residues available for auctioning may be lower, resulting in lower Settlement Residue Auction proceeds to end customers currently used to offset transmission charges. This may result in increased transmission charges TransGrid noted.[392]

C.13.4 Inter-regional trading and risk management

Ergon Energy stated that a change in region boundaries should be accompanied by significant net economic efficiencies and enhanced market operations because of

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386 Snowy Hydro, Supplementary s.95 submission, Abolition proposal, 20 November 2006, Attachment A.

387 Origin Energy, s.95 submission, p.1.

388 ERAA, s.95 submission, Abolition proposal, 23 March 2006, p.1.

389 Southern Generators, s.95 submission, p.6.

390 Ibid; Westpac, s.95 submission, para 13.

391 Snowy Hydro, Submission on June 2006 Information Disclosure Statement, p.5.

392 TransGrid, s.95 submission, p.3.

risks (and resultant costs) associated with trading across regions.[393] It is these risks and costs that submissions focused on when commenting on the affect the Abolition and discontinued Macquarie Generation proposals may have on a participant's ability to manage inter-regional price risk.

Submissions recommended that the Commission should consider the potential impact of the dissipating the NSW Electricity Tariff Equalisation Fund (ETEF) arrangements on Retailers. The NSW Government announced its intention to phase out ETEF from October 2008 to 20 June 2010. Submissions commented that uncertainty of the Snowy region boundary was influencing NSW retailers willingness to contract at this time to cover the volume previously covered by ETEF. Effected retailers face increased uncertainty regarding counterparty risk, price, and instrument type.[394] Snowy Hydro also stated that uncertainty over the Snowy region boundary was limiting its own ability to transact in medium- and long-term contracts.[395]

When considering the affect of a region boundary change on risk management, submissions favoured the Abolition proposal. Country Energy, Origin Energy, and Snowy Hydro all noted that this proposal was the less disruptive compared to the discontinued Macquarie Generation proposal. Submissions considered that the Abolition proposal would:

- improve hedging contract liquidity;[396] and
- create fewer regions meaning fewer transmission paths to be hedged by retailers, reducing basis risk and encouraging inter-regional trade.[397]

One of the main criticisms submissions presented for the discontinued Macquarie Generation proposal related to the significant market impact on existing hedging contracts and the future implications of inter-regional trading. Submissions considered that the discontinued Macquarie Generation proposal would:

- create substantial contract basis risk and increased volatility for participants;[398]
- reduce market liquidity, encouraging the creation of smaller "regional markets";[399]
- introduce financial complexity by creating two new load-bearing regions, which the additional Settlement Residue Auctions required for hedging the added price

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393 Ergon Energy, s.95 submission, Abolition and discontinued Macquarie Generation proposals, 25 March 2006, p.1.

394 Country Energy, Submission on implementation, 13 October 2006, p.2; Snowy Hydro, Supplementary s.95 submission, p.2-3.

395 Snowy Hydro, Supplementary s.95 submission, p.2.

396 Country Energy, Submission on implementation, p.3; Origin Energy, s.95 submission, p.1.

397 Origin Energy, s.95 submission, p.1.

398 Eraring Energy, s.95 submission, p.5; Wambo Power Ventures, Supplementary s.95 submission, discontinued Macquarie Generation proposal, 15 May 2006, p.1; Origin Energy, s.95 submission, p.1.

399 Delta Electricity, Submission on Implementation, 11 October 2006, p.2

risk and would not efficiently manage because the Auctions are not a firm instruments for hedging;[400]

- introduce significant new system and transaction costs for retailers, including the cost and time of unravelling and renegotiating existing contracts, which could take up to five years to complete;[401] and
- introduce "substantial complexity for retailers in ensuring customer prices in each state remain uniform in line with requirements by state governments". [402]

On the other hand, the EUAA considered that a potential for well-defined regions, like in the discontinued Macquarie Generation proposal, would provide customers for Snowy Hydro to contract with no additional inter-regional trading risk. The additional regions in northern Victoria and southwest NSW could provide more economic incentives for local generation, including co-generation, leading to lower losses and lower prices for customers. The EUAA did note that some of these benefits may be offset with the additional costs of trading through more regions and that this trade-off would need to be investigated by the Commission.[403]

C.13.5 Power system security, supply reliability, and technical factors

The only one to discuss power system security and supply reliability, NEMMCO's submission noted that neither Snowy Hydro nor Macquarie Generation acknowledged whether there may be any unintended consequences on the power system should their proposals be accepted.[404]

C.13.6 Good regulatory practice

Almost all submissions agreed that the intra-regional congestion problem in the existing Snowy region affected dispatch and pricing efficiency, and investment efficiency.

C.13.6.1 Assessment principles

Snowy Hydro stated that any "dispatch efficiency losses from current pricing arrangements have to be balanced against any dispatch inefficiencies under regional pricing arrangements." It also considered investment efficient and price impacts

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[400] Country Energy, Submission on implementation, p.2

[401] Origin Energy, s.95 submission, p.1; Country Energy, Submission on implementation, p.1; ERAA, Submission on implementation, 13 October 2006, p.2-3.

[402] Origin Energy, s.95 submission, p.2

[403] EUAA, Attachment to s.95 submission, p.6.

[404] NEMMCO, s.95 submission, p.3.

were important assessment criteria to include when considering region boundary change proposals.[405]

Eraring Energy suggested criteria that was consistent with the MCE proposal, with the addition of considering that a change should not introduce major "basis risk" for market participants that cannot be managed by recontracting or using inter-regional hedging products.[406]

C.13.6.2 Minimisation of operational intervention in the market

Eraring Energy commented that the Snowy CSP/CSC Trial had a number of problems including: being complicated, having no defined assessment criteria; lack of transparency with CSC allocation; and no defined means of allocating CSC rights. Eraring Energy suggested that conceptually, implementation of a CSP/CSC mechanism avoids the need for additional region boundaries because the mechanism introduces localised nodal pricing in a dynamic way. However, it noted the CSP/CSC mechanism was complicated to both understand and implement. Eraring Energy agreed with both the Abolition and discontinued Macquarie Generation proposals to convert the cross-section between Murray and Tumut generation into an interconnector. It did not support the proposal's choices to move away from explicitly pricing congestion on the existing interconnectors.[407]

Eraring Energy put forward an alternative proposal in its first round submission ("Eraring counter-factual") that retained the existing interconnectors and would explicitly price the Murray-Tumut constraint in a more transparent way than the existing CSP/CSC regime. It proposed its option: would not introduce "basis risk" for market participants; could be implemented quickly; and resolved the negative residue problem for Victoria to Snowy region flows.[408]

C.13.6.3 Promotion of stability and predictability

CS Energy viewed continued stability of region boundaries as crucial for market certainty as changes in regional boundaries are a significant and long term regulatory risk for the NEM. [409] Ergon Energy concurred stating that a stable region boundary structure prompted efficient dispatch, pricing, and risk management.[410]

Noting that every region boundary adds trading risks, the ERAA supported region boundaries that allowed for retailers to effectively manage the risk of trading in a

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[405] Snowy Hydro, Submission on June 2006 Information Disclosure Statement, p.3, 4.

[406] Eraring Energy, s.95 submission, p.1.

[407] Ibid, pp.2, 3, 5.

[408] Ibid.

[409] CS Energy, s.95 submission, discontinued Macquarie Generation proposal, 24 March 2006, p.1.

[410] Ergon Energy, s.95 submission, p.1.

multi-region market, minimising the number of regions while maintaining economic efficiency.[411]

C.13.6.4 Promotion of transparency

CS Energy stated that consideration of these region boundary change proposals should not be considered precedent for future reviews/boundary change proposals.[412] To minimise uncertainty, Ergon Energy noted that all boundary Rule change proposals should be subject to the proposed MCE process.[413]

C.13.6.5 Market power

Snowy Hydro stated that use of ramp rates was not a signal or market power. Nor was having generators from the same company on either side of an interconnector, it commented.[414]

C.13.7 Implementation

Snowy Hydro noted that NEMMCO had already initiated a region boundary change during its processing of the Directlink conversion to regulated interconnector status. Part of the conversion was to redefine Terranora load to another NEM market region.[415]

C.13.7.1 Execution and operational issues

Under the discontinued Macquarie Generation proposal, the ERAA noted, the "rapid partitioning of a customer base into multiple price regions" would introduce major challenges for retailers operationally (e.g. risk management and providing regulated price/service offering to all customers.) The ERAA also commented that the majority of customers were insensitive to electricity prices and therefore such a region boundary change was unlikely to produce much efficiency benefit.[416] Origin Energy concurred stating that the discontinued Macquarie Generation proposal would increase the complexity for retailers to ensure customer prices in each state remained uniform in line with State requirements.[417]

Regarding the setting of reserve margins for its proposal, Macquarie Generation suggested that NEMMCO currently set a combined minimum reserve level for

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411 ERAA, s.95 submission, Abolition proposal, p.1.

412 CS Energy, s.95 submission, Abolition proposal, p.1.

413 Ergon Energy, s.95 submission, p.1.

414 Snowy Hydro, s.95 submission, Abolition proposal, p.3.

415 Snowy Hydro, Submission on implementation, p.4.

416 ERAA, Submission on implementation, p.2.

417 Origin Energy, s.95 submission, p.2.

Victoria and South Australia. It did not see a reason why a similar methodology could not be extended for South West NSW with the NSW region, and Northern Victoria with the joint Victoria/South Australia region. Macquarie Generation considered the calculations were unlikely to change significantly in two years and NEMMCO could consider individual regional reserve levels when it undertook its next NEM-wide review in 2008.[418]

Considering NEMMCO's advice on receiving demand forecasts from relevant TNSPs, Macquarie Generation commented that TransGrid and VENCorp currently prepare subregional load forecasts as inputs to their Annual Planning Reviews and network planning processes. It may be possible, it suggested, that these TNSPs already have forecast load levels in the new regions it proposed.[419]

Snowy Hydro and NEMMCO raised complications with the proposed Macquarie Generation boundary between Ballarat and Horsham as it was across a semi-distribution line rather than across a transmission line. NEMMCO's proposed solution was to move the boundary south of Ballarat to accommodate for the lack of appropriate metering on the proposed boundary. Macquarie Generation had no objection to this approach.[420]

Snowy Hydro also raised an issue with the lack of revenue quality metering to measure flows on the Macquarie Generation proposed region boundaries. It also flagged the implementation risks for the TNSPs in determining new regional energy and demand forecasts for the modified region loads.[421] Country Energy expressed concern about the generation to load ratio in the Macquarie Generation proposed regions.[422]

C.13.7.2 Transaction costs

Macquarie Generation expressed that implementation costs represented a small fraction of the overall gains recognised from eliminating distortions created by misaligned region boundaries and intra-regional congestion.[423]

However, one of the transaction costs raised in multiple submissions was that of renegotiating contracts. These costs were seen to be significantly greater under the discontinued Macquarie Generation proposal compared to the Abolition proposal.

Under the International Swaps and Derivatives Association Master Agreements [ISDA MA], a change in region boundaries is considered a "Market Disruption Event." This can trigger renegotiation of affected contracts. Many submissions

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418 Macquarie Generation, Submission on implementation, 17 October 2006, p.2.

419 Ibid.

420 Snowy Hydro, Submission on implementation, p.3; NEMMCO, Letter on implementation, 25 August 2006, p.13; Macquarie Generation, Submission on implementation, p.2.

421 Snowy Hydro, Submission on implementation, p.2-3.

422 Country Energy, Submission on implementation, p.3.

423 Macquarie Generation, Submission on implementation, p.1.

commented on the implications of such renegotiation such as the requirement for parties to enter into complex and time and resource consuming renegotiations.[424]

Snowy Hydro and the ERAA consider that while there may be some contracts affected under the Abolition proposal, they suspect most contracts would not be impacted.[425]

The ERAA suggested that under the discontinued Macquarie Generation proposal, there may be a need to consider introducing new risk management instruments to assist retailers in meeting their obligations to supply customers with regulated price or service offering across multiple regions. Under the Abolition proposal, the ERAA commented that retailers would need to reassess their inter-regional trading and hedging strategies, including Settlement Residue Auction requirements.[426]

Delta Electricity and the ERAA raised in their submissions that there would be significant work to incorporate additional regions into existing IT systems.[427] Snowy Hydro added that the discontinued Macquarie Generation proposal would require extensive updating of region based data in NEMMCO's market system and a solution to the problem of no revenue quality metering to measure flows on the proposed region boundaries.[428]

In its advice on implementation, NEMMCO noted that its "ability to implement additional 2007 initiatives without additional costs may be restricted."[429] Snowy Hydro noted this point in its submission, commenting that the NEM was set up to allow on-going changes in region boundaries so it would expect that NEMMCO's market systems would be flexible enough to accommodate this market design feature.[430]

C.13.7.3 Transition

ERAA, Country Energy, CS Energy, and Macquarie Generation all supported the extension of the Snowy CSP/CSC Trial until implementation of a boundary change in the Snowy region.[431]

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[424] Delta Electricity, Submission on implementation, p.2.; ERAA, Submission on implementation, p.2; Snowy Hydro, s.95 submission, Abolition proposal, p.8.

[425] Snowy Hydro, Submission on implementation, p.3; ERAA, Submission on implementation, p.2.

[426] ERAA, Submission on implementation, p.3.

[427] Delta Electricity, Submission on implementation, p.2.

[428] Snowy Hydro, Submission on implementation, p.2-3.

[429] NEMMCO, Letter on implementation, 25 August 2006, p.1.

[430] Snowy Hydro, Submission on implementation, p.2.

[431] ERAA, Submission on implementation, p.1-2; Country Energy, Submission on implementation, p.3; CS Energy, s.95 submission, Abolition proposal, p.1.; Macquarie Generation, Submission on implementation, p.3.

C.13.7.4 Implementation lead time

In its first round submission, NEMMCO stated that the proposed commencement dates of 1 July 2007 (Snowy Hydro) and 1 August 2006 (Macquarie Generation) did not provide sufficient time to formally implement either proposal. In its advice to the Commission on implementation, NEMMCO articulated that it could implement either proposal by November 2006. This was conditional on the Commission issuing its Draft Rule Determination on 15 December 2006 and its Final Rule Determination in March 2007.

Eraring Energy commented that market participants required "adequate forward notice" for implementing a region boundary change.[432]

The Southern Generators preferred a lead time of two years, but at a minimum, proposed four quarters.[433]

ERAA considered the minimum lead time for any region boundary change should be three years to account for the impact of any region boundary change on customer load and the value of financial instruments.[434] This is particularly relevant for the discontinued Macquarie Generation proposal, the ERAA noted, because the "rapid partitioning of a customer base into multiple price regions introduces major challenges for retailers operationally" (e.g. risk management and providing regulated price/service offering to all customers). Ergon Energy supported this approach, noting that NEMMCO's proposed timeframe would greatly stretch NEMMCO's resources, which may impact the efficient delivery of other services, increase the possibility of errors, and reduce the ability to deliver the necessary changes as an efficient cost.[435]

Macquarie Generation stated it had no problem with a proposed commencement date of 1 July 2008 for its proposal. It considered the deferred commencement date would: decrease the number of existing hedge and retail contracts affected by the realignment of region boundaries; greater notice period for SRA participants; reduce NEMMCO's implementation costs due to increased planning and implementation time; greater time for TNSPs to provide their necessary information to NEMMCO; and allow for new loss factors to be introduced at the start of a financial year.[436] ERAA supported a commencement date aligned with the start of a financial or calendar year, or at an absolute minimum, a start of a quarter.[437]

Delta Electricity commented that the complexities with the contract market make it difficult to quantify the exact impact on implementation of a region boundary change. It considered further review was necessary to determine the extent to which

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[432] Eraring Energy, s.95 submission, p.2.

[433] Southern Generators, s.95 submission, p.10.

[434] ERAA, Submission on implementation, p.2.

[435] Ergon Energy, Submission on implementation, 31 October 2006, p.1, 2.

[436] Macquarie Generation, Submission on implementation, p.3.

[437] ERAA, Submission on implementation, p.3.

these issues would undermine NEMMCO's estimate of earliest implementation of November 2007.[438]

C.13.8 Consistency and relationship with policy environment

C.13.8.1 Consistency with MCE policy

Southern Generators stated that the MCE policy was aimed at stability and avoiding, if possible, the multiple subdivision of existing regions. Their submission continued stating there was "no express policy regarding the reduct[ion] [of] the existing number of regions. They concluded there was "no 'stability benefit' gained by elimination of a region".[439]

C.13.8.2 MCE proposal on boundary change process and criteria

Many submissions did not support the discontinued Macquarie Generation proposal as it did not correspond to the MCE's proposed region boundary change criteria and process (which takes into account of its proposed staged approach to congestion management). Inconsistencies identified included:

- Creation of two new regions whose boundaries do not reflect identified areas of material and enduring congestion;[440]
- Introduction boundary change prior to considering transmission augmentation options or potential interim congestion pricing mechanisms, if appropriate;[441]
- Creation of multiple regions within jurisdictions;[442] and
- Placement of a boundary between two firmly physically connected locations – Upper Tumut and Canberra/Yass.[443]

The MCE Rule change proposal on boundary change criteria and process includes a requirement for applications to provide:

- "A detailed description of the proposed region change and reasons for the change;

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438 Delta Electricity, Submission on implementation, p.2.

439 Southern Generators, s.95 submission, p.6.

440 ERAA, s.95 submission, discontinued Macquarie Generation proposal, 23 March 2006, p.1; Origin Energy, s.95 submission, p.2; Snowy Hydro, s.95 submission, discontinued Macquarie Generation proposal, p.7-8.

441 Snowy Hydro, s.95 submission, discontinued Macquarie Generation proposal, p.7-8; Snowy Hydro, Submission on implementation, p.3.

442 CS Energy, s.95 submission, discontinued Macquarie Generation proposal, p.1.

443 Snowy Hydro, Submission on implementation, p.3.

- All the relevant technical details concerning the proposed region change; and

- A detailed analysis of whether the region change is likely to result in a material and enduring net economic benefit to all those who produce, consume, and transport electricity."[444]

Submissions were critical of the two proposals because neither proposal appeared to provide a compelling case as to how either proposal promoted the NEM Objective.[445]

Snowy Hydro stated in its submission that its proposal was consistent with proposed MCE boundary change process, criteria, and approach to congestion management.[446]

C.13.8.3 MCE proposed staged approach to congestion management

Noting the staged approach for congestion management proposed by the MCE, many submissions acknowledged it was unlikely that problems with the Murray-Tumut constraint would be addressed through network augmentation in the short-to-medium term.[447]

Submissions also noted that the Murray-Tumut constraint was being managed by an interim congestion pricing mechanism ("Snowy CSP/CSC Trial"). This, in conjunction with the unlikely event of network augmentation, left a region boundary change as the remaining option to address the congestion problem.[448]

C.14 Long-term investment and end user impacts and utilisation

Country Energy preferred the Abolition proposal because it (a) recognised that a region boundary change was the most appropriate long term solution; and (b) considered that proposal the least disruptive to future generation investment.[449]

Snowy Hydro stated that "an early change to the Snowy region boundary would substantially reduce the risk of inefficient generation investment, by ensuring that new entrant generators compete on more level terms with incumbents for access to the transmission network."

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444 Ministerial Council for Energy, Proposed Rule on Reform of Regional Boundaries, clause 3.5.2 (d), 7 October 2005. Available on the AEMC website.

445 ERAA, s.95 submission, Abolition proposal, p.1; ERAA, s.95 submission, discontinued Macquarie Generation proposal, p.1; Ergon Energy, s.95 submission, p. 1; Delta Electricity, s.95 submission, p.1-2; NEMMCO, s.95 submission, p.1, 3; Wambo Power Ventures, s.95 submission, p.1.

446 Snowy Hydro, s.95 submission, Abolition proposal, p.10.

447 CS Energy, s.95 submission, Abolition proposal, p.1; Delta Electricity, s.95 submission, p.1; ERAA, s.95 submission, Abolition proposal, p.1; Ergon Energy, s.95 submission, p.1; TransGrid, s.95 submission, p.1; Origin Energy, s.95 submission, p.2.

448 ERAA, s.95 submission, discontinued Macquarie Generation proposal, p.1; Delta Electricity, s.95 submission, p.1; Origin Energy, s.95 submission, p.2

449 Country Energy, Submission on implementation, p.3.

Wambo Power Ventures' preliminary assessment indicated that any increase in the number of regions should be approached with caution given the negative impact on financial product liquidity and risk from the consequential increase in inter-regional hedging arrangements.[450] It stated that its investment in intermediate generation was only justified on the basis of the existing regulatory process assumptions, including the "MCE's overarching requirements of only incremental change supported by robust economic criteria, and no impact on generation investment".[451]

In its supplementary submission, Wambo Power Ventures stated that the discontinued Macquarie Generation proposal was just a gaming opportunity to maintain a commercial advantage for its own proposed gas-fired plant. The discontinued Macquarie Generation proposal, Wambo Power Ventures stated, would affect its own announced new gas-fired power station.[452]

In a further supplementary submission, Wambo Power Ventures argued against the claim that new generation at Wagga can displace Snowy Hydro generation on northward flows and that it is an inefficient generation investment. Wambo Power Ventures noted that gas turbines in the Wagga area are a significant positive non-network contribution to remedy south-west NSW region supply and voltage limitations, inter-state interconnection limitations, and to improve the marginal supply/demand balances in NSW in the near term.[453]

ERAA stated that unconstrained changes in the NEM created uncertainty, which may threaten the viability of investment and strategic decision making.

[450] Wambo Power Ventures, s.95 submission, p.1.

[451] Ibid, p.2.

[452] Wambo Power Ventures, Supplementary s.95 submission, 15 May 2006, p.2.

[453] Wambo Power Ventures, Supplementary Submission, Regulatory Risks re: Possible Snowy Boundary Changes & Southern Region Constraints, 5 January 2007.

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D Background on the Snowy region

This Appendix provides background to the three Rule change proposals by explaining the background to the National Electricity Market (NEM) regional structure, describing the network in the Snowy region, discussing the Snowy region network loop, and the way in which this has been managed and considering the potential for investment to address the issues arising from congestion in the Snowy region.

Appendices E and F contain additional background on the 1997 decision on the current Snowy region boundary and the historical incidence of constraints, respectively.

D.1 NEM regional structure and Rules on region boundaries

The NEM spot market is priced on a region basis. In 1997, the NEM was established with five regions, and expanded to six regions when Tasmania joined on 29 May 2005. The decision on the appropriate region boundaries was based on technical criteria in the National Electricity Code (NEC or Code) regarding the design of regions (clause 3.5) and modelling of losses (clause 3.6).[454]

The purpose of the region division was to allow market prices to reflect the real-time cost of transmission congestion, where "cost" is based on market participants' bids and offers.[455] Region boundaries were initially established at the points across the NEM where transmission network connection was weak and hence congestion was greatest and/or most likely. This enabled the region boundary structure to facilitate price signalling when generation and demand patterns created network congestion. Generation investors would be encouraged to develop new capacity in regions experiencing high prices and load investors would be encouraged to locate their operations in regions experiencing low prices.

The original version of the Code envisaged that region boundaries would be reviewed annually, and changed as required to reflect and price new points of "material" congestion. Materiality was to be assessed according to a number of technical criteria, including whether network constraints were likely to affect optimal dispatch (taking bids and offers as given) for more than 50 hours over a financial year. Various other technical criteria were also relevant, relating to matters such as the ease of defining transfer limits and the accuracy of static intra-regional loss factors.

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454 NEMMCO – TIRC 1997, *Report on Marginal Loss Factors and Regional Boundaries for Victoria, South Australia and New South Wales in the National Electricity* Market, NEMMCO, Melbourne, September 1997 (including Recommendation on NEM Regions & MLF, dated 14/08/1998).

455 Cost based on bids and offers received may diverge from the economic cost of dispatch, which is based on underlying resource costs, particularly where generators behave strategically.

Appendix E provides further information on the 1997 Determination of Region Boundaries, but in summary, a separate, generation only, Snowy region was decided upon at NEM start for a number of reasons including:[456]

1. Tidal flows (i.e. power switching direction) in and out of Snowy area, which meant that variance (as measured by the standard deviation of the static marginal loss factor (MLF) under a range of load and generation patterns) was large enough under the Code's criteria to warrant a separate region being created, with dynamic loss equations being used on the interconnectors;

2. Dispatch inefficiencies arising from the use of static loss factors. It was considered that use of a single static MLF at either Murray or Tumut would result in significant dispatch inefficiencies at those times when the actual, dynamic, loss factor diverged substantially from the static MLF; and

3. A generation only region was allowed for in the Code.

Since the start of the NEM, there have been a number of reviews considering the criteria to apply when reviewing the current region boundary structure. These reviews were accompanied by a moratorium on region boundary changes by the NEM Ministers Forum in 2002, pending the development of an appropriate long term framework for making region boundary changes.

The most recent review was initiated by the Ministerial Council on Energy (MCE) submitting a Rule change proposal to the Commission on 5 October 2005 regarding the process and criteria to assess region boundary changes in the NEM. The Rule changes that may result from this proposal would supersede the current moratorium on region boundary changes contained in the Rules.[457] The MCE Rule change proposal on the reform of region boundaries is informed by a report prepared by consultants Charles River Associates (CRA), who were commissioned by the MCE to develop criteria and processes for boundary changes and initial boundary options.[458] The Commission will soon publish its draft Rule determination on the MCE's proposed process for region change.

D.2 Description of the network in the Snowy region

The Snowy region provides a crucial transmission link in the middle of the NEM. The transmission grid within the Snowy region and between NSW and Victoria was designed to deliver energy from the Snowy Mountains to major load centres and to connect the state-based power systems in NSW and Victoria. Figure D.1 shows the network configuration in the Snowy region.

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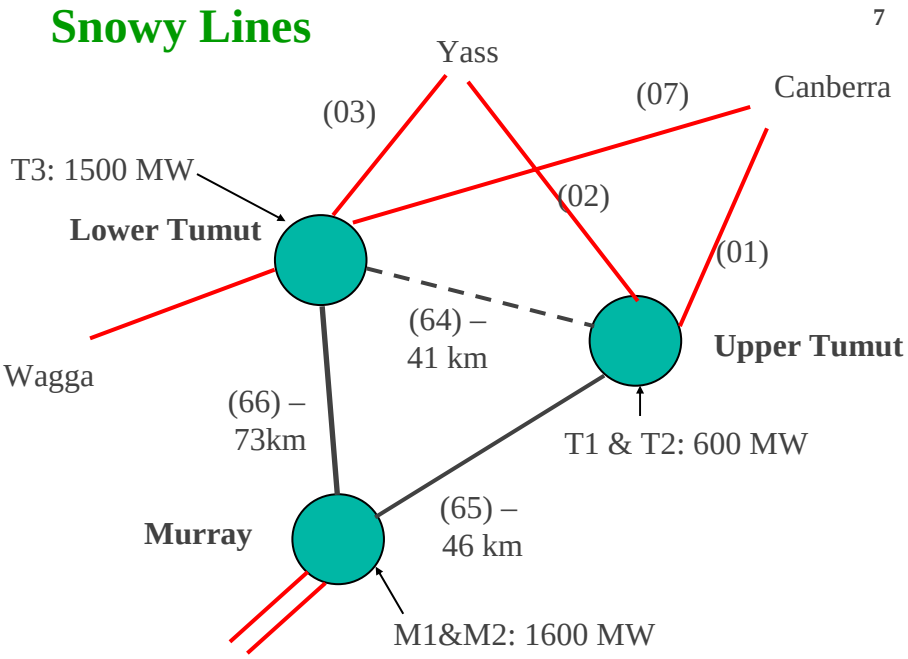
456 NEMMCO – TIRC 1997 Report.

457 Clause 3.5.4 of the Rules.

458 Charles River Associates, *NEM – Transmission Region Boundary Structure, Final Report*, submitted to Ministerial Council on Energy, Melbourne, September 2004.

Figure D.1 Transmission lines in Snowy Mountains & connections into NSW & VIC



Note: Transmission line numbers are in brackets. The lines between Murray, Lower Tumut, and Upper Tumut are 330kV lines. M1 and M2 represent the Murray power stations and T1, T2, and T3 represent the Tumut power stations.

Data source: TransGrid

A key feature of the Snowy Region is that it only contains generation and very little demand. Hence, virtually all the electricity generated by the Snowy generators is exported to other NEM regions. Snowy Hydro is the major provider of peaking generation during periods of high Victoria and NSW demand.

The critical transmission elements between Murray and Tumut are the 65 and 66 lines (see Figure D.1). Thermal limits on these lines mean that loading of one line has to be protected against the potential loss of the other. These thermal limits largely determine the typical 1,350MW transfer limit across the Murray–Tumut cutset of lines.[459]

There are multiple lines from the Snowy region into NSW and Victoria, with a substantially higher transfer capacity from Snowy to NSW (commonly 3,100MW) than from Snowy to Victoria (in extreme circumstances up 1,900MW). The differing transfer capabilities are, in part, a legacy of water and power entitlements set out in

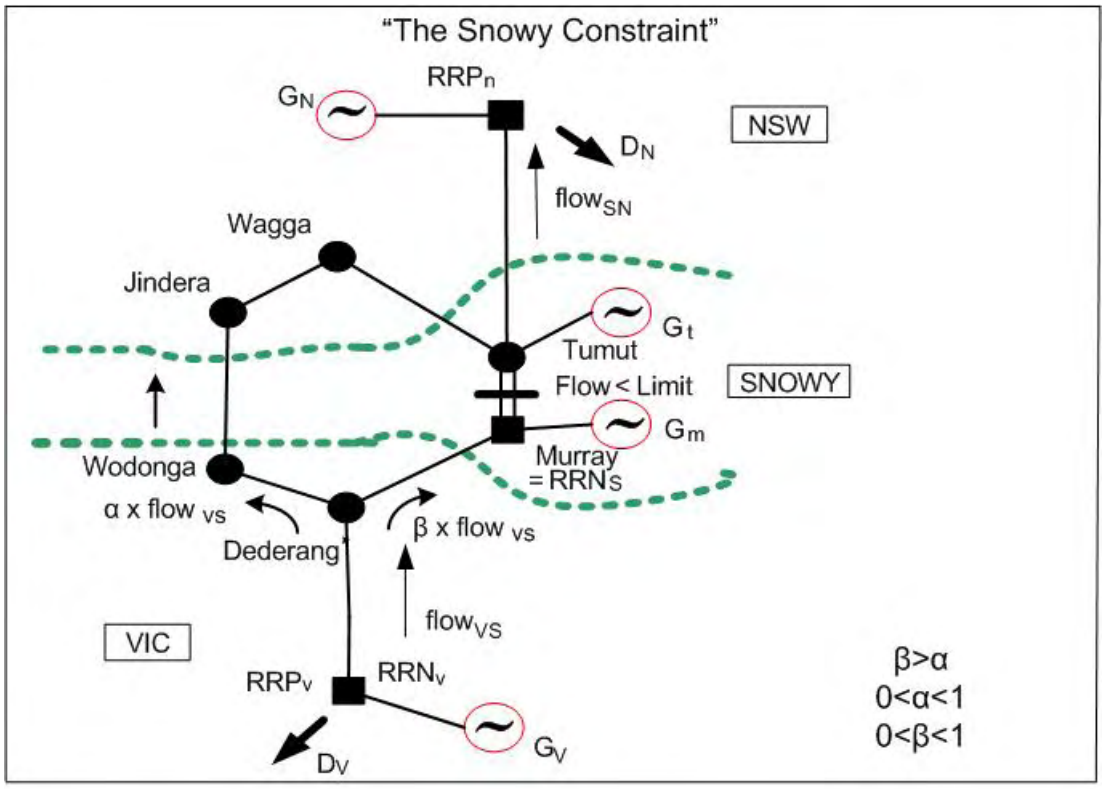
[459] The Murray-Tumut cutset comprises: a) the 64, 65 and 66 lines between Murray, Lower Tumut and Upper Tumut; and b) the 60, 62 and 51 lines between Wodonga, Jindera, Wagga and Tumut. The first group of lines pass over steep alpine terrain in the Kosciuszko National Park.

the 1957 Commonwealth-States Agreement (the Agreement) on entitlements to power and water from the Scheme.[460]

D.3 Loop flows in the Snowy region

Figure D.2 shows the looped network in and around the Snowy Region. Power flows around the loop are determined by the relative impedance of the different paths around the loop and it is common for flow across the Snowy network to alternate from northwards (i.e. Victoria-to-NSW) to southwards on a daily basis. Electricity can also flow both north and south from the Snowy region simultaneously.

Figure D.2 Snowy region network topology



The limit on the Murray to Upper and Lower Tumut transmission lines ranges between 1,250MW and 1,350MW under normal network conditions. The congestion on these lines has increased since NEM start, especially since 2002, and the point of congestion is referred to as the Murray-Tumut constraint. This is a cutset constraint in the sense that it limits flows across a cutset of lines which also include the lines

[460] The Agreement was ratified by the NSW and Victorian parliaments in 1958 — e.g. *Snowy Mountains Hydro-electric Agreements Act 1958 No.20 (NSW)* — and was a schedule added to the *Snowy Mountains Hydro-electric Power Act 1949*.

between Wagga and Wodonga. Appendix F present information on the incidence of binding for the Murray Tumut constraint from 2003/04 to 2006/07

D.3.1 Implications of the Snowy network loop

The current location of the Snowy region boundary, combined with the network configuration and limitations within the region, may have a number of implications for the economic efficiency of dispatch and longer term investment incentives. This is because the regional reference price (RRP) for the Snowy region is set at Murray, and lies on a physical transmission loop that straddles three regions. Congestion on this loop can result in the marginal value of electricity (as measured by the "shadow price") around the loop varying when a constraint binds between Murray and Tumut.[461] Describing the network loop as going from Murray to Dederang to Tumut, if the constraint binds in a northward direction, the shadow price of electricity rises through the loop.[462] If the constraint binds in a southward direction, the shadow price falls through the loop.[463]

This means that given that the Snowy regional reference node (RRN) is at Murray, and in the absence of constraints between Dederang and Melbourne, the Dederang shadow price will be similar to the Victorian RRN price. The consequences of a constraint between Murray and Tumut are that:

- The Victorian RRN price will exceed the Snowy RRN at times of northward flows – implying counter-price flows from Victoria to Snowy in the absence of intervention; and

- The Snowy RRN price will exceed the Victorian RRN at times of southward flows – implying counter-price flows from Snowy to Victoria in the absence of intervention.

These pricing outcomes may, in turn, have several important implications for dispatch and risk management.

First, Snowy Hydro and other generators may face incentives to bid their plant in a way that does not reflect their underlying costs. As discussed in more detail in Appendix A, this may result in inefficient dispatch.

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[461] The "shadow price" of electricity is equal to the marginal value of electricity at the relevant location on the transmission network. At the regional reference node (RRN), the shadow price of electricity sets the price for the region. However, at all other nodes within a region, the shadow price can be above or below the RRN price, depending on whether the marginal value of electricity at that location is greater or less, respectively, than at the RRN. For example, if an injection of electricity at a particular location would help alleviate a constraint that affects the price at the RRN, the marginal value of electricity (and hence the shadow price) at that location would typically be greater than the price at the RRN. On the other hand, if an injection of electricity at a particular location would exacerbate a constraint that affects the price at the RRN, the shadow price at that location would typically be less than the price at the RRN.

[462] In other words, the shadow price of electricity at Tumut would exceed the shadow price at Dederang (i.e. Victoria), which in turn would exceed the shadow price at Murray.

[463] In other words, the shadow price of electricity at Murray would exceed the shadow price at Dederang (i.e. Victoria), which in turn would exceed the shadow price at Tumut.

Second, counter-price flows (i.e. when power flows from a higher priced to a lower price region) result in negative settlement residues. This can affect the usefulness of inter-regional settlement residue (IRSR) units (sold through Settlement Residue Auctions (SRAs)) as a hedging mechanism for participants to manage the risk of entering inter-regional financial contracts, as discussed in Appendix A. The occurrence of negative residues has also historically been a trigger for intervention by the National Electricity Market Management Company (NEMMCO) (in the form of "clamping" flows or "re-orientating" constraints under the derogation in Part 8 of Chapter 8A of the Rules), which can distort economic dispatch.[464]

D.3.2 Interim congestion management measures

A number of interim measures have been introduced to the Snowy region to address some of the issues arising from counter-price flows and the associated generator incentives. The introduction of the Tumut Constraint Support Pricing /Constraint Support Contract Trial (Tumut CSP/ CSC Trial) on 1 October 2005 changed the settlement outcomes (and hence bidding incentives) for generators located at Tumut at times when the Murray–Tumut constraints bound. At times of northward flows and constraint between Murray and Tumut, generators located at Tumut now receive the Tumut nodal shadow price. This is similar to the NSW RRN price in the absence of binding constraints between Tumut and Sydney. The NSW RRN price tends to be higher than the Snowy RRN price set at Murray at these times. At times of southward flows and constraints between Murray and Tumut, the trial leads to Tumut receiving the Victorian RRN price on most of its output instead of the (typically lower) NSW RRN price.

The Commission's final Rule determination to make the Southern Generators Rule on 14 September 2006[465] introduced a new mechanism for managing negative settlement residues arising on the Victoria-Snowy interconnector. The Rule requires positive settlement residues on the Snowy to NSW interconnector to be used to offset negative settlement residues accruing on the Victoria to Snowy interconnector (in both directions). This was intended to enhance the usefulness of Victoria to Snowy IRSRs, particularly for participants in Victoria seeking to hedge contracts referenced to the NSW RRN, and to overcome the imperative for NEMMCO to intervene in dispatch or pricing.

These interim measures were deemed necessary pending introduction of a longer term solution to address the congestion and associated issues.

D.4 Investment options

Investment to increase the transmission capacity between Murray and Tumut could address some of the issues associated with the Snowy region. The 2005 and 2006

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[464] A detailed explanation of the occurrence of counter price flows caused by the Snowy region is contained in the Commission's Final Rule Determination on the Management of Negative Settlement Residues in the Snowy Region, 14 September 2006, Section 2.3, p.7-8.

[465] AEMC 2006, *Management of negative settlement residues in the Snowy region*, Final Rule Determination, 14 September 2006, Sydney. Available on AEMC website.

Annual National Transmission Statement (ANTS) highlighted that there are potential benefits to upgrading the Victoria to Snowy and Snowy to NSW interconnectors, but that preliminary investigations concluded that such upgrades are, at best, marginal and unlikely to pass the Regulatory Test.[466]

TransGrid, who owns the transmission network in the Snowy region, has (in conjunction with VENCorp) investigated a range of longer term options to upgrade the interconnectors. Two of the options (NEWVIC Stage 1 and NEWVIC Stage 2) involve upgrading the capacity of the Murray-Tumut cutset, while the remaining two options (NEWVIC 2500 and 3500) entail the construction of new transmission lines to the west of the existing Murray-Tumut cutset.[467] None are presently deemed to be worth pursuing because they are unlikely to pass the reliability limb of the Regulatory Test. However, TransGrid considers that upgrading the NSW network that supplies the Newcastle-Sydney-Wollongong area ("western ring") from 330KV to 500KV as a pre-requisite for any upgrading of the network between NSW and Victoria.[468] The 500kV upgrade has passed the Regulatory Test and TransGrid intends completing the work by 2009/10.[469]

Environmental considerations also influence the possibility of investment in the Snowy region transmission network. Some of the current lines between Murray and Tumut are on some of the steepest terrain in Australia, which would make investment expensive.[470] Further, engineering works on the steep slopes have the potential to cause soil erosion, which would be a factor in the decision to grant an environmental permit for the works. In addition, the lines are primarily located within the Kosciuszko National Park, which raises a range of environmental issues.[471]

The Commission has sought advice from TransGrid on the potential for a transmission upgrade to the Murray-Tumut cutset to relieve congestion on the interconnector. In October 2006, TranGrid advised the Commission that:[472]

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466 NEMMCO, *Annual National Transmission Statement*, 2005 and 2006.

467 For details of these four options, see TransGrid, *Annual Planning Report 2006*, pp.88.

468 TranGrid consider the most pressing transmission capacity upgrade to its network involves improving voltage support into the Newcastle-Sydney-Wollongong area, so that reliability and security of supply can be increased. TransGrid believe that the best means of improving voltage support entails finishing the construction of a 500kV transmission ring around Sydney, which will allow voltage to be better controlled.

469 TransGrid, *2006 Annual Planning Report*, and TransGrid, *Final Report on Proposed New large transmission network asset development to the Newcastle-Sydney-Wollongong Area*, October 2006.

470 For example, the number 65 line running between Murray and Upper Tumut Switching Stations rises from 300 metres at Murray 2 to around 1200 metres near Upper Tumut.

471 Environmental regulations and permits relating to the operations of the Snowy Mountains Scheme in the Kosciuszko National Park are set out in a range of documents, including: *Snowy Hydro Act 1997*; Snowy Park Lease; Kosciuszko National Park Plan of Management; Road Maintenance Agreement; Schedule of Existing Developments; Snowy Management Plan; and *Snowy Mountains Cloud Seeding Trial Act 2004*. For details, see: NSW National Parks and Wildlife Service, *2006 Plan of Management Kosciuszko National Park*, NSWPWS, Sydney. Available: http://www.nationalparks.nsw.gov.au/npws.nsf/Content/k_np_mgmtplan

472 TranGrid, Submission on Investment Options in the Snowy Region, 30 October 2006.

1. TransGrid's 2006 Annual Planning Report (APR) contains the latest information on options to upgrade the NSW to VIC (particularly Sections 7.3.12 and 7.3.13).

2. Initial assessments of an Aerial Laser Survey (ALS) of the 64, 65 and 66 lines between Murray, Upper Tumut and Lower Tumut indicate:

   (a) that any remedial works to the Murray-Tumut lines is "unlikely to result in any material increase in the capability of these lines. Any substantial increase of this capacity would require a major reconstruction of these lines that are wholly within the Kosciuszko National Park. That work would be subject to passing the "Regulatory Test" and extensive Environmental Approval processes";

   (b) that "uprating the lines…may not substantially change the occurrence of binding constraints in other parts of the NSW to Victoria link" which also limit interconnector flows.

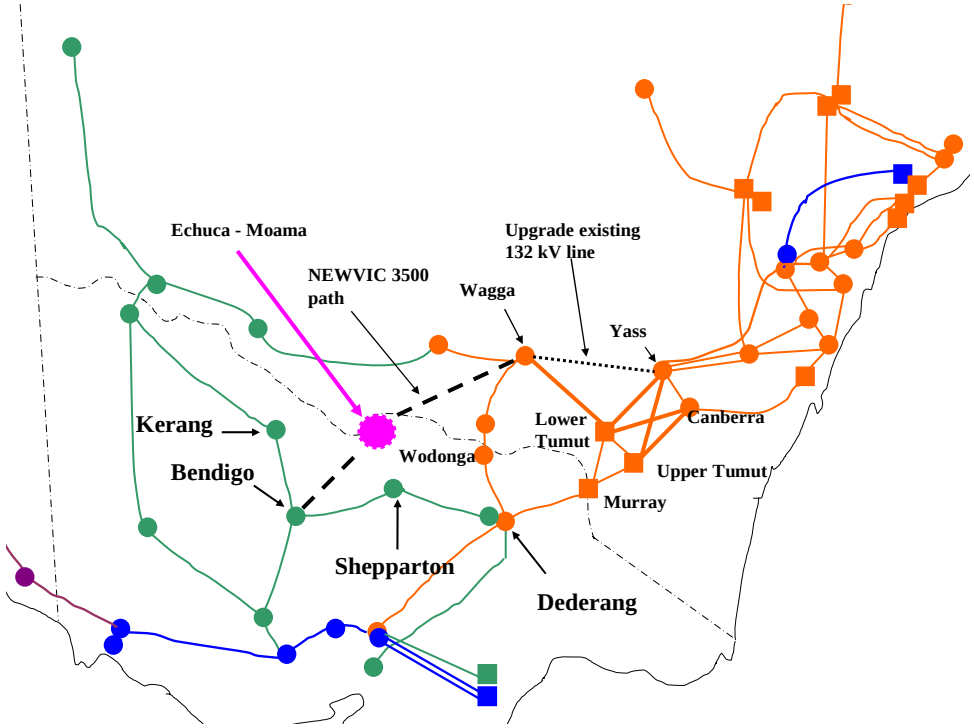
3. "As highlighted in Chapter 7 of the TransGrid's 2006 APR, a number of alternative arrangements to increase NSW-Victoria interconnection have been assessed. It is unlikely that these could be implemented in less than say the next three years. The 2006 Statement of Opportunities (SOO) and the ANTS indicate that this project could have at best marginal market benefits [i.e. with a Net Present Value (NPV) of $10–$100 million]. TransGrid will continue to investigate this upgrade."

The Commission understands that two of the four longer term (5-15 years ahead) options for upgrading transmission capacity between Sydney and Melbourne involve transmission lines south west of Wagga, to the west of the Murray-Tumut cutset. These two options, NEWVIC 2500 and NEWVIC 3500, appear to offer the greatest potential for increased transfers between the Victoria and NSW regional reference nodes in the longer term. The geography of the area west of Wagga is flat, open farmland, which is likely to mean that upgrades to transmission capacity there will be relatively cheaper than if the same upgrades were carried out in steep alpine terrain.

Further, the Commission is aware that there is significant load growth in the area to south-west of Wagga (in the Euchuca-Moama area) that may necessitate increased transmission capacity being built 5 to 15 years into the future (Figure D.3).[473] Any such transmission upgrades could eventually form part of a new, 500kV branch of the NEWVIC 3500 interconnector between Sydney and Melbourne. Should that potential augmentation prove to be economic in future, it could relieve the loading of lines on the Murray-Tumut cutset by providing an alternative, higher voltage, parallel path to the existing 330kV lines.

[473] TransGrid, *Annual Planning Report 2006*, pp.86-87.

Figure D.3 Possible route for the NEWVIC 3500 option



Note. 500kV lines (blue), 330kV lines (orange), 220kV lines (green), 275kV lines (purple),

Source: TransGrid

The Commission notes that building out the congestion across the Murray-Tumut cutset does not appear to be a viable alternative to a boundary change in the next three to five years, based on current assessments under reliability limb of the Regulatory Test. The Commission also understands that upgrades to the Murray-Tumut lines that involve raising the height of transmission towers are likely to require extensive outages over many months. Such outages would likely lead to physical separation of the southern and northern regions of the NEM for extended periods of time, causing considerable market disruption.

In its 2007 Annual Planning Report, TransGrid confirmed that works to rehabilitate the transmission lines between Lower Tumut and Upper Tumut, Murray and Upper Tumut and Murray and Lower Tumut in the Snowy area were underway. However, there is no new information on either the NEWVIC 2500 or NEWVIC 3500 projects.

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E 1997 Determination on Region Boundaries

This Appendix outlines the location of existing transmission network and region boundaries and explains the historical reasons behind the choice of these boundaries. After briefly summarising the discussion, this Appendix outlines the current regional structure of the National Electricity Market (NEM), and presents the reasoning and analysis behind the 1997 region boundary structure recommendations. It then outlines the limitations with the 1997 analysis, before considering the implications for the Rule changes considered in this Rule determination.

E.1 Summary

The National Electricity Market Management Company (NEMMCO) used historical data on congestion and forward looking market simulations in 1997 to inform its decision on the structure of existing region boundaries. Two important factors in its recommendation to implement the existing boundaries were:

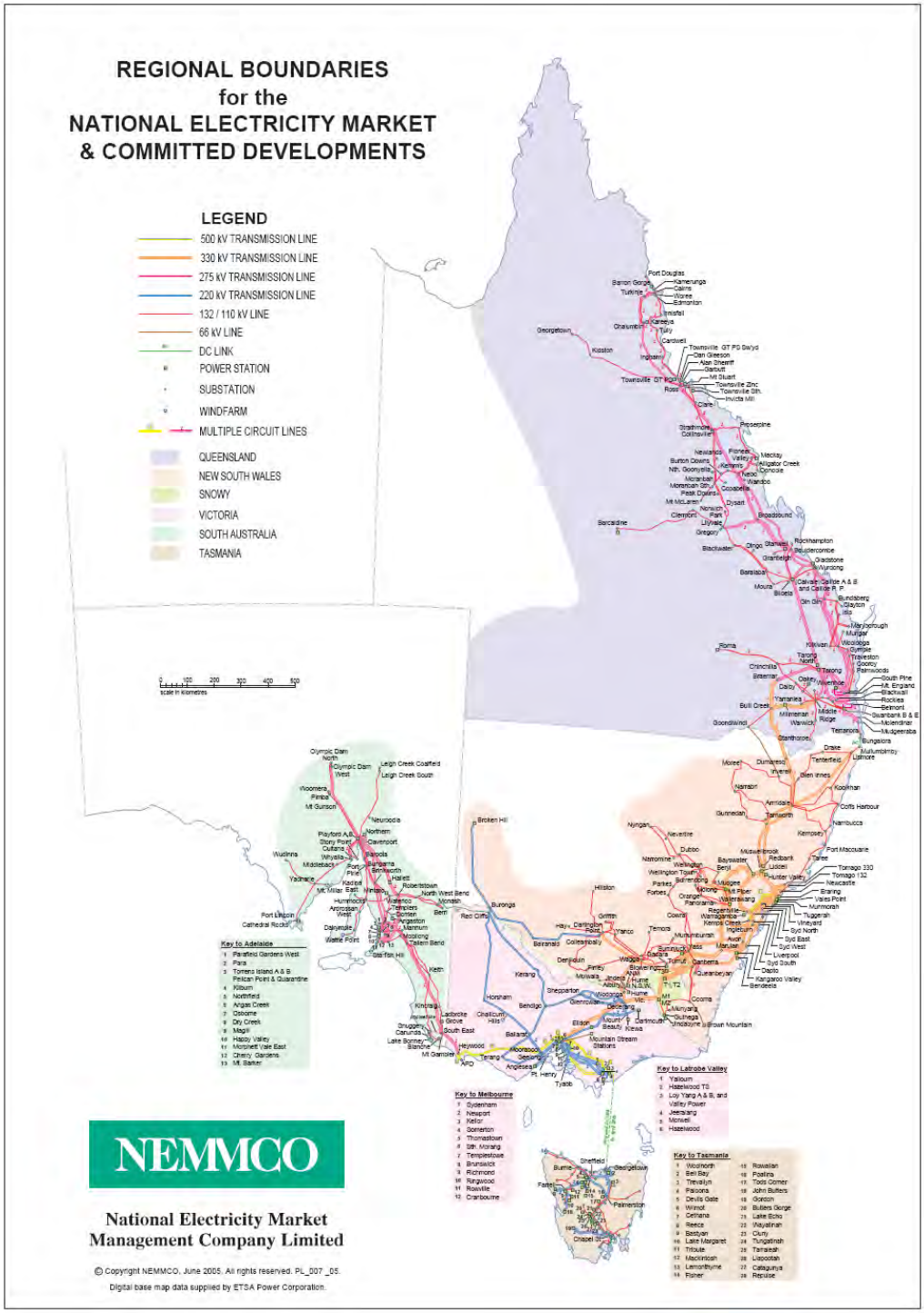
- Significant congestion between Sydney and Murray, in the areas between Tumut and Canberra/Yass (which limited flows from Snowy to NSW) and Yass and Marulan (which limited flows from NSW to Snowy); and

- The potential dispatch inefficiencies arising from the use of static loss factors for Murray and Tumut generation if both were included in the NSW pricing region. Using static loss factors when there are tidal flows of energy (to and from the Snowy area) decreases dispatch efficiency because losses are inaccurately taken into account in dispatch calculations.

E.2 NEM Transmission Network and existing region boundaries

Figure E.1 shows the existing region boundaries of the NEM, together with the transmission network and the points at which generators and loads connect to that network. These boundaries reflect the recommendation of NEMMCO in 1997, discussed in more detail in the next Section.

Figure E.1 NEM Transmission network and region boundaries

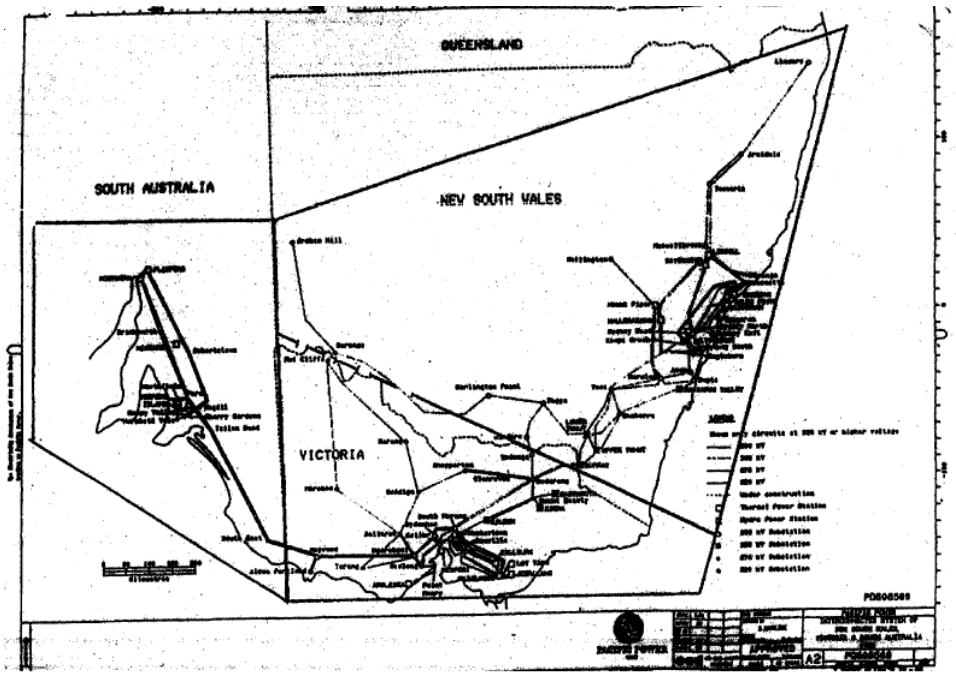


E.3 NEMMCO-TIRC recommendations

E.3.1 The 1997 decision

Following a consultation process in 1997, NEMMCO recommended to the National Electricity Code Administrator (NECA) that the existing structure of boundaries be used for the NEM, based on analysis by the Transitional Inter Regional Committee (TIRC) and Network Losses Working Group.[474] NEMMCO and TIRC considered four possible region boundary configurations and assessed them against the National Electricity Code's (the Code's) criteria for determining region boundaries (clauses 3.5.1, 3.5.2 and 3.5.3) and modelling losses (clauses 3.6.1 and 3.6.2). The four options were:

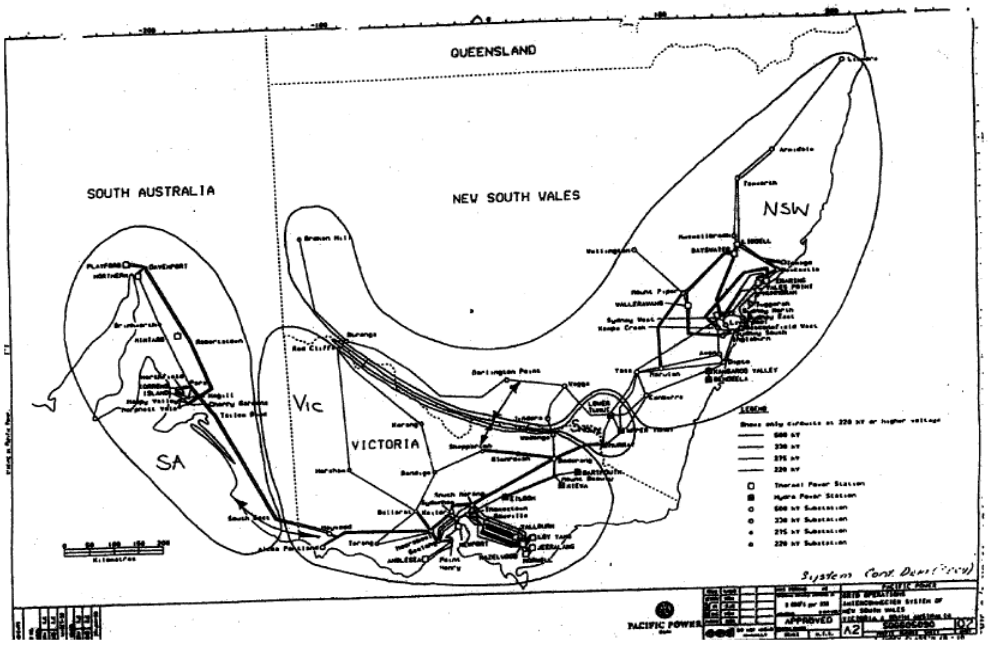
1. Region boundaries aligned with State boundaries (as used in NEM1);



Source: NEMMCO-TIRC 1997, page F.1

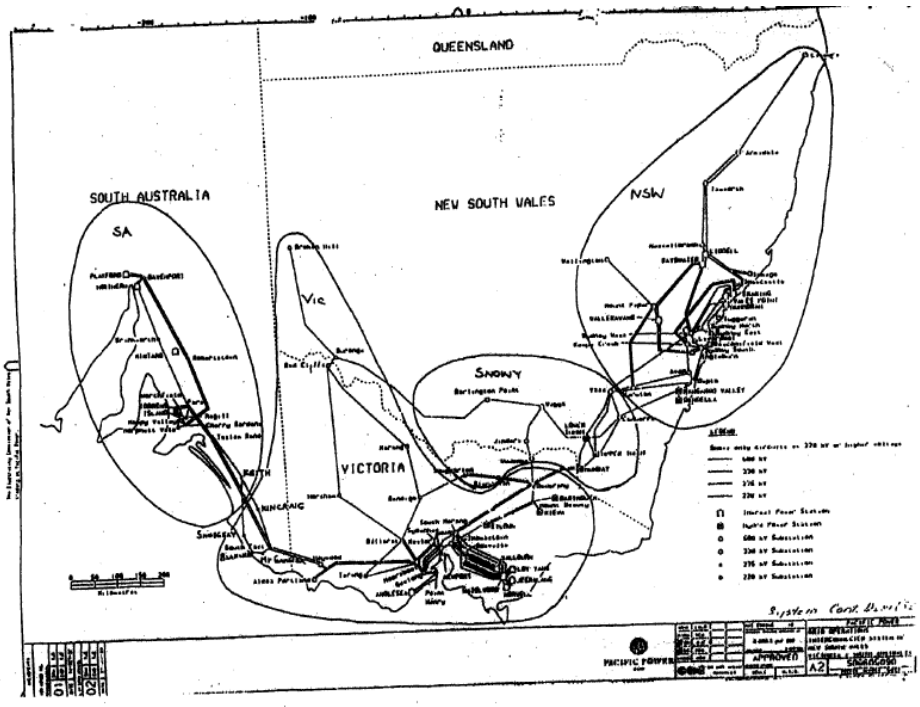
474 NEMMCO – TIRC 1997, *Report on Marginal Loss Factors and Regional Boundaries for Victoria, South Australia and New South Wales in the National Electricity Market*, NEMMCO, Melbourne, September 1997 (including Recommendation on NEM Regions & MLFs dated 14/08/1998).

2. Four regions based on current transfer flow measurement points i.e. Snowy Generation as a separate region;



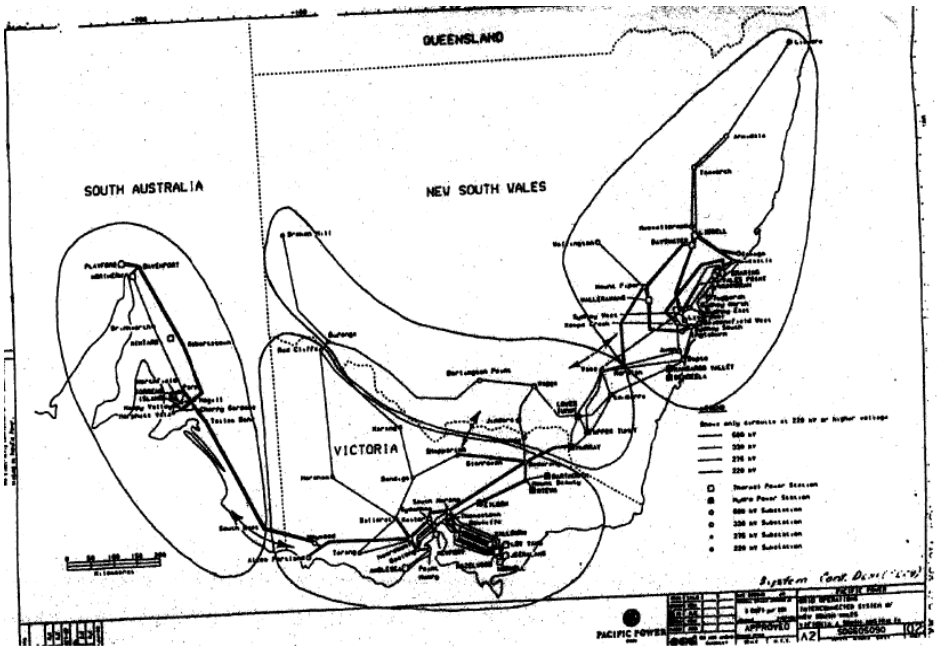
Source: NEMMCO-TIRC 1997, page F.2

3. Four regions based on minimisation of marginal loss factor (MLF) errors;



Source: NEMMCO-TIRC 1997, page F.3

4. Four regions — SA, Victoria (including distribution into NSW), NSW, and Snowy region (including load centres at Wagga, Yass, Canberra).



Source: NEMMCO-TIRC 1997 page F.4

NEMMCO and the TIRC unanimously recommended option 2 (Snowy generation in a separate region), stating:

> "The analysis clearly demonstrates the potential for Network Constraints to occur between NSW and Snowy. This is a major "driver" for the creation of a new region in Southern NSW and (possibly) northern Victoria. Although option 3 is the best technical solution for minimising loss factor variations (as well as recognising constraints), NEMMCO and the TIRC unanimously recommend option 2 (Snowy generation in a separate region).
>
> This option:
>
> - Provides for optimal dispatch of Snowy generation.
> - Fully recognises physical market reality of the potential for Network constraints to occur in southern NSW.
> - Does not bisect the franchise areas of NSW or Victoria distributors.
> - Can be implemented using existing metering infrastructure.

- Existing physical power-flow limits can apply for inter-regional power flows."[475]

There are a number of reasons why the 1997 determination is relevant to the Commission's current assessment of proposals to change the Snowy region boundary:

1. The NEM's pricing model is explained, emphasising the role region boundaries play in allowing the impacts of losses and significant constraints to be factored into the dispatch and pricing;

2. The criteria used to determine region boundaries, their interpretation and weighting are clearly discussed (see below);

3. The location and materiality of congestion on the Snowy-NSW interconnector and VIC-Snowy interconnector is assessed (see below);

4. The economic and engineering principles adopted in allocating generation and loads to specific regions in a "zonal" pricing market design are explained;

5. A central concern was the allocation of Snowy Hydro generation to a pricing region;

6. One of the four options considered in 1997 is similar to the Abolition alternative [476];

7. Limits placed on the choice of boundaries by jurisdiction-specific derogations are outlined. The derogations typically required a single price region for loads in each state. However, the Victorian jurisdiction later advised that it would consider amending its derogation to allow more than one pricing region in its state;

8. It provides a record of the responses of interested parties on matters including:

   (a) the principles and methodology used;

   (b) the commercial significance of region boundaries; and

   (c) the potential need for generators to have financially firm access to load centres; and

9. The methodology used in the 1997 assessment has a number of limitations.

---

[475] NEMMCO – TIRC 1997, p.17.

[476] The Commission made its final Rule determination to accept the Abolition of Snowy Region Rule change proposal on 30 August 2007. For the purposes of this Rule determination, the Abolition proposal is referred to as the "Abolition alternative" to reflect that at the time of the comparison of these alternatives, the Abolition proposal was a proposal, whereas now the Commission has made and commenced the *National Electricity Amendment (Abolition of Snowy Region) Rule 2007 No* 7 to implement the abolition of the Snowy region. For more information see "AEMC 2007, Abolition of Snowy Region, Rule Determination, 30 August 2007, Sydney", available on the AEMC website.

E.3.2 Principles and weightings used in 1997 region boundary determination

Clause 3.5.1(b) of the Code sets out the principles to be applied by NEMMCO in determining region boundaries and regional reference nodes (RRNs). Given the potential for conflict among these principles, they are listed in priority order.

The table below compares each of the four region boundary options with the seven selection criteria detailed in the Code. The weight given by NEMMCO-TIRC to each Code principle is shown, together with the score (in stars) of each option against the principles.

Although region boundary Option 3 scored the highest (135/147), Option 2 (132/147) was recommended, for the reasons discussed below, and has been in use since 1998.

Table E.1: Alignment of options with code principles

CODE PRINCIPLE		OPTION 1		OPTION 2		OPTION 3		OPTION 4	
(i) Enclosed regions	(10)	***	30	***	30	***	30	***	30
(ii) Constraints do not affect dispatch	(9)	*	9	***	27	***	37	***	37
(iii) Limits defined and measurable	(8)	***	24	***	24	**	16	**	16
(iv) Loss factors approximate optimal dispatch	(7)	*	7	***	21	***	21	***	21
(v) Low errors in all loss factors	(6)	*	6	**	12	***	18	**	12
(vi) Low errors in intra-regional loss factors	(5)	*	5	**	10	***	15	**	10
(vii) Minimal number of regions	(4)	***	12	**	8	**	8	**	8
SCORE			93		132		135		124 MAX 147

Data source: NEMMCO-TIRC 1997, p.15.

Note: The numbers in ( ) give the weighting for each Code principle. The 1 to 3 is used to multiply the weighting to give an overall score. E.g. Score for Code Principle (i) is 10 x 3 = 30

Recommended Option 2 has score of 132 out of max 147.

Legend: *** = best alignment
* = worst alignment

E.3.2.1 Reasoning behind the trade-off in dispatch efficiency and the number of regions

The 1997 decision to recommend Option 2 was strongly influenced by considerations regarding the economic efficiency of dispatch arising from the accurate modelling of losses and their impact on prices. The final recommendation sought to balance: a) the economic benefits of higher dispatch efficiency from more accurate pricing; and b) the benefits in terms of simplicity and trading arising from minimising the number of regions. The reasoning was presented as follows:

> "Investigations have shown that distortions in the determination and application of MLFs are minimised if regions are appropriately defined. As is the case with any "zonal" based system there is potential for difficult boundary issues which have the potential to distort outcomes for participants close to region boundaries. There is a trade off between complexity and accuracy in considering the number of regions that should be adopted.
>
> In order that distortions from the ideal nodal pricing arrangement are minimised the following aspects must be considered:
>
> - Separate regions must be declared where significant constraints can allow different prices to apply.
>
> - Within each region there should not be significant changes to loss factors with operating conditions, particularly flows. This requires declaration of a separate region with loss factor variations modelled on a dynamic basis.
>
> - Where a connection point can be assigned to more than one region in terms of network constraints, application of transfer limits and impact on central dispatch, the connection point should be assigned to the region for which the variation of pre-determined intra-regional loss factors and the resultant averaged loss factors is minimised."[477]

E.3.3 Location of binding constraints

With regards to the location of binding constraints at the time of the study, NEMMCO-TIRC made the following observations:

> "It is well documented that network constraints are currently defined in both directions between:
>
> - *Victoria and South Australia:* South Australian import capability is usually determined by transformer rating, but occasionally by transient stability

[477] NEMMCO – TIRC 1997, p.5.

considerations. South Australian export capability is determined by transient stability.

- *Victoria and Snowy*: Victorian import capability is determined by line rating considerations, voltage control constraints in the Melbourne area or by voltage control constraints in southern NSW. Victorian export capability is determined by transient stability limitations.

- *Snowy and NSW*: NSW import capability is determined by the rating of the lines between Snowy and Yass/Canberra. NSW export capability is determined at different times by either transient stability or the rating of the lines between Yass and Marulan.

It should be noted that the limits are, in most cases, not determined by the network elements located at the region boundaries, but are either embedded within networks [i.e., intra-regional limits that affect interconnector flow] or associated with the structure of the networks (viz system stability limits)."[478]

E.3.4 Materiality of congestion and its impact on choice of region boundaries

The materiality of congestion was assessed in 1997 using historical analysis and forward looking modelling that was based on historic bidding behaviour.

NEMMCO-TIRC noted that historic data showed that constraints between Victoria-South Australia and Victoria-Snowy bound frequently, but those between Snowy-NSW rarely bound. In the years leading up to 1998, binding system normal constraints on the Snowy-NSW interconnector primarily occurred in the NSW-Snowy direction, with no binding constraints in the Snowy-NSW direction. Constraints in the NSW-Snowy direction bound for more than 50 hours per year in ways that affected central dispatch — the threshold specified in Clause 3.5.2(b) (ii) of the Code as signifying congestion significant enough to warrant consideration of region boundary. Because of this experience, much of the analysis by NEMMCO-TIRC regarding the region boundaries for the NEM focussed on Snowy-NSW interconnector limits, and the most appropriate region boundary locations for the area containing Snowy Mountains Hydro-electric Scheme's power stations.

The forward-looking modelling carried out by NEMMCO-TIRC tried to assess the effects of the four different region boundary options on the economic efficiency of dispatch. Two independent models were used.[479] Each model tested a range of bidding scenarios and seasonal patterns of demand, based on historic bidding behaviour, "rather than just that which has been experienced since the start of NEM1 and consequently demonstrates the robustness of the conclusions".[480] Only the forward-looking modelling results for the first year of the NEM (i.e. 1998-99) were reported (see Table E.2), with NEMMCO-TIRC reaching the following conclusion:

---

[478] NEMMCO – TIRC 1997, p.6.

[479] Neither model is named in the NEMMCO-TIRC paper.

[480] NEMMCO – TIRC 1997, p.6.

"This analysis indicates that it should be expected that the NSW to Snowy constraint will be binding for more than the 50 hours set as the criterion in the Code. The conditions under which this is most likely to occur are those typical of summer, namely high demand in Victoria and South Australia and/or low generator availability in those States or any time of NSW generators bid lower prices than Victorian / Snowy generation."[481]

Table E.2: Estimated hours of binding constraints for typical and atypical bidding scenarios

Constraint	Constraint hours per annum		
	Lower bound	Typical	Upper bound
NSW to Snowy	50	200+	400-1000+
Snowy to NSW	0	15	60

Data source: NEMMCO-TIRC 1997, p.7.

Two other conclusions were made about the financial impacts of having Snowy generation and Southern NSW loads in a separate region. These two conclusions were based on limited modelling that used a single set of historic "typical bids" from the NEM1 market:

- "The effect of Snowy not being in a region separate from other NSW generators may be material (assessed as energy dispatched and income received for a given bid). This is believed to be due to the loss factor averaging not including a price component; and

- The effect of Southern NSW loads not being in a separate region is immaterial, assessed on the basis total annual energy costs." [482]

E.3.5 Impact of tidal flows of energy on loss factors, dispatch efficiency and settlements

A key consideration in the rejection of Option 1 (i.e. both Murray and Tumut generation in NSW) was the distortions to economic dispatch arising from the use of a static MLF when there were significant "tidal flows" of energy (i.e. power switching direction) between Victoria-Snowy-NSW.[483] It was considered that in the presence of tidal flows, the use of a single static MLF at either Murray or Tumut would result in significant dispatch inefficiencies at those times when the actual, dynamic, loss factor diverged substantially from the static MLF. Tidal flows in and out of Snowy area also meant that the variance (i.e. standard deviation) on static

481 NEMMCO – TIRC 1997, pp.6–7.

482 NEMMCO – TIRC 1997, p.7 and Attachment 3.

483 NEMMCO – TIRC 1997, p.5 and p.12.

MLFs for Murray and Tumut generation under Option 1 was considered large enough under the Code's criteria to warrant a separate Snowy region being created, with dynamic marginal loss equations being used on the resulting Victoria-Snowy and Snowy-NSW interconnectors.

These tidal flows can also increase the variance of static MLFs applied to loads in Southern NSW,[484] with the potential to affect the energy purchase costs for these loads. The standard deviation on MLFs for these Southern NSW loads were generally substantially less under region boundary Options 3 and 4 than under Options 1 and 2.[485]

In order to assess the potential settlement impacts of different static MLFs on Southern NSW loads and Snowy generation, NEMMCO-TIRC calculated the settlement outcomes for Snowy generation and a 100MW customer load in Canberra (the largest load centre in Southern NSW). Based on restrictive modelling assumptions, it was concluded that:

- There was potential for Snowy Generation to have a significantly different settlement outcome, depending on whether it was in its own region or included in the NSW region—even when the time-weighted regional reference prices it faced were similar. Snowy Hydro's annual output was 6% higher and its annual income 7% higher when it had its own pricing region rather than being included in NSW; and

- The energy purchase costs for 100MW of customer load in Canberra were unlikely to be different if Snowy generation had its own region or was included in NSW.[486]

E.4 Limitations of NEMMCO-TIRC analysis

With the benefits of hindsight and significant developments in modelling strategic behaviour in electricity markets, the following can be listed as limitations of the NEMMCO-TIRC's 1997 analysis:

- *Simple bidding assumptions* — the modelling used typical bids based largely on NEM1 behaviour, rather than strategic bidding that is responsive to region boundary changes;

- *Inadequate treatment of basis risk* — Dispatch modelling took no account of inter-regional hedging risks and incentives for generator behaviour. This is because IRSRs were not yet designed, yet alone implemented. However, NEMMCO-TIRC mentioned these risks and sought expert advice and input from market participants. Since 1997, IRSR units have been developed and there is increased

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484 Load connection points in Southern NSW include: Albury 132, ANM, Broken Hill 22, Broken Hill 220, Burrinjuck 132, Canberra 132, Coleambally, Cooma 132, Deniliquin 132, Finley 132, Goulburn 132, Griffith 132, Hay 132, Mulwala 132, Murrumburrah 132, Queanbeyan 132, Temora 132, Tumut 132,Wagga Town 132, Yanco 132, Yass 132.

485 NEMMCO – TIRC 1997, Attachment 4.

486 NEMMCO – TIRC 1997, Attachment 3.

understanding of: a) the limitations of IRSR units for managing inter-regional trading risks; b) the magnitude of those risks; and c) the firmness of IRSRs on the Victoria-Snowy and Snowy-NSW interconnector; and

- *Marginal Loss Factors* — the calculation of static MLFs and dynamic loss equations relied on historic data on: generation, loads and network limits. NEMMCO-TIRC recommended that all future calculations of losses use a forward-looking approach.

Nonetheless, the 1997 analysis provides a useful reference point for the Commission in 2007 because many of the issues concerning the Snowy region's boundary—and options for addressing them—are the same.

E.5 Similarities between region boundary options in 1997 and 2007

Both the Abolition alternative and the Split Snowy Region proposal aim to address the "legacy" issue surrounding the existing Snowy region boundary. These legacies have been discussed elsewhere, but include the following:

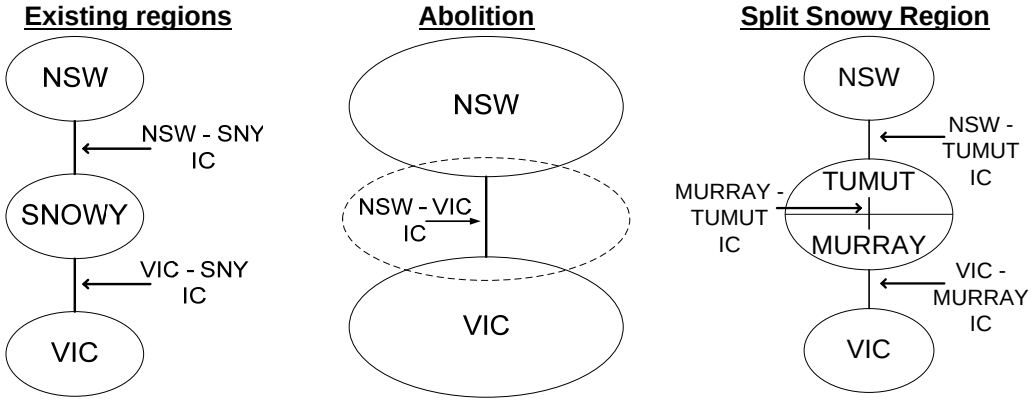
- The existing Snowy region being a separate pricing region, with:
  - a generation only region, with a large monopoly generator and no independent load; and
  - a network loop straddling three pricing regions. This loop can create counter-price flows;
- The ability of Snowy Hydro generation to influence the level of power transfers and congestion within the Snowy region and along interconnectors between Victoria and NSW;
- The partial Tumut CSP/CSC Trial, and its modification arising from implementation of Southern Generators Rule change proposal; and
- The design, topology and operation of the transmission network through the Snowy Mountains.

The difference between the Abolition alternative and the Split Snowy Region proposal is the solution put forward to address congestion in the Snowy region:

1. **The Abolition alternative** would abolish the existing Snowy region, allocating Murray generation to the existing Victorian region and Tumut generation to the existing NSW region. The proposal would abolish the Victoria-Snowy and Snowy-NSW interconnectors, replacing them with a Victoria-NSW interconnector.
2. **The Split Snowy Region proposal** would divide the existing Snowy region into two pricing regions – Murray and Tumut, creating a region boundary between Tumut and Murray generation. The proposal would also retain the existing interconnectors between the Victorian region and Murray generation and the NSW region and Tumut generation. The RRN in the Murray region will be at

Dederang, which is relocated from the Victorian region to the new Murray region and at Lower Tumut in the Tumut region.

Figure E.2 Comparison of region boundary proposals



Note. IC – Interconnector, SNY - Snowy

Both proposals are likely to change the way in which congestion costs—arising from least-cost, security constrained, economic dispatch—are reflected in the regional reference prices used to settle the NEM:

- The Abolition alternative eliminates the existing Snowy region and removes the current economic signals arising from explicit, dynamic, pricing of congestion between the existing Snowy region and the NSW and Victorian RRNs.

- The Split Snowy Region proposal continues to dynamically price congestion between the Victorian region and Murray generation and between Tumut generation and the NSW region. It would also dynamically price the congestion across the Murray–Tumut cutset, on the newly defined interconnector between the Murray and Tumut regions.

These changes in the pricing of inter-regional congestion potentially affect the:

- Magnitude of any dispatch efficiency gains arising from any move away from the existing regional structure by changing the economic incentives faced by generation plant within the newly defined regions; and

- Trading risks faced by participants trading across regions, and potentially, within each region.

These factors are discussed in more detail in Appendix A.

Interestingly, option 1 which was considered by NEMMCO and the TIRC in 1997 is similar to the Abolition alternative. In option 1 there is no separate Snowy region, but it differs from the Abolition alternative in that all Snowy Hydro generation (rather than just Tumut generation) is included in the NSW region.

Two other 1997 observations regarding the impact of Option 1 on constraints are relevant to the Commission's 2007 consideration of the Abolition alternative. The Option 1 regional configuration:

- "Ignores constraints between Snowy and NSW. If constraints between Snowy and NSW remain they will be embedded in the NSW region. This may result in Snowy being dispatched at a price different from its regional price to supply the Victorian or SA regions when intra-regional constraints apply. (This has the potential to increase the complexity of operation of the NEM.)

- There is no requirement for inter-regional hedging contracts between Snowy generators and participants in the NSW region, or between southern NSW loads and NSW generators. (Snowy generators may wish to obtain firm (transmission) access arrangements with TransGrid)."[487]

Both of these issues are also relevant to the assessment of Split Snowy Region proposal. As discussed in Appendix A, the Split Snowy Region proposal, the concerns are: a) the economic efficiency of dispatch; and b) the effectiveness of hedging inter-regional trading risks using IRSRs in a market with a greater number of regions and interconnectors.

[487] NEMMCO-TIRC 1997, p.12.

F Historical congestion between Victoria, Snowy and NSW regions

This Appendix assesses the historical frequency, type, and location of congestion between the Snowy region and the regional reference nodes (RRNs) in Victoria and New South Wales (NSW) over the four year period from financial year 2003/04 to 2006/07, inclusive.

The Commission has undertaken this analysis of binding constraints on a historical basis with the aim of better understanding the historic level of congestion at the existing regional boundaries, and the proposed borders of the new regions. This analysis will provide some insight into the possible consequences of changing regional boundaries around the Snowy region.

However, the Commission recognises the limitations of using historical data on network congestion at particular points of the network to assess potential future congestion. Information on the historical frequency and location of congestion between Victoria, Snowy and NSW must be used with caution, because past congestion is not an indicator of future congestion unless circumstances are unchanged. Because of this, forward looking modelling that accounts for changed circumstances and economic incentives is required to assess the potential economic efficiency impacts of potential changes in the location of region boundaries. The forward looking modelling undertaken by the Commission to inform its assessment of the three Rule change proposals is presented in Appendix B.

F.1 Summary

The historical analysis considered flows on the Snowy to NSW interconnector and the Victoria to Snowy interconnector. Key findings from the examination of the historical pattern of congestion over the period between 1 July 2003 to 30 June 2007 can be summarised as follows:

1. Snowy-NSW interconnector:

    (a) In simple terms the transfer capability on the Snowy-NSW interconnector is limited by a series of key cutsets, including the Murray-Tumut cutset, the North Tumut cutset, and the north and south Marulan cutsets.[488]

    (b) Binding constraints on the Snowy-NSW interconnector have increased from 137 dispatch intervals (11.4 hours) in 2003/04 to 2,164 dispatch intervals (180.3 hours) in 2006/07.

    (c) The vast majority of binding cutset constraints that limit Snowy-NSW interconnector flows in both directions arise under system normal conditions.

[488] Cutsets are defined in Section F.2.2 of this Appendix.

(d) Constraints on the Murray-Tumut cutset are the most frequent limitation on the interconnector flow capacity under system normal conditions. These constraints account for almost 74% of all binding constraints on the Snowy to NSW interconnector.

(e) During 2005/06 and 2006/07, constraints on the Liddell-Tomago cutset were the second most frequent limitation on the flows between Snowy and NSW.

(f) Discretionary constraints are the third most frequent limitation on Snowy-NSW interconnector flows.[489] However, there has been a significant reduction in the use of discretionary constraints in the past year.

(g) Together, constraints north and south of Marulan are the next most frequent limitation on Snowy-NSW interconnector flows. However, these only tend to bind under outage conditions, possibly because generators south of the constraint (e.g. Snowy Hydro, Wallerawang, and Mount Piper) adjust their output to maintain "headroom" on the cutset constraints under system normal conditions.[490]

(h) Constraints on the North Tumut cutset (i.e. between Tumut and Canberra/Yass) rarely limit interconnector flows. This result is at odds with the Split Snowy Region proposal, which maintains the existing Snowy region boundary across that cutset on the basis that it is a major "pinch point".

2. Victoria-Snowy interconnector:

(a) In simple terms the transfer capability on the Victoria-Snowy interconnector is limited by cutsets south of the Victorian RRN, cutsets between South Morang and the Snowy RRN, cutsets to the north of Murray, and transformers located at South Morang and Dederang.

(b) Binding constraints on the Victoria-Snowy interconnector have varied over the period considered, ranging from 5,924 dispatch intervals (493.7 hours) in 2005/06 to 12,734 dispatch intervals (1,061.2 hours) in 2003/04.

(c) Around 80% of all binding cutset constraints that limit Victoria-Snowy interconnector flows in both directions arise under system normal conditions.

(d) Stability constraints are the most frequent limitation on flows along the Victoria-Snowy interconnector.

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[489] Discretionary constraint sets are used to limit flows on an interconnector to less than or equal to a fixed value. NEMMCO advises that these sets are invoked at the discretion of operating staff, and are not necessarily associated with any specific outage or system condition. Discretionary constraints are used by NEMMCO to manage negative settlement residues by "clamping".

[490] The practice of generators limiting output with the aim of avoiding constraining lines that would cause their settlement price to fall is known as maintaining headroom. This is discussed in more detail in Appendix A.

(e) South Morang transformer constraints, discretionary constraints and voltage constraints were, respectively, the three next most frequent limitations on interconnector flows over the three years.

(f) Constraints between Dederang and South Morang very rarely represent the most limiting factor on interconnector flows. This result is at also odds with the Split Snowy Region proposal, which maintains the existing southern Snowy region boundary, with the exception of relocating Dederang into Murray, on the basis that it is a major "pinch point".

F.2 Historic data on the incidence of congestion between Victoria and NSW

The Commission's analysis of historical congestion between Victoria and NSW was based on statistical data provided by the National Electricity Market Management Company (NEMMCO). The data covered four directional interconnectors: Victoria-Snowy, Snowy-Victoria, Snowy-NSW and NSW-Snowy. For each directional interconnector NEMMCO provided the frequency of binding constraints, according to a number of criteria: by cutset, by constraint type, by financial year, by season (summer, autumn, winter, spring), and time of day (peak, off-peak).

The data was extracted from NEMMCO's Market Management Systems (MMS) and covers the period between 1 July 2003 and 30 June 2007. NEMMCO calculated the most binding constraint on each interconnector in each 5-minute dispatch interval, and then used this data to calculate the frequency of binding constraints across each financial year.

Before analysing this data, it is important to have a clear understanding of:

- The various network elements that make up the interconnectors;
- How these elements can be grouped into geographic "cutsets";
- The types of limits and constraints that affect cutsets; and
- How different types of cutset limits affect the overall transfer capacity of an interconnector.

This is discussed in more detail below.

F.2.1 Network elements making up interconnectors

The interconnection between the RRNs of Victoria (Thomastown), Snowy (Murray), and NSW (Sydney West) comprises many individual transmission lines at various voltages. Figure F.1 illustrates these transmission lines, showing the lines with capacities of 330kV (orange), 220kV (blue) and 132kV (red). The backbone is the 330kV network, which also links with the 500kV networks (yellow) of Victoria and NSW. Associated with these lines are transformers, switching stations, and network support and control infrastructure.

Figure F.1 Transmission network elements – Victoria-Snowy and Snowy-NSW Interconnectors

Data source: NEMMCO

For dispatch and pricing purposes, the National Electricity Rules (Rules) group these lines into two "notional interconnectors", along which power flow is measured at the region boundary. By convention, the direction of flow from Victoria to NSW is assigned a positive sign and the reverse flow a negative sign. These flow conventions allow each interconnector to be divided into two individual "directional interconnectors"— one for each direction of power flow. Table F.1 shows the notional and directional interconnectors between the Victorian and NSW RRNs.

Table F.1: Interconnectors & directional interconnectors, Victoria to NSW

Notional Interconnector	Direction of flow on interconnector	Sign convention for flow direction	Directional interconnector
V-Snowy	Victoria to Snowy	+	VIC-SNY
	Snowy to Victoria	-	SNY-VIC
SNOWY1	Snowy to NSW	+	SNY-NSW
	NSW to Snowy	-	NSW-SNY

Each interconnector can also be divided into a series of "cutsets" (or "flow paths").

F.2.2 Cutsets

A cutset is a group of transmission lines that limits power transfers from one area to another and whose removal from the network's topology (via switching or an outage) would split the network in two, one on each side of the cutset.[491] The maximum power that can be transferred across a cutset is limited by thermal and stability constraints. The power transfer limitations applying to a cutset mean that the cutset is sometimes referred to as a "transmission pinch point".

The National Electricity Market's (NEM's) very long alternating current (AC) transmission network (over 4,000km), widely dispersed and unbalanced centres of generation and load, all contribute to stability constraints (rather than thermal constraints) often being the most significant limitation on power transfers across cutsets.

Each notional interconnector in the NEM comprises the group of cutsets affecting power flows between two RRNs. Limits on each cutset in the group limit the power transfer capability between two segments of the notional interconnector, and hence limit the transfers across the entire interconnector.

The following Section considers the key cutsets forming the Snowy-NSW and Victoria-Snowy interconnectors in turn.

F.2.2.1 Snowy-NSW interconnector (Snowy1)

Figure F.2 is a simplified representation of the Snowy-NSW interconnector, which comprises five cutsets of lines between the Snowy RRN (Murray) and the NSW RRN (Sydney West). This box, containing all the cutsets, comprises the notional interconnector, as does the single diagonal line running from the south-west corner of the box to the northeast corner. This single line is a simplification of the many lines that make up the cutsets that together form the interconnector. Significant connection points used to define the cutsets are shown next to the diagonal line, for example Canberra and Marulan.

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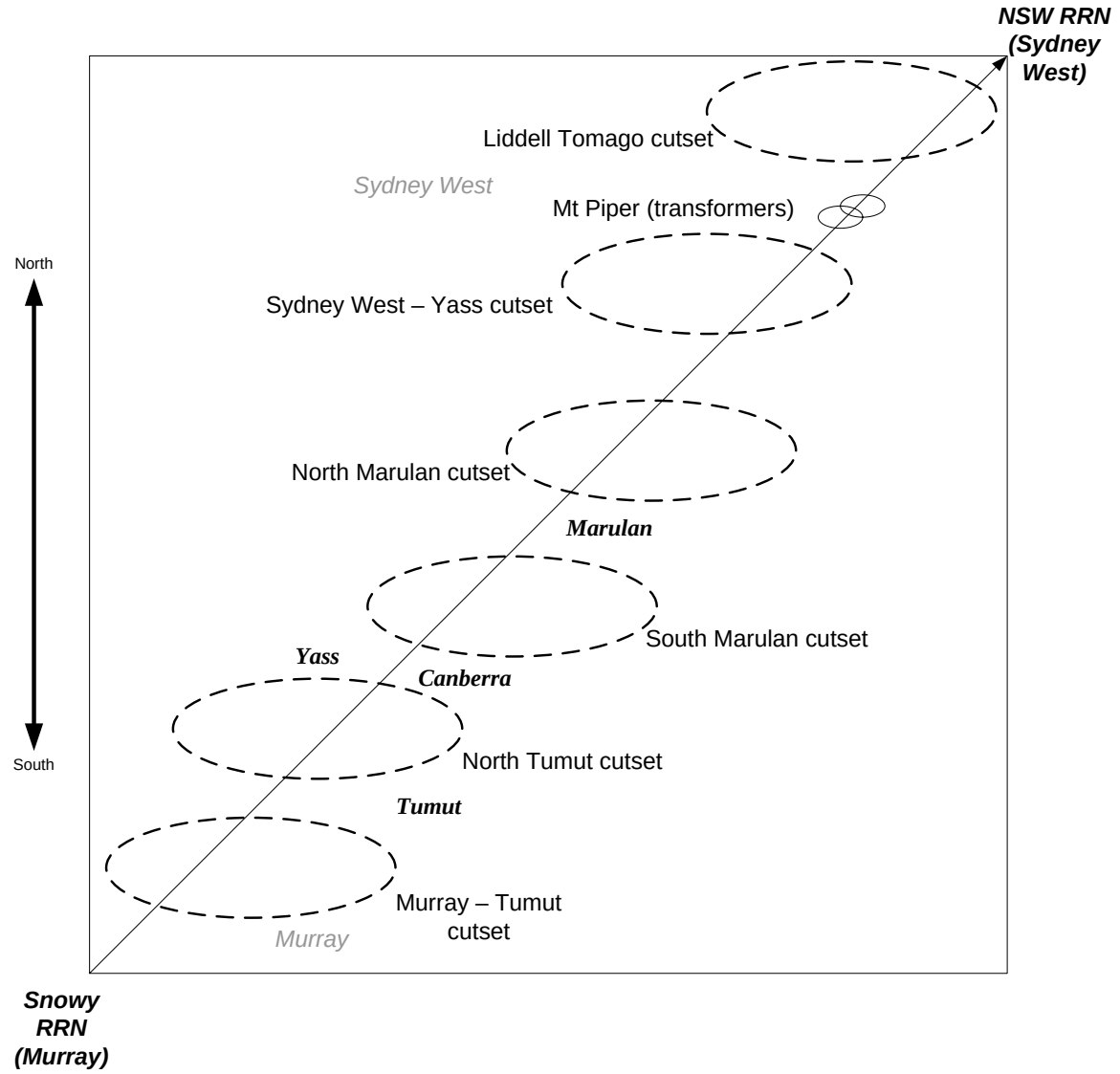
[491] In strict terms, an electricity cutset is defined as a set of branches of a network such that the cutting of all the branches of the set increases the number of separate parts of the network, but the cutting of all the branches except one does not.

Importantly, the Liddell-Tomago cutset and Mount Piper transformers, which lie geographically to the north of Sydney West, can also limit flows from Murray to Sydney West.

These cutsets closely correspond to those in the 17-zone Annual National Transmission Statement (ANTS) model in NEMMCO's 2005 *Statement of Opportunities*.

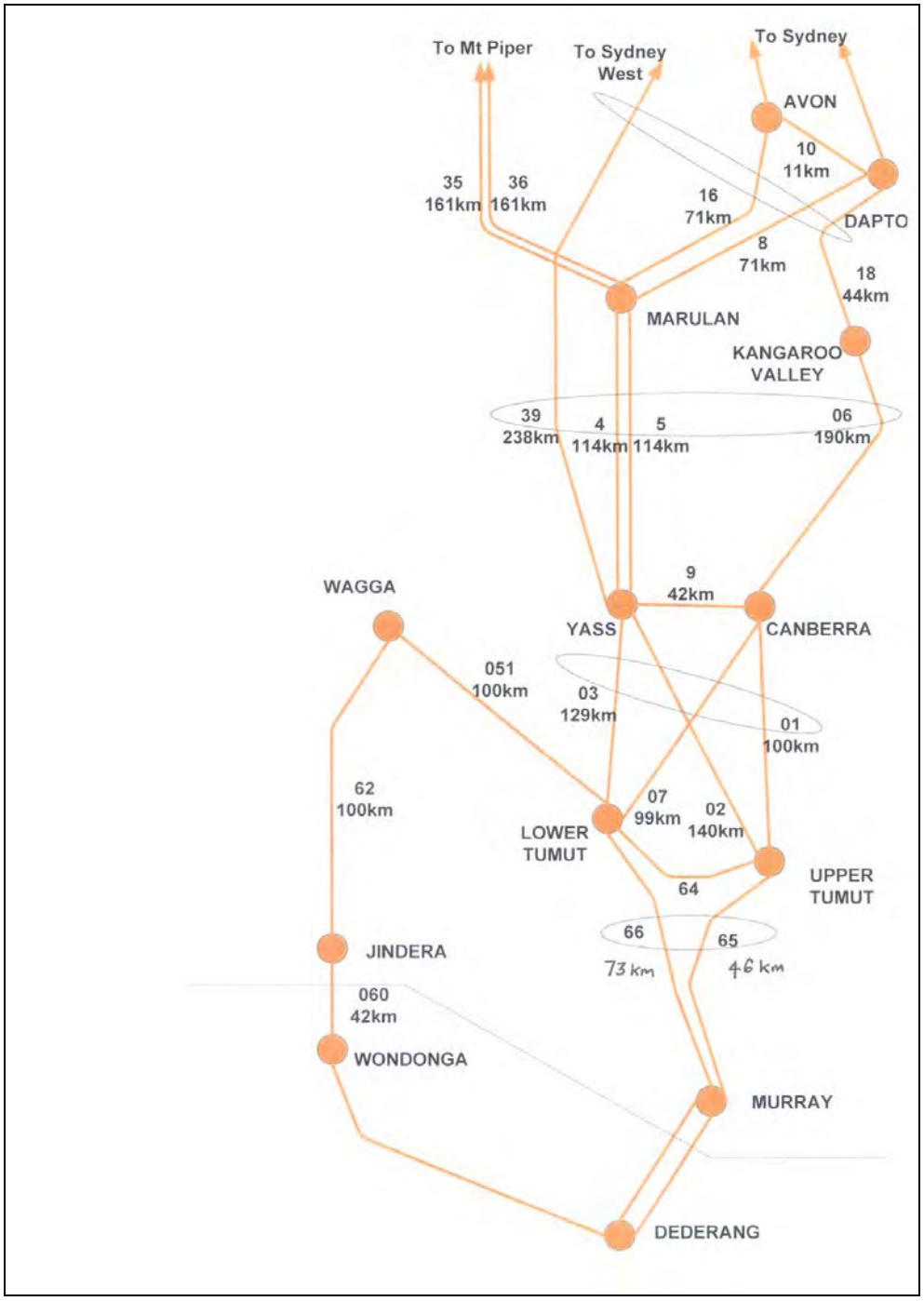
Figure F.2 Simplified representation of Snowy-NSW notional interconnector



A more detailed picture of the transmission lines that form the five southern cutsets on the Snowy-NSW interconnector is shown in Figure F.3. The lines are numbered and their length is shown. For example, in Figure F.3, the line from Murray to Upper Tumut is the "65 line", whose length is 46km. The length of a line affects its electrical impedance and degree to which voltage drops along the line as power flows from

one end to the other. In general, the longer the line, the greater its impedance (i.e. losses) and voltage drop.

Figure F.3 Snowy-NSW interconnector – transmission lines and cutsets, detail



Data source: TransGrid

TransGrid's 2006 and 2007 Annual Planning Reports (APRs) state that limitations on the Snowy-NSW interconnector's transfer capability are affected by five factors:

1. Thermal limits on lines in the South Marulan cutset, which restrict the level of flows both north and south. At present, the limits predominantly restrict southwards flows;[492]

2. Thermal ratings of lines in the Murray-Tumut cutset;[493]

3. Transient stability limits that apply in the "event of a fault on a critical 330kV transmission line in southern NSW (i.e., the Wagga to Darlington Point line)";[494]

4. "Thermal ratings of plant in southern NSW" around Wagga and between Wagga and Yass;[495] and

5. Voltage control and reactive power limitations around Canberra.[496]

NSW import capability along the Snowy-NSW interconnector is currently determined at different times by factors (1), (2), (4) and (5) above.

NSW export capability to the Snowy and Victorian regions is currently determined at different times by factors (1), (2), (3) and (4) above.

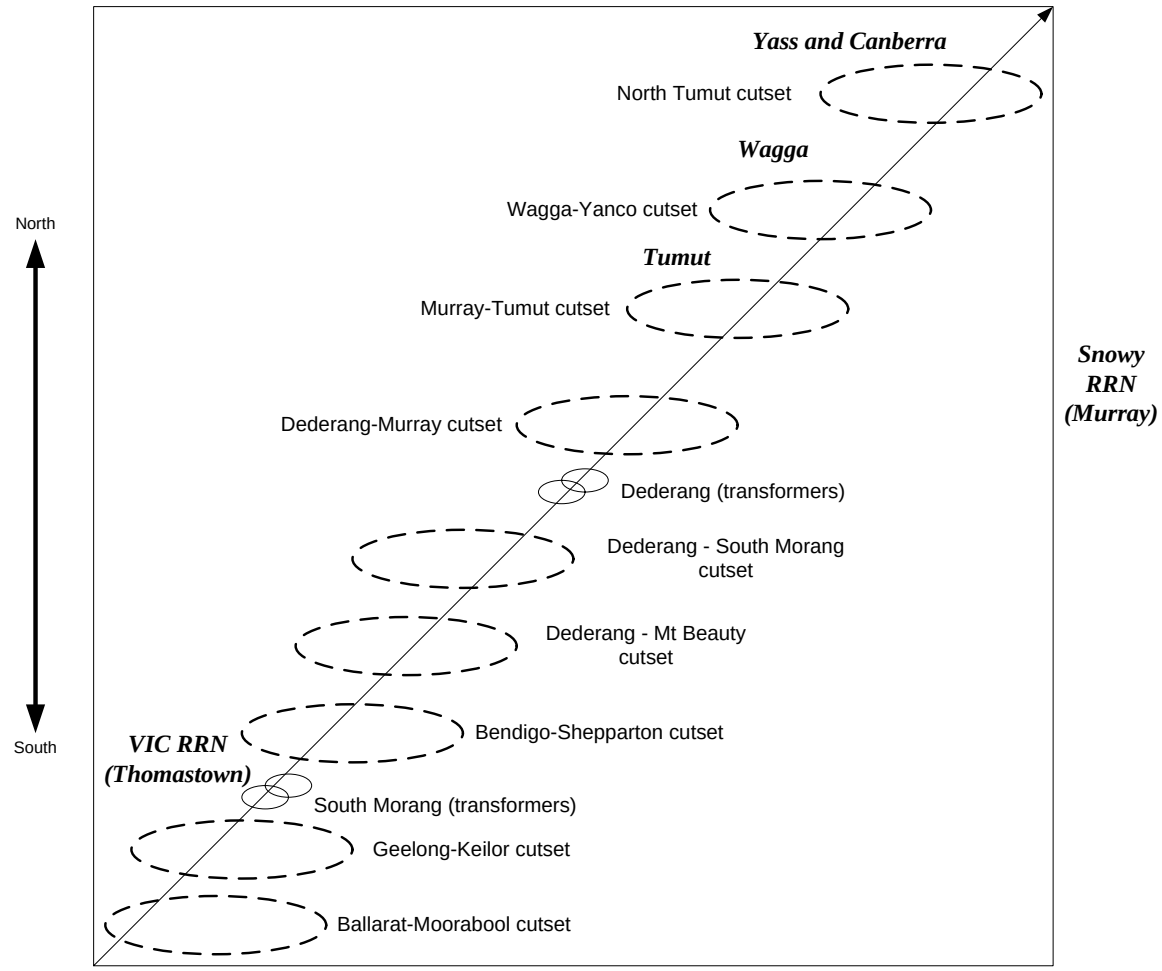
F.2.2.2 Victoria-Snowy Interconnector

Figure F.4 is a simplified representation of the Victoria-Snowy interconnector, whose transfer capability is limited by:

- Two cutsets of lines south of the Victorian RRN (Thomastown);
- Four cutsets of lines between South Morang (near the Victorian RRN) and the Snowy RRN (Murray);
- Four cutsets to the north of Murray; and
- Transformers located at South Morang and Dederang. The South Morang transformers convert power from the Latrobe Valley from 220kV to 330kV and 500kV to 330kV. The three Dederang transformers alter voltages from 220kV to 330kV.

[492] TransGrid, APR 2007, p.48.
[493] TransGrid, APR 2006, p.78.
[494] TransGrid, APR 2006, p.78, p88.
[495] TransGrid, APR 2006, p.78-80.
[496] TransGrid, APR 2006, p.79.

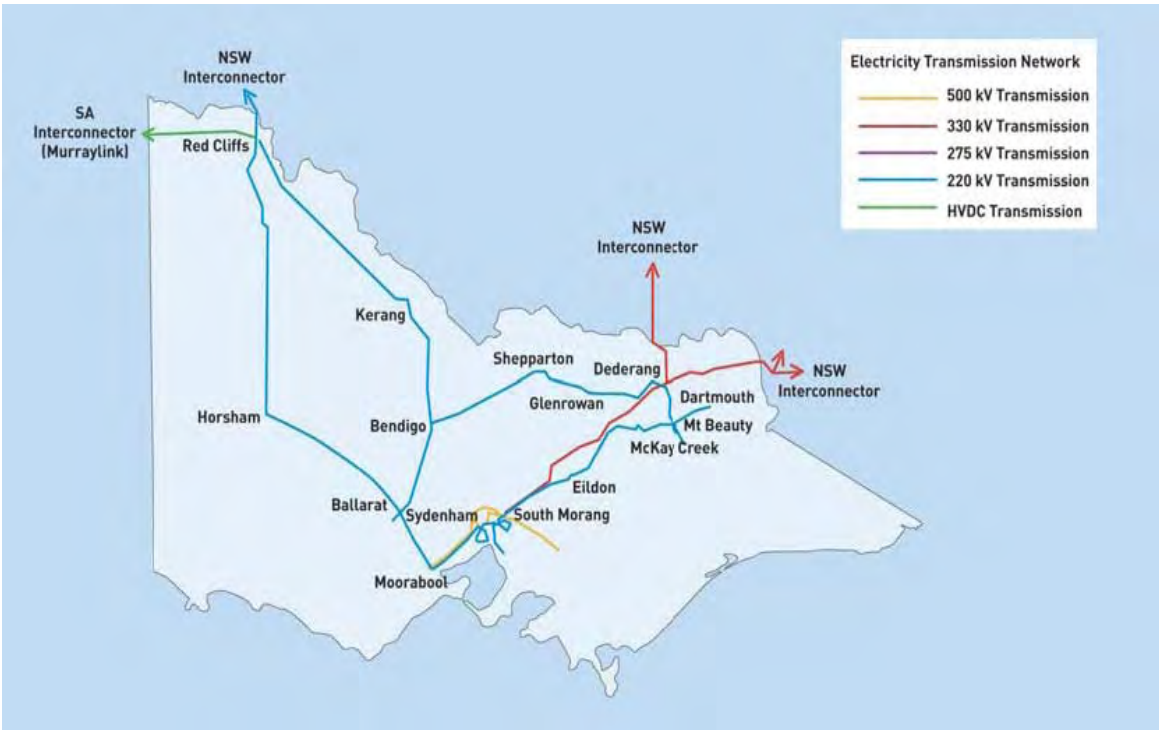
Figure F.4 Simplified representation of Victoria-Snowy notional interconnector



As with the Snowy-NSW interconnector, the cutsets on the Victoria-Snowy interconnector are similar to those in NEMMCO's 17-zone ANTS model.

Figure F.5 shows the 330kV and 220kV lines that make up the Victoria-Snowy interconnector. The South Morang Terminal Station is the key point where power from the Latrobe Valley's 500kV and 220kV lines is injected into the Victoria-Snowy interconnector.

Figure F.5 Victoria-Snowy – main transmission elements



Data source: VENCorp 2006 APR (Electricity), p. 61

VENCorp's 2007 APR states that Victorian import capability on the Victoria-Snowy interconnector is determined by:[497]

1. Thermal limits on the 330kV lines in the Dederang-Murray cutset, which largely define the "system normal" upper import limit of 1,900MW;

2. Overlapping voltage collapse and thermal constraints (on the Dederang transformers constraints and Eildon to Thomastown 220kV line) that apply in the event of an outage to one of the lines in the Dederang-South Morang cutset;

3. Thermal constraints on the three Dederang 330/220kV transformers. Under system normal conditions and no generation from Kiewa or Eildon, constraints on the Dederang transformers limit Victorian imports from Snowy to around 1,200MW. Under system normal and more than 60% of Kiewa or Eildon generation dispatched, import capability of up to 1,900MW is possible. An outage of one of the Dederang transformers can reduce Snowy-Victoria import capability to between 100 and 1400MW, depending on Kiewa and Eildon generation;

4. Thermal constraints on the Eildon to Thomastown 200kV line when there is an outage of one of the 330kV lines in the Dederang-South Morang cutset, can (in

[497] VENCorp 2006, *Electricity Annual Planning Report 2007*, VENCorp, Melbourne, pp. 60-63.

combination with other constraints) restrict Victorian imports from Snowy to around 1,200MW; and

5. Thermal limits on the South Morang 220/330kV and 500/330kV transformers.

Victorian export capability on the Victoria-Snowy interconnector is determined by:[498]

1. Thermal limits on the 330kV lines in the Dederang-South Morang cutset, which restrict exports to between 1,000MW and 1,150MW when all other plant is in service;

2. In the event of an outage to one of 300kV lines in the Dederang-Murray cutset, the Victoria-Snowy export limit is reduced by around 130MW; and

3. Thermal limits on the South Morang 220/330kV and 500/330kV transformers.

F.3 Analysis of Historic Pattern of Constraints — 2003/04 to 2006/07

In the period 2003/04 to 2006/07, according to NEMMCO data, binding constraints on six cutsets affected flows on the Snowy-NSW interconnector. In the same period, binding constraints on ten cutsets affected flows on the Victoria-Snowy interconnector.

Table F.2 identifies three broad types of constraints that restrict power flows along the cutsets that comprise each interconnector. Stability and voltage constraints generally apply to the whole interconnector and are difficult to assign to a particular cutset, so are separately categorised.

[498] VENCorp 2006, *Electricity Annual Planning Report 2007*, VENCorp, Melbourne, pp.60-63.

Table F.2: Constraint types

Constraint types	Snowy-NSW Interconnector	VIC-Snowy Interconnector
Cutset thermal limitations or contingency constraints for loss of lines in the cutset	Liddell-Tom	Yass-Control
	Sydney West-Yass	Nth Tumut
	Nth Marulan	Wagga-Yanco
	Sth Marulan	Murray-Tumut
	Nth Tumut	Ded-Murray
	Murray-Tumut	Ded-Sth Morang
		Ballarat-Moorabool
		Geelong-Keilor
Transformer overloading or loss contingency constraints	Mt Piper Tx	Dederang Tx
		Ded-Mt Beauty
		Bendigo-Shepparton
		Sth Morang Tx
Other security constraints on interconnectors		Voltage
	Stability	Stability
	Discretionary	Discretionary

Note: Tx is an abbreviation for transformer

The frequency and location of binding constraints differs depending on whether the flow is northwards or southwards along an interconnector. The following Section considers the frequency and location of binding constraints for the Snowy-NSW and Victoria-Snowy interconnectors.

F.3.1 Snowy-NSW interconnector

Table F.3 shows the frequency and location of binding constraints along the Snowy-NSW interconnector between 1 July 2003 and 30 June 2007, for flows both to and from the Snowy region. The data shows the number of 5-minute dispatch intervals in which a cutset constraint was both binding and the most restrictive constraint on the entire interconnector. The data includes all times of the day (peak and off-peak), all four seasons (summer, autumn, winter, spring), and outage conditions (system normal, network outage).

It should be noted that on many occasions, multiple constraints are binding in a way that affects interconnector flows. By focussing on the most restrictive binding constraint in a dispatch interval, it is possible to characterise the location and type of constraint that is having the greatest influence in limiting flow along the interconnector. The more frequently a particular constraint sets the overall flow-limit of an interconnector, the greater its effect on dispatch outcomes.

Table F.3: Frequency of most binding constraints (Number of binding dispatch intervals), Snowy-NSW interconnector (Snowy1), System normal and outage conditions, 1 July 2003 to 30 June 2007

Frequency for Snowy-NSW	Year				
Key	2003/04	2004/05	2005/06	2006/07	Total
Liddell-Tom			199	430	629
Mt Piper Tx				5	5
SydWest-Yass			3		3
Nth Marulan			20	2	23
Sth Marulan		17	14	27	58
Nth Tumut	11	12	4		27
Murray-Tumut	91	416	1,190	1,554	3,251
Stability	11	28	3	144	186
Discretionary	24	45	158	1	228
Grand Total	137	518	1,591	2,164	4,410

Note: In 2005/06 and 2006/07 stability data was divided into stability, transient stability and voltage stability. For the purposes of consistency, data for these years have been combined to a single stability figure.

Data source: NEMMCO

The following observations can be made about the data in Table F.3:

1. Binding constraints on the Snowy-NSW interconnector have increased from 137 dispatch intervals (11.4 hours) in 2003/04 to 2,164 dispatch intervals (180.3 hours) in 2006/07;

2. Constraints on the Murray-Tumut cutset are the most frequent limitation on the interconnector flow capacity. There has been a large increase in the frequency of Murray-Tumut constraints binding between 2003/04 and 2006/07. These constraints bound for 91 dispatch intervals (or 7.6 hours) in 2003/04, rising to 1,554 dispatch intervals (or 130 hours) in 2006/07;

3. Liddell-Tomago constraints are the second most frequent limitation on interconnector flows;

4. Discretionary constraints are the third most frequent limitation on interconnector flows, however, in 2006/07 there was only one instance of this type of binding constraint;

5. Together, constraints north and south of Marulan are the fourth most frequent limitation on interconnector flows; and

6. Constraints on the North Tumut cutset (i.e. between Tumut and Canberra/Yass) rarely limit interconnector flows. This result is at odds with the Split Snowy Region proposal, which locates a region boundary at this cutset on the basis that it is a major "pinch point".

The increased level of congestion on the Murray-Tumut cutset is likely to be associated with a number of factors, including: i) increasing application of "fully optimised" constraint formulations by NEMMCO; ii) changes in Snowy Hydro's contract position; and iii) implementation of the Tumut CSP/CSC Trial and its impacts on Snowy Hydro's incentives and bidding behaviour.

Similarly, the reduction in the use of discretionary constraints could be linked to: i) different patterns of line outages over time; and/or ii) increased network control arising from the use of "fully optimised" constraint forms.

Table F.4 splits the data in Table F.3 into the frequency of binding constraints limiting:

- Flows north from the Snowy region to the NSW region (exports from Snowy); and

- Flows south from the NSW region to the Snowy region (imports to Snowy).

This information enables further insights into constraints on the interconnector.

Table F.4: Frequency of most binding constraints by direction of flow (Number of binding dispatch intervals), Snowy-NSW interconnector (Snowy1), System normal and outage conditions, 1 July 2003 to 30 June 2007

Key	Data	Year				Total
		2003/04	2004/05	2005/06	2006/07	
Liddell-Tom	Export (SN to NSW)			198	430	628
	Import (NSW to SN)			1	0	1
Mt Piper Tx	Export (SN to NSW)				5	5
	Import (NSW to SN)				0	0
SydWest-Yass	Export (SN to NSW)			0		0
	Import (NSW to SN)			3		3
Nth Marulan	Export (SN to NSW)			20	3	23
	Import (NSW to SN)			0	0	0
Sth Marulan	Export (SN to NSW)		0	0	0	0
	Import (NSW to SN)		17	14	27	58
Nth Tumut	Export (SN to NSW)	1	12	4		17
	Import (NSW to SN)	10	0	0		10
Murray-Tumut	Export (SN to NSW)	14	293	788	960	2,055
	Import (NSW to SN)	77	123	402	594	1,196
Stability	Export (SN to NSW)	0	0	0	18	18
	Import (NSW to SN)	11	28	3	126	168
Discretionary	Export (SN to NSW)	15	39	9	1	64
	Import (NSW to SN)	9	6	149	0	164
Total Export (SN to NSW)		30	344	1,019	1,417	2,810
Total Import (NSW to SN)		107	174	572	747	1,600

Data source: NEMMCO

Table F.4 shows the following:

1. Constraints on the Murray-Tumut cutset constrain flows both north and south, but northward flows are more frequently affected by these constraints;

2. Liddell-Tomago cutset constraints nearly always restricted flows from Snowy to NSW;

3. Discretionary constraints mainly affect northward flows from Snowy to NSW;

4. Binding constraints on the North Marulan cutset limit exports from Snowy to NSW. Constraints on the South Marulan cutset limit southward flows from NSW to Snowy;

5. North Tumut cutset constraints restrict flows from Snowy to NSW more than flows in the reverse direction; and

6. In total, there is significantly greater frequency of constraints that limit flows from the Snowy region (Snowy to NSW) than flows from NSW (NSW to Snowy).

F.3.2 Victoria-Snowy Interconnector

Table F.5 shows the frequency and location of binding constraints along the Victoria-Snowy interconnector over the period 1 July 2003 to 30 June 2007, for flows both to and from the Snowy region. As before, the data shows the number of 5-minute dispatch intervals in which a cutset constraint was both binding and the most restrictive constraint on the entire interconnector. The data includes all times of the day (peak and off-peak), all four seasons (summer, autumn, winter, spring), and outage conditions (system normal, network outage).

Table F.5: Frequency of most binding constraints (Number of binding dispatch intervals), Victoria-Snowy interconnector (V-Snowy), System normal and outage conditions, 1 July 2003 to 30 June 2007

Frequency for VIC-Snowy	Year				
	2003/04	2004/05	2005/06	2006/07	Total
Yass Control		12			12
Nth Tumut	3				3
Wagga-Yanco			28	113	141
Murray-Tumut	425	45	146	910	1,526
Ded-Murray	122	64	65	2	253
Dederang Tx	5	2	470	456	933
Ded-Sth Morang		3			3
Ded-Mt Beauty				7	7
Bendigo-Shepparton				4	4
Sth Morang Tx	2,227	1,097	944	3,772	8,040
Geelong-Keilor				115	115
Ballarat-Moorabool				431	431
Voltage	516	194	889		1,599
Stability	7,945	6,426	2,511	5,685	21,637
Discretionary	1,491	1,008	871	307	3,677
Grand Total	12,734	8,921	5,924	10,803	38,382

Data source: NEMMCO

The following observations can be made about the data in Table F.5:

1. Binding constraints on the Victoria-Snowy interconnector have varied over the period considered, ranging from 5,924 dispatch intervals (493.7 hours) in 2005/06 to 12,734 dispatch intervals (1,061.2 hours) in 2003/04;

2. Stability constraints are the most frequent limitation on flows along the Victoria-Snowy interconnector. For example, in 2003/04 these constraints affected 7,945 dispatch intervals (or 662 hours), representing 62% of the total 12,734 dispatch intervals in which the interconnector was constrained;

3. South Morang transformer constraints were the second most frequent limitation on interconnector flows;

4. Discretionary constraints represent the third most frequent restriction on Victoria-Snowy transfers. The frequency of discretionary constraints has been decreasing significantly since 2003/04;

5. Voltage constraints represent the fourth most frequent restriction on Victoria-Snowy transfers;

6. The Murray-Tumut constraint was the next most frequent limiting factor on interconnector flows over the four years. However, in 2006/07 constraints on this cutset were the third most frequent determinant of interconnector flows — comprising 8% of the occasions (i.e. 910/10,803 dispatch intervals) when interconnector flow was at its limit;

7. Constraints between Dederang and South Morang are very rarely the most limiting factor on interconnector flows. This result is at odds with the Split Snowy Region proposal, which locates a region boundary at this cutset on the basis that it is a major "pinch point";

8. Binding constraints on the Dederang-Murray cutset determine the limit on interconnector flows around 1% of the time per year in each of the first three years;

9. South Morang transformer constraints were the second most frequent limitation on interconnector flows in each year; and

10. Constraints associated with "Yass Control", North Tumut, Wagga Yanco, Dederang-South Moran, Bendigo-Shepparton, Dederang-Mt Beauty and Geelong-Keilor are very rarely the most limiting factor on flows on the Victoria-Snowy interconnector.

Table F.6 segments the data in Table F.5 into the frequency of binding constraints limiting:

- Flows north from the Victorian region to the Snowy region (exports from Victoria); and

- Flows south from the Snowy region to the Victorian region (imports to Victoria).

Table F.6: Frequency of most binding constraints by direction of flow (Number of binding dispatch intervals), Victoria-Snowy interconnector (V-Snowy), System normal and outage conditions, 1 July 2003 to 30 June 2007

Key	Data	Year				Total
		2003/04	2004/05	2005/06	2006/07	
Yass Control	Export (VIC to SN)		0			0
	Import (SN to VIC)		12			12
Nth Tumut	Export (VIC to SN)	0				0
	Import (SN to VIC)	3				3
Wagga-Yanco	Export (VIC to SN)			0	3	3
	Import (SN to VIC)			28	110	138
Murray-Tumut	Export (VIC to SN)	10	4	13	645	672
	Import (SN to VIC)	415	41	133	265	854
Ded-Murray	Export (VIC to SN)	21	0	0	0	21
	Import (SN to VIC)	101	64	65	2	232
Dederang Tx	Export (VIC to SN)	0	0	0	41	41
	Import (SN to VIC)	5	2	470	415	892
Ded-Sth Morang	Export (VIC to SN)		0			0
	Import (SN to VIC)		3			3
Dederang-Mt Beauty	Export (VIC to SN)				7	7
	Import (SN to VIC)				0	0
Bendigo-Shepparton	Export (VIC to SN)				1	1
	Import (SN to VIC)				4	4
Sth Morang Tx	Export (VIC to SN)	1,461	1,072	850	3,631	7,014
	Import (SN to VIC)	766	25	94	141	1,026
Geelong-Keilor	Export (VIC to SN)				110	110
	Import (SN to VIC)				5	5
Ballarat-Moorabool	Export (VIC to SN)				366	366
	Import (SN to VIC)				65	65
Voltage	Export (VIC to SN)	0	0	0		0
	Import (SN to VIC)	516	194	889		1,599
Stability	Export (VIC to SN)	7,945	6,426	1,545	2,284	18,135
	Import (SN to VIC)	0	70	966	2,466	3,502
Discretionary	Export (VIC to SN)	309	678	362	169	1,518
	Import (SN to VIC)	1,182	330	509	138	2,159
Total Export (VIC to SN)		9,746	8,180	2,770	7,192	27,888
Total Import (SN to VIC)		2,988	741	3,154	3,611	10,494

Data source: NEMMCO

The following observations can be made about the data in Table F.6:

1. Stability constraints overwhelmingly limit export flows from Victoria and more rarely limit import flows to Victoria;

2. South Morang transformer constraints are also predominantly a restriction on Victorian exports, rather than imports;

3. Voltage constraints only appear to restrict imports of power into Victoria from the Snowy region;

4. Murray-Tumut cutset constraints were often associated with restrictions of import into Victoria rather than exports;

5. Constraints between Dederang and South Morang were only a limiting factor on Victorian imports;

6. Dederang-Murray cutset constraints limit imports;

7. South Morang transformer constraints tend to limit Victorian exports much more than Victorian imports;

8. "Yass Control", North Tumut, and Wagga-Yanco constraints limit power flows from Snowy to Victoria; and

9. Discretionary constraints affect imports more than exports from Victoria.

F.3.3 Controlling for network outages

Network outages change the topology of the transmission network and alter the constraints and limits used to manage the network that remains in service. Network outages can be planned (for maintenance), forced (by fire, mechanical failure), or as a result of routine circuit switching to clear faults.

It is possible to divide the data on the frequency of binding constraints into classes to enable congestion to be characterised as relating to the physical design limits of the network with, either:

- All network elements in operation (i.e. system normal); or

- One or more network elements out of operation (i.e. outage conditions).

It is well known that binding constraints on one part of an electrical network can affect dispatch and pricing all across the entire network. The economic consequences of this depend on how persistently the constraints affect the efficiency of economic dispatch, the reliability of supply, and power system security and control.

System normal constraints that bind frequently may be having a material effect on dispatch, but may not necessarily be economic to build out. That is, these types of binding constraints are likely to reflect that both the network's design and its capacity are economically efficient. However, the existence of persistently binding system normal constraints in a regional pricing market structure may also indicate a location of material congestion. Such material congestion relating to system normal conditions may warrant consideration being given to a region boundary being located at that location—in order to explicitly price the congestion and improve economic efficiency of dispatch—especially if a network upgrade either fails to pass the Regulatory Test or is not physically feasible (e.g. the easement cannot accommodate additional lines).

Although specific outage conditions may occur relatively infrequently, they can have a significant effect on the location of congestion, its severity, the efficiency of dispatch, and the financial risks faced by market participants. Congestion at a particular part of the network that arises under outage conditions may not justify a region boundary, because although it might cause significant changes in the economic efficiency of dispatch, the outage conditions are of such limited duration or occur rarely enough, that the creation of a new pricing region is not warranted. That is, market participants accommodates the economic inefficiencies and financial risks associated with congestion that arises from rare outage conditions.

Table F.7 and Table F.8 below contain data on the frequency of congestion on the Snowy-NSW (Snowy1) and Victoria-Snowy (V-Snowy) interconnectors, by cutset constraint type, for "modified system normal" conditions. Modified system normal conditions means that there are no outages of the usual system normal transmission topology, apart from the 64-line (between Lower Tumut and Upper Tumut) being switched out of service. NEMMCO has advised that the 64-line is normally switched out of service during dispatch in order to avoid the stability problems on the Victoria-Snowy and Snowy-NSW interconnectors that arise when the 64-line is switched in and Snowy region generation is high (which generally coincides with high interconnector flows). Recognising this, the ANTS constraint set also assumes the 64-line is normally out of service.

The mathematical difference between the data in Table F.7 and Table F.4 equals the congestion attributable solely to network outage conditions. Based on this comparison, Table F.7 reveals that for the Snowy-NSW (Snowy1) interconnector:

1. The vast bulk of binding cutset constraints that limit Snowy-NSW interconnector flows in both directions arise under system normal conditions. Across the four years, 45% of the total instances (i.e. 1271/2810 instances) in which Snowy-NSW (export) flows were restricted occurred under system normal conditions. However, 87% of the total most limiting binding constraints NSW-Snowy (import) flows occurred under system normal conditions (i.e. 1,397/1,600 instances);

2. Binding constraints on the North Marulan and South Marulan cutsets were the most limiting constraint on interconnector flows only under outage conditions. This is why North Marulan does not appear in Table F.7 and South Marulan shows very few incidences;

3. In only one dispatch interval under system normal conditions did the Liddell-Tomago cutset limit flows from Snowy to NSW. Outage conditions were associated with 91% (573/628) of the binding constraints on the Liddell-Tomago cutset that limited export flows on the Snowy-NSW interconnector. There were no outages in the only time that flows from NSW to Snowy were limited by Liddell-Tomago cutset;

4. Binding constraints on the North Tumut cutset are associated with outage conditions. For exports, across the three years, only 1/17 constraints occurred under system normal conditions. For imports, the figure is 1/10;

5. Almost half of the binding constraints on the Murray-Tumut cutset that determined the interconnector flow limit from Snowy to NSW and nearly all binding constraints on flow from NSW to Snowy, occurred under system normal conditions. For exports (i.e. Snowy to NSW flow), 55% (i.e. 1,136/2,055) instances of binding constraints in the four years occurred in system normal conditions. For imports, the corresponding figure is 92%(i.e. 1,101/1,196);

6. The bulk (91%) of stability constraints affecting imports in 2003/04 were related to outage conditions, with only 1/11 occurring under system normal conditions. In 2006/07, 25% (i.e. 43/168) of the stability constraints that determined NSW to Snowy flow limits arose under system normal conditions; and

7. Across the three years, nearly all the binding discretionary constraints (i.e. 58/64 instances) that determined Snowy-NSW export flows arose under system normal conditions. In 2005/06 and 2006/07, all discretionary constraints occurred under system normal conditions.

Table F.7: Frequency of most binding constraints by direction of flow (Number of binding dispatch intervals), Snowy-NSW interconnector (Snowy1), Modified system normal conditions, 1 July 2003 to 30 June 2007

Key	Data	Year				Grand Total
		2003/04	2004/05	2005/06	2006/07	
Liddell-Tom	Export (SN to NSW)			55		55
	Import (NSW to SN)			1		1
Mt Piper Tx	Export (SN to NSW)				3	3
	Import (NSW to SN)				0	0
Sth Marulan	Export (SN to NSW)				0	0
	Import (NSW to SN)				11	11
Nth Tumut	Export (SN to NSW)	1				1
	Import (NSW to SN)	1				1
Murray-Tumut	Export (SN to NSW)	9	249	694	184	1,136
	Import (NSW to SN)	77	107	395	522	1,101
Stability	Export (SN to NSW)	0	0		18	18
	Import (NSW to SN)	1	14		110	125
Discretionary	Export (SN to NSW)	15	33	9	1	58
	Import (NSW to SN)	9	0	149	0	158
Total Export (SN to NSW)		25	282	758	206	1,271
Total Import (NSW to SN)		88	121	545	643	1,397

Data source: NEMMCO

Table F.8 focuses on Victoria-Snowy interconnector congestion under modified system normal conditions. Comparing Table F.6 and Table F.8 reveals the following:

1. Around 80% of all binding cutset constraints that limit Victoria-Snowy interconnector flows in both directions arose under system normal conditions;

2. Binding constraints around Wagga-Yanco, Yass Control, and Dederang-Mt Beauty cutsets only determined Victoria-Snowy interconnector flows under outage conditions – neither appear in Table F.8;

3. All the instances in which constraints on the North Tumut cutset determined Victoria-Snowy flows occurred under system normal conditions;

4. Across the four years, Victoria to Snowy flows were limited by the Murray-Tumut constraint for 672 dispatch intervals, 656 of which were associated with system normal conditions. Over the three years, 61% of the instances in which flows from Snowy to Victoria were determined by the Murray-Tumut cutset constraint occurred under system normal conditions;

5. Dederang transformer limits rarely set the Victoria-Snowy interconnector flow limits under system normal conditions;

6. All the instances of the Dederang-South Morang cutset determining Victoria-Snowy interconnector flow limits (north and south) relate to system normal conditions;

7. All the instances in which constraints on the Bendigo-Shepparton cutset determined Victoria-Snowy flows occurred under system normal conditions;

8. In 2005/06 and 2006/07 nearly all binding constraints on the South Morang transformers on flows from Snowy to Victoria occurred under system normal conditions. In total across the four years, 87% of these binding constraints occurred on exports to Snowy and 79% occurred on imports to Victoria;

9. In total across the four years, 78% of the stability constraints on Victoria-Snowy exports (14,223/18,135) occurred under system normal conditions. In the same period, 76% the stability constraints determining Snowy-Victoria flows occurred under system normal conditions (2,693/3,502); and

10. 99% of both the import and export discretionary constraints that determined Victoria-Snowy interconnector flow limitations occurred under system normal conditions. These discretionary constraints include those used to manage negative residues by "clamping" the Victoria-Snowy interconnector.

Table F.8: Frequency of most binding constraints by direction of flow (Number of binding dispatch intervals), Victoria-Snowy interconnector (V-Snowy), Modified system normal conditions, 1 July 2003 to 30 June 2007

Key	Data	Year				Grand Total
		2003/04	2004/05	2005/06	2006/07	
Nth Tumut	Export (VIC to SN)	0				0
	Import (SN to VIC)	3				3
Murray-Tumut	Export (VIC to SN)	1	4	12	639	656
	Import (SN to VIC)	116	41	132	239	528
Ded-Murray	Export (VIC to SN)	21	0	0		21
	Import (SN to VIC)	25	64	61		150
Dederang Tx	Export (VIC to SN)		0	0	3	3
	Import (SN to VIC)		2	53	40	95
Ded-Sth Morang	Export (VIC to SN)		0			0
	Import (SN to VIC)		3			3
Bendigo-Shepparton	Export (VIC to SN)				1	1
	Import (SN to VIC)				4	4
Sth Morang Tx	Export (VIC to SN)	1,447	722	715	3,224	6,108
	Import (SN to VIC)	564	15	94	140	813
Geelong-Keilor	Export (VIC to SN)				21	21
	Import (SN to VIC)				5	5
Ballarat-Moorabool	Export (VIC to SN)				69	69
	Import (SN to VIC)				13	13
Voltage	Export (VIC to SN)	0	0	0		0
	Import (SN to VIC)	204	157	759		1,120
Stability	Export (VIC to SN)	6,963	4,741	863	1,656	14,223
	Import (SN to VIC)	0	70	864	1,759	2,693
Discretionary	Export (VIC to SN)	309	676	356	169	1,510
	Import (SN to VIC)	1,182	328	503	138	2,151
Total Export (VIC to SN)		8,741	6,143	1,946	5,782	22,612
Total Import (SN to VIC)		2,094	680	2,466	2,338	7,578

Data source: NEMMCO

F.4 Limitations of historical data on the frequency of congestion[499]

The above information on the historical frequency and location of congestion between Victoria, Snowy and NSW should be used with caution. There are several reasons for this.

[499] Drawn from: D. Biggar, "On the use of Information on the Historical Frequency and Location of Constraints to Determine Region Boundaries", 26 June 2006.

First, under the existing region boundary structure, there may exist significant points of congestion that do not appear in the historical data because generators that can affect whether the constraint binds may have the incentive and ability to adjust their generation in such a way that the constraint does not bind.

Second, past patterns of congestion may not be a good indicator of future congestion if circumstances change. Changed circumstances may arise from:

- Changes in supply conditions, such as generator outages, changes in generation capacity or changes in market power, transmission outages, changes in transmission capacity and so on;

- Changes in demand conditions due to economic growth, changes in weather, changes in appliance mix (e.g. increased penetration and use of air-conditioning), or changes in demand-side responsiveness; and

- Changes in the formulation of the constraint equations used in dispatch (in particular, the re-writing of constraint equations in the "fully optimised" form).

Third, changing region boundaries will change the bidding incentives on generators, thereby changing the flows on the network and the resulting pattern of constraints. A change in region boundaries could make existing persistent, material constraints disappear and/or reappear in other parts of the network.

Consequently, forward looking market modelling incorporating potential boundary options and the network constraints applying to those options is required to understand the likely patterns of congestion under a new NEM regional pricing structure and its impact on dispatch efficiency. NEMMCO-Transitional Inter Regional Committee (TIRC) applied this modelling approach in 1997 (as discussed in Appendix E) and the Commission has also committed to this approach to evaluate the various options for region boundary changes.

G Interaction between the Southern Generators Rule and the South Morang Constraint

In two submissions to the Commission, Snowy Hydro argued that the Southern Generators Rule creates market problems and dispatch inefficiencies because of the way it interacts with the South Morang constraint.[500] Snowy Hydro claimed that this was leading to both Murray generation being dis-incentivised to act as a positive gatekeeper for Victoria to New South Wales (NSW) flows, and counter-price flows from Victoria to South Australia and Tasmania. In two separate submissions, the "Southern Generators"[501] disagreed, contending that the problems raised by Snowy Hydro were caused by the underlying physical network, and previously disguised by the National Electricity Market Management Company (NEMMCO) clamping interventions.[502]

This Appendix assesses the arguments made by Snowy Hydro and the Southern Generators on the interaction between the Southern Generators Rule and the incidence of binding of the South Morang constraint, and puts forward the Commission's position on this issue. The purpose of this Appendix is to consider the merits of the arguments made by Snowy Hydro and the Southern Generators. It does not provide an analytical comparison of how each of the different Rule change proposals interacts with the South Morang constraint.

In preparing this Appendix, the Commission has had regard to the submissions prepared by Snowy Hydro and the Southern Generators on this issue. The Commission requested Dr Darryl Biggar to analyse the claims presented by Snowy Hydro and the Southern Generators. This Appendix also incorporates Dr Biggar findings.

This Appendix begins by explaining the South Morang constraint and the Southern Generators Rule. The next Section sets out the arguments presented in the various Southern Generators' and Snowy Hydro submissions. It then explains the pricing relationship between various regions when the constraints under consideration bind, before analysing each of the positions put forward and presenting the Commission's conclusion.

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[500] Snowy Hydro, "Extension of the expiry date for the Snowy CSP/CSC Trial and NEMMCO's power to manage negative residues", 29 January 2007; and Snowy Hydro, "Supplementary Submission to Snowy Region Boundary Change and Southern Generators Rule Extension", 26 March 2007.

[501] The Southern Generators group includes: Loy Yang Marketing Management Company Pty. Ltd., AGL Hydro Pty. Ltd., International Power (Hazelwood, Synergen, Pelican Point and Loy Yang B), TRUenergy Pty. Ltd., Flinders Power, and Hydro Tasmania.

[502] Southern Generators, "Submission on Draft Rule Determination – Abolition of the Snowy Region: Response to Snowy Hydro Ltd. letter to AEMC dated 29th January 2007", 8 March 2007; and Southern Generators, "Supplementary Submission to Snowy Region Boundary Change and Southern Generators Rule Extension", 24 April 2007.

G.1 The South Morang constraint

Victorian exports to the Snowy region are limited by both transient stability and thermal considerations. The transient stability constraint manages stability for faults on the lines between Hazelwood Terminal Station to South Morang Terminal Station.[503] The thermal limit relates to the thermal ratings of the (1) South Morang to Dederang 300 kV line; and (2) South Morang 500/330 kV (F2) transformer (South Morang F2 transformer).

The South Morang F2 transformer constraint is one of the more frequently binding constraints in the National Electricity Market (NEM) (as discussed below in Section G.1.2). There are currently two constraints that represent this transformer limit.[504] The first is a pre-contingent overload constraint that reflects the normal continuous rating of the F2 transformers. The post-contingent overload constraint reflects a 15 minute rating for the transformers, if required; this rating tends to be higher than that under the pre-contingent constraint form.

The constraint referred to in Snowy Hydro submission is the post-contingent constraint for overloading the South Morang F2 transformer.[505] Snowy Hydro did not refer to the South Morang to Dederang 300 kV line thermal constraint, the transient stability constraint, or the thermal pre-contingency constraint for the South Morang F2 transformer.

The remainder of this Section discusses the terms that form the South Morang constraint, considers the historical experience of the binding of this constraint, and presents evidence on the potential for network investment to relieve the constraint.

G.1.1 Characterising the South Morang F2 transformer constraint

Both the pre-contingent and post-contingent constraint equations have a large number of terms on the left hand side (LHS). In simple terms variables on the LHS of a constraint equation can be optimised or controlled within the dispatch process, such as generation output. In contrast, variables on the right hand side (RHS) of a constraint equation are assumed to remain unchanged from their most recently measured value. Each term in a constraint equation is multiplied by a coefficient that reflects the effect a change in the respective market factor would have on the constraint. For a generation unit, if its coefficient is positive, an increase in that generator's output would increase pressure on the constraint. If the coefficient is

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503 In the past, the most constraining influence on Victorian exports to the Snowy region was the constraint used to manage the transient stability for a fault on a Hazelwood Terminal Station to South Morang Terminal Station. Constraints relating to this limit bound a total of 597 hours in 2004/05 but did not bind in 2005/06. Instead, this constraint limited flows from Victoria to South Australia during 2005/06.

504 The constraint representing the South Morang F2 transformer has changed several times over the past few years. It was formulated as a fully co-optimised constraint on 17 August 2005, and was subsequently updated on 24 July 2006, and again on 6 March 2007. The pre contingent overload constraint is labelled V>>V_NIL_2_R and the post contingent equation is labelled V>>V_NIL_3_R. In July 2006, each equation was further divided into 2 separate equations.

505 This is the V>>V_NIL_3B_R constraint.

negative, greater output from that generator would help relieve the constraint. The larger the coefficient, the greater the effect the factor has on the constraint, either positive or negative.

The LHS variables in the South Morang thermal constraint equations include the Latrobe Valley generators,[506] northern Victoria hydro generators (e.g. Southern Hydro), and export flows from South Australia and Tasmania. The Latrobe Valley generators and export flows from Tasmania and South Australia all have positive coefficients, indicating increased generation or flows place pressure on the constraint. The coefficients for the South Australian export flows are smaller than those others, meaning while additional flows place pressure on the constraint, they place less pressure relative to increased generation from the Latrobe Valley, for example. The northern Victoria generators have negative coefficients.

When the South Morang constraints bind, generators in Victoria (especially in the Latrobe Valley) can find themselves being constrained-off. As discussed in Appendix A, this means they are missing out on being dispatched even though their offer price is below the (Victorian) regional reference price (RRP). This can give rise to mis-pricing at virtually all the connection points in Victoria (with Valley Power and Yallourn being the only connection points not mis-priced). On the other hand, hydro generation in northern Victoria, like Southern Hydro, can find themselves constrained-on when the constraints bind, meaning they are being dispatched and settled at prices below their offer price.

G.1.2 Incidence of binding of the South Morang constraint

As noted above, the South Morang F2 transformer constraint has been one of the more frequently binding constraints since the commencement of the market start in 1998. Appendix F details the historical data on constraint binding between the Snowy region and the Victorian and NSW regional reference nodes (RRNs) over the four year period from financial year 2003/04 to 2006/07, inclusive. Table F.6 contains the frequency of binding constraints on flows from Victoria to Snowy. Observations from that data relevant to this discussion include:

- Stability constraints overwhelmingly limit export flows from Victoria to Snowy;
- Thermal constraints relating to the South Morang F2 transformer were the second most frequent limitation on Victoria to Snowy flows;
- The thermal constraint for the Dederang to South Morang line does not appear to bind; and
- There has been a significant increase in incidences of binding constraints between Victoria and Snowy over the period over the period 2005/06 to 2006/07, with the number of five-minute dispatch intervals binding increasing from 2,770 to 7,192 (around 259%). The incidence of binding for the South Morang F2 transformer

[506] The Latrobe Valley generators include: Yallourn, Hazelwood TS, Loy Yang A & B, Jerralang, Morwell, and Hazelwood.

constraint increased from 850 to 3,631 (around 428%) while the stability constraints increased from 1,545 to 2,284 intervals (around 148%).

We consider the likely reasons for the frequent binding of the South Morang constraint in Section G.8 below.

G.1.3 Future investment to address the South Morang constraint

VENCorp, the Victorian transmission network operator, has recently committed to an augmentation of the South Morang terminal station. These works at South Morang will improve the Victorian export transfer capability, therefore improving flows between the Victorian and Snowy regions. Work is currently underway at the South Morang Terminal Station, including the establishment of a switchyard and the installation of two transformers. This work will see the transfer of existing load from the Thomastown terminal station to a new connection point at South Morang, and the transfer of the Somerton power station from its existing connection point within the Thomastown network to the new network supplied from South Morang Terminal Station. This augmentation will relieve the thermal rating limit constraints for the South Morang transformer.

In its 2007 Annual Planning Report, VENCorp indicated that there was no justifiable solution to the loading on the Dederang – South Morang line in the short term (i.e. five-year outlook). While there are options available to address this problem, such as the up-rating of the lines or the installation of a third line between Dederang and South Morang, VENCorp does not consider the market benefits associated with these options sufficient enough to justify the augmentation. VENCorp considers that the system normal constraints associated with this line can be economically managed until at least 2011/12.

G.2 Southern Generators Rule

On 14 September 2006, the Commission accepted the Southern Generators' and NEMMCO's Rule proposal (Southern Generators Rule) for an interim mechanism to manage negative residues in the Snowy region.[507] The Rule commenced on 1 November 2006.

The Southern Generators Rule introduces a new process for managing negative settlement residues (negative residues) in the Snowy region. Negative residues in the Snowy region are an issue due to the looped network configuration in that part of the NEM, and the location of the Snowy RRN on that loop. Appendix D describes both the physical properties and the pricing implications of this loop when the line between Murray and Tumut constrains.

In summary, for northward flows, when the Murray-Tumut constraint binds, increased output at Murray places the most pressure on the constraint relative to an increase in power injected anywhere else on the loop (including the Victorian RRN).

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507 AEMC 2006, *Management of Negative Settlement Residues in the Snowy Region*, Final Rule Determination, 14 September 2006, Sydney.

Accordingly, the value of generation at Murray is less than the value of generation at the Victorian RRN. Since Murray is also the location of the RRN for the Snowy region, this results in the Snowy RRP being lower than the Victorian RRP, leading to negative residues on the Victoria-Snowy directional interconnector.

As also discussed in Appendix D, these negative settlement residues were historically managed by intervention by NEMMCO for non-system security reasons. NEMMCO would previously intervene, by imposing an alternative constraint equation to restrict flow on the Victoria–to-Snowy interconnector (or "clamping"), to manage the accumulation of negative residues. Instead, the Southern Generators Rule enables NEMMCO to offset negative settlement residues on the interconnector between the Victoria and Snowy regions using positive residues accumulated on the interconnector between the Snowy and NSW regions. The Southern Generators Rule eliminates the need for NEMMCO intervention in market dispatch by reducing the risk of negative residues arising on the Victoria-Snowy interconnector.

G.3 Snowy Hydro and Southern Generators' arguments

This Section presents the arguments raised by Snowy Hydro and the Southern Generators in relation to the South Morang constraint their submissions.

G.3.1 Snowy Hydro

Snowy Hydro considers that the Southern Generators Rule has led to increased mis-pricing for almost all of the Latrobe Valley generators, resulting in decreased dispatch efficiency. Snowy Hydro claims that this is due to the way the Southern Generators Rule interacts with the South Morang constraint.

In its supplementary submission, Snowy Hydro presents analysis on the pricing relationships between RRPs when either or both the South Morang or Murray-Tumut constraints bind. It states that when the South Morang thermal constraint is binding, there is a relationship between the Victorian price, the Snowy region price, and what they refer to as "generation behind the South Morang constraint". When the Murray-Tumut constraint is also binding, Snowy Hydro also presents a relationship between the Victorian price, the NSW price, the Snowy price, and "generation behind the South Morang constraint." Snowy Hydro indicates that the generation behind the South Morang constraint refers to generation in South Australia and the Latrobe Valley, as well as exports into Victoria from Tasmania.

Snowy Hydro argues that as a result of these pricing relationships, whenever the Murray-Tumut constraint binds the Victorian price is defined by marginal generator offers in NSW and at Murray. It argues that under these conditions the Latrobe Valley generators are unable to directly influence the Victorian price. As there is no price/volume trade off facing these generators, Snowy Hydro contends that these generators will seek to maximise volume against the Victorian RRP, which leads to them bidding in a disorderly manner (as low as -$1,000/MW) in order to get dispatched. Snowy Hydro argues that this results in Latrobe Valley generation displacing both South Australian and Tasmanian generation, and an increase in binding of the South Morang constraint.

Snowy Hydro argues that these outcomes have a number of negative implications. First, these outcomes can lead to counter price flows from Victoria to both South Australia and Tasmania. They can also reduce transfers north to the Snowy and NSW regions. This is because South Australian generation places less pressure on the South Morang constraint than Latrobe Valley generation, as discussed in Section G.1. Replacing South Australian generation with Latrobe Valley generation as a result of disorderly bidding therefore increases the likelihood of the South Morang constraint binding, limiting transfers north.

Furthermore, Snowy Hydro argues that in situations when the South Morang constraint binds, the Southern Generator Rule dis-incentivises generation at Murray, which could actually help relieve that constraint. Under the current regional structure, Murray generation is settled at its local price as it is located at the Snowy RRN. When flows are northward, and the Murray-Tumut constraint binds, the Snowy RRP will often be below the Victorian RRN due to the pricing around the loop in the Snowy region. Snowy Hydro reasons therefore that that it is dis-incentivised to increase Murray generation, since doing so may result in the constraint binding, leading to Murray output facing a lower RRP. It states, therefore, that it is not incentivised to act as a positive gatekeeper for Victoria to Snowy flows when both the Murray-Tumut and South Morang constraints bind.

Snowy Hydro also indicated that it believes the Southern Generators Rule had led to an increase in binding of the South Morang constraint. It stated that the incidence of binding constraints for the thermal South Morang post-contingency F2 transformer constraint ("V>>H_NIL_3_R") had increased from a total of 26 dispatch intervals over the financial year 2005/06 to 400 dispatch intervals for the period from 1 January to 26 March 2007. Snowy Hydro also referred to several recent examples of the constraint binding, including 12 January 2007, 30 January 2007, 3 March 2007 and 17 March 2007.

G.3.2 Southern Generators

In their response to Snowy Hydro's arguments, the Southern Generators contended that the dispatch problems cited by Snowy Hydro are not attributable to the Southern Generators Rule but result from the physical characteristics of the network, particularly the effect of a network limitation at South Morang.

In their response, the Southern Generators argued that negative residues can arise on the Victoria-South Australia interconnector even if the Murray-Tumut constraint does not bind for a number of reasons, including that the South Morang transformer constraint is just as likely to give rise to counter-price flows between Victoria to South Australia.

The Southern Generators agreed with Snowy Hydro's statements that it is not uncommon for a RRP to be set by "conditions outside the region", including offers in another region. In fact, they noted that the price in one region may be:

"set by prices in other regions combined algebraically with local offer or bid prices in a relationship defined by the terms of a constraint equation."[508]

The Southern Generators noted, in particular, that the Victorian price at times can be influenced by the network limits of the Murray-Tumut constraint and the South Morang F2 transformer constraint.

Another point the Southern Generators raised related to NEMMCO's clamping intervention before the introduction of the Southern Generators Rule. They state that NEMMCO's clamping on the Victoria-Snowy interconnector acted as a form of artificial congestion in the sense that it did not relate to any limitation in the physical network. The Southern Generators Rule has made the underlying network limitations more transparent. Now that NEMMCO no longer clamps, the Southern Generators argued that the network is now being more fully utilised, which is revealing other underlying network limitations that have been masked to date.[509]

G.3.3 Assessment of issues raised

To assess the arguments raised by the participants, the Commission has considered the following key issues:

- Can the Latrobe Valley generators bid at -$1000/MWh and not influence the Victorian RRN? (Section G.5)
- What are the incentives on Murray generation when both the Murray-Tumut and South Morang constraints bind? (Section G.6)
- Can the increase in the incidence of binding constraints at South Morang be explained by the introduction of the Southern Generators Rule? (Section G.7)
- Has the Southern Generators Rule contributed to negative residues occurring on the Victoria to South Australia interconnector (and Basslink)? (Section G.8)

Before considering these questions, however, it is important to understand the pricing relationships between the various regions when either or both the South Morang and Murray-Tumut constraint binds. This is explained in the following Section.

G.4 What is the pricing relationship between the Victorian, Snowy, and NSW regions when either or both South Morang and Murray-Tumut binds?

This Section assesses the accuracy of the pricing relationships presented by Snowy Hydro.

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[508] Southern Generators, 8 March 2007 submission, p.3.

[509] Snowy Hydro also notes that the impact of the South Morang constraint was largely masked by NEMMCO's intervention prior to the implementation of the Southern Generators Rule and NEMMCO's reformulation of the South Morang constraint to a fully co-optimised form.

The key pricing relationships noted in Snowy Hydro's submission can be replicated using the relevant constraint equations. By definition, when a binding constraint has more than one interconnector term, the price differences across these interconnectors are related to one another by the coefficients in that binding constraint equation.

The South Morang constraint includes terms for both the Victoria-Snowy interconnector and Victoria-South Australia interconnector. The Murray-Tumut constraint[510] includes terms for the Victoria-Snowy interconnector and the Snowy-NSW interconnector. As these constraints contain a common interconnector term, Snowy Hydro is correct to state there will be a relationship in the price differences across the three interconnectors when both these constraints bind simultaneously. The coefficients in these constraints equations define the price relationship between the respective regions when one or both the constraints bind.

Using the constraint equations (and ignoring inter-regional losses), when the South Morang post-contingent thermal constraint (V>>V_NIL_3B_R) binds the following pricing relationships must hold:

$$P_{SA} - P_{VIC} = -0.9699 \times \lambda^1 \text{ and}$$

$$P_{SN} - P_{VIC} = 0.8538 \times \lambda^1$$

where λ^1 is the marginal value of the South Morang post contingent thermal constraint; and where P_{SA}, P_{VIC} and P_{SN} are the RRPs in South Australia, Victoria, and Snowy respectively.

These equations can be solved to show the following relationship between the those regional prices when that particular South Morang constraint binds:

$$P_{VIC} = 0.468 \times P_{SA} + 0.532 \times P_{SN}$$

This result shows that the Victorian price *must* be between the South Australian RRP and the Snowy RRP. Therefore, as long as the South Morang constraint is the only binding constraint, the Snowy RRP will by definition, be greater than the Victorian RRP. This means that Snowy Hydro should face incentives to generate at Murray to help alleviate the South Morang constraint under these circumstances. This confirms the first of pricing relationship presented by Snowy Hydro.

Snowy Hydro claims that if the Murray-Tumut constraint binds at the same time as the South Morang constraint, then there is no incentive on Murray to generate and alleviate the South Morang constraint. When both of these constraints are binding the following relationships between the prices will arise:

$$P_{SA} - P_{VIC} = -0.9699 \times \lambda^1$$
$$P_{SN} - P_{VIC} = 0.8538 \times \lambda^1 - 0.164 \times \lambda^2$$
$$P_{NSW} - P_{SN} = 0.823 \times \lambda^2$$

[510] The relevant constraint name is H>>H-NIL_A.

where λ^1 is the marginal value of the South Morang post-contingent thermal constraint (V>>V_NIL_3B_R) constraint; and λ^2 is the marginal value of the Murray to Tumut (H>>H-NIL_A) constraint.

Rearranging these equations we can find the following relationship between the Victoria price, the NSW price, the South Australia price, and the Snowy price when both of these constraints bind:

$$P_{VIC} = 0.106 \times P_{NSW} + 0.468 \times P_{SA} + 0.426 \times P_{SN}$$

Analysis of the constraint equations confirms that when only the South Morang constraint binds, the Victorian price must lie between the South Australia RRN price and the Snowy RRN price, with the Snowy price above the Victorian price. When both constraints bind, the Victorian price is set by a sum of 10.6% of the NSW price, 46.8% of the SA price, and 42.6% of the Snowy price. This verifies the pricing relationship presented in Snowy Hydro's supplementary submission.

G.5 Can the Latrobe Valley generators bind at -$1000/MWh and not influence the Victorian RRN?

Snowy Hydro stated that:

> "The Southern Generators' rule creates the situation where the Victorian price is defined by NSW and Murray marginal offers whenever the Murray to Tumut constraint binds. Under these conditions the Southern Generators offers do not directly influence the Victorian price (there is no price volume tradeoff). In effect, the Latrobe Valley generators receive the high Victorian price irrespective of what they bid, hence they maximise their dispatch volume by making negative priced offers."[511]

The constraint equation analysis in G.4 above shows that there is a pricing relationship between the Victorian RRP and the RRPs in South Australia, Snowy, and NSW regions. However, in his analysis, Dr Biggar concluded that Snowy Hydro is not correct in its statement that the Latrobe Valley generators cannot influence the Victorian price when the South Morang constraint binds.

The constraint equation analysis shows that when both constraints bind, the RRP in Victoria will be determined by the marginal generators in the other regions. This does not imply that generators in a region have no control over their price, since their bids will determine and influence the marginal–price setting generator. While the Victorian price is determined by the offers of non-Victorian generators, a change in the output of Victoria generators will affect which generators are marginal in neighbouring regions.

[511] Snowy Hydro, March 2007 submission, p.9.

The Southern Generators support Dr Biggar's conclusion, noting that the binding of the relevant constraints did not necessarily mean that Victorian generators did not affect on the Victorian price. For example, the Southern Generators pointed to the outcomes of 12 January 2007. They stated that while the price in Victoria reflected the "underlying physical realities", it was not unaffected by Victorian generator offers, arguing that "an offer need not to set the price to have an influence in the outcome."[512]

The Commission considers that Snowy Hydro is correct in its assessment that the South Morang constraint may lead to significant mis-pricing of generators in the Latrobe Valley. However, even when the mis-pricing occurs and the offer prices from the Latrobe Valley generators do not set the Victorian price, it does not necessarily follow that these Latrobe Valley generators are completely unable to influence the Victorian price. However, whatever the degree of influence, it seems clear that, on occasions, several Latrobe Valley generators had incentives to offer their output at a low price in order to increase the amount for which they were dispatched.

G.6 What are the incentives on Murray generation when both constraints bind?

Snowy Hydro claims that when the Murray-Tumut constraint binds for northward flows, the loop flow effect in the Snowy region means that the nodal price at Murray is lower than the Victorian price. Snowy Hydro contends that this is significant because it does not incentivise Murray generation to increase output to relieve the South Morang constraint, despite being a positive gatekeeper.

The Southern Generators consider that under present arrangements, Murray generation faces efficient incentives to increase generation when it assists in relieving constraints, and to reduce generation when it contributes to constraints. The Southern Generators note that the incentives for Murray generation varies with the production level chosen by Snowy Hydro, and in a way which provides the appropriate incentive in each circumstance. For example, under northward flow, the present arrangements create incentives for Murray to increase its output to relieve the South Morang constraint, until its increased generation causes the Murray-Tumut constraint to bind.

The Commission considers that the actual incentives facing Murray generation are more complicated than those put forward by Snowy Hydro. This is because the incentives facing Murray generation depend on how the South Morang and Murray-Tumut constraints interact.

Snowy Hydro's statement that Murray generation will receive a lower settlement price than the Victoria RRP is correct when the Murray-Tumut constraint is the *only* constraint that binds. In Section G.4 above, the constraint equation analysis shows that Murray generation must receive a *higher* price than the Victoria RRP when the South Morang constraint is the only constraint that binds.

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[512] Southern Generators, 8 March 2007 submission, p.4.

When both constraints bind there is a relationship between prices in four regions:

$$P_{VIC} = 0.106 \times P_{NSW} + 0.468 \times P_{SA} + 0.426 \times P_{SN}$$

Dr Biggar presented that there is no reason why, given this relationship, the Victorian price *must* be above the Snowy price. In fact, suppose the NSW price is $256, the South Australian price is $18.68, and the Snowy price is $150. Using the relationship above, the Victorian price must be $100.07, which is significantly lower than the Snowy price.[513] On the days raised in Snowy Hydro's submission, further investigation found that:

- On the 12 January 2007, the South Morang constraint was binding for 76 dispatch intervals. For all except 12 of those intervals, the Snowy price was higher than the Victorian price.

- On 30 January 2007, the South Morang constraint was binding for 65 dispatch intervals. In every one of these intervals, the Snowy price was above the Victorian price (including those intervals when the Murray-Tumut constraint was binding).

- On 3 March 2007, the South Morang constraint was binding for 88 dispatch intervals. In every one of these intervals the Snowy price was above the Victorian price (including those intervals when the Murray-Tumut constraint was binding).

From his analysis, Dr Biggar found that when both the South Morang and Murray-Tumut constraints were binding, the relationship between them depends upon which of the two constraints has the most "severe" (or limiting) effect on dispatch efficiency. The most severe constraint would be the one that would yield the most efficient dispatch if it were relaxed.

If the Murray-Tumut constraint is the most severe, then the Victorian price is more likely to be higher than the Snowy price. This is because, for northward flows, generation at Murray places the greatest pressure on the Murray-Tumut constraint. The most effective way to relax that constraint would be to reduce output at Murray. The Snowy RRP would be correspondingly low to reflect this. Therefore, when the Murray-Tumut constraint is the most severe, it is not economically efficient to encourage Murray to generate, more to try and relieve the South Morang constraint.

When the South Morang constraint is the most severe constraint, the Snowy RRP is likely to be higher than the Victorian RRP. Generation at Murray is able to help relieve congestion on the South Morang constraint. The Snowy RRP will reflect this incentive for Murray to increase its output. It is economically efficient, therefore, for Murray to generate more in this circumstance, even though the Murray-Tumut constraint is also binding, because there is a greater benefit for the market from relaxing the South Morang constraint and offsetting Victorian exports on the Victoria-Snowy interconnector with an increase in Murray generation.

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[513] In fact these were the prices in the NSW, South Australian, and Snowy regions at 3:30 pm on 12 January (the Victorian price at that time was, in fact, $91.44. The difference arises because the analysis here ignores losses).

The Commission therefore considers Snowy Hydro's claim that its Murray generation does not face incentives to relieve the South Morang constraint is not always true. The above analysis shows that during these periods when the South Morang constraint was binding, the settlement price for Murray generation can actually be higher than the Victorian price, depending on whether it is economically efficient for Snowy Hydro to increase its Murray output.

G.7 Can the increase in the incidence of binding constraints at South Morang be explained by the introduction of the Southern Generators Rule?

As discussed in Section G.3.1, Snowy Hydro contended that the Southern Generators Rule had led to an increase in binding of the South Morang constraint. Snowy Hydro argued that this increase was because Murray generation was no longer incentivised to generate to relieve the South Morang constraint when it was binding under the Southern Generators Rule. As discussed above, however, the Commission does not consider that it is always economically efficient for Murray generation to increase when the South Morang constraint binds.

Snowy Hydro also presented data on the trend in the incidence of binding for the South Morang constraint over the past year. It stated that the thermal South Morang post-contingency F2 transformer constraint ("V>>H_NIL_3_R") only bound for a total of 26 dispatch intervals over the financial year 2005/06. It noted, however, that the incidence of binding for this constraint increased to 400 dispatch intervals for the period from 1 January to 26 March 2007.

The Commission notes that Snowy Hydro did not consider the South Morang pre-contingency F2 transformer constraint ("V>>H_NIL_2_R"), which during the financial year 2005/06, bound for a total of 964 dispatch intervals. The Commission considers this to be a major oversight in the Snowy Hydro analysis.

The Commission considers that Snowy Hydro submission does not give a complete picture of the pattern of binding for the South Morang constraint before and after the introduction of the Southern Generators Rule because it only referenced the incidence of binding of the post-contingency F2 transformer constraint and not the pre-contingency constraint.

In addition, the Commission considers that there is some ambiguity as to what may be driving this increased incidence of binding, and whether it is solely attributable to implementation of the Southern Generators Rule. Binding levels may have changed due to:

- the reformulation of the relevant constraints to the fully co-optimised form;
- the severe drought conditions that developed over that period; and/or
- the introduction of the Southern Generators Rule.

While the reformulation of constraints to the fully co-optimised form does provide NEMMCO with a greater ability to maintain power system security, it may affect some generators' bidding incentives. To the extent this is true for the reformulation

of the South Morang constraints, this may contribute to the increased incidence of binding of these constraints. As discussed above, when the South Morang constraint binds, almost all the Latrobe Valley generators can be mis-priced, introducing some perverse bidding incentives. However, these bidding incentives are independent to the Southern Generators Rule.

The severe drought conditions have also affected Snowy Hydro's bidding incentives. Under normal energy constrained conditions, when the South Morang constraint binds, Snowy Hydro's Murray generation would normally face pricing incentives to generate and help alleviate the constraint. Given its limited water supply, Snowy Hydro may not face those same incentives to generate, unless the Snowy RRP is sufficiently high enough to warrant use of its scarce fuel. The water constraints have also affected Southern Hydro's generating ability. Output at Southern Hydro also helps alleviate the South Morang constraint. However, its limited access to water restricts ability to generate when the South Morang constraint binds. This may also be a contributing reason for the higher incidence of binding for that constraint.

Given the changes to bidding incentives resulting from these first two conditions, it is unlikely that the Southern Generators Rule is solely responsible for an increased incidence of binding of the South Morang constraints. The Commission considers that the changes in the incidence of the South Morang constraint binding were most likely driven by the interaction of all these factors along with other dynamic market processes.

G.8 Has the Southern Generators Rule contributed to negative residues occurring on Victoria-South Australia and Victoria-Tasmania interconnectors?

Snowy Hydro claims that the incentives facing the Latrobe Valley generators to offer negative bids when the South Morang constraint binds is contributing to counter-price flows on the interconnectors to both South Australia and Tasmania. This, it says, has led to NEMMCO having to intervene to minimise negative residues accumulating on the Victoria to South Australia interconnectors. With Basslink being a merchant network service provider, settlement residues do not accrue.

As shown in the constraint equation analysis in Section G.4, when the South Morang constraint binds, the Victoria RRP is higher than the South Australia price. However, if the Latrobe Valley generators have relatively lower offers compared to South Australia generation, the dispatch process could result in flows from Victoria to South Australia even though Victoria has a higher RRP. This point was raised in the Southern Generators supplementary submission.[514]

Between 1 April 2006 and 31 March 2007, there were 381 occurrences of negative residues on the Victoria-South Australia directional interconnector, totalling $584,412. Around 84% of this (or $492,919) accrued on 16 January 2007 when bushfires in Victoria caused a multiple contingency event resulting in South

[514] Southern Generators, 8 March 2007 submission, p.2.

Australia separating from Victoria. In the previous year, there were 238 occurrences with a total value of $47,640.[515]

Since the Southern Generators Rule took effect on 1 November 2006, NEMMCO has clamped flows between Victoria and South Australia due to counter-price flows four times: 30 January 2007, 3 February 2007, and twice on 4 February 2007. Over the period 1 January 2005 to the start of the Southern Generators Rule on 1 November 2006, NEMMCO did not intervene to clamp Victoria to South Australia flows.[516] During these clamping incidences, the South Morang constraint was binding and there was significant negative bidding by Latrobe Valley generators.

The evidence suggests that the Southern Generators Rule may have contributed to the incidences of clamping on the Victoria-South Australia interconnector, as suggested in the Snowy Hydro submission. However, as discussed above, there are a number of factors such as the increasingly severe drought conditions over this same period which may have increased the incidence of the South Morang constraint binding, resulting in an increased level of counter-price flows on the Victoria-South Australia interconnector.

It is important to note that the negative residues that arose on 16 January 2007 were not under system normal conditions. Bushfires in Victoria on that day resulted in system separation and load shedding in Victoria. NEMMCO invoked the value of lost load (VoLL) override, setting the Victorian RRP to $10,000/MWh for dispatch intervals 16:25 to 18:20.[517] NEMMCO's action to restore power system security and the generator bidding incentives triggered by the VoLL override swamped any possible incentives driven by the Southern Generators Rule. No conclusions can therefore be drawn from this day on what possible bidding incentives for the Latrobe Valley generators result from implementation of the Southern Generators Rule.

G.9 Conclusion

In two submissions to the Commission, Snowy Hydro argued that the Southern Generators Rule created market problems and dispatch inefficiency as a result of its interaction with the South Morang constraint. In their submission, the Southern Generators disagreed with this conclusion and argued that the problems raised by Snowy Hydro were actually caused by the underlying physical network.

The Commission has assessed both participants' arguments and the associated implications of the pricing relationships between regions when the Murray-Tumut and South Morang constraints bind. The Commission considers the negative bidding by the Latrobe Valley generators has the potential to sometimes result in inefficient dispatch, but that this is ultimately driven by the risk of those generators being constrained off due to the South Morang constraint binding. There are a number of factors other than the introduction of the Southern Generators Rule that

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515 NEMMCO, Settlement Residue Auction Information Memorandum, 3 July 2006 version and 2 July 2007 version.

516 Based upon a review of Market Notices issued by NEMMCO.

517 NEMMCO, System Separation and Load Shedding, Market Event Report, 16 January 2007.

may have affected the incidence of binding of the South Morang constraints, including for example the reformulation of constraints to a fully optimised form, or the reduced ability of Murray and Southern Hydro to generate due to water constraints. The Commission considers it is unlikely that the Southern Generators Rule is solely responsible for an increased incidence of binding of the South Morang constraints.

In addition, VENCorp has identified the thermal South Morang constraint as a problem in the Victorian transmission network and has committed resources to addressing the problems associated with the transformer in the next year. This suggests VENCorp had identified a problem with the underlying network well before implementation of the Southern Generators Rule or the prevalence of the severe drought conditions. While it is possible that those two conditions increased the incidence of binding for the South Morang constraint over the past year, they do not appear to be the sole triggers for the problem.

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H Summary of related reforms

This Appendix presents the policy reforms, Rule changes, and Reviews that relate to the issues being considered in the Abolition alternative[518], and the Split Snowy Region and Southern Generators Congestion Pricing proposals.

The Commission's decisions on the Rule changes relating to the congestion in the Snowy Region were taken in the context of two other important pieces of work relating to congestion: the Congestion Management Review (CMR), and the Rule change proposed by the Ministerial Council on Energy (MCE) to put in place a new process for changing regions in the NEM. The decisions relating to Snowy address an important legacy congestion issue from market start. The other work on congestion will set the enduring framework for congestion management in the NEM. In considering all of these issues, the Commission has sought to adopt, where practicable, a comprehensive and integrated approach.

H.1 Congestion Management Review

In October 2005, the MCE directed the Commission to undertake the CMR to identify and develop improved arrangements for managing financial and physical trading risks associated with material network congestion. The Commission was also directed to take account of, and clearly articulate, the relationships between a constraint management regime, constraint formulation, region boundary review criteria and review triggers, the Annual National Transmission Statement (ANTS) flow paths, the Last Resort Planning Power (LRPP), the Regulatory Test and transmission network service provider (TNSP) incentive arrangements from the perspective of the management of congestion.

The Commission published an Issues Paper on 3 March 2006 and released a Directions Paper on 12 March 2007. On 27 September 2007, the Commission published its CMR Draft Report. Submissions on the Draft Report are due by 3 December 2007.

Following consideration of the submissions to the Draft Report and further analysis, the Commission will prepare its Final Report for submission to the MCE.

H.2 MCE's Rule Change proposal for process for region change

The Commission received a Rule change proposal on 5 October 2005 from the MCE regarding the process and assessment criteria for considering changes to region

[518] The Commission made its final Rule determination to accept the Abolition of Snowy Region Rule change proposal on 30 August 2007. For the purposes of this Rule determination, the Abolition proposal is referred to as the "Abolition alternative" to reflect that at the time of the comparison of these alternatives, the Abolition proposal was a proposal, whereas now the Commission has made and commenced the *National Electricity Amendment (Abolition of Snowy Region) Rule 2007 No 7* to implement the abolition of the Snowy region. For more information see "AEMC 2007, Abolition of Snowy Region, Rule Determination, 30 August 2007, Sydney", available on the AEMC website.

boundaries in the NEM. The MCE proposed an application-driven process leading to region change determinations by the Commission, following a process of consultation and assessment of applications. The assessment criteria would be economic and forward-looking, replacing the technical and backward looking criteria and NEMMCO-led process in the current Rules. The MCE also indicated that the Commission should clarify when region change is appropriate having regard to the other means by which congestion can be managed. The MCE observed that region change should only be considered where network congestion is material and enduring and there is no commitment to transmission investment to relieve the congestion problem.

On 27 September 2007, the Commission published the draft Rule determination. The draft Rule would introduce an application initiated process to change regions only when there is a material and enduring congestion problem.

H.3 National Transmission Planner

On 3 July 2007, the MCE requested that the AEMC develop a detailed implementation plan for the national transmission planning function, as specified in the Council of Australian Governments (COAG) decision of 13 April 2007.[519] The AEMC will conduct a review into the development of a detailed implementation plan for the national electricity transmission planning function to ensure a more strategic and nationally coordinated approach to transmission network development. The new arrangements will provide a balance between the delivery of a coordinated and efficient national transmission grid, and local and regional reliability and planning requirements. It will guide network investment and provide signals for efficient generation investment. The Commission will consider the merits of aligning transmission regulation timetables, and will replace the current Regulatory Test, by amalgamating the criteria of reliability and market benefits and including the benefits to the national market in the latter. The AEMC has also been requested to conduct a review into electricity transmission network reliability standards, with a view to developing a consistent national framework for network security and reliability. The AEMC published a scoping paper in August 2007 and intends to publish an Issues Paper in early November 2007.

H.4 Economic Regulation of electricity transmission revenue and pricing Rules (the Chapter 6 Rule proposal)

The NEL required the Commission to amend the Rules for electricity transmission revenue requirements and pricing matters. The Commission undertook this project in two phases: Pricing and Revenue.

On revenue, the Commission has clarified the revenue setting rules. The Commission considers this will provide Transmission Network Service Providers (TNSPs) more certainty about recovery of costs for augmentation investments, including investment in alternatives such as network support contracts with

[519] MCE letter to the AEMC, 3 July 2007.

generators or providers of demand side measures. The Commission published a Final Rule Determination and made the National Electricity Amendment (Economic Regulation of Transmission Services) Rule 2006 on 16 November 2006.[520]

On pricing, the Commission published a Final Rule Determination and Rule on 21 December 2006.[521] The Final Rule largely confirms the continued operation of current pricing methodologies while also providing scope for innovation in the future. This has been achieved by recasting the regulatory framework incorporating codification in the Rules of the key design features of the regime including:

- Principles for prescribed transmission service pricing methodologies (arrangements for the pricing of negotiated services have been dealt with in the Draft Revenue Rule);
- The requirement for the Australian Energy Regulator (AER) to make guidelines in specific areas of pricing implementation and administration with a focus towards consistency across the NEM; and
- Clear procedural requirements for the development, implementation and administration of pricing methodologies.

The Rule commenced on 28 December 2006. The Commission considers that, in combination, the amended Rules provide a balanced package of incentives for TNSPs to invest in and operate their networks efficiently while maintaining the quality and reliability of transmission services. In September 2007, the AER released its Final Decision on the Submission Guidelines, which set out the requirements a TNSP must follow when developing and submitting a revenue proposal to the AER.

H.5 Last Resort Planning Power Rule change proposal (LRPP)

On 12 October 2005, the Commission received a Rule change proposal from the MCE requesting the introduction of a Rule to provide for the Commission to have a Last Resort Planning Power (LRPP). This power provides for the Commission to direct certain market participants to take the Regulatory Test in relation to potential inter-regional transmission investment projects across regions. The Transmission Last Resort Planning Rule requires the Commission to seek advice from the industry prior to exercising the power.

The Rule seeks to ensure timely and efficient inter-regional transmission investment for the long term interests of consumers. The Rule seeks to ensure that appropriate consideration is given to transmission investment in circumstances where existing incentives to undertake transmission investment may be lacking. These circumstances may arise where a potential transmission investment results in inter-regional benefits, which would result in positive net benefits to the market as a

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[520] AEMC 2006, *National Electricity Amendment (Economic Regulation of Transmission Services) Rule 2006*, Rule Determination, 16 November 2006, Sydney.

[521] AEMC 2006, *National Electricity Amendment (Pricing of Prescribed Transmission Services) Rule 2006*, 21 December 2006, Sydney.

whole, but which is not economic for any one Network Service Provider operating in one region of the market.

On 8 March 2007,[522] the Commission issued a Final Rule Determination on the LRPP Rule proposal, which largely accepts the MCE's proposed Rule. The Rule provides an intervention mechanism for the Commission to ensure that appropriate inter-regional investments are examined. It does not give the Commission the power to direct market participants to make the investments. However, the Rule requires the results of the Regulatory Test application to be published to inform potential investors of whether an economically viable project exists, thereby providing information for potential investors as to the viability of undertaking the investment. During the course of the Rule change process, the Commission identified a number of matters that it considered were matters of detail or implementation that were more appropriately the subject of guidelines. Subsequently, on 10 July 2007[523], the Commission published its LRPP Guidelines and the associated decision addressing issues such as requests from the Commission for information to inform its decision making, the procedure for public consultation on the panel's advice and public reporting on the exercise of the LRPP.

H.6 Review of Regulatory Test principles

Another Rule change proposal from the MCE sought to reform the principles of the existing Regulatory Test for assessing new transmission investment. The purpose of the Regulatory Test is to evaluate a proposed regulated transmission investment against all other reasonable network and non-network alternatives. The overarching objective of the Regulatory Test is to deliver economically efficient transmission investment within the NEM's network regulatory regime. The MCE's intention with this proposal was to provide greater clarity for the application of the Regulatory Test and reduce the scope for dispute, which has proved problematic in the past.

The Commission made a Final Rule Determination on the Rule change for the Reform of Regulatory Test Principles on 30 November 2006.[524] The Commission considers that the Rule change will allow the Regulatory Test to operate more effectively, providing greater policy guidance for the promulgation of the Test and increasing the certainty and transparency of the application of the Test. In its Determination, the Commission outlined a suite of principles that would provide minimum coverage guidelines for the AER to apply in promulgating the Regulatory Test. These principles include an economic and competition focus, which were underplayed in the original Regulatory Test. These principles are intended to establish a streamlined process that helps to maximise the net economic benefits to the market.

The Rule makes the market benefits limb of the Test simpler, through the provision of an information mechanism for alternative projects and requiring that the

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522 AEMC 2007, *National Electricity Amendment (Transmission Last Resort Planning) Rule 2007*, Rule Determination 8 March 2007, Sydney.

523 AEMC 2007, *Last Resort Planning Guidelines*, 10 July 2007.

524 AEMC 2006, *Reform of Regulatory Test Principles*, Rule Determination, 30 November 2006, Sydney.

comparison of the proposed investment be made only against identified alternatives rather than all possible alternatives. The Commission considers that this will lead to greater incentives for TNSPs to utilise the market benefits limb of the Regulatory Test and this will facilitate investments to relieve congestion.

H.7 Comprehensive Reliability Review

The Commission has requested the Reliability Panel[525] to undertake a comprehensive and integrated review of the effectiveness of NEM reliability settings, including whether there may be a need to improve or change them. The panel is focusing on whether an adequate level of generation and bulk transmission is made available. In June, an additional request was made by the MCE to provide advice on strengthening the market's ability to manage generator inputs.

The panel released a second interim report in September 2007, and intends to publish its final decisions in November 2007.

H.8 Rule on the Recovery of Negative Inter-regional Settlements Residue[526]

On 30 March 2006, the Commission made its Final Rule Determination and Rule on NEMMCO's proposal on the recovery of negative inter-regional settlements residue as part of the Settlement Residue Auction. The Rule (which commenced on 1 July 2006) enables NEMMCO to recover outstanding negative inter-regional settlements residue (negative residues) from future auction proceeds rather than future auction fees. This reduces NEMMCO's recovery period from up to three years to a minimum of one month or a mean of two months, and therefore reduces the cost of cross-subsiding the debt over that period.[527]

In its Final Determination, the Commission stated that it did not consider the Rule on the recovery of negative residues was a long-term solution to the problems with the current Settlements Residue Auction and because it did not address the underlying causes of negative residues. Consequently, the Rule approved by the Commission by the Commission had a three year sunset and the Commission signalled that an alternative permanent means of managing negative residues needed to be assessed as part of the CMR.

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525 The NEL requires the AEMC to establish the Reliability Panel in accordance with the National Electricity Rules. The role of the Panel is: to monitor, review and report on, in accordance with the Rules, the safety, security and reliability of the national electricity system; at the request of the AEMC, to provide advice in relation to the safety, security and reliability of the national electricity system; and any other functions or powers conferred on it under the Law and the Rules. Clause 8.8.1 of the Rules sets out the functions of the Panel in more detail.

526 AEMC 2006, Recovery of Negative Inter-regional Settlements Residue, Final Rule Determination, 30 March 2006, Sydney.

527 NEMMCO, Review of the Trigger Level for Management of Negative Settlement Residues, Final Determination Report, 27 October 2006, p.3.

H.9 Rule on the Management of negative residues in the Snowy region[528] and Determination on the Management of negative residues by re-orientation[529]

On 14 September 2006, the Commission accepted the Southern Generators' and NEMMCO's Rule proposal (Southern Generators Rule) for an interim mechanism to manage negative residues in the Snowy region. The Rule commenced on 1 November 2006. The Commission concurrently rejected a proposed alternative to the same problem from Snowy Hydro and NEMMCO (Re-orientation proposal).

The Southern Generators Rule introduced a new process for managing negative settlement residues in the Snowy Region. It eliminated the risk of Victoria to Snowy inter-regional settlement residue (IRSR) units (in either direction) being in deficit, thereby eliminating the reason for NEMMCO to intervene in the operation of the market to impose, under the Part 8 derogation, an alternative constraint equation to restrict flow on the Victoria–to-Snowy interconnector (called clamping). Instead, the Rule enabled NEMMCO to offset negative settlement residues on the interconnector between the Victoria and Snowy regions using positive residues accumulated on the interconnector between the Snowy and NSW regions.

The Commission considers that implementing a short term congestion management pricing measure before adopting a region boundary change is consistent with the approach proposed in the MCE's Congestion Management Review.

H.10 Extension of the expiry date for the Tumut CSP/CSC Trial and NEMMCO's power to manage negative residues

On 4 May 2007, the Commission published its determination[530] to extend the expiry date for the Snowy CSP/CSC Trial and NEMMCO's power to manage negative residues from 31 July 2007 to 31 October 2008 with the option to expire the whole derogation, the Tumut CSP/CSC Trial and/or Southern Generators Rule on a date other than 31 October 2008 or a specified event.

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528 Final Rule Determination, Southern Generators Rule, 14 September 2006.

529 AEMC 2006, Management of negative residues by re-orientation, Final Rule Determination, 9 November 2006, Sydney.

530 AEMC 2006, *Extension of the Participant Derogation in Part 8 of Chapter 8A of the National Electricity Rules*, (Draft) Determination, 14 December 2006, Sydney.

I Review of ROAM Consulting Report

I.1 Introduction

The Southern Generators submitted a report by ROAM Consulting as part of their "Congestion Pricing and Negative Residue Management Arrangements for the Snowy Region" Rule change proposal (ROAM report).[531] The ROAM report also supplemented the Southern Generators' submission on the Commission's Abolition of Snowy Region draft Rule determination (Abolition proposal draft Rule determination). According to the ROAM report, its purpose was to seek to replicate the dispatch and pricing modelling undertaken by the Commission's consultants, Frontier Economics (Frontier), in order to test the veracity of those results. Those modelling results informed the Commission's draft decision on Snowy Hydro Limited's Abolition of Snowy region proposal (Abolition proposal).[532]

The following sections discuss the options modelled by ROAM, the key results they obtained, the assumptions and methodology ROAM applied, the similarities and differences between the ROAM report and the modelling prepared by Frontier for the Commission, and presents the Commission's conclusions.

I.2 Options modelled by ROAM

ROAM modelled the following regional boundary configurations and scenarios:[533]

- BAU (Business as Usual): The existing regional boundaries excluding implementation of the Tumut Constraint Support Pricing/Constraint Support Contract Trial (Tumut CSP/CSC Trial) and the Southern Generators Rule. Clamping was implemented to manage counter-price flows on interconnectors;

- BAU-CSP: The Business As Usual case but with the Tumut CSP/CSC Trial in effect as well as the Southern Generators Rule – this reflects the current market structure;

- SHP (Snowy Hydro proposal): The Abolition alternative [534] to abolish the Snowy region, excluding clamping intervention on the Victoria to NSW interconnector;

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[531] ROAM Consulting, *Report to Southern Generators' Coalition, Analysis of the AEMC Draft Rule Determination to Abolish Snowy Region – Appendix A Modelling*, 3 April 2007 (ROAM report).

[532] AEMC 2007, *Abolition of Snowy Region*, Draft Rule Determination, 19 January 2007, p.13 and section 5, pp.29-67.

[533] ROAM report, pp.8-10.

[534] The Commission made its final Rule determination to accept the Abolition of Snowy Region Rule change proposal on 30 August 2007. For the purposes of this Rule determination, the Abolition proposal is referred to as the "Abolition alternative" to reflect that at the time of the comparison of these alternatives, the Abolition proposal was a proposal, whereas now the Commission has made and commenced the *National Electricity Amendment (Abolition of Snowy Region) Rule 2007 No* 7 to

- SHP-CLAMP: The Abolition alternative but with clamping activated on the Victoria to NSW interconnector; and

- SRD (Split Snowy Region proposal – Dederang): The Split Snowy Region proposal with Dederang included in the Murray region and designated the RRN.

The BAU, SHP, and SRD scenarios were designed to mimic those scenarios considered in the Frontier modelling for the Commission's Abolition proposal draft Rule determination in January 2007. The BAU-CSP and SHP-CLAMP scenarios were intended to reflect options that ROAM considered more realistic than the corresponding BAU and SHP options. The BAU-CSP reflects the Southern Generators' Congestion Pricing proposal, which was submitted as a proposed Rule change to the Commission on 15 March 2007 and the SHP-CLAMP reflects what the Southern Generators considered a more realistic implementation of the alternative Abolition proposal.

I.3 Key results

ROAM modelled the different cases using two different assumptions about Snowy Hydro's bidding behaviour. The first assumption involved Snowy Hydro engaging in "typical" bidding while the second assumption involved Snowy Hydro engaging in "strategic" bidding.[535] These assumptions are discussed in more detail in the following section.

For typical Snowy Hydro bidding, ROAM found that the SRD (Split Snowy Region) option gave the lowest production costs of all the options, with the BAU option yielding the highest costs. The results are summarised in the Table below.

Table I.1: Production cost results with Snowy Hydro typical bidding

Case	NEM Cost ($ millions)
BAU	2,098.8
BAU-CSP	2,096.7
SHP	2,096.7
SHP-CLAMP	2,096.5
SRD	2,096.5

Source: ROAM report, Executive Summary, p.I.

For strategic Snowy Hydro bidding, ROAM found that the BAU-CSP (Southern Generators' Congestion Pricing) option gave the lowest production costs of all the options, with the SRD option yielding the highest costs.[536] ROAM suggested that the CSP/CSC scheme removed the benefit of strategic operation of Tumut, which

implement the abolition of the Snowy region. For more information see "AEMC 2007, Abolition of Snowy Region, Rule Determination, 30 August 2007, Sydney", available on the AEMC website.

535 Ibid, pp.4-6.

536 Ibid, Executive Summary, p.II and p.18.

existed under the BAU case, to constrain the Snowy intra-regional link, thereby decreasing Snowy Hydro's incentives to "import the [high] VIC pool price into Snowy".[537] ROAM found that in the BAU case, Snowy Hydro had incentives to offer low levels of Murray output with varying levels of Tumut output to achieve this end. The removal of clamping in the BAU-CSP case also promoted more efficient dispatch by not limiting flows from region to region.

By contrast, under the SHP (Abolition) option, Snowy Hydro had a strong incentive to withdraw Tumut output at times of low reserve and high southerly flows.[538] This could cause the NSW-Snowy interconnector to bind, allowing Murray to optimise output. Finally, ROAM found that the SRD option led to the highest (most inefficient) production cost outcomes despite the fact that this option involved pricing Murray and Tumut "correctly" more frequently.[539]

The results are summarised in the Table below.

Table I.2: Production cost results with Snowy Hydro strategic bidding

Case	NEM Cost ($ millions)
BAU	2,095.8
BAU-CSP	2,094.8
SHP	2,094.7
SHP-CLAMP	2,094.0
SRD	2,093.7

Source: ROAM report, Executive Summary, p.II and p.18.

ROAM pointed out that its strategic bidding results conflicted with Frontier's results, in that Frontier found that:

- The BAU case led to $2 million higher production costs than the SHP case; and
- The SRD option led to $3.5 million lower production costs than the BAU option.

ROAM concluded that appropriate dynamic and static loss factors were included in Frontier's modelling for the Abolition proposal draft Rule determination. However, it also noted that in the real market, during times when Snowy Hydro will bid in a manner so as to set the price, the change from dynamic inter-regional loss factors to static intra-regional loss factors will create market inefficiencies.[540] The modelling undertaken for this final Rule determination uses static and dynamic loss factors prepared by NEMMCO, and therefore captures the efficiency effects of changing loss factors.

[537] Ibid, p.11.
[538] Ibid, p.13.
[539] Ibid, p.16.
[540] Ibid, p.24

ROAM also highlighted that Frontier's results were highly dependent on the outcomes from a particular demand point (demand point 29) and that ROAM could not find the benefits identified by Frontier under those sorts of demand conditions.[541]

In conclusion, ROAM found that the SHP option was inferior to a number of other options, including both the BAU and the BAU-CSP option that the Southern Generators have proposed as a Rule change to the Commission.[542]

I.4 Assumptions and methodology

This section outlines the key assumptions and methodology used by ROAM in its modelling. ROAM modelled only one financial year – 2008-09 – which it said was representative of several future years ahead.[543] ROAM also used the "2-4-C" modelling software to undertake its modelling, which it said has been used on behalf of National Electricity Market Management Company (NEMMCO) to establish minimum reserve levels for all regions of the National Electricity Market (NEM) since 2004.[544]

I.4.1 Network, load and plant entry assumptions

ROAM employed a 19 zone interconnected model of the NEM in its modelling.[545] Eleven of those 19 zones were in Queensland, with two each in NSW, Snowy, and Victoria and one each in South Australia and Tasmania. ROAM stated that it applied the interconnector limit equations from the 2005 Annual National Transmission Statement (ANTS) workbook, and used transmission limit equations for the SHP and SRD consistent with those used in the Abolition proposal draft Rule determination.[546] ROAM also stated that it applied relevant dynamic and static loss factor assumptions in all cases, obtained from either NEMMCO or the Commission.

ROAM developed half-hourly load trace forecasts for the NEM corresponding with the 2006 NEMMCO Statement of Opportunities (SOO) medium economic growth, 50% probability of exceedence forecasts for regional energy and demand. The 2005-06 load trace was used to develop the 2008/09 forecast load traces.[547]

All existing NEM plant was included in the modelling, with no plant retirements. New plant assumed to be commissioned by 2008-09 were Kogan Creek (750MW) in

[541] Ibid, pp.24-29.
[542] Ibid, p.30.
[543] Ibid, p.1.
[544] Ibid, p.1.
[545] Ibid, p.2.
[546] Ibid, p.3.
[547] Ibid, p.3.

Queensland (by Q3, 2007), Hallet B (120MW) in South Australia (by Q3, 2008) and Tallawarra (400MW) in NSW (by Q3, 2008).[548]

Generator forced and planned outage rates were based on the NEMMCO 2006 Minimum Reserve Level studies, except for Snowy Hydro units. ROAM was concerned that subjecting Snowy Hydro units to outages could interact adversely with the strategic modelling of those units.[549]

Finally, all short-run marginal cost (SRMC) and long-run marginal cost (LRMC) assumptions for plant were as published in the 2006 Minimum Reserve Levels Assumption report.[550] The value of loss load (VoLL) was assumed at $10,000/MWh, but NEM production costs under the different cases did not reflect this value in the event of load shedding.[551] To the extent that the volume of load shedding varied across cases, this may have distorted the relative production cost savings of the different options.

I.4.2 Bidding assumptions

All baseload and intermediate plant in the NEM were offered at SRMC and all peaking plant were offered at LRMC, except for Snowy Hydro's Murray and Tumut plant.[552] In the strategic bidding scenarios, ROAM allowed Murray and Tumut to offer different levels of capacity into the market (at $1/MWh) based on 12.5% capacity increments. This led to 81 potential different bidding combinations. Murray and Tumut were given an energy budget of up to 4,900 GWh per annum.[553]

ROAM's approach to determining the optimal Murray and Tumut bids involved the following steps:[554]

- For each half-hour, Snowy Hydro's revenue per MWh was compared for each of the 81 potential Murray and Tumut bidding combinations against the "typical" bid for the half-hour. The typical bid was based on ROAM's analysis of Snowy Hydro's historical bidding behaviour, and reflects annual, monthly, weekly and daily energy limitations;[555]
- For each half-hour, the best combination of potential bids was selected as the effective bid so long as:
  - The Snowy Hydro spot revenue (in $/MWh) for that combination exceeded the "typical" bid revenue by an adjustable margin; and

[548] Ibid, p.6.
[549] Ibid, p.6.
[550] Ibid, p.7.
[551] Ibid, p.7.
[552] Ibid, pp.4-5.
[553] Ibid, pp.5 and 11.
[554] Ibid, p.5.
[555] Based on a discussion between AEMC staff and ROAM Consulting, 30 July 2007.

– The outcome for the combination increased Snowy Hydro's gross revenue (in $) for that half-hour.

This meant that Snowy Hydro could increase or decrease output compared to the typical situation provided the half-hourly revenue increased (in both $/MWh and overall $). ROAM found that for more than 75% of hours, the typical bid was retained.[556]

ROAM stated that its approach to dynamic bidding was consistent with Frontier's approach.[557]

I.4.3 Clamping assumptions

ROAM stated that its modelling of the BAU option incorporated NEMMCO management of negative inter-regional residues on the Victoria-Snowy and Snowy-NSW interconnectors. ROAM referred to NEMMCO's Operating Procedure but gave a fuller explanation of its approach in section 5 of its report. This section explained that in the BAU case, clamping was implemented if the dispatch was expected to cause a negative settlement residue greater than $1,500 in any single trading interval. ROAM's results showed that the strategic bidding of Snowy Hydro caused a greater incidence of negative settlement residues than under typical bidding.[558]

However, ROAM applied clamping rather than re-orientation for southward flows on the Victoria-Snowy interconnector in the BAU case.[559] This appears to have been an oversight and may explain some of the differences between the results obtained by ROAM and those produced by Frontier.

I.5 Discussion of ROAM methodology, results and explanation

The Commission acknowledges and supports the effort made by the Southern Generators to analyse the different region boundary change proposals by commissioning independent modelling analysis. The ROAM modelling provided a useful counterpoint to the Frontier results.

The Commission has identified a number of areas of difference between the ROAM modelling and the Frontier modelling. The Commission also noted there were some results that did not accord with intuition and these the ROAM report did not elaborate on reasons for the difference.

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[556] ROAM report, p.5.

[557] Ibid, p.5.

[558] Ibid, pp.8 and 11.

[559] Based on a discussion between AEMC staff and ROAM Consulting, 30 July 2007.

I.5.1 Areas of difference between the ROAM methodology and Frontier methodology

The key points of difference between the ROAM and Frontier modelling methodologies relate to the use and meaning of "strategic" bidding. Strategic bidding refers to any situation where a generator does not offer all its available capacity to the market at its marginal or avoidable costs. Strategic bidding includes a generator offering some or all its available capacity above cost, withholding a proportion of its available capacity from the market, or some combination of the two.

The ROAM modelling allowed only the Murray and Tumut generators to bid at prices diverging from their costs. All other plant were bid at some measure of their marginal cost. In contrast, Frontier assumed that the Murray and Tumut generators, as well as a number of other large generation portfolios, could bid strategically. These other portfolios were Delta Electricity, International Power, LYMMCO, Macquarie Generation, Enertrade, and TRU Energy.[560] These non-Snowy Hydro participants were able to withhold between 10% and 30% of their portfolio capacities in order to maximise their profits. This difference in assumptions alone may explain the different results obtained by ROAM from those obtained by Frontier.

Another key difference in the methodologies was in respect of the nature of each consultant's approach to finding equilibrium dispatch outcomes under strategic bidding. Frontier's methodology applied a game-theoretic approach to determine optimal plant bids. This game-theoretic approach utilised the Nash Equilibrium solution concept to find sets of bids in which no strategic "player" was able to increase its profits – taking account of both its spot and contract position – by unilaterally changing its bid or offer. The merit of this approach is that it yields bidding combinations that are theoretically robust and sustainable across all relevant players.

By contrast, the ROAM approach to strategic bidding only involved one player (Snowy Hydro) having the freedom to make or change bids in order to maximise its revenue. The bids and offers of all other participants were fixed at SRMC or LRMC, allowing those other participants no ability to respond to the strategy chosen by Snowy Hydro or the resultant market price outcomes. The bidding strategies resulting from this approach would only coincidentally be mutually consistent (i.e. would only coincidentally be Nash Equilibria).

From this point of view, the modelling exercises undertaken by Frontier and ROAM are not directly comparable. While it is unclear, at this stage, which approach has better predictive qualities, the Commission considers that for this type of analysis, a modelling approach that accounts for a greater number of strategic players is likely to be more consistent with market outcomes than an approach that focuses on a single strategic player.

A related issue to the approach to defining strategic bidding was the approach that ROAM used to find the optimal Snowy Hydro bidding combination. ROAM's approach involved first finding the Murray/Tumut bid combination (out of the 81

[560] Abolition Draft Rule Determination, Appendix A, pp.97-99.

possible combinations) that led to the highest $/MWh revenue, and then checking whether this exceeded the revenue obtained (in both $/MWh and absolute $ terms) compared to the typical bid combination for that half hour.[561] However, it is not clear why a given bid combination for Murray and Tumut need necessarily increase the $/MWh revenue in order for it to be regarded as "optimal". Assuming zero fuel costs, the objective of Snowy Hydro would presumably be to maximise the revenue from its energy budget over a given year.

In some cases, such as at extremely high demand times, it may be worthwhile for Snowy Hydro to offer more capacity to the market to increase its total $ revenue, even though that may reduce its $/MWh revenue at that time. The opportunity cost of such behaviour would be to reduce available energy for dispatch at other (non-super-peak) times. However, that may well be the optimal strategy for Snowy Hydro since prices are likely to be much lower outside the super-peak times.

By contrast, Frontier's approach to Snowy Hydro bidding involved removing the energy budget constraint from Snowy Hydro at "super-peak" summer and winter times, thereby allowing their model to find the fully optimal bidding strategy at these times.

The Commission has discussed this matter with ROAM and ROAM has acknowledged that the approach it adopted may not produce Snowy Hydro's optimal strategy in certain high-demand situations. ROAM highlighted that the approach it adopted was chosen in part to enable its work to be completed within the required timeframe.[562] The way in which ROAM modelled clamping of the Victoria-Snowy and Snowy-NSW interconnectors was also different to the approach adopted by Frontier. In the Abolition proposal draft Rule determination Frontier's approach implemented clamping of the Victoria-Snowy interconnector (northward) and the Snowy-NSW interconnector (in both directions) based on a zero threshold for negative settlement residues and perfect foresight. That is, the relevant interconnector limit was immediately set to zero when there would otherwise have been any negative settlement residues accruing on the interconnector for the given set of bids. NEMMCO's actual implementation of clamping involves the use of a $6,000 threshold. ROAM's approach used a $1,500 per trading interval threshold as an approximation for NEMMCO's implemented approach.

The Frontier's zero threshold perfect foresight approach to clamping applied in the modelling for the Abolition proposal draft Rule determination has been modified to better reflect NEMMCO's implemented approach for the modelling undertaken for this determination. These revised assumptions can be found in Appendix [B].

The Commission considers that differences in modelling methodology explain many of the differences between the Frontier and ROAM modelling results. For example, ROAM's finding that demand point 29 was not significant in driving dispatch efficiency benefits is likely to be a function of differences in strategic bidding assumptions. Similarly, the change in the rankings of the options modelled by ROAM with the introduction of strategic bidding assumptions highlights the

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[561] See ROAM report, p.5.

[562] Based on a discussion between AEMC staff and ROAM Consulting, 30 July 2007.

importance of bidding assumptions on the results produced. However, the limitations in ROAM's treatment of strategic bidding make it difficult for the Commission to confidently rely on the ROAM report results.

I.5.2 Areas where ROAM results were inconsistent with intuition, and therefore required additional explanation

The Commission found the commentary of some of the production costs presented by ROAM did not provide a clear explanation of what was driving those results. Where modelling results do not align with economic intuition, a full explanation is required to reconcile the differences. The lack of explanation of several key results made it difficult for the Commission to reconcile the departure from intuition, and therefore confidently rely on the results.

An example is the explanation for the beneficial predicted impacts of the BAU-CSP option. ROAM suggested that the reason why this option led to the most efficient dispatch was that it priced Tumut generation correctly, reducing Snowy Hydro's incentives to bid Tumut strategically in forcing constraints between Murray and Tumut.[563] ROAM observed that:

> "…the CSP/CSC trial has been successful through application of 'pseudo-nodal pricing' for the Tumut node in alleviating the incentive for Snowy Hydro to exercise market power. Since its implementation, binding constraints on the Murray-Tumut intra-regional interconnector [sic] have significantly reduced."[564]

However, the Commission's conceptual analysis suggests it is likely that *all* the options would reduce the incentives for Tumut to "flood" the lines south to Murray at times of high Victorian demand, as *all* the alternative options would lead to Tumut being settled at a different price to the Murray price when constraints between Murray and Tumut bound. Furthermore, the other option that involved pricing Tumut correctly in all cases was the SRD option. However, ROAM found this option produced the worst dispatch results, even worse than the BAU case. This suggests that the "correct" pricing of Tumut generation alone cannot explain why the BAU-CSP ought to produce the most efficient dispatch results.

Having discussed this matter with ROAM, the Commission understands that ROAM's justification for the positive results for the BAU-CSP case was based on the fact that it correctly priced *both* Tumut *and* Murray. However, as discussed by the Commission in its current and previous modelling appendices, correct nodal pricing of generation may not necessarily lead to the most efficient dispatch results in the presence of transient market power – generators' desire to leave "headroom" on

[563] ROAM report, p.19.

[564] Ibid, p.22.

downstream lines may mitigate against the positive efficiency implications of overcoming mis-pricing.[565]

Another example of where the results did not accord with intuition, and the difference was not appropriately explained, was where the SHP option was criticised by ROAM on the basis that it gave Snowy Hydro incentives to withhold Tumut generation at times of high southward flows and low reserve levels.[566] ROAM likewise criticised the Frontier modelling for not discussing the possibility of Snowy Hydro bidding strategically by withholding output.[567]

However, ROAM does not explain why Snowy Hydro would be incentivised to withhold Tumut output at these times to a greater degree than under the BAU-CSP or SRD options. In all cases, Snowy Hydro may be able to import the Victorian price north to Tumut by bidding Tumut in such a way as to ensure that the lines between Tumut and Murray do not bind.

What may be possible is that under the SHP option, Snowy Hydro can swap Tumut output for Murray output, as constraints south of Murray under the SHP option would not reduce the price at which Murray output would be settled. However, this explanation is not proffered by ROAM in its report. Based on later discussions with ROAM, it appears that this may have been the intended explanation. However, even if it is, it is not clear why this behaviour ought to necessarily lead to less efficient outcomes than the BAU-CSP and SRD options, in which Snowy Hydro has an incentive to leave some headroom on the lines south of Murray to avoid being constrained-off from the (high) Victorian price at these times.

Finally, as noted above, the Frontier modelling did explicitly allow for Snowy Hydro to engage in the type of withholding strategies mentioned in the ROAM report. Therefore, the claim that Frontier's modelling did not allow for the possibility of this outcome is unfounded.

The failure to satisfactorily explain the inconsistency between the conceptual analysis and the modelling results makes it difficult for the Commission to confidently rely on the ROAM analysis.

I.6 Conclusion

The Commission welcomes the contribution made by the Southern Generators and ROAM to the analysis of the Frontier modelling presented in the Abolition proposal draft Rule determination. The ROAM modelling provides a useful counterpoint to the Frontier modelling. It is clear to the Commission that all simulation modelling contains limitations and can thus only ever provide an indication of likely results rather than definitive predictions. The Commission also appreciates that ROAM undertook its modelling exercise within a very short time period.

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565 Abolition Draft Rule Determination, p.32.

566 ROAM report, p.13.

567 Ibid, p.23.

However, it appears that the assumptions made within the ROAM modelling are more limiting than those made by the Commission's consultants. In addition, there were several cases where the ROAM modelling analysis produced results that there inconsistent with intuition, and this inconsistency was not satisfactorily explained. The narrower treatment of strategic bidding, the lack of a Nash Equilibrium approach, the limited explanation for some of the results, and the use of only a single year of analysis suggests that the Commission should place limited weight on these results when compared to those prepared by Frontier.

This is the last page of this Rule determination.