AEMC

Australian Energy Market Commission

Final Rule Determination

National Electricity Amendment (Management of Negative Settlement Residues in the Snowy Region) Rule 2006

Rule Proponents
Loy Yang Marketing Management Company Pty. Ltd. (LYMMCO), Southern Hydro Pty. Ltd., International Power (Hazelwood, Synergen, Pelican Point, Loy Yang B), TRUenergy Pty. Ltd., NRG Flinders Pty. Ltd., Hydro Tasmania, and NEMMCO

14 September 2006

Signed: .....

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Chairman
For and on behalf of
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About the AEMC

The Council of Australian Governments, through its Ministerial Council on energy, established the Australian Energy Market Commission (Commission) in July 2005 to be the Rule maker for national energy markets. The AEMC is currently responsible for Rules and policy advice covering the National Electricity Market. It is a statutory authority. Our key responsibilities are to consider Rule change proposals, conduct energy market reviews and provide policy advice to the Ministerial Council as requested, or on AEMC initiative.

Contents

This document is presented in three main Parts.

Part 1 provides a summary of the issue being considered by the Commission, the proposed Rule changes that have been evaluated, the basis of the Commission's evaluation and its decision and reasons for making this decision.

Part 2 provides a more detailed, but non-technical, version of Part 1.

Part 3 is comprised of a series of appendices that provide a detailed technical description of the issue, the analysis conducted by the Commission, and its consideration of the analysis and information available to it.

Part 1. Summary

On 9 November 2005, the Commission received a revised request for a Rule change proposal from a group of six generators and the National Electricity Market Management Company (NEMMCO).[1] The generators (collectively known as the Southern Generators) are Loy Yang Marketing Management Company Pty. Ltd. (LYMMCO), Southern Hydro Pty. Ltd., International Power (Hazelwood, Synergen, Pelican Point, Loy Yang B), TRUenergy Pty. Ltd., NRG Flinders Pty. Ltd., and Hydro Tasmania. The Rule change proposal involves the introduction of a new process for managing negative settlement residues in the Snowy Region. The objective is to improve the use of the interconnector between the Snowy region and Victoria, thereby improving the efficient use of electricity generators and increasing inter-regional competition.

The National Electricity Market (NEM) is designed to provide price signals at different times and locations for the efficient production and use of power. Trading of electricity between pricing regions in the interconnected NEM normally involves power flows from low priced areas to high priced areas. This sharing of lower priced power can reduce overall production costs and prices for customers.

When generators export power to a higher priced region they do not receive the higher price paid by customers in the importing region; they receive the lower price that prevails in their generating region. This causes a surplus of funds to build up, known as *inter-regional settlement residues* (IRSRs), which are collected by NEMMCO. Units corresponding to shares of IRSRs are auctioned to market participants to help fund any hedging contract payment shortfalls that arise due to inter-regional price differences.

On occasion, however, power flows from higher-priced regions to lower-priced regions.[2] In this case, "negative settlement residues" may accrue between two regions. Since, under the current market arrangements, NEMMCO has a limited means for funding large negative residues, NEMMCO takes action to prevent the accumulation of negative settlement residues when they would otherwise arise.[3]

The Southern Generators' Rule change proposal concerns the management of negative settlement residues that can arise due to transmission constraints within the Snowy region of the NEM. The Snowy Region is unique in the NEM in that it contains a network loop that intersects a regional boundary. As a result of these features and the design of the market, there are occasions when counter-price flows and negative settlement residues can arise on the Victoria to Snowy interconnector.

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1 The Southern Generators originally submitted their proposal to the National Electricity Code Administrator on 10 May 2005. The commencement of the National Electricity (South Australia) (New National Electricity Law) Amendment Act 2005 on 1 July 2005 introduced a requirement, under s.91(6) of the NEL, for NEMMCO to be a proponent of any participant derogation that relates to its functions. As a result of these provisions, NEMMCO agreed to formally join the request and the revised request was submitted to the Commission on 9 November 2005.

2 Appendix 5 of the Commission's Congestion Management Review Issues Paper highlighted the different ways in which counter-price flows and negative settlement residues could arise in an alternating current network.

3 Although negative residues are recovered later, in accordance with Clause 3.6.5(a)(4A) of the Rules, NEMMCO has to carry the cost of deficit for a period of time.

NEMMCO presently manages the accumulation of negative settlement residues on the Victoria-Snowy interconnector by:

- Restricting ("clamping") power flows at times of northward flow on the interconnector; and

- "Re-orientating" network constraints to Dederang at times of southward flows, in order to eliminate counter-price flows.

However, clamping power flows in this way at times of northward flows can undermine competitive pressure, distort the efficiency of dispatch and pricing outcomes, and reduce the effectiveness of IRSR units as an inter-regional price hedging instrument.

The Southern Generators' proposal aims to eliminate the risk of Victoria to Snowy IRSR units (in either direction) being in deficit, thereby eliminating the reason for NEMMCO to intervene in the operation of the market to impose clamping. Under the Southern Generators' proposal, in the case of either northward or southward power flows, positive settlement residues accumulated on the interconnector between Snowy and NSW would be used to offset negative settlement residues accumulated on the interconnector between Victoria and Snowy.

The Southern Generators presented their proposal as an interim measure, for the summer of 2006-07 and expiring on 31 July 2007, such that it would not foreclose other longer-term solutions to transmission congestion in and around the Snowy region.

The Southern Generators' proposal is one of a number of proposals before the Commission addressing regional boundary and network congestion related matters. The Commission notes that there is a broad consensus in the market that there is a problem with the existing Snowy region boundary, which is the subject of two Rule change proposals currently before the Commission. The Ministerial Council on Energy (MCE) has submitted a Rule change proposal to establish principles for assessing region boundary change proposals and Terms of Reference for a Congestion Management Review to identify options for the development of a more effective network congestion management regime in the NEM. The MCE has proposed that a boundary change would be the final step in a staged approach for the management of congestion. In its 6 June 2006 "Congestion Management Program – Statement of Approach", the Commission recognised the linkages between these projects and provided guidance on the integrated approach it will adopt in dealing with these related projects.[4]

Of the various related proposals before the Commission, the most relevant for its assessment of the Southern Generators' proposal is the one from Snowy Hydro and NEMMCO on 24 May 2006, which advances an alternative solution to the Snowy Region negative settlement residue problem (Snowy Hydro Re-orientation proposal). The Snowy Hydro Re-orientation proposal was lodged almost six months after the Commission received the Southern Generators' Rule change proposal and two weeks

4 The Commission's Congestion Management Program – Statement of Approach is published on the AEMC website.

prior to the publication of the Southern Generators Draft Rule Determination on 6 June 2006.

Snowy Hydro proposed that at times of northward flows when negative settlement residues on the Victoria to Snowy interconnector are expected to be material (i.e. exceed $6,000)[5], NEMMCO would "reorient" certain network constraints in the region so that the Snowy region price at Murray aligned with the price at Dederang in Victoria. This approach would effectively align the Victorian and Snowy prices, thus removing any negative settlement residues and the need for NEMMCO to clamp the interconnector. Snowy Hydro proposed that its approach be implemented until the earlier of 31 July 2007 or the implementation of a change to the Snowy region boundaries.

If it is the case that the long term solution to the Snowy region "legacy" issues involves a region boundary change, it would not be possible to implement the change in time for the 2006-07 summer. However, the Commission has before it short-term proposals from the Southern Generators and Snowy Hydro that involve a modification to the current congestion pricing trial in the Snowy region ("Snowy Constraint Support Pricing/Constraint Support Contract (CSP/CSC) Trial"[6]), are said to represent improvements on the status quo and can be implemented before the coming summer. Implementing a short-term congestion management pricing measure before adopting a region boundary change is consistent with the approach proposed in the MCE's Terms of Reference for the Congestion Management Review. The analytical work undertaken in assessing the Southern Generators' proposal and Snowy Hydro Re-orientation proposal will also be of value in informing the broader range of congestion related issues the Commission has under consideration.

Both the Southern Generators' and Snowy Hydro Re-orientation proposals seek to address the accrual of negative settlement residues, which are the driver of NEMMCO's clamping of northward inter-regional power flows from Victoria to NSW via the Snowy Region.

In considering these competing proposals, the Commission must choose the option that will or is likely to best meet the NEM objective[7] in light of all the circumstances. This could mean that the Commission decides to reject both Rule change proposals

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5 NEMMCO is presently consulting on raising the $6,000 trigger threshold to $100,000 (see NEMMCO, Review of the Trigger Level for the Management of Negative Settlement Residues, Draft, 5 September 2006, available on the NEMMCO website at www.nemmco.com.au). This review follows a Rule change that allows NEMMCO to recover outstanding negative settlement residues within 3 months rather than having to wait up to 21 months.

6 The Snowy congestion management trial—i.e., the Snowy CSP/CSC trial—established by the Part 8 Chapter 8A derogation in the Rules, seeks to test the use of Congestion Support Prices (CSPs) and Congestion Support Contracts (CSCs) in managing network congestion. For a non-technical description of the CSPs and CSCs and the Snowy CSP/CSC trial, see Sections 5.4.1 and 5.4.3 of AEMC "Congestion Management Issues Paper", AEMC, Sydney, March 2006 (available at http://www.aemc.gov.au) Part 3 Appendix E describes the Commission's assessment of the consistency between the Southern Generators' and Snowy Hydro Re-orientation proposals and the Snowy CSP/CSC Trial.

7 Section 7 of the National Electricity Law states that: the National Electricity Market Objective is to promote the 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 reliability, safety and security of the national electricity system.

and maintain the current arrangements or it could accept *one of* the proposals put to the Commission. Since the proposals are alternatives, the Commission cannot accept both.

On the basis of the analysis set out in this Final Rule Determination and its consideration of the views in submissions, the Commission has concluded that both the Southern Generators' proposal and Snowy Hydro's proposal are clearly superior to the current intervention arrangements involving clamping of power flows by NEMMCO.

The Commission considers that while both proposals are an improvement on the status quo, on balance, the Southern Generators' proposal would provide greater certainty, predictability, and consistency in market reform when compared to the competing Snowy Hydro Re-orientation proposal. The Commission is satisfied that when assessed against the Snowy Hydro Re-orientation proposal, the Southern Generators' proposal would more effectively promote improvements in competition and efficiency in the NEM compared to the current arrangements and that it would be in the long-term interests of electricity consumers. The detailed reasons for this decision are summarised below and presented in further detail in Parts 2 and 3 of this Final Rule Determination. The Commission's reasons for not accepting Snowy Hydro's Re-orientation proposal are set out in more detail in the Commission Draft Rule Determination on that proposal.[8]

The Commission found that, compared to the current arrangements, both the Southern Generators' and Snowy Hydro Re-orientation proposals would be likely to promote marginally more efficient dispatch of generators across the NEM, resulting in lower costs of production. Similarly, both proposals would be likely to result in spot price changes that more closely reflected costs, thereby promoting allocative and dynamic efficiency over time.

Further, in the absence of clamping, both the Southern Generators' and Snowy Hydro Re-orientation proposals would be likely to improve the management of inter-regional contract trading risk, resulting in an increased willingness by participants to trade hedge contracts inter-regionally. This increased willingness to trade inter-regionally should, in turn, promote retail competition, efficient generation investment, and more efficient pricing. Importantly, these gains would come at little cost, involving only the costs of establishing and maintaining revised arrangements within existing settlement systems.

The Commission received correspondence from Snowy Hydro on 28 August 2006, which suggested, for the first time, that the Southern Generators' proposal may adversely affect reliability of supply in Victoria during the 2006-07 summer. The Commission has thoroughly assessed the basis of these contentions by Snowy Hydro and has concluded that supply reliability for Victoria is unlikely to be materially different from the status quo under either the Southern Generators' proposal or the Snowy Hydro Re-orientation proposal. The Commission's assessment is presented in Part 3 Appendix D.

8 AEMC, Management of negative settlement residues by re-orientation, Draft Rule Determination 14 September 2006, Sydney. Published on the AEMC website.

The key differences between the proposals lie in the manner in which they would be implemented.

The Southern Generators' proposal implementation mechanism would involve an automatic, *ex post* adjustment to the settlement procedures to net off positive and negative residues. By contrast, the Snowy Hydro Re-orientation proposal would require the exercise of judgment by NEMMCO as to when material negative settlement residues may occur and when and for how long to intervene in the market to alter the arrangements for price determination.

In addition, the Commission views consistency with existing regulatory interventions as an important aspect of good regulatory practice. In this context, the consistency of each proposal with the Snowy CSP/CSC Trial (a partial CSP/CSC Trial which both proposals are seeking to amend) is also relevant, especially as both proposals are only short-term initiatives.[9] The Commission believes the Southern Generators' proposal is more consistent with the current Snowy CSP/CSC Trial as it represents a consistent extension of the CSP/CSC regime by maintaining efficient locational pricing for Murray as well as Tumut generation when the Snowy region constraint binds, whereas the Snowy Hydro Re-orientation proposal represents a move away from efficient locational pricing at these times.

The Commission considers that the Southern Generators' proposal would provide a simpler, more transparent and predictable means of managing negative settlement residues. The operation of the proposal would be clearly defined in the Rules and it would be implemented after the fact, through the NEM settlement procedures. As the Southern Generators' proposal appears to be more consistent with the existing congestion pricing trial that it would amend, it further promotes consistency with existing regulatory interventions.

For these reasons, the Commission has concluded that the Southern Generators' proposal would deliver better market outcomes when compared to the Snowy Hydro Re-orientation proposal and therefore, it also, on balance, better contributes to the requirements of the NEM objective.

As a result, the Commission has determined that the Southern Generators' proposal meets the Rule making test and has determined to approve the Southern Generators' Rule change proposal and make the National Electricity Market Amendment (Management of negative settlement residues in the Snowy Region) Rule 2006. This "Rule as Made" will commence on 1 November 2006.

9 Part 3 Appendix E explains the Snowy CSP/CSC Trial in more detail.

Part 2. The Commission's summary consideration

2.1 Southern Generators' proposal

On 9 November 2005, the Commission received a revised request for a Rule change proposal from a group of six generators (the Southern Generators) and the National Electricity Market Management Company (NEMMCO).[10] The Southern Generators are Loy Yang Marketing Management Company Pty. Ltd. (LYMMCO), Southern Hydro Pty. Ltd., International Power (Hazelwood, Synergen, Pelican Point, Loy Yang B), TRUenergy Pty. Ltd., NRG Flinders Pty. Ltd., and Hydro Tasmania.

The Southern Generators' proposal aims to improve the way the interconnector between Snowy and Victoria is used, thereby improving the efficient use of the generation system and increasing interstate competition. More specifically, the proposal aims to end NEMMCO's current practice of restricting the flows over the interconnector between Victoria and Snowy under certain circumstances (this practice is known as "clamping").

The Southern Generators' proposal aims to eliminate NEMMCO's need for intervening in the dispatch of the market through clamping by eliminating the risk of the IRSR fund relating to the Victoria to Snowy interconnector being in deficit. The Southern Generators proposed that positive settlement residues that have accumulated on the Snowy to NSW interconnector be used to offset negative settlement residues accumulated on the Victoria to Snowy interconnector.

In their proposal, the Southern Generators presented the benefits of their proposed solution over the status quo as: improving the economic efficiency of dispatch; improving participants' ability to trade inter-regionally; and improving reliability of supply.[11] They also stated that their proposal was a "specific response to an acute problem in the National Market implementation."[12]

2.2 Proposals related to Southern Generators' proposal

The Commission is also considering a Rule change proposal from Snowy Hydro and NEMMCO. [13] The Commission received the proposal on 24 May 2006.

Snowy Hydro proposed an alternative method for managing negative settlement residues on the Victoria to Snowy interconnector. Snowy Hydro's proposal aims to align the Snowy and Victorian prices at times when material negative settlement residues on this interconnector would be expected to occur (in either direction). The effect of this would be that counter-price flows between Snowy and Victoria do not

10 The Southern Generators originally submitted their proposal to the National Electricity Code Administrator on 10 May 2005. The commencement of the National Electricity (South Australia) (New National Electricity Law) Amendment Act 2005 on 1 July 2005 introduced a requirement, under s.91(6) of the NEL, for NEMMCO to be a proponent of any participant derogation that relates to its functions. As a result of these provisions, NEMMCO agreed to formally join the request and the revised request was submitted to the Commission on 9 November 2005.

11 Southern Generators Rule change proposal, p.4-5, 9, 11-14

12 Southern Generators Rule change proposal, p.5

13 NEMMCO is a co-applicant to the Snowy Hydro Rule change proposal because s.96(6) of the NEL requires NEMMCO to be a proponent of any participant derogation that relates to its functions.

occur and so there would be no accumulation of negative settlement residues. This result would be achieved using the same approach that NEMMCO currently applies to managing negative settlement residues on the Snowy to Victoria interconnector for southward flows. While this approach would avoid the potential inefficiency of clamping, it would nevertheless involve a degree of NEMMCO discretion as to when to invoke the re-orientated form of constraints.

Both Rule change proponents agree that the key problem is NEMMCO's clamping intervention in the market, but differ on the appropriate solution.

Further, both the Southern Generators and Snowy Hydro presented their proposals as an interim arrangement for the management of congestion within the Snowy region and both accepted that a more effective long-term solution, such as a change in the boundary of the Snowy pricing region, is ultimately required. On 11 November 2005, the Commission received a Rule proposal from Snowy Hydro Limited regarding a change to the Snowy regional boundary. A revision of this proposal was then received on 22 December 2005. On 6 February 2006, the Commission received a Rule proposal from Macquarie Generation, also proposing a change to the Snowy regional boundary.

Importantly, the proposals considered in this Determination relate to a temporary derogation and the Commission has not yet made any decision as to the nature of its longer term views on proposed changes to the Snowy regional boundary.

For the purposes of this evaluation, the Commission considered the merits of the Southern Generators' proposal and Snowy Hydro Re-orientation proposal as compared to the current arrangements. As both proved superior to the status quo, it has also considered the relative merits of the two proposals. An evaluation of longer-term boundary change and related proposals will be the subject of separate reviews.

2.3 Problems addressed by the Southern Generators' proposal

A central design feature of the NEM is the use of price signals to reflect the differing cost of producing and using power at different times and locations. These prices are intended to send transparent signals to producers as to when, where, and how much production to offer the market and to consumers regarding the costs of consumption at different times and locations. Consumer price signals are aimed at promoting more informed choices about electricity use.

Prices vary every half hour at six different pricing reference points across the interconnected NEM. For the most part these pricing reference points, or regions, approximate the State boundaries of the jurisdictions participating in the NEM (Queensland, New South Wales, Victoria, South Australia, and Tasmania). The Snowy Hydro generators are located in a separate pricing region known as the Snowy Region.

Typically, but not always, power in the NEM is exported from lower priced regions to higher priced regions. Generators are paid the price that prevails in the region they generate in, not the higher price paid by customers in the region importing their power. This difference between the prices paid by customers and received by generators results in a surplus when all payments are finally settled. Surplus funds

arising from these inter-regional power transfers are known as *inter-regional settlement residues* (IRSRs).

IRSRs are administered by NEMMCO and IRSR units corresponding to specific directional flows from one region to another,[14] defined over quarters in the year, are used by market participants to help manage the risks of inter-regional contract trading. Market participants pay for the right to secure IRSR units to help fund any hedging contract payments that they may be liable to make in the event of inter-regional price differences occurring.

Occasionally, because of the relationship between the transmission system capacity limits and the boundaries of the NEM pricing region, or because of the power flow characteristics of the grid, there are occasions when power flows from a higher priced to lower priced region. This is known as a counter-price flow, meaning wholesale electricity is being sold to customers more cheaply than the price paid for its purchase. This is known as a negative settlement residue and reduces the net IRSRs relating to the relevant interconnector.

If these counter-price flows persist, the negative settlement residues could outweigh positive settlement residues, resulting in the IRSRs relating to a particular directional interconnector being in deficit. As NEMMCO does not have an effective way to fund this deficit, it presents a financial risk to NEMMCO as administrator of the IRSR funds.

The transmission system 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. It was not designed with the NEM pricing arrangements in mind. The current location of the Snowy regional boundary, when combined with the configuration of the network in the vicinity of the Snowy Region sometimes causes counter-price power flows. This outcome does not necessarily indicate inefficient dispatch and does not create a power system security problem. The principal problem resulting from counter-price flows is the funding of negative residues, and consequently the way that NEMMCO intervenes in market dispatch to manage its financial risk arising from the negative settlement residues.

Status quo arrangements

In accordance with a derogation in Part 8 of Chapter 8A of the Rules, NEMMCO uses one of two methods to manage this financial risk depending on the direction of power flows between Snowy and Victoria:

- For *northward* flows on the Victoria to Snowy interconnector, NEMMCO manages the risk of negative settlement residues by restricting the flow of power from the higher to lower priced region (widely known as "clamping"). NEMMCO only clamps the interconnector flows if this does not threaten power system security; and

14 For example, Snowy-NSW; Snowy-Victoria.

- For *southward* flows on the Victoria to Snowy interconnector, NEMMCO "reorients" certain network constraints in the Snowy region once material negative settlement residues accrue so that the Snowy region price is set at the value of the nodal price for Dederang in Victoria, rather than at the nodal price for Murray (which is the Regional Reference Node for the Snowy region). This effectively equates the Victorian and Snowy region prices, so that there are no counter-price flows and no further accumulation of negative settlement residues.

When the Victoria to Snowy interconnector is clamped, output by generation in Victoria, SA, and Tasmania is likely to be less than it would have been if access to the NSW market were not artificially restricted in this way. The Southern Generators consider the potential inefficiencies of this intervention to be sufficiently high to warrant a change to the Rules. This is the problem the Southern Generators' proposal addresses.

At times when NEMMCO intervenes by setting the Snowy region price equal to the price at Dederang, earning a lower price could discourage Snowy Hydro's Murray generation from producing the efficient level of output. Therefore, inefficient price signals may arise in both directions under the current arrangements.

Another concern with the current arrangement is that it requires NEMMCO to exercise considerable judgement as to the precise implementation of its interventions – exactly when, to what extent and for how long it should intervene.

The evaluation set out in this Final Rule Determination assesses the merits of the Southern Generators' proposal in addressing the problems identified with NEMMCO's current intervention under the Status Quo. As the Snowy Hydro Re-orientation proposal is an alternative to the Southern Generators' proposal, aimed at addressing the same problems identified by the Snowy Hydro Re-orientation proposal, the Commission has compared the Southern Generators' proposal against the Snowy Hydro Re-orientation proposal in addition to the status quo.

2.4 Reform context

A number of reviews of aspects of the NEM are currently underway, which are directed to ensuring an efficient, reliable, and secure power system in Australia.

The ongoing scrutiny of the NEM and the power system more generally reflects the importance that policy makers, businesses, and consumers place on the essential contribution that energy supply and infrastructure makes to the economic well being of the community. In recent times there has been a particular focus on so-called "infrastructure bottlenecks" or infrastructure capacity shortages. In the power system, infrastructure shortages are manifested in the form of higher prices and lower supply reliability and power system security.

On 10 February 2006 the Council of Australian Governments (COAG) convened a high-level Energy Reform Implementation Group (ERIG), which will report to COAG before the end of 2006 on *detailed implementation* arrangements for:

> (i) achieving a fully national transmission grid including the most suitable governance and transitional arrangements having regard to COAG's objective of achieving a truly national approach to the future

development of the electricity grid, the legitimate commercial interests of asset owners, and the need to promote investment that supports the efficient provision of transmission services;

(ii) any measures that may be necessary to address structural issues affecting the ongoing competitiveness and efficiency of the electricity sector; and

(iii) any measures that may be necessary to ensuring there are transparent and effective financial markets to support energy markets.

At the same time the ERIG review is being conducted, the Commission has an extensive work program underway involving proposed changes that will affect the efficiency of the market, supply reliability, and security of the power system. These include the:

- Congestion Management Review;
- Comprehensive Reliability Review;
- Technical Standards Enforcement and Compliance Review; and
- Review of transmission revenue and pricing regulation.

The Commission reviews are inter-related. For example, transmission regulatory arrangements that create an environment where transmission companies are more prepared to efficiently invest in new infrastructure and to strengthen existing capacity will improve the efficiency of the market and the reliability of supply. Similarly, arrangements that improve the way that network congestion is managed will improve market efficiency, power system security and supply reliability.

The Commission recognises the inter-relationship and inter-dependence between these tasks. To ensure that these multiple reviews are co-ordinated and result in a coherent set of arrangements for the NEM, it published a "Congestion Management Program - Statement of Approach" on 6 June 2006. This Statement of Approach sets out the integrated way that the Commission intends to deal with the five congestion related Rule change proposals and the Congestion Management Review in the context of the Commission's broader work program.[15]

The Statement of Approach also notes that the NEM is characterised by a small number of "legacy" congestion issues, such as those that arise from transmission network limits within the Snowy Region, where the building out of transmission constraints is unlikely in the foreseeable future. The Statement of Approach indicates that the Commission will address these issues as a matter of priority while recognising that any legacy issues must be resolved within an overarching and coherent framework for managing congestion in the NEM. To this end, the Commission will only promote changes to address legacy issues, whether short- or long-term arrangements, that are consistent with and support the suite Rule changes that are being contemplated through the consideration of these inter-related reviews.

15 AEMC 2006, Congestion Management Program – Statement of Approach, 6 June 2006, Sydney

The Southern Generators' proposal is one of a number of proposals before the Commission addressing regional boundary and network congestion related matters. The Commission notes that there is a broad consensus in the market that there is a problem with the existing Snowy region boundary, which is the subject of two Rule change proposals currently before the Commission. The Ministerial Council on Energy (MCE) has submitted a Rule change proposal to establish principles for assessing region boundary change proposals and Terms of Reference for a Congestion Management Review to identify options for the development of a more effective network congestion management regime in the NEM. The MCE has proposed that a boundary change would be the final step in a staged approach for the management of congestion.

If it is the case that the long term solution to the Snowy region "legacy" issues involves a region boundary change, it would not be possible to implement the change in time for the 2006-07 summer. However, the Commission has before it short-term proposals from the Southern Generators and Snowy Hydro that involve a modification to the current congestion pricing trial in the Snowy region ("Snowy CSP/CSC Trial" [16]), are said to represent improvements on the status quo and can be implemented before the coming summer. 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. The analytical work undertaken in assessing the Southern Generators' proposal and Snowy Hydro Re-orientation proposal will also be of value in informing the broader range of congestion related issues the Commission has under consideration.

2.5 Commission's approach

This Section describes the Commission's general approach in examining Rule change proposals and references from the MCE. It also describes the decision making framework used to consider the Southern Generators' proposal in a context of a competing proposal also being considered by the Commission from Snowy Hydro on managing negative settlement residues in the Snowy region.

Role of the NEM objective

The Rule making test requires that the Commission only adopt a proposed Rule change proposal if it is satisfied that it will or is likely to satisfy the NEM objective.[17] The NEM objective requires the Commission, when considering or developing Rule proposals, to consider the promotion of efficient investment in, and use of, electricity services for the long term interests of consumers with respect to the price, quality, reliability, and security of electricity supply. Economic efficiency is commonly defined as having three elements and in the context of considering the Southern Generators' proposed Rule change, these are:

- **Productive efficiency** – meaning the electricity system is operated on a "least cost" basis given existing infrastructure and the status of the network. For

16 The "Snowy CSP/CSC Trial" is a partial congestion pricing trial and is described in more detail in Part 3 Appendix E.

17 Section 88, NEL

example, generators should be dispatched in a manner that minimises the total system costs of meeting consumers' demands;

- **Allocative efficiency** – meaning electricity production and consumption decisions are based on prices that reflect the opportunity cost of the available resources; and

- **Dynamic efficiency** – meaning maximising ongoing productive and allocative efficiency over time, and is commonly linked to the promotion of efficient longer term investment decisions.

Further, the Commission has taken the view that the NEM objective is not solely focussed on a technical approach to the promotion of efficiency. Rather, the NEM objective has implications for the *means* by which regulatory arrangements operate as well as their intended *ends*. This means that the Commission also seeks to:

- **Minimise operational intervention in the market** – intervention in the operation of competitive markets should be limited to circumstances of market failures, although the Commission recognises that this is only a necessary and not sufficient condition for regulatory intervention;

- **Promote stability and predictability** – other things being equal, the Rules for the dispatch and pricing of the market and treatment of IRSRs should be sufficiently stable and predictable to enable participants to plan and make both short- and long-term decisions; and

- **Create transparency** – to the extent that intervention in the market is required, it should be based on, and applied according to, transparent criteria.

These requirements are founded on the principles of good regulatory design and practice, which the Commission believes is central to its task in furthering the NEM objective.

The Commission also notes that proposed Rule changes may have distributional impacts. The Commission considers that the NEM objective is primarily concerned with efficiency and good regulatory practice. These qualities will help ensure that the arrangements will benefit consumers in the long term. Rather than seeing distributional outcomes as a distinct limb or component of the NEM objective, the Commission has taken the view that distributional outcomes have relevance only in so far as they may negatively influence the stability and integrity of the market arrangements. Basing fundamental decisions on the operation of the market primarily on distributional criteria rather than efficiency and good regulatory practice is likely to be counter-productive to the interests of consumers in the long term.

In applying the Rule making test and considering the role of the NEM objective, the Commission may give weight to any such aspect of the NEM objective as it considers

appropriate in all the circumstances, giving regard to any relevant MCE statement of policy principles.[18]

Finally, the NEM objective requires the Commission to consider the likely effect of a Rule proposal on the quality, security, and reliability of the national electricity system. The Commission will carefully consider Rule proposals that may have implications for these important factors.

Commission's analytical framework

The Commission adopts a rigorous approach in evaluating Rule change proposals involving the following steps:

- Clearly describing the problem(s) to be addressed to ensure that the Commission has a clear understanding of what problem(s) the proposal is trying to address in order to develop an appropriate assessment framework;
- Assessing the materiality of these problems to ensure that the uncertainty that inevitably follows a Rule change process is justified because of the severity of the problem;
- Applying well developed and accepted economic analysis to evaluate the effects of the proposal, supported by empirical modelling where appropriate; and
- Seeking stakeholder views on the Commission's characterisation of the problem, assessment of the materiality of the problem, approach for analysing the merit of the Rule change proposal, and, ultimately, the Commission's assessment of the merits of the proposal evaluated against the NEM objective.

In the Commission's view, the assessment of the Southern Generators' proposal against the NEM objective and in light of the Snowy Hydro Re-orientation proposal requires consideration of the likely implications of the proposals on:

- Economic efficiency of dispatch;
- Pricing outcomes;
- Inter-regional trading and risk management;
- Revenue adequacy;
- Power system security and supply reliability;
- Good regulatory practice;
- Long-term implications; and
- Implementation.

18 Section 88(2), NEL

In deciding to make the Southern Generators' Rule instead of the Snowy Hydro Re-orientation proposal, the Commission must not only be satisfied that it contributes to the NEM objective but, given the fact that there is a competing proposal, that it also contributes to the NEM objective better than the competing Snowy Hydro Re-orientation proposal. This means that the Commission could choose to reject both Rule change proposals and maintain the current arrangements or it can accept *one of* the proposals put to the Commission. Since the proposals are alternatives, the Commission cannot accept both.

This Final Rule Determination sets out the Commission's analysis and conclusions on the Southern Generators' Rule change proposal and how it relates to the Snowy Hydro Re-orientation proposal. The Commission has presented its more extensive assessment and findings on the two proposals in Part 3.

2.6 Consultation process

The Southern Generators originally submitted their proposal to NECA on 10 May 2005. The commencement of the National Electricity (South Australia) (New National Electricity Law) Amendment Act 2005 on 1 July 2005 introduced a requirement, under s.91(6) of the NEL, for NEMMCO to be a proponent of any participant derogation that related to its functions. As a result of these provisions, NEMMCO agreed to formally join the request. The Southern Generators then submitted this revised proposal to the Commission on 9 November 2005.

On 8 December 2005, the Commission commenced consultation under s.95 of the NEL on the Southern Generators' Rule change proposal. Consultation closed on 11 February 2006. The Commission received eight submissions from: the Australian Energy Regulator (AER) (with attachments); Delta Electricity; Eraring Energy; Macquarie Generation; Origin Energy; Snowy Hydro Limited; the Southern Generators; and Westpac Institutional Bank. These submissions have all been published on the Commission's website.

The Southern Generators gave a presentation to the Commission in support of their proposal at the Commission's office in Sydney on 3 February 2006. This presentation has been published on the Commission's website.

The Commission used market and risk modelling of the NEM to help inform its assessment of the Southern Generators' Rule change proposal. The Commission formed the Congestion Management Technical Reference Group to advise on the modelling assumptions and scenarios. On 9 May 2006, the Commission published an Information Disclosure Statement, which set out the analytical framework, modelling methodology and assumptions used for the information of interested parties. The Statement of Approach has been published on the Commission's website.[19]

On 6 June 2006, the Commission published its Draft Rule Determination and draft Rule on this proposal on its website. On 8 June 2006, the Commission published a

19 Part 3 Appendix 3 provides further detail on the modelling and the role of the Congestion Management Technical Reference Group.

notice under s.99 of the NEL commencing consultation on the Draft Rule Determination.

Snowy Hydro Limited gave a presentation to the Commission at the Commission's office in Sydney on 21 June 2006. The presentation addressed the modelling presented in the draft National Electricity Amendment (Management of negative settlement residues in the Snowy Region) Rule 2006 determination, which the Commission used to assess the Southern Generators' proposal. This presentation has been published on the Commission's website.

Consultation on the Draft Rule Determination closed on 20 July 2006. The Commission received four submissions on the Draft Rule Determination from: NEMMCO; the Southern Generators; Snowy Hydro Limited; and Westpac Institutional Bank. These submissions have all been published on the Commission's website.

Issues raised in these submissions related to: (1) the implementation of both the Southern Generators' and Snowy Hydro Re-orientation Rule change proposals; and (2) trade-offs between those proposals.

On 10 August 2006, the Commission extended publication of this Final Rule Determination under s.107 of the NEL to 31 August 2006. This extension aligned the release date of this Final Rule Determination and the Draft Rule Determination on the Snowy Hydro Re-orientation proposal.

On 28 August 2006, the Commission received a correspondence from Snowy Hydro raising, for the first time, that the Southern Generators' proposal may adversely affect reliability of supply in Victoria. On 5 September 2006, Snowy Hydro gave a presentation to the Commission at its office on the reliability assertions presented in that letter. A copy of this presentation and the preceding letter were also published on the Commission's website.

On 31 August 2006 and again on 7 September 2006, the Commission issued additional s.107 notices, further extending, for one week each time, the publication date of this Final Rule Determination.

The extension on 7 September 2006 was to provide stakeholders with an opportunity to provide comments on Snowy Hydro's 28 August correspondence and its supplementary information, received on 5 September 2006, plus advice from NEMMCO on the issue, also received on 5 September 2006. The Commission received one further submission from the Southern Generators on 7 September 2006.

In evaluating the Southern Generators' proposal, the Commission considered a number of issues that were raised in submissions. The Commission analytically assessed these issues and then informed its conclusions with the modelling results. The quantitative modelling focussed on informing and testing the views the Commission had reached through analytical assessments.

2.7 Power to make a Rule

The Southern Generators' Rule change proposal seeks to alter the current congestion pricing trial within the Snowy region, thereby reducing the likelihood of NEMMCO

intervening in the dispatch and pricing process for the interconnector between the Victorian and Snowy regions.

The Commission is satisfied that the Rule as made falls within the subject matter for which the Commission can make Rules set out in s.34 of the National Electricity Law (NEL). Specifically, the Rule as made relates to the following items under Schedule 1 of the NEL:

> "(7) The settling of prices for electricity and services purchased through the wholesale exchange operated and administered by NEMMCO, including maximum and minimum prices;
>
> (8) The methodology and formulae to be applied in setting prices referred to in item 7;
>
> (9) The division of the national electricity market into regions for the purposes of the operation of the wholesale exchange operated and administered by NEMMCO…; and
>
> (11) The operation of generating systems, transmission systems, distribution systems or other facilities."

The following section presents the Commission's reasoning as to how the Southern Generators' proposal satisfies the NEM objective and the statutory Rule making test.

2.8 Assessment of Final Rule – Rule making test and National Electricity Market objective

2.8.1 Commission's decision

The NEM objective, as set out in s.7 of the NEL, is to:

> "Promote 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."

Under s.88 of the NEL, the Commission:

> "(1) May only make a Rule if it is satisfied that the Rule will or is likely to contribute to the achievement of the national electricity market objective.
>
> (2) For the purposes of subsection (1), the AEMC may give such weight to any aspect of the national electricity market objective as it considers appropriate in all the circumstances, having regard to any relevant MCE statement of policy principles."

On the basis of its assessment of the information and analysis before it, the Commission has concluded that the Southern Generators' proposal does meet the NEM objective as it would result in significant efficiency and related improvements compared to the current arrangements. The Commission is satisfied that the proposal will promote improvements in competition and efficiency in the NEM

compared to maintaining the current arrangements to avoid negative settlement residues, involving clamping the Victoria-Snowy interconnector for northward flows, and re-orienting constraints to align the Snowy price to the Victorian price for southward flows.

The Commission has also concluded that the alternative solution set out in the Snowy Hydro Re-orientation proposal meets the NEM objective, as it would also be an improvement compared to the status quo. As discussed previously in this Final Rule Determination, the Commission may determine to not make either Rule proposal or determine to make one Rule proposal, but it cannot make both.

The Commission considers that the circumstances of having two alternative proposals that both meet the NEM objective have required it to choose between the two. As stated above, section 88(2) of the NEL allows the Commission to exercise its discretion "give such weight to any aspect of the national electricity market objective as it considers appropriate in all the circumstances." In giving weight to certain aspects of the NEM objective as noted in Sections 2.8.2 and 2.8.3, which deal with the role of the NEM objective in relation to this proposal, the Commission has identified differences between the two proposals in their ability to achieve the NEM objective.

The Commission considers that while both the Southern Generators' and Snowy Hydro Re-orientation proposals are an improvement on the status quo, on balance, the Southern Generators' proposal provides greater certainty, predictability, and consistency in market reform when compared to the competing Snowy Hydro Re-orientation proposal. The Commission is satisfied that when assessed against the Snowy Hydro Re-orientation proposal, the Southern Generators' proposal promotes more effectively, improvements in competition and efficiency in the NEM, and therefore more effectively promotes the long-term interests of electricity consumers. It therefore satisfies the Rule making test.

On the basis of its analysis and all relevant considerations, the Commission has determined to make the Rule requested in the Southern Generators' Rule proposal and therefore make the National Electricity Market Amendment (Management of negative settlement residues in the Snowy Region) Rule 2006.

Commission's determination

The Commission has determined in accordance with s.102 of the NEL to publish this Final Rule Determination and in accordance with s.103 of the NEL, to make the National Electricity Amendment (Management of negative settlement residues in the Snowy Region) Rule 2006 attached to this Final Rule Determination (Part 3 Appendix F). The Rule will commence on 1 November 2006.

The Rule gives affect to the Southern Generators' proposal by requiring NEMMCO to transfer inter-regional settlement residues from the Snowy-to-NSW interconnector to the Victoria-to-Snowy interconnector as proposed. The Rule does this by amending subparagraph (n)(2) and subparagraph (o)(4) in Chapter 8A Part 8 of the Rules. The Rule as made does not differ substantially from the proposed Rule or draft Rule. The Commission has modified the structure of the Rule as made to promote ease of understanding and consistency in drafting.

The reasons for this decision are summarised below.

2.8.2 Comparison of proposal with current arrangements

On the basis of its own conceptual and modelling analysis and consideration of submissions, the Commission has concluded that Southern Generators' proposal, like the Snowy Hydro Re-orientation proposal, is clearly superior to the current arrangements on the following economic efficiency and other grounds because it:

- **Economic efficiency of dispatch** –appears likely to result in relatively modest, variable cost savings compared to the current arrangements. These savings would primarily arise from freeing the Victoria-Snowy interconnector and allowing lower cost plant to be dispatched across the NEM;

- **Pricing outcomes** –appears likely to produce modest improvements in the efficiency of pricing outcomes arising principally from expected price falls in NSW compared to the current arrangements;

- **Inter-regional trading and risk management** - is likely to produce an improved environment for managing inter-regional trading risk arising in the main from a narrowing in inter-regional prices differences and the improvement of IRSR units as a more effective mechanism to manage the risk of contract trading between Victoria and NSW;

- **Revenue adequacy** – is expected to be self-funding;

- **Power system security and reliability** – is expected to be consistent with maintaining power system security and reliability of supply; and[20]

- **Implementation issues** – can be implemented before their proposed commencement dates and even if this was not possible, effective transitional arrangements can be implemented.

These improvements over the status quo support the Commission's decision to accept one of the proposals.

2.8.3 Comparison of the alternative proposals

While the above conclusions support the Commission's case for a change from the status quo, the assessment against those criteria does not provide a basis for preference for the Southern Generators' proposal over the Snowy Hydro Re-orientation proposal. However, the Commission has identified a basis for distinguishing between the Southern Generators' proposal and the Snowy Hydro Re-orientation proposal when they are compared against other key decision criteria, including the promotion of good regulatory practice and consistency with the long-term direction of the market that promote the NEM objective and satisfy the NEM objective.

20 Snowy Hydro raised concerns about how the Southern Generators' proposal may impact Victoria's supply reliability because of the incentives it could have to manage its water resources under the proposal. The Commission's assessment suggested that the contentions made by Snowy Hydro were unlikely to impact supply reliability for Victoria.

In conjunction with the case for a change from the status quo, the Commission's assessment against the following criteria provide the basis for its on balance conclusion that the Southern Generators' proposal satisfies the Rule making test because when compared to the Snowy Hydro Re-orientation proposal, it better satisfies the NEM objective:

- **Good regulatory practice** – a key benefit of the Southern Generators' proposal is that it removes NEMMCO's need to intervene in the dispatch *and* pricing process through clamping. The Southern Generators' proposal involves an *ex post* intervention in the settlement process using a transparent automatic mechanism that affects the amounts paid to certain IRSR unit holders, but not the real-time dispatch and pricing processes. By contrast, while the Snowy Hydro Re-orientation proposal avoids the need for intervention in dispatch by eliminating the need for clamping, it still requires NEMMCO's intervention in the real-time price-setting process. Implementation of the latter intervention would continue to require the exercise of NEMMCO's judgment and discretion. Therefore, in the Commission's view, the Southern Generators' proposal requires a less intrusive and more predictable form of intervention than the Snowy Hydro Re-orientation proposal.

  The Commission views consistency with existing regulatory arrangements as an important aspect of good regulatory practice. In this context, the consistency of each proposal with the Snowy CSP/CSC Trial (a partial CSP/CSC Trial which both proposals are seeking to amend) is also relevant, especially as both proposals are short-term initiatives only. The Commission considers that the Southern Generators' proposal represents a consistent extension of the CSP/CSC instrument by maintaining efficient locational pricing to Murray as well as Tumut generation when the Snowy region constraint binds, whereas the Snowy Hydro Re-orientation proposal is less consistent with the current Snowy CSP/CSC Trial as it represents a move away from efficient locational pricing whereas at those times; and

- **Longer term implications** – both proposals are consistent with the Commission's intended longer-term direction of the market in that they both involve incremental changes designed to produce competition and efficiency benefits. However, by offering greater advantages on the criterion of good regulatory practice, the Commission believes that the Southern Generators' proposal is more consistent with and promotes further the long-term direction of the market compared to the Snowy Hydro Re-orientation proposal.

2.9 Reasons for the Commission's decision

In making its decision, the Commission has assessed the Southern Generators' proposal on the basis of stakeholder submissions, conceptual analysis, and quantitative modelling analysis and in comparison to the Snowy Hydro Re-orientation proposal.

This Section summarises the Commission's reasons for making the Rule proposed by the Southern Generators. Further details on the Commission's comparison of the Rule change proposals are provided in Part 3.

Economic efficiency of dispatch

The Commission's assessment of the implications of the proposal for productive efficiency in the NEM focuses principally on improvements in the economic efficiency of dispatch. As this proposal is for a short period (less than one year) during which the stock of capital is unlikely to change, the Commission's focus is on the effects of the proposal on the variable costs of power production.

Historical analysis

An analysis of the historical data from August 2004 to March 2006 found that the vast majority of clamping interventions to manage counter-price flows were at times of northward flows on the Victoria-Snowy interconnector. This usually occurred at peak times in the spring and summer months and times of high NSW demand, which coincided with times when customers in NSW would most value additional competition and supplies from Victoria. Southward flow constraints between Tumut and Murray triggering re-orientation intervention occurred far less frequently.

Conceptual analysis

The NEM dispatch algorithm minimises the cost of dispatch based on participants' bids and offers and network and power system constraints. If bids and offers reflect opportunity costs, and constraints are properly taken into account, the NEM dispatch engine (NEMDE) will produce economically efficient dispatch. However, dispatch may not be efficient if either of the following occurs:

- intervention in the dispatch process, such as clamping (intervention); or
- bids and offers do not reflect opportunity costs (strategic bidding).

Both of these situations can be referred to as involving "distortions" to a theoretically efficient dispatch scenario. If only one form of distortion is present, the removal of that distortion should improve the efficiency of dispatch. However, in an environment of competitive generator bidding, the Southern Generators' proposal is likely to produce more efficient dispatch when compared to either the status quo arrangements or the Snowy Hydro Re-orientation proposal. This is because the Southern Generators' proposal involves the removal of the other remaining distortion (NEMMCO's interventions via clamping and re-orientation) and therefore ensures an efficient structure of prices around the Snowy network loop. Furthermore, the Snowy Hydro Re-orientation proposal involves a deliberate mis-pricing at the Murray node, which is likely to lead to a degree of dispatch inefficiency as Murray responds to a price signal that does not reflect the true value of its output.

However, if *both* types of distortions are present (non-competitive bidding *and* NEMMCO intervention), there is no guarantee that removing only one (intervention) will lead to more efficient dispatch if the other (strategic bidding) remains in place. For example, under the Southern Generators' proposal at times of northward flows, Snowy Hydro has incentives to offer Murray generation at a price above its opportunity cost (or withhold some of Murray's capacity from the market). This could lead to an inefficiently low level of Murray output and an inefficiently high level of output by generators in the Southern regions of the NEM at these times. Similarly, under the Snowy Hydro Re-orientation proposal at times of northward

flows, Snowy Hydro may have incentives to offer Murray output at a price in excess of its opportunity cost (or may withhold Murray generation[21]). This could lead to inefficient dispatch in a similar way as under the Southern Generators' proposal.

For these reasons, market modelling was undertaken to assist the Commission gain greater insight into the potential impacts of the two Rule change proposals.

Modelling analysis

The model used to test the Southern Generators' proposal was also used to test the alternative Snowy Hydro Re-orientation proposal and replicates the NEM dispatch engine's operation of dispatching the least-priced combination of generation to meet a given demand. An important aspect of the modelling approach is that it specifically examined the changes to generator bidding behaviour, and thus pricing and generator dispatch, resulting from the proposed Rule changes. The model achieved this by using game-theoretic solution techniques. This approach allowed the Commission to test the overall effects of the different proposals over a very wide range of bidding and contracting conditions.[22]

A base case was established that reflects the current market arrangements incorporating clamping and re-orientation by NEMMCO. The model was then respecified to incorporate the Southern Generators' proposal in order to analyse the dispatch costs and pricing outcomes of the proposal compared to the base case. The model was also respecified to incorporate the Snowy Hydro Re-orientation proposal.

In summary, the modelling indicated that both the Southern Generators' and Snowy Hydro Re-orientation proposals resulted in a net expected annual production cost saving of $1-3 million per annum. Importantly, achieving these savings would not involve any capital outlay or any appreciable operating costs, such as would be required for an equivalent increase in the capacity of the interconnector.

Commission's assessment of economic efficiency of dispatch

The Commission considers that the Southern Generators' proposal results in similar productive efficiency improvements over the current arrangements or the Snowy Hydro Re-orientation proposal. In fact, both proposals are likely to result in similar modest productivity efficiency improvements, which although supports the case for a change towards one or other of the proposals, it does not support the case for a change for one proposal over the other. The relatively small magnitude of the potential improvements is consistent with the relatively few periods over a year in which negative settlement residues between Victoria and Snowy could arise and clamping or re-orientation presently occurs.

Accordingly, neither the conceptual analysis nor the modelling undertaken for the Commission provides a clear basis to prefer the Southern Generators' proposal over the Snowy Hydro Re-orientation proposal on dispatch efficiency grounds. The Commission is also aware that modelling outcomes are sensitive to the assumptions adopted about generators' bidding strategies, contracting levels and locations and

21 Under some circumstances, Snowy Hydro may have incentive to offer Murray output at a price below its opportunity cost under the Snowy Hydro Re-orientation proposal.

22 Details of the modelling approach can be found in Part 3 Appendix C.

transmission constraints elsewhere in the NEM. For these reasons, the Commission has ensured that it has not placed undue weight on dispatch efficiency impacts in choosing between the two proposals.

Pricing outcomes

The Commission also considered the likely effect of the Southern Generators' proposal in comparison to the status quo and the Snowy Hydro Re-orientation Rule change proposal on price outcomes in the market. At a high level, the Commission notes that resources will be allocated efficiently where prices equal the opportunity cost of supply. At this point, the price consumers pay to consume electricity will equal the cost generators incur to produce electricity. Therefore, a move to prices that more closely reflect the opportunity cost of supply would be likely to produce economic efficiency benefits, although the Commission notes that there may be lags in the process of moving from more efficient spot prices to economic welfare gains.

Conceptual analysis

The impacts of the Southern Generators' proposal on NEM spot prices should follow from the impacts of the proposals on dispatch outcomes. This means that assuming competitive bidding, the Southern Generators' proposal is likely to lead to lower NSW and Snowy prices and slightly higher Victorian prices when compared to the Snowy Hydro Re-orientation proposal. This can be attributed to the inefficiently high Murray generation and inefficiently low Southern generation that would prevail under the Snowy Hydro Re-orientation proposal and the status quo compared with the benchmark efficient dispatch under the Southern Generators' proposal.

When the assumption of competitive bidding is relaxed, it becomes more difficult to make definitive comments on the likely price impacts of the proposals based on conceptual analysis alone. However, it would be reasonable to assume that clamping could encourage Snowy Hydro to offer Tumut output at above opportunity cost (or withhold some Tumut generation) in order to force NSW (and hence Snowy) regional prices higher and earn greater pool revenues. Under the Southern Generators' proposal and also the Snowy Hydro Re-orientation proposal, flows from Victoria to Tumut may be higher and Murray output lower due to the absence of clamping. This may reduce the ability of Tumut and NSW generators to push up NSW prices and may increase prices in the Southern regions due to greater effective demand (i.e. local regional demand plus net exports) for Southern region generation. However, this outcome may be contingent on the assumption that flows from the Snowy region to NSW are not already limited by constraints north of Tumut, as claimed by Snowy Hydro.

At times of southward flows, the Southern Generators' proposal should lead to more output by Murray (because it receives its nodal price rather than the lower Victorian price) and hence a greater flow on the Victoria-Snowy interconnector compared to the Snowy Hydro Re-orientation proposal. This should then help dampen Victorian prices as well as NSW prices more than under the Snowy Hydro Re-orientation proposal.

Market modelling

The modelling undertaken to assess the dispatch efficiency impacts of the Southern Generators' proposal produced average regional prices for summer peak, winter peak and the remainder of the year periods. Similar results were produced for the Snowy Hydro Re-orientation proposal. A very wide range of bidding conditions and scenarios were modelled. The scenarios considered different patterns of hedging (which can affect, in the short term, bidding behaviour and prices), IRSR holdings and bidding choices (see Part 3 Appendix C).

The results of this modelling indicate that, relative to the status quo, implementation of the Southern Generators' proposal could result in a reduction in the time-weighted average annual wholesale spot prices in the NSW and Snowy regions. This fall in annual spot prices could be between $1.20 to $4.80/MWh, while prices in other regions generally could fall by up to 50c/MWh or, in the case of Victoria, either fall or rise by no more than 10c/MWh. However, there was no obvious relationship between different levels or locations of contracts and the magnitude of pricing impacts. For example, the smallest reduction in NSW prices was predicted for the scenario with high levels of Snowy Hydro contracting (80%), medium levels of other generators' contracting and a high proportion of Snowy Hydro contracts at the NSW node (70%) compared with the Victorian node (30%). The largest reduction in NSW and Snowy prices was predicted for the scenario with medium levels of contracting and 60% of Snowy Hydro contracts at the NSW node and 40% at the Victorian node. Intermediate NSW price reductions of about $2/MWh were predicted for other scenarios. Further, limitations on NSW imports due to constraints north of Tumut did not appear to influence the dispatch or pricing outcomes.

According to the modelling analysis, the Snowy Hydro Re-orientation proposal could lead to similar price impacts as the Southern Generators' proposal. The modelled price falls in NSW were marginally greater under the Snowy Hydro Re-orientation proposal than under the Southern Generators' proposal.

An important modelling result arising from the Southern Generators' proposal was the reduction in the difference between prices in the NSW, Snowy, and Victoria regions, relative to the status quo. This reduction in the differentials between regional prices could reduce the risks of inter-regional trading (discussed below).

Commission's assessment of pricing outcomes

The Commission considers that the Southern Generators' proposal could produce small but significant price falls in NSW compared to the status quo base case. Similar results were produced in relation to the Snowy Hydro Re-orientation proposal. These changes in spot market prices may eventually be passed on to customers in the form of more competitive and cost-reflective price structures, with consequential allocative and dynamic efficiency benefits. However, the short term nature of the proposals could limit the extent to which any changes in spot market prices could be passed on to customers. To the extent that the falls in NSW spot prices lead to greater convergence between Victorian and NSW prices, this could promote inter-regional contract trading (see below). These findings support the Commission's view that there is a case for a move away from the existing negative settlement residues arrangements towards one or other of the two proposed Rule changes.

However, once again, the modelling analysis does not show one proposal to be clearly superior to the other on the basis of pricing impacts. The Commission is also aware that the modelling outcomes are sensitive to the assumptions adopted about generators' strategies, contracting levels and locations, and transmission constraints elsewhere in the NEM. Therefore, the Commission has not relied on the predicted pricing impacts of the proposals as a basis for choosing between them.

Inter-regional trading, risk management and revenue adequacy

This Section sets out the Commission's analysis of the likely impacts of the Southern Generators' proposal when compared with the Snowy Hydro Re-orientation proposal, on hedging inter-regional trading risk, including an examination of the revenue adequacy of the proposal.

The comparative impact the proposal has on hedging is important because a large proportion of the revenues of participants in the wholesale electricity market derive from trading in hedging instruments. Hedging instruments therefore provide important signals for long-term investment and entry decisions by generators, retailers and large loads. For example:

- **Retail competition** – retailers tend not to enter the market without access to hedging instruments, as the risks of purchasing electricity in the (potentially volatile) spot market and selling it to consumers at fixed prices may be too great. Similarly, large loads purchasing power independently, such as smelters, may be unwilling to invest in new capacity without a means of gaining price certainty;

- **Generator investment** – generators are generally less inclined to commit funds to invest in new plant unless they have a degree of revenue certainty provided by contracts; and

- **Pricing efficiency** - in a market where all buyers and sellers pay and earn, respectively, the same spot price for electricity, hedging contracts (and customer supply contracts) provide a means for producers to charge different prices to customers with varying price sensitivities. This enhances efficiency as more customer demand can be met using a range of prices rather than a single price. Hedging contracts also offer a means of providing different customers with different degrees of exposure to changes in the wholesale spot price – for example, some customers may seek long term contracts to provide long term price certainty while other customers may be willing to renegotiate contracts more often in exchange for a lower premium over the expected future spot price.

IRSR units play a key role in allowing traders to arbitrage inter-regional differences in contract prices. In theory, if IRSR units could be bought and sold at short notice and if it were possible to predict exactly when interconnector flows or limits were changed, even IRSR units that were not fully firm could be used by participants to eliminate inter-regional risk. However, participants typically acquire IRSR units up to one year in advance and seldom can predict when transmission limits will be reduced due to clamping or other reasons.

Therefore, under more realistic market conditions, actual settlement residues that accrue may be less than sufficient to allow IRSR units to provide a perfect inter-regional hedge. This will affect the willingness of participants to trade electricity

contracts across regional boundaries. Consequently, the impact of each of the Rule change proposals on the firmness of IRSRs is an important consideration for the Commission in determining which (if any) of the Rule change proposals is most likely to promote the NEM objective.

Conceptual analysis

Under the Southern Generators' proposal, it is theoretically possible to achieve a perfect inter-regional hedge using IRSR units. The same can be achieved under the status quo and the Snowy Hydro Re-orientation proposal. However, analysis undertaken for the Commission reveals that the conditions required are strict. From a practical perspective, by avoiding the need to "clamp" the Victoria-Snowy interconnector at times of northward flows, the Southern Generators' proposal may enhance opportunities for managing inter-regional trading risk. Like the Snowy Hydro Re-orientation proposal, the Southern Generators' proposal may enhance those opportunities in two key ways:

- As noted above, clamping may be associated with larger spot price differentials between Victoria and NSW. This may increase the risk or cost of trading inter-regionally. Therefore, it may help promote the trading of inter-regional contracts; and

- Other things being equal, it may reduce the importance of participants needing to accurately predict when the Murray-Tumut constraint will bind in order for IRSRs to provide a reasonable inter-regional price hedging instrument from Victoria to NSW.

In relation to the second point, the Southern Generators' proposal is likely to increase the combined value of the IRSR units on both the Victoria-Snowy and Snowy-NSW interconnectors. The Snowy Hydro Re-orientation proposal is likely to have a similar affect. Under the present arrangements, when clamping is implemented, the Snowy regional reference price can rise towards the NSW regional reference price. This means that, practically speaking, the Snowy-NSW IRSRs provide an inadequate means of hedging Victoria-NSW price differences, while at the same time the Victoria-Snowy IRSRs have diminished value as a risk management tool due to clamping.

By avoiding the need to clamp, the Southern Generators' proposal allows (subject to transmission outages or deratings) Southern region participants holding an equal number of Victoria-Snowy and Snowy-NSW directional IRSR units to have a firmer inter-regional hedge against NSW-Victoria price differences than under the status quo. This additional firmness can arise in either of two ways:

- First, assuming the Murray-Tumut lines remain constrained and counter-price flows persist, the positive IRSRs on the Snowy-NSW interconnector will exceed the negative residues on the Victoria-Snowy interconnector. This should yield a

net settlement residue per unit that approximates the NSW-Victoria price difference[23]; and

- Second, by reducing the incentive for Snowy Hydro to bid Murray generation at low prices to induce clamping, the proposal could lead to the Murray-Tumut constraint not binding in the first instance. This would lead to positive residues on both the Victoria-Snowy and Snowy-NSW interconnectors and avoid the need to transfer value from the Snowy-NSW directional IRSRs to the Victoria-Snowy directional IRSRs.

For southward flows, the Southern Generators' proposal would replace NEMMCO's current practice of reorientating affected constraints to Dederang. The overall result should be little net change in the ability of NSW generators to hedge contracts written against the Victorian node.

For a participant based in the Snowy region, the implementation of the Southern Generators' proposal is likely to:

- Reduce the payments to Snowy-NSW IRSR unit holders because of the transfer from the Snowy-NSW IRSR fund to the Victoria-Snowy IRSR fund;

- Create a level of unfunded difference payment risk on contracts that have been written based on the assumption of dispatch at high prices when clamping occurs; and

- Reduce the ability of those trading out of the Snowy region to closely align the Snowy region price with a high NSW price than is possible under clamping, because of the introduction of competitive pressures from Southern regions at times when clamping would otherwise have occurred.

In any case, participants trading out of the Snowy region are likely to have a wider range of tools for managing inter-regional trading risks compared to other participants due to the unique characteristics of the Snowy region. The potential availability of these other tools has been taken into account in assessing risk management implications of the proposal.

The net effect of the Southern Generators' proposal on the inter-regional financial risks and returns of a participant trading out of the Snowy region is difficult to gauge analytically because of the combination of effects that the proposal is likely to have. Therefore, the Commission considered it important to test the arguments and conclusions described above using quantitative modelling of portfolio risk, which uses IRSRs to hedge an inter-regional trading position.

Finally, the Southern Generators' proposal is likely to be revenue adequate in most (but perhaps not all) operating situations, in that the positive settlement residues on the Snowy to NSW interconnector will almost always exceed any negative settlement residues on the Victoria to Snowy interconnector.

23 The acquisition of both sets of units may not provide a perfect inter-regional price hedge due to the unpredictability of actual flows on the interconnectors.

Risk modelling

The details of the modelling approach used to assess the nature of changes to inter-regional trading as a result of both proposals are described in more detail in Part 3 Appendix C. In summary, the approach involved establishing an experiment using Modern Portfolio Theory to determine the changes in contracting behaviour that are likely to occur under both the Southern Generators' proposal and also the Snowy Hydro Re-orientation proposal. The aim of the experiment was to determine whether generators in Victoria would find it more efficient (at minimum risk as measured by the standard deviation of returns) to buy IRSR units to meet a fixed load (100 MW) in NSW or to sell to the load at spot prices. The converse was tested for NSW generators selling to a load in Victoria and for Snowy region generators selling into either NSW or Victoria.

Overall, the results of the modelling indicate that implementation of the Southern Generators' proposal is likely to increase the extent of inter-regional contract trading between the largest regions in the NEM - NSW and Victoria, to a similar level as the Snowy Hydro Re-orientation proposal. The increased competition in NSW appears likely to stem from generators in the Southern regions being able to offer more contracts into NSW, thereby competing with other suppliers of contracts in NSW. Competition for Victorian reference node contracts appears likely to increase if Snowy Hydro increases the share (and/or volume) of its contracts referenced to the Victorian node.

Commission's assessment of inter-regional trading, risk management, and revenue adequacy

The conceptual analysis and modelling results provide support for the proposition that the Southern Generators' proposal can be expected to, on balance, promote inter-regional contract trading and competition in the NEM compared to the status quo.

Overall, the Commission considers that the proposals will:

- decrease inter-regional price differentials which may increase participants' preparedness to enter into inter-regional trades; and

- by removing NEMMCO clamping and enabling IRSR units to be a firmer instrument for inter-regional price hedging from Victoria to NSW, reduce the risks and complexity of inter-regional contract trading.

The Commission considered that the Snowy Hydro Re-orientation proposal also promoted inter-regional contract trading and competition in the NEM compared to the status quo. The Commission found in focusing on inter-regional trading impacts, there is a case for a move away from the status quo towards one or other of the two proposed Rule changes. However, the analysis of inter-regional impacts does not provide a clear means for distinguishing the Southern Generators' proposal as superior to the Snowy Hydro Re-orientation proposal or vice versa.

In addition, the Commission considers that the Southern Generators' proposal will be revenue adequate in almost all cases, but that revenue adequacy in all circumstances is not a necessary requirement for the implementation of the Southern

Generators' proposal. This is due to the other means available for NEMMCO to recover outstanding net negative residues.[24]

Power system security and reliability

The NEM objective emphasises the need for market reforms to serve the long-term interests of consumers, including with respect to the reliability and security of electricity supply.

The Southern Generators' proposal is effectively a change to the settlement arrangements in the NEM. As such, it is not expected to change the underlying network transfer limits between Victoria, Snowy and NSW, although it will change the commercial incentives that drive participants' generation offers. However, the derogation in Chapter 8A Part 8 of the Rules will continue to require that NEMMCO not "[prejudice] its obligations to maintain power system security" when it intervenes to manage counter price flows.[25] The Rules also empower NEMMCO to direct generation to achieve either supply reliability or power system security.

Similarly, although the Snowy Hydro Re-orientation proposal seeks to amend Part 8 of Chapter 8A of the Rules, it will not alter or impede NEMMCO's ability to meet its obligation to maintain power system security as set out in paragraph (c) of Part 8.

The Commission received correspondence from Snowy Hydro contending that the adoption of the Southern Generators' proposal would create reliability risks for Victoria. The Commission requested additional information from both Snowy Hydro and NEMMCO to understand the veracity of Snowy Hydro's reliability contentions. It also sought stakeholder consultation on Snowy Hydro's contentions. Part 3 Appendix D presents the Commission's analysis and assessment on the question of whether supply reliability to Victoria would differ under the Southern Generators' proposal.

Commission's assessment on power system security and reliability

The Commission considers that while the Southern Generators' proposal may influence participants' operational behaviour in the market, the effect of the change in behaviour on power system security would be the same under the Snowy Hydro Re-orientation proposal and unlikely to be materially different compared to the status quo.

The Commission also considers that it is unlikely that the Southern Generators' proposal would have a less or more material impact on supply reliability relative to the Snowy Hydro Re-orientation proposal or the status quo. In particular, having considered Snowy Hydro's correspondence and presentation, NEMMCO's advice, and its own analysis, the Commission has concluded that, on balance, adoption of the Southern Generators' proposal would not materially increase the risk of supply shortfalls in the NEM over the summer of 2006-2007, thereby removing a point of distinction with the Snowy Hydro Re-orientation proposal on this issue.

24 Clause 3.6.5(a)(4A) of the Rules currently provides NEMMCO with a mechanism to recover outstanding net negative residues.

25 Clause (c), Chapter 8A, Part 8, National Electricity Rules

Therefore, the Commission has proceeded with its Final Rule Determination on the Southern Generators' proposal and its Draft Rule Determination on the Snowy Hydro Re-orientation proposal on the basis that the NEM supply reliability implications of the Southern Generators' proposal are not substantially different than the implications for the status quo or Snowy Hydro Re-orientation proposal.

Good regulatory practice

An important consideration in assessing the Southern Generators' proposal is the extent to which it contributes to achieving best practice in the regulation and operation of the NEM. The Commission considers that good regulatory design and practice promotes confidence in markets and provides greater predictability and regulatory certainty for investors, thereby promoting the NEM objective.

In the current context, the Commission considers good regulatory practice to involve arrangements that support an effective competitive market. It is also important that regulation be adopted only where there are net benefits from doing so, having regard to the inefficiencies created by the regulation itself. To the extent that regulatory arrangements result in a reallocation of wealth between producers and consumers, and between individuals within these groups, it is important that this does not create an uncertain or unstable market environment, which could result in further inefficiencies. These could arise, for example, from reluctance by investors to commit capital to a sector with a history or an expectation that regulatory intervention can erode asset value or where ongoing policy changes raises perceived investment risks and costs. In general, good regulatory practice would promote a sense of greater certainty and predictability about the regulatory framework and the operation of the market. Arrangements that would introduce or replace an existing market intervention with a more arbitrary and unpredictable one would not be consistent with good regulatory practice.

More particularly, the Commission believes that good regulatory practice requires that:

- Regulatory interventions minimise distortions – regulatory interventions that distort the operation of competitive markets should be avoided or minimised, particularly where the objective can be achieved by alternative non-distorting means;

- Wealth transfer impacts do not jeopardise the stability of the market and regulatory arrangements;

- Regulatory interventions are consistent with other forms of regulation; and

- Regulation should attempt to standardise the exercise of bureaucratic discretion, so as to reduce discrepancies between government regulators, reduce uncertainty and lower compliance costs.

Degree of intervention

In this context, the Southern Generators' proposal will involve some degree of intervention in the NEM.

The Southern Generators' proposal would not require any NEMMCO intervention in dispatch or price-setting. It would operate through an ex post settlement adjustment to the amounts payable to certain IRSR unit holders (those holding IRSR units for interconnectors between Victoria and Snowy and between Snowy and NSW). As an intervention that is an automated ex post adjustment to settlements, this proposal would not change pre-dispatch, real-time dispatch, or pricing arrangements for the market. It also does not require NEMMCO to exercise discretion or judgment as it would be an automated process. There would still be a degree of uncertainty on the impact on those affected IRSR unit holders to use those units to effectively manage inter-regional trading risk, though their effectiveness is likely to be greater than the status quo.

In comparison, the status quo requires NEMMCO to impose discretionary constraints on the Victoria-Snowy interconnector when negative settlement residues are forecast to reach $6,000 in a continuous series of dispatch intervals.[26] NEMMCO is required to remove the discretionary constraints when such removal will not lead to counter-price flows.[27] In short, NEMMCO judgment is required as to precisely when and for how long the discretionary constraints are to be applied based on the accumulation of negative settlement residues to date and the rate of change of the accumulation. This intervention by NEMMCO in the status quo can apply in both pre-dispatch and dispatch. This intervention increases the uncertainty of being able to effectively use certain IRSR units (those holding IRSR units for interconnectors between Victoria and Snowy and between Snowy and NSW) as inter-regional risk management tools.

The Snowy Hydro Re-orientation proposal would require NEMMCO to impose the re-orientated form of constraints when accumulated negative settlement residues are forecast to reach $6,000 in a continuous series of dispatch intervals. This would have the impact of directly altering the Snowy region price and consequently, NEM settlements. This option would involve less NEMMCO judgment than the existing arrangements, but would still require NEMMCO to make a decision, in real-time, as to when and for how long the re-orientated form of constraints should apply. This option would also involve a degree of uncertainty as to precisely when the re-orientated form of constraints would be implemented, due to lags between the decision to impose the constraints and the actual application of those constraints. While an improvement on the status quo, there is still an impact on using certain affected IRSR units as effective inter-regional risk management tools.

When compared to the Snowy Hydro Re-orientation proposal and the status quo, the Southern Generators' proposal appears to be a more certain and predictable intervention with respect to its impact on dispatch and pricing. This also implies that its impact on IRSR units as effective risk management tools would be significantly more predictable than the status quo, and marginally more predictable than the Snowy Hydro Re-orientation proposal.

26 As noted above, NEMMCO is currently consulting on a proposal to increase the threshold to $100,000.

27 NEMMCO operation procedure SO_OP3705 (Dispatch) pp.30-32

Consistency with current regulatory interventions

The Southern Generators' proposal seeks to amend Chapter 8A Part 8 of the Rules. In particular, it seeks to amend the current Tumut Pricing Trial, which is a partial CSP/CSC Trial (also known as the "Snowy CSP/CSC Trial").[28]

As it currently stands, the Snowy CSP/CSC Trial only relates to the interconnector between Snowy and NSW and pricing for generation at the Tumut node in the Snowy region. It does not address the issue of negative settlement residues arising between the Victorian and Snowy regions due to counter-price flows. The Southern Generators' proposal, like the Snowy Hydro Re-orientation proposal, seeks to overcome the need for NEMMCO intervention in dispatch and/or pricing in response to the prospect of negative settlement residues.

In this context, the Southern Generators' proposal appears to be more consistent with the purpose of the Snowy CSP/CSC Trial. The rationale for the Snowy CSP/CSC Trial was the provision of an efficient locational price for Tumut generation in order to promote more efficient dispatch and congestion management at times when the Snowy region constraint binds. By maintaining the Murray generation nodal price when the constraint binds, the Southern Generators' proposal would ensure that Murray generation is paid an efficient locational price for those times. This accords with the intent behind the development of the CSP/CSC regime (see Appendix E). By contrast, as noted above, the Snowy Hydro Re-orientation proposal extends the deliberate mis-pricing of Murray generation when congestion occurs by settling Murray at the locational price at Dederang. This represents a move away from the Snowy CSP/CSC Trial's aim of refining pricing signals to promote efficient dispatch.

Commission's assessment of good regulatory practice

The Commission has concluded that on the basis of these differences in the Southern Generators' proposal when compared with the Snowy Hydro Re-orientation proposal, the Southern Generators' proposal is more consistent with the principles of good regulatory practice.

A key benefit of the Southern Generators' proposal is that it removes NEMMCO's need to intervene in the dispatch *and* pricing process through clamping. The Southern Generators' proposal involves an *ex post* intervention in the settlement process using a transparent automatic mechanism that affects the amounts paid to certain IRSR unit holders, but not the real-time dispatch and pricing processes. By contrast, while the Snowy Hydro Re-orientation proposal avoids the need for intervention in dispatch by eliminating the need for clamping, it still requires NEMMCO's intervention in the real-time price-setting process. Implementation of the later intervention would continue to require the exercise of NEMMCO's judgment and discretion. Therefore, in the Commission's view, the Southern Generators' proposal requires a less intrusive and more predictable form of intervention than the Snowy Hydro Re-orientation proposal.

In addition, the Commission is of the view that there would be a benefit in implementing the proposal that is most consistent with the existing Snowy CSP/CSC

28 See Part 3 Appendix E for a more detailed explanation of the current CSP/CSC trial and how the two proposals interact with the trial.

Trial, given that the Snowy Hydro Re-orientation proposal and Southern Generators' proposal are short-term measures. The Commission considers that the Snowy CSP/CSC Trial seeks to promote more efficient locational pricing within the Snowy region at times of constraint between Murray and Tumut. The Commission regards the Southern Generators' proposal represents an extension of the CSP/CSC instrument by extending more efficient locational pricing to Murray as well as Tumut generation during times of congestion whereas the Snowy Hydro Re-orientation proposal is less consistent with the current Snowy CSP/CSC Trial as it represents a move away from accurate locational pricing.

Therefore, the Commission considers that in comparison to the Snowy Hydro Re-orientation proposal, the Southern Generators' proposal is more likely to contribute to the achievement of the NEM objective.

Long-term implications

Earlier in this Final Rule Determination, the Commission noted the importance of consistency and predictability in contributing to the achievement of the NEM objective and its view that both proposals appear to be consistent with its general direction for the development of the market. This direction involves the adoption of incremental changes that promote the competitive process, result in more efficient dispatch and pricing to achieve the aims and in these ways advance the NEM objective.

The Commission is mindful of the need to provide a clear signal of the direction it will take in modifying the market Rules that determine the revenues received by market participants from their investments. Thus, even though the Southern Generators' proposal, like the Snowy Hydro Re-orientation proposal, is for a short period, it should take the market in a direction that is consistent with a longer-term trajectory of change. At the same time, the Southern Generators' decision or the Snowy Hydro decision should not foreshadow any particular position in respect of the Commission's broader consideration of the "Congestion Management Regime" or the question over the appropriate boundaries for the Snowy region. The Commission's "Congestion Management Program – Statement of Approach" provides information about the co-ordination of a number of congestion related matters under consideration by the Commission, leading to the development of a comprehensive "Congestion Management Regime" for the NEM in the longer-term.

Commission's assessment of long-term implications

The Commission considers that the Southern Generators' proposal represents an incremental improvement over the current arrangement in that it both offers the potential for relative competition and efficiency benefits. It offers greater advantages on the criterion of good regulatory practice when compared to the Snowy Hydro Re-orientation proposal. The Commission is of the view that, on balance, the Southern Generators' proposal sends more appropriate signals to market participants about the approach the Commission will adopt to Rule change proposals in the future when compared to the Snowy Hydro Re-orientation proposal.

Implementation issues

The issues associated with implementing the Southern Generators' proposal have also been assessed by the Commission. This includes the way in which NEMMCO could integrate the requirements of the proposals into its Market Management Systems (MMS), the likely time this would take, and the impact and transitional steps required to manage existing trading positions across the NEM. The implementation of this proposal has also been compared with the Snowy Hydro Re-orientation proposal. The Southern Generators' proposal will differently affect current trading positions in comparison to the Snowy Hydro Re-orientation proposal and consideration needs to be given as to how the different implementation issues could be managed, particularly having regard to the relative urgency with which the arrangements needed to be implemented.

In its s.99 submission on the Southern Generators Draft Rule Determination, NEMMCO recognised that the Southern Generators' proposal is of a "short-term nature and has fast-tracked MMS development by using the Draft Rule Determination to start the development cycle."[29] NEMMCO stated that if the Southern Generators' Rule proposal commenced on 1 November 2006, then NEMMCO would make "retrospective settlement adjustments when the MMS software [was] ready."[30]

Regarding the Snowy Hydro Re-orientation proposal, NEMMCO stated that the Snowy Hydro Re-orientation proposal did not require a modification to market systems as the re-orientation arrangements are already in place for the management of negative settlement residues for southward flows. NEMMCO estimated that it would require a maximum of two weeks of implementation time to amend, publish, and revise procedures as required by the Final Rule.[31] NEMMCO advised that these procedures would require it to "use reasonable endeavours" to trigger this intervention if it forecasts the negative residue accumulation over the period of counter-price flows to reach $6,000. The market would be advised through Market Notices of its intervention, as is normally the case.[32]

If a Rule or process change impacts on the method of calculating the settlements residue, the Auction Participant Agreement enables auction participants to terminate any IRSR units they hold with respect to impacted future periods.[33] It is anticipated that the implementation of either the Southern Generators' or Snowy Hydro Re-orientation proposal would constitute such a change for the Victoria-Snowy, Snowy-Victoria, Snowy-NSW, and NSW-Snowy directional interconnectors.

If auction participants terminate and return their units to NEMMCO with sufficient notice, NEMMCO would be able to re-auction those returned units along with any new units being offered. The settlement residue auction rules require NEMMCO to

29 NEMMCO, Southern Generators' proposal, s.99 submission, , 18 July 2006, p.2
30 Ibid
31 NEMMCO, Southern Generators' proposal, s.95 submission, , 6 July 2006, p.2
32 NEMMCO, Operating Procedure: Dispatch, SO_OP3705, 21 June 2006, v40, p.33
33 NEMMCO, section 13.5, Auction Participant Agreement, 1 September 2004, p.13

notify units for sale at least ten business days before the auction.[34] If the implementation date for the proposal did not allow for sufficient time to re-auction terminated units, NEMMCO would retain those unsold units and would pass on to the relevant Transmission Network Service Provider the settlement residue allocated to those unsold units.[35]

Given that the potential benefits to the market of implementing the Southern Generators' proposal are similar to the Snowy Hydro Re-orientation proposal, and as the benefits are most likely to accrue over the summer period, the Commission considers it important to implement the chosen proposal as soon as realistically possible. This may mean there would not be sufficient time to re-auction any surrendered IRSR units.

Commission's assessment of implementation issues

The Commission considers that the Southern Generators' proposal can be implemented in time without any undue effects on market participants, similarly to the Snowy Hydro Re-orientation proposal.

While re-auctioning any terminated IRSR units may be preferable, the Commission does not consider that any benefits from delaying implementation to enable the re-auctioning of the units are likely to outweigh the efficiency benefits from implementing the proposal as soon as practicable.

34 NEMMCO, section 4.6, National Electricity Market Settlement Residue Auction Rules, 1 September 2004, p.8

35 This process is explained in clause 3.18.4(a)(2) of the National Electricity Rules.

Part 3. Commission's detailed analysis and reasoning

The Commission has undertaken a comprehensive assessment of both the Southern Generators' and Snowy Hydro Re-orientation proposals. Its detailed analysis, consideration, and reasoning for its decisions on the Southern Generators Final Rule Determination and Snowy Hydro Draft Rule Determination are presented in the Appendices that make up Part 3. A description of each Appendix included in Part 3 is below.

Appendix A Commission's assessment, considerations and findings

Appendix A presents the Commission's comprehensive analysis of issues, consideration of submissions, and reasons for its decisions relating to both the Southern Generators' Final Rule Determination and the Snowy Hydro Re-orientation Draft Rule Determination. It includes a description of both proposals, a summary of submissions received on both proposals, and the Commission's analysis of the assessment criteria discussed in the Southern Generators' Final Rule Determination and the Snowy Hydro Draft Rule Determination. The assessments in this Appendix draw on the conceptual assessment presented in Appendix B, the quantitative modelling results presented in Appendix C, analysis on supply reliability presented in Appendix D, and analysis on the Snowy CSP/CSC Trial presented in Appendix E.

Appendix B Conceptual Assessment of the Southern Generators' and Snowy Hydro Re-orientation Proposals

Appendix B presents the Commission's conceptual assessment of the Southern Generators' and Snowy Hydro Re-orientation proposals against the status quo and one another.

Appendix C Modelling

The Commission undertook quantitative modelling to further inform its analysis on both the Southern Generators' and Snowy Hydro Re-orientation proposals. A description of the modelling and the results are presented in Appendix C.

Appendix D Reliability of Supply for Victoria

Following correspondence from Snowy Hydro that contented that implementation of the Southern Generators' proposal would result in supply reliability risks for Victoria, the Commission undertook an assessment to evaluate the veracity of those contentions. The Commission's analysis and findings are presented in Appendix D.

Appendix E Consistency with Snowy CSP/CSC Trial

Appendix E provides a description of the Snowy CSP/CSC Trial currently in the Rules and assesses the consistency of the Southern Generators' proposal and Snowy Hydro Re-orientation proposal with the current Trial.

Appendix F Rule as Made

Appendix F presents the National Electricity Market Amendment (Management of negative settlement residues in the Snowy Region) Rule 2006, the Rule as made.

Appendix A – Commission's assessment, considerations and findings

A1 Introduction

This Appendix is a more detailed presentation of the Commission's assessment, considerations, and findings regarding the Southern Generators' Rule change proposal and the Snowy Hydro Re-orientation Rule change Proposal. The discussion takes into account and references analysis from Appendices B and C in order to link the Commission's assessment to those more specific sources of analysis.

In the National Electricity Market (NEM), electrical power normally flows from lower-priced regions to higher-priced regions. This means that NEMMCO, as market and system operator, effectively purchases power in the lower-priced regions and sells it in higher-priced regions, yielding a "profit", or "surplus" on inter-regional flows of power. NEMMCO, in turn, offers this surplus back to the market in the form known as "inter-regional settlement residues" (IRSRs). Market participants may buy shares of these residues, known as IRSR units, which can be used for hedging inter-regional trading risk.[1]

On occasion, however, power flows from higher-priced regions to lower-priced regions. In these cases, "negative settlement residues" may accrue between two regions. Since, under the current market arrangements, NEMMCO has a limited means for funding large negative residues, NEMMCO takes action in the market to prevent the accumulation of negative settlement residues when they would otherwise arise.[2]

To manage the financial risk of the IRSR fund relating to a given interconnector being in deficit as a result of material and persistent negative settlement residues, NEMMCO's general current practice is to intervene in the market by restricting ("clamping") power flows on the relevant interconnector. However, clamping power flows in this way can undermine competitive pressure, distort the efficiency of dispatch and pricing outcomes and reduce the effectiveness of IRSR units as a hedging instrument for managing inter-regional price differences.

NEMMCO has two specific arrangements for managing the accumulation of negative settlement residues on the Victoria-Snowy interconnector—"clamping" and "re-orientation"—which have been established within the context of the current congestion management trial in the Snowy region.[3]

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1 NEMMCO sells IRSR units at Settlement Residue Auctions (SRAs).

2 Although negative residues are recovered later, in accordance with Clause 3.6.5(a)(4A) of the Rules, NEMMCO has to carry the cost of deficit for a period of time.

3 The Snowy congestion management trial — i.e. the Snowy CSP/CSC trial— established by the Part 8 Chapter 8A derogation in the Rules, seeks to test the use of Congestion Support Prices

The Southern Generators' proposal and Snowy Hydro's Re-orientation proposal seek to alter these specific arrangements in the period before the Snowy congestion management trial ends.[4] The two proposals present alternative means of reducing the frequency and distortionary impacts of NEMMCO's current interventions to manage negative residues on the Victoria-Snowy interconnector.

A1.1 Background

Network flows in an alternating current (AC) power system can occur from regions with relatively high prices to regions with relatively low prices where there is an intra-regional constraint or there is a constraint on an electrical loop between regions.[5] This is because electricity in such a system follows the path of least impedance rather than paths determined by relative prices. Such "counter-price flows" can lead to the accrual of negative settlement residues.

As discussed below, counter-price flows can arise between the Victoria and Snowy regional reference nodes (RRNs) when the Murray-Tumut constraint binds due to the impact of the 'spring washer' effect. This effect operates because, at times of:

- Northward flows between Victoria and NSW - the value of incremental generation at the Murray node (also the Snowy regional reference node) is lower than the incremental generation at any other point around the Snowy network loop (see Box A1). This low value is consistent with the physical situation that a marginal increase in Murray generation increases congestion on the binding Murray-Tumut constraint by more than the same marginal increase in Victoria-Snowy interconnector exports. Conversely, a marginal decrease in production at Murray will have the greatest effect in relieving the constraint compared to a marginal decrease in production at other location on the loop. An implication of the relatively low value of incremental Murray generation is that the price at the Snowy regional reference node is less than at the Victorian regional reference node;

- Southward flows between Victoria and NSW - the value of incremental generation at the Murray node is higher than the incremental generation at any other point around the Snowy network loop (see Box A2). This high value is consistent with the physical situation that a marginal increase in Murray generation reduces congestion on the binding Murray-Tumut constraint to a greater degree than the same marginal reduction elsewhere

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(CSPs) and Congestion Support Contracts (CSCs) in managing network congestion. For a non-technical description of the CSPs and CSCs and the Snowy CSP/CSC trial, see Sections 5.4.1 and 5.4.3 of AEMC "Congestion Management Issues Paper", AEMC, Sydney, March 2006 (available at http://www.aemc.gov.au)

4 See Appendix 5 of the Congestion Management Review Issues Paper for a discussion of the different ways in which counter-price flows can arise. For a description of the way the two proposals alter the Snowy CSP/CSC trial, see Appendix E.

5 AEMC 2006, *Management of negative settlement residues in the Snowy region*, Final Rule Determination, 14 September 2006, Sydney, Part 3 Appendix B, paragraph 4.

around the loop. The same marginal increase in NSW-Snowy interconnector exports increases congestion on the constraint to a greater degree than the same marginal increase elsewhere around the loop. An implication of the relatively high value of incremental Murray generation is that the price at the Snowy regional reference node is more than at the Victorian regional reference node.

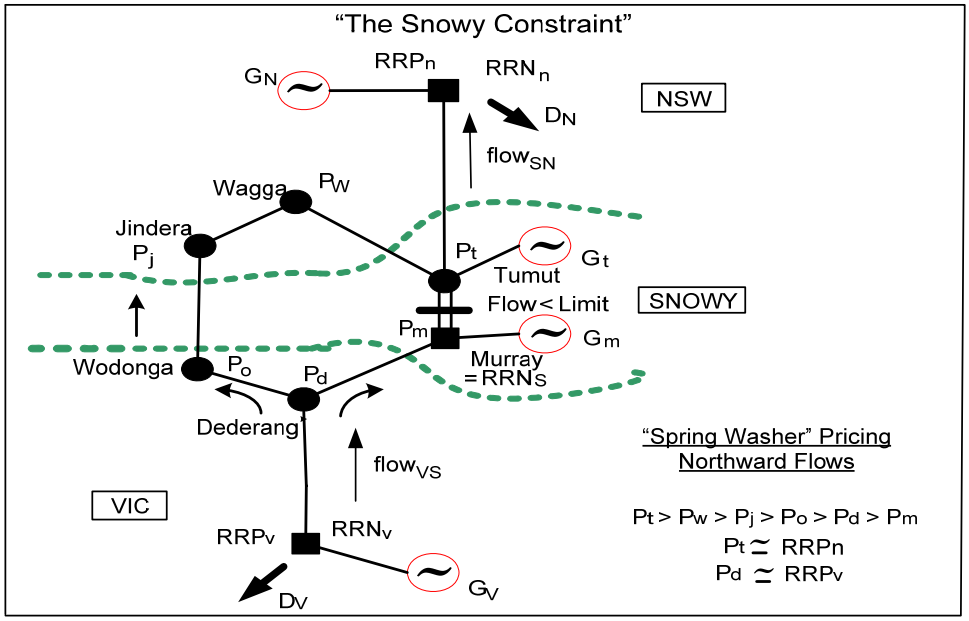
Importantly, the so-called spring washer effect can arise even under conditions where dispatch is economically efficient.

Box A1: Counter-price flows for northward flow conditions and the "spring washer effect" around the Snowy loop

Counter price flows can occur on the VIC-Snowy interconnector, for both northerly and southerly flows in the absence of intervention by NEMMCO. Figure A1 illustrates counter-price flows on the VIC-Snowy interconnector, for northerly flows. These counter-price flows arise from the "spring washer" effect on the electrical loop around the Snowy region. With a binding constraint between Murray and Tumut, the "spring washer effect" results in nodal prices around the loop that rise in an anti-clockwise fashion from Murray to Tumut (i.e. $P_m < P_d < P_o < P_j < P_w < P_t$). Generation located at a point that most relieves congestion (Tumut in this case) is paid the highest price, whereas generation located at a point that most increases congestion (Murray in this case) is paid the lowest price. The "spring washer" effect captures the economic costs and benefits of re-balancing power injections at different locations around a constrained loop, so that security constraints are not violated.

Because the price at the Murray node, P_m, is less than the Victorian reference price, RRP_v, there are counter-price flows which create negative settlement residues to accumulate on the VIC-Snowy interconnector.

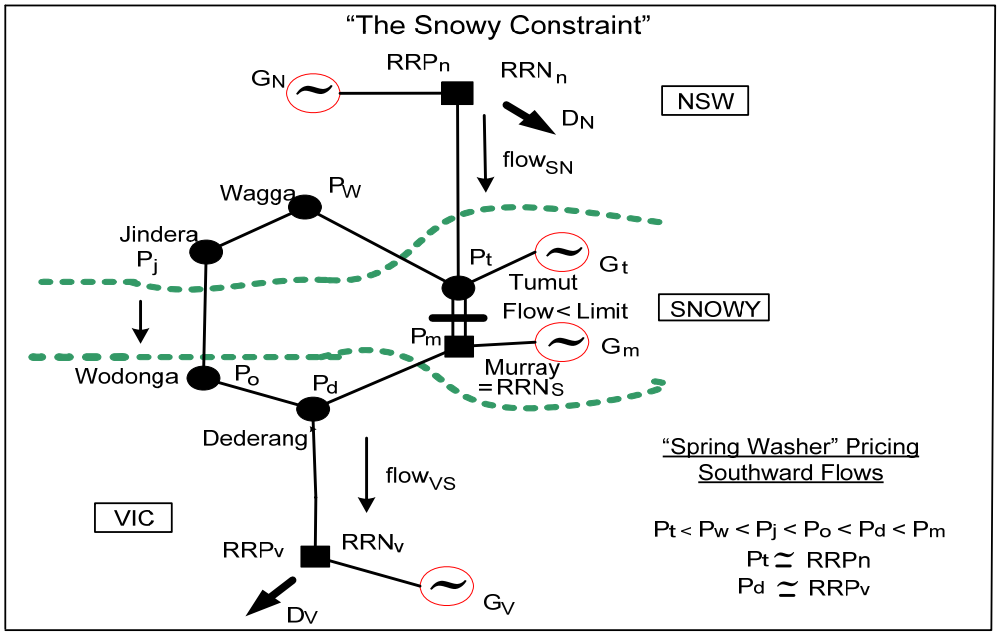
Figure A1: Negative residues on the VIC-Snowy interconnector, northward flows



Box A2: Counter-price flows under southward flow conditions

Figure A2 illustrates counter-price flows on the VIC-Snowy interconnector, for southerly flows. For southwards flows, a binding constraint between Murray and Tumut results in a 'spring washer effect' in nodal prices around the loop, which rise in an anti-clockwise fashion from Tumut to Murray (i.e. $P_m > P_d > P_o > P_j > P_w > P_t$). Because the price at the Murray node, P_m, is greater than Dederang nodal price, P_d – which (excluding losses and absent any binding constraints from Dederang to Melbourne) equals the Victorian reference price, RRP_v – there are counter-price flows, which cause negative settlement residues to accumulate on the Snowy-VIC interconnector.

Figure A2: Negative residues on the Snowy-VIC interconnector, southward flows



NEMMCO currently has limited means of funding large negative residues. Although under the current Rules, NEMMCO has the ability to offset negative residues on an interconnector against positive residues within the same week, the risk that there will be a net shortfall increases when there are periods where large negative residues accrue. NEMMCO therefore seeks to mitigate this risk by intervening in the market to limit the accumulation of negative residues, in accordance with provisions in the Rules and published operating procedures.[6] Any

6 NEMMCO's process for managing negative residues is detailed in Section 18 of its *Operating Procedure: Dispatch, SO_OP3705*, v40, 21 June 2006.

net negative residues are then recovered from future Settlement Residue Auction proceeds.[7]

At present, NEMMCO intervenes in either of two ways to limit negative settlement residues between the Snowy region and the Victorian region:

- For northward flows on the Victoria to Snowy interconnector, NEMMCO restricts the flow of power from Victoria to Snowy (widely known as "clamping"). NEMMCO only clamps the interconnector flows if this does not threaten power system security;

- For southward flows on the Victoria to Snowy interconnector, NEMMCO "re-orients" the relevant constraints with the effect that the pricing reference point shifts further south (to Dederang in Victoria), which effectively equates Victorian and Snowy prices and means that there is no counter-price flows and no accumulation of negative settlement residues.[8]

NEMMCO intervenes in the above ways when the level of negative residues accruing in a continuous series of dispatch intervals exceeds (or is forecast to exceed) a $6000 trigger level. NEMMCO recently announced a review of the on the trigger level for the management of negative settlement residues (Box A3).

Box A3 – Review of the Trigger Level for Management of Negative Settlement Residues

On 5 September 2006, NEMMCO commenced a review on the trigger level for the management of negative settlement residues. NEMMCO's current trigger level to intervene to manage negative settlement residues is set at $6,000 per event, during which counter-price flows are evident or forecast. NEMMCO's consultation is seeking to raise the $6,000 trigger threshold to $100,000. The review follows a Rule change (which commenced on 1 July 2006) that allows NEMMCO to recover outstanding net negative settlement residues from future Settlement Residue Auction proceeds rather than future auction fees. This reduces NEMMCO's recovery timeframe of net negative settlement residues to within 3 months rather than having to wait up to 21 months, as was the case before the revised Rule. NEMMCO is currently proposing to issue a final determination on 27 October 2006.

In their Rule change proposal, the Southern Generators contended that clamping (in particular) distorts efficient outcomes in the market and that their proposal provides a better approach for managing the accrual of negative settlement residues on the Victoria-Snowy interconnector. In a separate Rule change proposal, Snowy Hydro agreed that clamping suffered from several problems but put forward an alternative means of addressing the need for this intervention, which it submitted had a number

7 Clause 3.6.5(a)(4A) of the Rules.
8 Chapter 8A Part 8 of the Rules empowers NEMMCO to intervene in this manner.

of advantages over the Southern Generators' proposal. Both of these proposals are outlined below.

A1.2 Southern Generators' Rule change proposal

The Southern Generators' proposal seeks to fund negative residues on the Victoria-Snowy interconnector (arising in either direction) with positive residues on the Snowy-NSW interconnector (arising in the same direction), thereby obviating the need for real-time NEMMCO intervention in dispatch or pricing:

- For northward flows on the Victoria to Snowy directional interconnector,[9] NEMMCO would fund negative settlement residues from positive settlement residues accumulated on the Snowy to NSW directional interconnector; and

- For southward flows on the Snowy to Victoria directional interconnector,[10] NEMMCO would fund negative settlement residues from positive settlement residues accumulated on the NSW to Snowy directional interconnector.

In both cases, the transfer of (positive) settlement residues from the Snowy-NSW or NSW-Snowy interconnector to the Victoria-Snowy or Snowy-Victoria interconnector is *just enough* to offset the negative settlement residues accumulating on the latter interconnector. The Southern Generators' proposal included an analysis aimed at demonstrating that it is possible to fully fund the accruing negative residues using the proposed mechanism in this manner. [11]

By ensuring that IRSR units for the Victoria-Snowy interconnectors cannot have a negative value, the Southern Generators noted that there is no longer any basis for NEMMCO to intervene in the market by clamping interconnector flows.

Implementation of the Southern Generators' proposal would be through an amendment to the NEMMCO derogation in Chapter 8A Part 8 of the Rules – Network Constraint Formulation. The proposal would expire with that derogation, which would occur on: a) 31 July 2007; b) implementation of the first regional boundary review by the AEMC; or c) as otherwise determined by the AEMC. The Southern Generators stated that the issues addressed by the derogation are separate to those addressed as part of the CSP/CSC trial at Tumut and may therefore continue to exist at the sunset. They recognised that some "inconsequential amendments" would be necessary if the proposal were to remain after the derogation's expiry. For this reason, the proponents thought it best to align the duration of this derogation with the current CSP/CSC derogation.[12]

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9 i.e; on the VIC-Snowy directional interconnector.

10 i.e; on the Snowy-VIC directional interconnector.

11 Southern Generators and NEMMCO, "Management of Negative Settlement Residues in the Snowy Region Rule change proposal", 9 November 2005, p.12.

12 Southern Generators Rule change proposal, p.6.

A1.3 Snowy Hydro Re-orientation Rule change proposal

Snowy Hydro's Re-orientation Rule change proposal seeks to overcome the accrual of negative settlement residues on the Victoria-Snowy interconnector at times of *northward flows* by the "re-orientation" of the affected constraints to ensure counter-price flows can no longer occur. As noted above, re-orientation is already applied at times of *southward flows* and constraint between Murray and Tumut.

The Re-orientation option was initially raised by Snowy Hydro in its submission on the Southern Generators' Rule change proposal as a preferable means of avoiding the need for NEMMCO clamping of the Victoria-Snowy interconnector. Subsequently, shortly before the Commission's Draft Rule Determination on the Southern Generators' Rule change proposal, Snowy Hydro submitted a formal Rule change proposal in favour of the re-orientation option.[13]

In the Draft Rule Determination on the Southern Generators' Rule change proposal, the Commission considered re-orientation as a counterfactual option (in addition to the status quo base case) to the Southern Generators' Rule change proposal. However, the analysis of the re-orientation option was limited at that time. The Commission has since undertaken a much more comprehensive analysis of both the Southern Generators' and the Snowy Hydro Rule change proposals against both the status quo and against each other.

The Snowy Hydro Re-orientation proposal manages the accumulation of negative residues on the Victoria-Snowy interconnector at times of *northward flows* by temporarily re-defining the Snowy regional reference price so that it takes a value that is similar to the Victorian RRN price.[14] This has the effect of settling Murray generation, which is connected at the Snowy regional reference node (Murray), at the Victorian price. This change in the settlement price of Murray generation under re-orientation (for either northward or southward flows) is akin to temporarily re-defining Murray generation as being in the Victoria region. This change is temporary, because it only occurs at those times when negative residues would have accumulated on the Victoria-Snowy interconnector when the Murray nodal price (i.e. the Snowy region reference node price) would have been used for settling Murray generation. At other times, the Snowy RRN price is aligned to the nodal price at Murray.

A key similarity with the Southern Generators' proposal is the Snowy Hydro Re-orientation proposal also effectively results in a transfer from the Snowy-NSW

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13 Snowy Hydro Limited and NEMMCO, "Rule change proposal for: Management of Negative Residues in the Snowy Region by re-orientation of constraints", Snowy Hydro Ltd, Sydney, 24 May 2006 (available at http://www.aemc.gov.au).

14 Strictly speaking, under re-orientation the Snowy RRN price is redefined to be equal to the Dederang nodal price at the relevant times. The Dederang nodal price will be equal (apart from losses) to the Victorian RRN price in the absence of binding constraints between the Victorian RRN and Dederang.

interconnector residue fund to the Victoria-Snowy interconnector residue fund. However, the mechanism and the precise magnitude of this effective transfer would be different under each of the two proposals.

As Re-orientation is an alternative means of addressing the accrual of negative settlement residues, it is a strict substitute for the Southern Generators' proposal and as such, only one of the two options can be implemented. This has motivated the Commission to analyse both Rule change proposals together and present its consideration on both in this Appendix.

A2 Commission's decision framework

A2.1 Role of the NEM objective

As noted in the Summary Report, the Commission may only adopt a proposed Rule change if it is satisfied that it will or is likely to satisfy the NEM objective.

The NEM objective requires the Commission to consider the promotion of efficient investment in, and use of, electricity services, when considering or developing Rule proposals.

The NEM objective, as set out in s.7 of the NEL, is to:

> "Promote 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."

Under s.88 of the NEL, the Commission:

> "(1) May only make a Rule if it is satisfied that the Rule will or is likely to contribute to the achievement of the national electricity market objective.
>
> (2) For the purposes of subsection (1), the AEMC may give such weight to any aspect of the national electricity market objective as it considers appropriate in all the circumstances, having regard to any relevant MCE statement of policy principles."

The NEM objective requires the Commission, when considering or developing Rule proposals, to consider the promotion of efficient investment in, and use of, electricity services for the long term interests of consumers with respect to the price, quality, reliability and security of electricity supply. Economic efficiency is commonly defined as having three elements and in the context of considering the Southern Generators' proposal as well as the Snowy Hydro Re-orientation proposal, these are:

- **Productive efficiency** – means the electricity system is operated on a "least cost" basis given existing infrastructure and the status of the network. For example, generators should be dispatched in a manner that minimises the total system costs of meeting consumers' demands;

- **Allocative efficiency** – means electricity production and consumption decisions are based on prices that reflect the opportunity cost of the available resources; and

- **Dynamic efficiency** – means maximising ongoing productive and allocative efficiency over time, and is commonly linked to the promotion of efficient longer term investment decisions.

Further, the Commission has taken the view that the NEM objective is not solely focussed on a technical approach to the promotion of efficiency. Rather, the NEM objective has implications for the *means* by which regulatory arrangements operate as well as their intended *ends*. This means that the Commission also seeks to:

- **Minimise operational intervention in the market** – intervention in the operation of competitive markets should be limited to circumstances of market failures, although the Commission recognises that this is only a necessary and not sufficient condition for regulatory intervention;

- **Promote stability and predictability** – other things being equal, the Rules for the dispatch and pricing of the market and treatment of IRSRs should be sufficiently stable and predictable to enable participants to plan and make both short and long term decisions; and

- **Create transparency** – to the extent that intervention in the market is required, it should be based on, and applied according to, transparent criteria.

These requirements are founded on the principles and practice of good regulatory design, which the Commission believes is central to its task in furthering the NEM objective.

The Commission also notes that proposed Rule changes may have distributional impacts. The Commission considers that the NEM objective is primarily concerned with efficiency and good regulatory practice. These qualities will help ensure that the arrangements will benefit consumers in the long term. Rather than seeing distributional outcomes as a distinct limb or component of the NEM objective, the Commission has taken the view that distributional outcomes have relevance only in so far as they may negatively influence the stability and integrity of the market arrangements. Basing fundamental decisions on the operation of the market primarily on distributional criteria rather than efficiency and good regulatory practice is likely to be counter-productive to the interests of consumers in the long term.

Finally, the NEM objective requires the Commission to consider the likely effect of a Rule change proposal on the quality, security, and reliability of the national electricity system. The Commission will carefully consider Rule proposals that may have implications for these important factors.

In the Commission's view, applying the NEM objective to the assessment of the Southern Generators' and Snowy Hydro's Rule change proposals requires consideration of the likely implications of the proposals on:

- Economic efficiency of dispatch;
- Spot market and contract pricing outcomes;
- Inter-regional trading risk (including revenue adequacy of the proposal);
- Power system security and reliability;
- Good regulatory practice; and
- Long term market outcomes.

Implementation issues surrounding the proposals also need to be considered to ensure they can be put in place within the assumed timeframes. Given that both proposals are due to sunset at the expiry of the existing NEMMCO derogation in Chapter 8A Part 8 of the Rules, the time required to put the proposals in place is of the essence in assessing whether one or the other of the proposals ought to be approved.

A2.2 Commission's approach to the assessment

In order to determine whether either the Southern Generators' Rule change proposal or the Snowy Hydro Rule change proposal is likely to satisfy the NEM objective, the Commission has:

- Carefully considered the views of the Rule change proponents and stakeholders expressed in submissions;
- Reviewed detailed conceptual analysis of the two proposals prepared for the Commission; and
- Reviewed market and risk modelling of the two proposals prepared for the Commission.

The Commission understands that the Southern Generators' and Snowy Hydro's Rule change proposals both attempt to address the same issue. Therefore, they are direct substitutes and cannot both be implemented.

A2.3 Conceptual analysis

The Commission's conceptual analysis applied the same approach the Commission has used in assessing other Rule change proposals. This is:

- Description and discussion of the problem the proposal purports to address;
- Description of how the proposal would operate;
- Analysis of the likely economic and power system effects of the proposal in comparison to the base case and any other appropriate counterfactual(s); and

- Analysis of the likely impacts of the proposal in comparison to the base case and any appropriate counterfactual(s), against each of the relevant aspects of the NEM objective.

During its initial consideration of the Southern Generators' proposal, the Commission recognised that the outcomes of the proposal would be difficult to predict solely on the basis of conceptual analysis. This is principally due to the complicated interactions between operational Rules and generators' bidding incentives and behaviour. Therefore, the Commission examined the predicted outcomes of the proposals produced by modelling analysis.

A2.4 Modelling analysis

Given the complexity of the market and the difficulties in conceiving and describing the range of possible outcomes from the Southern Generators' and Snowy Hydro Rule change proposals, the Commission considered that modelling of the proposals would help inform its decision. The Commission considered both:

- Market modelling – to inform the Commission's assessment of the implications of the proposals on the economic efficiency of dispatch and spot price impacts; and

- Risk modelling – to inform the Commission's assessment of the implications of the proposals on the management of inter-regional trading risk.

The market modelling undertaken on behalf of the Commission involved the use of a bid-based security-constrained dispatch model, allowing for strategic bidding by selected NEM generators. The Southern Generators' proposal was modelled as a cessation of clamping by NEMMCO. Generators were dispatched based on minimising the bid-based cost of supplying load and there was no attempt to prevent or control counter-price flows arising as a result of dispatch. Instead, negative settlement residues arising from the counter-price flows on the Victoria-Snowy interconnector were financed out of positive residues on the Snowy-NSW interconnector. The Snowy Hydro Re-orientation proposal was modelled as the replacement of the Snowy region price (at Murray) with the Dederang price when the Murray-Tumut constraint bound.

The Commission also considered risk modelling analysis of the Southern Generators' and Snowy Hydro Re-orientation proposals using a portfolio optimisation model.

Base case and other counterfactuals

As noted above, a key requirement for assessing a Rule change proposal is the characterisation of an appropriate base case to provide a means of identifying the impact of the proposal.

In its Draft Rule Determination on the Southern Generators' proposal, the Commission modelled two cases to provide points of comparison for the Southern Generators' proposal:

- the base case (status quo arrangements, including clamping and the Snowy CSP/CSC trial); and

- re-orientation of the Snowy constraints to Dederang when counter-price flows occurred for both northward and southward flows on the Victoria to Snowy interconnector.[15]

Consideration of the base case and the re-orientation counterfactual provided the Commission with a means of testing the robustness of its results and the relative advantages and disadvantages of the Southern Generators' proposal.

Following Snowy Hydro's formal Re-orientation Rule change proposal, the Commission has extended the analysis and quantitative modelling of both proposals, to provide a robust basis for assessing and comparing the proposals.

A2.5 Structure of this Report

The remainder of this Report is structured as follows:

- The Southern Generators' and Snowy Hydro's views of the various merits of their respective Rule change proposals are elaborated in Section A3;

- Views expressed in stakeholder submissions on the different implications of the proposals are described in Section A4; and

- The Commission's assessment of both Rule change proposals against the Status Quo base case and each other is then described in Section A5.

The Commission's findings and conclusions on the Southern Generators' Rule change proposal are presented in Parts 1 and 2 of the Final Rule Determination on the Management of negative settlement residues in the Snowy region. The Commission's draft findings and conclusions on the Snowy Hydro Rule change proposal are presented in Parts 1 and 2 in the Draft Rule Determination on the Management of negative settlement residues by re-orientation.

A3 Proponents' views

A3.1 Southern Generators' Rule change proposal

The Southern Generators stated that their Rule change proposal would promote the NEM objective by offering a number of benefits over the status quo arrangements, which include the CSP/CSC trial at Tumut and clamping of the VIC-Snowy interconnector. These purported benefits are:

- **Improvement in the economic efficiency of dispatch** – the Southern Generators stated that their proposal overcomes the need to clamp to avoid counter-price flows, which are the result of efficient dispatch. In their view,

15 The constraint equations for the Snowy region are identified in Part 3 Appendix C, p.C25.

clamping is driven by the lack of an adequate means of funding negative settlement residues, reflecting a shortcoming in the current Rules.[16] The Southern Generators argued that the absence of clamping is consistent with efficient dispatch because it retains accurate locational marginal pricing at the Snowy RRN and, unlike the status quo, does not provide incentives for generators receiving the Snowy region price to bid at prices below marginal cost to maximise volume.[17] Finally, the proposal "…ensures efficient use of the Dederang-Wagga-Tumut-Murray-Dederang transmission loop, maximising the transmission capacity for inter-regional transfers";[18]

- **Improved ability to trade inter-regionally** – the Southern Generators stated that clamping harms the ability of generators in the regions south of the Snowy region to enter contracts with purchasers in the regions north of Snowy. This is because clamping both increases the risk that they will not be physically dispatched for a given bid and reduces the firmness of the northward IRSRs that are relevant to hedging their inter-regional price risks.[19] The Southern Generators suggested that their proposal would produce firmer IRSRs on the combined VIC-Snowy and Snowy-NSW interconnectors than either clamping or the Snowy Hydro reorientation proposal, despite the depletion of some Snowy-NSW residue.[20] The Southern Generators also provided a proof to demonstrate that their proposal will be revenue adequate.[21] The Southern Generators conceded that their proposal may create an issue for generators in the Snowy region wishing to sell contracts to NSW customers, but contended that "…most Snowy generation is effectively in NSW for northward flow limit conditions.";[22] and

- **Improved reliability** – the Southern Generators argued that their proposal would improve supply reliability in both NSW and Victoria.[23]

Finally, the Southern Generators contended that their proposal is a "specific response to an acute problem in the National Market implementation." Over time, they expected that a more general measure may replace their specific one.[24]

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16 Southern Generators' Rule change proposal, p. 4.
17 Southern Generators' Rule change proposal, p.5.
18 Southern Generators' Rule change proposal, p.5.
19 Southern Generators' Rule change proposal, pp.4 and 9.
20 Southern Generators' Rule change proposal, p.5.
21 Southern Generators' Rule change proposal, pp.12-14. The Southern Generators' proof assumed a particular relationship between the regional prices (in Victoria, Snowy, and NSW) that occurs when the constraint between Murray and Tumut is binding (Murray-Tumut constraint). The proof sought to demonstrate that on the basis of this relationship and maximum interconnector capacities, the surplus on one interconnector was greater than the deficit on the other interconnector for both northward and southward flows.
22 Southern Generators' Rule change proposal, p.11.
23 Southern Generators Rule change proposal, p.5.
24 Southern Generators Rule change proposal, p.5.

In addition to setting out their own proposal in their Rule change proposal document, the Southern Generators took the opportunity to comment on the re-orientation option. In considering NEMMCO's current intervention practice for southward flows, the Southern Generators referred to conclusions reached by NEMMCO when it consulted on the benefits of re-orientation as a way to manage negative residues. The Southern Generators stated that NEMMCO's conclusion identified a trade-off between removing negative residues and introducing a mis-pricing of generation at the Murray node. The Southern Generators considered that the re-orientation approach resulted in:

> "A distortion of efficient dispatch and thus degrade[d] the performance of the market in relation to the objectives."[25]

A3.2 Snowy Hydro's Rule change proposal

In its Re-orientation Rule change proposal, Snowy Hydro agreed that there are several problems with the status quo clamping approach to managing constraints between Murray and Tumut. First, clamping reduced dispatch options at times of higher demand and northward flows between Victoria and NSW.[26] Second, Snowy Hydro argued that the status quo raises concerns about the predictability of the speed with which NEMMCO will respond to negative residues between Victoria and Snowy.[27] Third, Snowy Hydro submitted that the status quo adversely affects inter-regional trade because Victorian participants have a reduced ability to manage inter-regional price risks due to the lack of settlement residues between Victoria and Snowy when NEMMCO clamps.[28] Finally, Snowy Hydro agreed that there is a need to manage negative settlement residues between Victoria and Snowy.[29]

However, Snowy Hydro contended that the Southern Generators' Rule change proposal has a number of shortcomings and therefore put forward its own Rule change proposal.

Snowy Hydro provided the following reasons in support of its proposal:

- **Better regulatory design** – Snowy Hydro considered that the Southern Generators' proposal, while "transparent and predictable", would require action "off-market" through the transfer of funds from Snowy to NSW IRSRs to the Victoria to Snowy IRSRs. By comparison, its own proposal would address the "underlying regional design deficiency" and provide "the best transition arrangement to a formal boundary change and in effect provides a trial of the Snowy Hydro regional boundary change proposal." Re-orientation was also already being used by NEMMCO for southward flows

25 Southern Generators Rule change proposal, p.4.
26 Snowy Hydro Rule change proposal, p.14.
27 Snowy Hydro Re-orientation Rule change proposal, p.4.
28 Snowy Hydro Re-orientation Rule change proposal, p.14.
29 Snowy Hydro Re-orientation Rule change proposal, p.2.

between Snowy and Victoria and "no concerns had been raised about uncertainty or lack of transparency in that context."[30];

- **Improved dispatch efficiency** – Snowy Hydro submitted that due to the effect of the constraint north of Tumut, both its proposal and the Southern Generators' proposal cannot displace generation in NSW.[31] Changes in flow across the transmission lines from Victoria to NSW would lead to opposite and offsetting changes in generation at Tumut.[32] Under this scenario, any dispatch efficiency benefits would be dependent on the opportunity cost of water at Tumut relative to Victorian generation. Snowy Hydro stated:

> "The possible impacts on dispatch are the substitution of marginal generation in Victoria for generation at Tumut. Marginal generation at Victoria is likely (but not certain) to be gas-fired… The opportunity cost of water at Tumut is around the highest black coal marginal cost, as this is the generation against which Tumut competes under the assumed inter-regional power flow conditions."[33]

Snowy Hydro went on to suggest that removing the constraint on Victorian exports during these periods would not enable lower cost dispatch, even if the opportunity cost of water varied;[34]

- **Beneficial price impacts** – Snowy Hydro argued that there would be no impact on net flows into NSW under either the Southern Generators' proposal or the Snowy Hydro Re-orientation proposal. As no NSW generator would be displaced, this means there would be no impact on the NSW price. However, Snowy Hydro did consider that the two proposals could have different impacts on prices in Victoria and Snowy. Snowy Hydro suggested that:

- The Southern Generators' proposal would remove Snowy Hydro's price protection of having the Snowy price align with the Tumut and NSW price.[35] To manage this new price risk, Snowy Hydro could: (1) withhold a large volume of Murray generation to prevent the Murray-Tumut constraint from binding. This would result in similar prices across Victoria, Snowy, and NSW; or (2) generate large volumes at Murray constraining the Murray-Tumut lines. This would have no impact on the NSW price but could place competitive pressures on Victorian generators, resulting in an increase of the

30 Snowy Hydro Re-orientation Rule change proposal, p.4-5.
31 Snowy Hydro Re-orientation Rule change proposal, p.7.
32 Ibid.
33 Ibid.
34 Ibid.
35 Snowy Hydro Re-orientation Rule change proposal, p.9.

Victorian price compared to the status quo, but not as great as under Snowy bidding strategy (1).[36]

- Under its Re-orientation proposal, Snowy Hydro would not have the incentive to withhold generation because: (1) it would not be exposed to low or negative prices at Murray; and (2) it would be competing on "substantially equal terms to Victorian generators".[37] While pricing Murray generation away from its nodal price could reduce incentives for it to bid to reveal marginal costs (with possible implications for dispatch efficiency), it would be unlikely to have a material effect given the limited circumstances and low hours that Murray generation could be priced at the Dederang node.[38] Snowy Hydro concluded that:

  > "The Southern Generators proposal is likely to lead to Snowy withholding capacity at Murray, resulting in higher prices in Victoria. The reorientation proposal is likely to lead to a higher level of competition and lower prices in Victoria."[39]

- **Risk –** Snowy Hydro stated that under the Southern Generators' proposal, it would have a reduced ability to hedge inter-regional price risk.[40] It indicated that the risk of price separation would be greater compared to the status quo and the effectiveness of Snowy to New South Wales IRSR units would be reduced. This is because the Snowy-NSW IRSRs would be used to offset any negative IRSRs accumulating on the Victoria-Snowy interconnector. However, under its Re-orientation proposal, Snowy Hydro argued that there would be no price separation between Victoria and the Snowy region and IRSRs between Victoria and NSW would be fully funded. "This would give the Victorian participants a better ability to manage inter-regional price risk than either the status quo or the Southern Generators proposal."[41]

- **Wealth transfers –** Snowy Hydro suggested that the Southern Generators' proposal would result in a material transfer of wealth from Victorian consumers to Victorian generators, and from Snowy Hydro to Victorian generators due to the increased prices in Victoria and the on-going cost due to Snowy Hydro's reduced capacity to contract in Victoria. Snowy Hydro itself would also be substantially worse off because of the transitional cost arising from adjusting its contract position for the duration of the proposal.[42] The Snowy Hydro Re-orientation proposal, however, would not adversely

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36 Snowy Hydro Re-orientation Rule change proposal, p.9-10.
37 Snowy Hydro Re-orientation Rule change proposal, p.10.
38 Snowy Hydro Re-orientation Rule change proposal, p.11.
39 Ibid.
40 Snowy Hydro Re-orientation Rule change proposal, p.12.
41 Snowy Hydro Re-orientation Rule change proposal, p.12-13.
42 Snowy Hydro Re-orientation Rule change proposal, p.13.

affect Snowy Hydro and would provide Victorian customers with lower prices.[43]

A4 Submissions on the Rule change proposals

This section summarises issues raised in submissions on both the Southern Generators' Rule change proposal and the Snowy Hydro Rule change proposal. In this context, it is important to note that the Southern Generators' proposal has been subject to two rounds of consultation (on the Rule change proposal itself and on the Commission's Draft Rule Determination approving the proposal) while the Snowy Hydro Re-orientation proposal has only been subject to one formal round of consultation (on the Rule change proposal). However, the re-orientation option has been given significant attention in some of the submissions made on the Southern Generators' proposal and in the Commission's Draft Rule Determination on that proposal.

A4.1 Submissions on the Southern Generators' Rule change proposal[44]

A4.1.1 Economic efficiency and price impacts

The Southern Generators and the Australian Energy Regulator (AER) made submissions that the proposal would promote dispatch efficiency because it allows demand to be met at a lower underlying cost than under the current arrangements in which NEMMCO intervention can occur.[45] The AER and Southern Generators supported the Southern Generators' proposal on the grounds that it would:

- Increase dispatch efficiency by allowing available lower cost generation (in Victoria, South Australia and Tasmania) to be used in place of higher cost generation (in Snowy and NSW), thereby reducing the total cost of dispatch;
- Provide greater competition across the NEM because flow on the Victoria-Snowy interconnector would no longer be artificially restricted ("clamped") at times of high demand; and
- Remove the current incentives on Snowy Hydro to encourage, rather than alleviate, congestion.

Snowy Hydro disagreed, stating that the proposal would:

43 Ibid.
44 These are formally referred to as the s.95 submissions.
45 Southern Generators, Southern Generators proposal, s.95 submission, p. 4; AER, Southern Generators proposal, s.95 submission, paragraph 13 in attachment.

> "Introduce transparent and blatant generation dispatch inefficiencies as marginally more expensive gas plant in Victoria/SA [would be] operated ahead of marginally cheaper Murray generation…this [would be] an inefficient outcome as the lowest marginal cost plant in the market [would be] displaced by the highest."[46]

Snowy Hydro also said that the Southern Generators' proposal would increase costs to Victorian and SA customers. It maintained that the Southern Generators' proposal would:

> "Artificially keep [the] Tumut [nodal] price high (by not addressing the real problem [i.e. location of the Snowy region boundaries]) and [would] force Murray generation to be cut in preference to more expensive generation located in Victoria/SA. The end effect [would be] that the proposal [would] significantly increase [the] cost to Victorian/SA customers without any additional benefit."[47]

Snowy Hydro acknowledged that all the current options to deal with the Snowy region were unsatisfactory.[48] However, it considered that re-orientation of constraints in the Snowy region to the Dederang node for northerly flows was the most appropriate transitional solution.[49] It proposed that this, in conjunction with its boundary change proposal, offered "the best holistic solution".[50]

Snowy Hydro also argued that the Southern Generators' proposal was attempting to enforce full nodal pricing at a single point to the "competitive detriment to their major competitor." Snowy Hydro stated that:

> "It [was] only a matter of months since the multi year market consultation and MCE policy review with the resulting clear rejection of full nodal pricing in favour of stable large load regions."[51]

In its supplementary submission dated 2 March 2006, Snowy Hydro reiterated this point, stating that the proposal "contradicts the MCE policy direction of rejecting Full Nodal Pricing".[52] Included in the submission was a request for the Commission to consider implementing re-orientation for northerly flows (as used currently for southerly flows) as an alternative to the Southern Generators' proposal. Snowy

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46 Snowy Hydro, Southern Generators' proposal, s.95 submission, p.3.
47 Snowy Hydro, Southern Generators' proposal s.95 submission, p.8.
48 Snowy Hydro, Southern Generators' proposal s.95 submission, p.3.
49 Snowy Hydro, Southern Generators' proposal s.95 submission, p.3 & 9.
50 Snowy Hydro, Southern Generators' proposal s.95 submission, p.1.
51 Snowy Hydro, Southern Generators' proposal s.95 submission, p.3.
52 Snowy Hydro, supplementary submission on Southern Generators' Rule change proposal, 2 March 2006, p.3.

Hydro attached Rule drafting that it suggested could be used to implement re-orientation.[53]

Origin Energy noted that NEMMCO's current intervention "interferes with what was previously an efficient dispatch".[54]

A4.1.2 Risk management impacts and revenue adequacy

Several submissions addressed the issue of the impacts of the Southern Generators' proposal on risk management:

- The Southern Generators stated that the status quo discouraged them from offering financial hedge contracts referenced to the northern regional reference nodes at (Sydney and Brisbane), reflected in the divergence between forward contract prices in NSW and Victoria.[55]

- The AER considered that clamping devalued the effectiveness of settlement residues as an inter-regional hedging instrument.[56]

- Westpac noted that recent uncertainty in flows in the Snowy region had resulted in a decrease in the liquidity of inter-regional hedges.[57]

- Origin said "substantial competition and trading benefits are associated with having greater liquidity around regional reference nodes" and strongly supported measures that minimised inter-regional trading risk.[58]

- Delta Electricity said the Southern Generators' proposal failed to address the problems associated with inter-regional trade.[59]

- Eraring considered the proposal to be unacceptable as it would enhance the performance of one interconnector at the expense of another, and did not solve the underlying problem (which it viewed as the location of the Snowy region boundary) but rather created additional burdens on inter-regional trade.[60]

In its attachment, the AER submission supported the revenue adequacy of the Southern Generators' proposal by demonstrating through a generalised mathematical proof that, having regard to the CSP/CSC trial, the total settlement

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53 Snowy Hydro, supplementary submission on Southern Generators' proposal, 2 March 2006, p.1.
54 Origin Energy, Southern Generators' proposal, s.95 submission, p.1.
55 Southern Generators, Southern Generators' proposal, s.95 submission, p.6.
56 AER, attachment, Southern Generators' proposal, s. 95 submission, p.2.
57 Westpac, Southern Generators' proposal, s.95 submission, p.1.
58 Origin Energy, Southern Generators' proposal, s. 95 submission, p.2.
59 Delta Electricity, Southern Generators' proposal, s. 95 submission, p.2.
60 Eraring Energy, Southern Generators' proposal, s. 95 submission, p.1.

residues across the VIC-Snowy and Snowy-NSW interconnectors were positive. [61] Westpac concurred with the Southern Generators' analysis that there would be sufficient funds available on the Snowy-NSW interconnector to cover the negative residues on the VIC-Snowy interconnector.[62]

A4.1.3 Reliability impacts

After having claimed in their Rule change proposal that it would enhance reliability of supply in NSW, the Southern Generators conceded in their submission that this would not be the case. [63]

Snowy Hydro disagreed with the Southern Generators' initial claims of both additional supply and supply reliability into NSW. Snowy Hydro argued that under the proposal, NSW reliability would not be improved and could be reduced if Murray generation is withheld, which Snowy Hydro believed it is incentivised to do under the proposal. [64]

The AER, in its attachment, supported the Southern Generators' position that the impact of the proposal could increase the total flow into NSW under conditions where there are no constraints north of Tumut power station.[65]

A4.1.4 Good regulatory practice

The Southern Generators' submission stated that it was important to eliminate market intervention by NEMMCO on other than system security grounds.[66]

Origin Energy and Delta Electricity considered that NEMMCO's current clamping intervention created uncertainty in the minds of participants.[67]

A4.1.5 Long term implications

The Southern Generator's submission was the only one that specifically addressed the longer term implications of implementing their proposal. They raised concerns that NEMMCO's intervention was harming investment efficiency by distorting contract prices. In particular, the Southern Generators suggested that NEMMCO intervention artificially inflated contract prices in NSW and depressed contract prices

61 AER, Southern Generators' proposal, s.95 submission, p. 4.
62 Westpac, Southern Generators' proposal, s.95 submission, p.2.
63 Southern Generators, Southern Generators' proposal, s.95 submission, p.17.
64 Snowy Hydro, Southern Generators' proposal, s.95 submission, p.7.
65 AER, Southern Generators' proposal, s.95 submission, p.4-5 of attachment.
66 Southern Generators, Southern Generators' proposal, s.95 submission, p.4.
67 Origin Energy, Southern Generators' proposal, s.95 submission, p.1; Delta Electricity, Southern Generators' proposal, s.95 submission, p.1.

in Victoria. This, in turn, encouraged inefficient investment in the northern regions while discouraging efficient investment in the southern regions.[68]

A4.1.6 Implementation

The Southern Generators considered there were no impediments to implementing their proposal.[69] They saw no conflict between the proposal and the Commission's Snowy regional boundary change consultations, as well as no need to delay consideration of the proposal because of those other consultations. Further, the Southern Generators saw no reason for delay to allow NEMMCO to adjust settlement systems or execute a Settlement Residue option surrender/re-auction cycle. The Southern Generators took this view because they considered:

- the actual settlement adjustment is sufficiently minor for NEMMCO to be able to do it manually;
- IRSR units have been devalued as a consequence of interventions; and
- the proposal would return value to the current units and improve market efficiency significantly.[70]

The Southern Generators commented that the adverse effects of the current delay and any further delay would "endure" because of the three to four year lead time in hedge contract trading.[71]

The only other submission that addressed implementation was from Westpac, who expressed a preference for the proposal to be introduced "sooner rather than later in the interests of market efficiency."[72]

A4.2 Submissions on Southern Generators' Draft Rule Determination[73]

The Southern Generators' submission focused on implementation of its proposal. Their view was that the 1 November 2006 commencement date proposed in the Draft Rule Determination was the latest implementation date in order to be in place before summer 2006/2007.[74] The Southern Generators concurred with the Commission's Draft Rule Determination finding that the settlement residue process was not "an impediment to timely implementation".[75] They also expressed the view that the Rule should be implemented by a "specialised process external to the MMS" because the market benefits of implementation by 1 November 2006 outweighed the "risks of

68 Southern Generators, Southern Generators' proposal, s.95 submission, p.7.
69 Southern Generators, Southern Generators' proposal, s.95 submission, p.10.
70 Southern Generators, Southern Generators' proposal, s.95 submission, p.10.
71 Southern Generators, Southern Generators' proposal, s.95 submission, p.10.
72 Westpac, Southern Generators' proposal, s.95 submission, p.2.
73 These are formally referred to as the s.99 submissions.
74 Southern Generators, Southern Generators' proposal, s.99 submission, pp.1-2.
75 Southern Generators, Southern Generators' proposal, s.99 submission, p.2.

audit or stability issues which may arise from a specialised external process to the MMS".[76]

Westpac expressed a preference for implementation to be aligned with the SRA product (i.e. 1 September 2006) rather than in the middle of a quarter, but accepted a 1 November 2006 start. Westpac also noted that the Settlement Residue Committee would be the best forum for deciding how to manage the impact on SRA participants.[77]

NEMMCO explained that it recognised the short-term nature of the proposal and had fast-tracked MMS development by using the Draft Rule Determination to start the development cycle.[78] NEMMCO stated that if the proposal commenced on 1 November 2006, NEMMCO would make retrospective settlement adjustments when the MMS software was ready.[79] NEMMCO would make settlement adjustments for the month of November 2006 according to the table below:

Week ID	Billing Period Start	Billing Period End	Preliminary Statement	Final Statement	Revised Statement
44	Sun-29-Oct	Sat-4-Nov	Fri-10-Nov	Wed-29-Nov	Tue-20-Mar
45	Sun-5-Nov	Sat-11-Nov	Fri-17-Nov	Wed-6-Dec	
46	Sun-12-Nov	Sat-18-Nov	Fri-24-Nov	Wed-13-Dec	

Statements where Rule change transactions will not be included if there is a 1 November commencement date.

The first statement where Rule change transactions will be included if there is a 1 November commencement date.

Source: NEMMCO, s.99 submission, Management of negative settlement residues in the Snowy region, Draft Rule Determination, 18 July 2006, p.2

NEMMCO stated that:

> Providing [proposed Rule] clauses or similar clauses were carried through the final Rule, NEMMCO would see no need in consulting with industry, as it would use those clauses as a basis to modify its operating procedures.[80]

In the submission, NEMMCO also noted that beyond modifying its operating procedure, there would be "no additional implementation expenses for the Re-

76 Ibid.
77 Westpac, Southern Generators' proposal, s.99 submission, p.1.
78 NEMMCO, Southern Generators' proposal, s.99 submission, p.2.
79 NEMMCO, Southern Generators' proposal, s.99 submission, p.2.
80 NEMMCO, Southern Generators' proposal, s.99 submission, p. 3

orientation proposal" it would absorb procedural modifications as part of its operations.[81]

NEMMCO also reiterated that while both the Southern Generators' and Snowy Hydro Re-orientation Rule change proposals would permit it to cease managing negative residues by restricting flow on the Victoria-Snowy interconnector, the Snowy Hydro Re-orientation proposal would:

> "Require NEMMCO to continue to judge when to apply the alternate formulation."[82]

Snowy Hydro took the opportunity in its submission to respond to the Southern Generators', Westpac's, and Origin Energy's submissions on its Re-orientation proposal. Snowy Hydro reiterated its position that the Southern Generators' proposal would be likely to reduce competition between Murray generation and generation in Victoria and South Australia. Snowy Hydro also restated that neither the Snowy Hydro Re-orientation nor Southern Generators' proposal would result in increased flows into NSW. [83]

Snowy Hydro argued that its Re-orientation proposal did not impede inter-regional trade because:

- It did not restrict interconnector flow;
- It enabled the Victorian and Snowy regional reference prices to equalise; and
- The Snowy-NSW IRSR units remained fully effective as a hedging tool as those residues would remain whole.[84]

Snowy Hydro stated that while the current arrangements made it difficult for the Southern Generators to hedge price separation between Victoria and NSW, their proposal would "simply transfer that difficulty and risk to Snowy Hydro." Re-orientation lowered the risk for all parties.[85]

Snowy Hydro also argued that the Southern Generators' proposal did not create incentives for Murray generation to reveal its opportunity cost in generator offers. According to Snowy Hydro, this notion wrongly and simplistically assumed that nodal prices themselves create incentives to reveal true marginal costs.[86] By contrast, Snowy Hydro stated that:

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81 Ibid.
82 NEMMCO, Southern Generators' proposal, s.99 submission, p.3.
83 Snowy Hydro, Southern Generators' proposal, s.99 submission, p.4.
84 Snowy Hydro, Southern Generators' proposal, s.99 submission, p.4.
85 Snowy Hydro, Southern Generators' proposal, s.99 submission, p.4.
86 Snowy Hydro, Southern Generators' proposal, s.99 submission, p.2.

> "Under re-orientation the price Murray receives is directly affected by the volume/price it bids, in exactly the same way that Loy Yang's volume/price bids affect the Victorian price…Murray output does and will affect the Spot price in Victoria."[87]

Snowy Hydro took issue with the dispatch instability argument raised by the Southern Generators' in their submission on its Re-orientation Rule change proposal. The Southern Generators had argued that stability in dispatch was important and re-orientation required intervention by NEMMCO, which may result in dispatch instability.[88] However, Snowy Hydro argued that there was no instability with using re-orientation for southern flows and so instability should not occur for northern flows. Snowy Hydro contended that NEMMCO could leave the re-oriented constraints in for a reasonable period following their introduction and that, "the impact of NEMMCO's exercise of judgement is also immaterial." At the same time, Snowy Hydro concluded by stating that NEMMCO would only need to use the re-oriented constraints for a limited number of hours.[89]

Snowy Hydro also stated that its Re-orientation proposal was:

> "Closely aligned with the likely future direction for regional boundary chance in the Snowy region, and so provide[d] a transition path for participants."[90]

Origin Energy argued that the Snowy Hydro Re-orientation proposal placed Murray generation on equal footing with other generators in Victoria. This, it stated, increased the competition and liquidity of contract trade around the node.[91]

Westpac stated that the AEMC should reject the Snowy Hydro Re-orientation proposal in preference for the Southern Generators' proposal on the basis that:

> "Snowy Hydro should not be allowed to cherry pick locational pricing when it suits them (i.e. full locational pricing at the Tumut node for north transfer due to the CSP scheme, partial nodal pricing for Tumut in the Southern direction due to the CSC scheme and an attempt to avoid the location price at the Murray node despite the fact that it is the regional reference node)."[92]

A4.3 Supplementary submissions on the Southern Generators' proposal and Snowy Hydro Re-orientation proposal

On 28 August 2006, Snowy Hydro made a supplementary submission to the Commission regarding the potential impact of the Southern Generators' proposal on

87 Snowy Hydro, Southern Generators' proposal, s.99 submission, p.4.
88 Southern Generators, Snowy Hydro Re-orientation proposal, s.95 submission, p.2, 4.
89 Snowy Hydro, Southern Generators' proposal, s.99 submission, p.4.
90 Snowy Hydro, Southern Generators' proposal, s.99 submission, pp.1-2.
91 Origin energy, Snowy Hydro Re-orientation proposal, s.95 submission, p.1.
92 Westpac, Southern Generators' proposal, s.99 submission, p.1.

supply reliability in Victoria. Snowy Hydro contended that, because of 1 in 100 year drought conditions and low water levels in its principal storage lake, the implementation of the Southern Generators' proposal instead of its own Re-orientation proposal (or maintenance of the Status Quo arrangements) could create risks for Victorian supply reliability over the summer of 2006-07. The details of this matter and the Commission's response are contained in Part 3 Appendix D.

A4.4 Submissions on the Snowy Hydro Re-orientation Rule change proposal

A4.4.1 Outcomes from previous consultations

Between 6 April and 20 September 2005, NEMMCO consulted on proposed modifications to its operating procedures to manage negative settlement residues by re-orienting constraints, which were similar to Snowy Hydro's Re-orientation proposal. In its submission, NEMMCO stated it rejected the proposal to re-orient constraints because:

> "The dispatch and pricing results under the proposed change to re-orient constraints was likely to be similar if not more pronounced than the outcomes of NEMMCO's current practice of restricting flows."[93]

In their submissions, both Westpac and the Southern Generators supported NEMMCO's 2005 findings and did not consider that there was any new information to support change now.[94]

A4.4.2 Dispatch efficiency

Westpac said that if Murray generation received the Victorian price, it would be incentivised to overproduce.[95] The Snowy Hydro Re-orientation proposal should be rejected, argued Westpac, because "it encouraged Snowy Hydro to behave in a strategic manner".[96]

In their submission, the Southern Generators' stated it would be "difficult for the AEMC to separate the economic gains" of the two proposals because of the uncertain effects that the mis-pricing introduced by the Snowy Hydro Re-orientation proposal would have on Snowy generator offers.[97] They stated their proposal modified the settlement process and did not distort incentives for generator offers. In addition, the Snowy Hydro Re-orientation proposal would involve both real-time dispatch

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93 NEMMCO, Snowy Hydro Re-orientation proposal, s.95 submission, p.1.
94 Westpac, Snowy Hydro Re-orientation proposal, s.95 submission, p.1; Southern Generators, Snowy Hydro Re-orientation proposal, s.95 submission, p.6-7.
95 Westpac, Snowy Hydro Re-orientation proposal, s.95 submission, p.2-3.
96 Westpac, Snowy Hydro Re-orientation proposal, s.95 submission, p.2.
97 Southern Generators, Snowy Hydro Re-orientation proposal, s.95 submission, p.1.

intervention by NEMMCO and the isolation of Murray generation from the settlement impacts of its spot market price.[98]

Snowy Hydro argued that the Southern Generators' proposal would introduce "nodal pricing at Murray," which it claimed would result in "incentives for inefficient dispatch to manage the resulting price risk".[99] Snowy Hydro stated that compared to the status quo and the Snowy Hydro Re-orientation proposal, the Southern Generators' proposal would result in a decrease of Murray generation (down to around 240MW), an increase Victorian generation, therefore increasing generation costs and lowering dispatch efficiency. Snowy Hydro believed there would be a minimal dispatch impact for southern flows.[100]

Origin Energy argued that the Snowy Hydro Re-orientation proposal removed Snowy Hydro's incentives to "engage in strategic bidding since it would no longer have control over its own pricing node".[101]

Snowy Hydro responded to the Southern Generators', Westpac's, and Origin Energy's s.95 Snowy Hydro Re-orientation proposal submissions in its s.99 submission to the Southern Generators' Draft Rule Determination (see above).

As an attachment to its submission, the AER included a paper in which he discussed the implications of re-orienting Snowy region constraints to Dederang ("the problems with merging two regions").[102] It concluded that while re-orientation eliminated negative residues, "inefficiency in dispatch" resulted from the "mis-match between pricing and dispatch" at the Murray node. The AER stated that this new pricing distortion may be "just as significant [a] distortion in dispatch" as NEMMCO's current intervention."[103]

A4.4.3 Pricing impacts

Westpac considered that the current low price for Murray generation was economically valid as that generation has a greater impact on network congestion compared to Victorian generation.[104] It stated that "no one participant should be able to directly or unilaterally influence the pool price and payoff of derivative instruments."[105]

98 Southern Generators, Snowy Hydro Re-orientation proposal, s.95 submission, p.2, 4.
99 Snowy Hydro, Snowy Hydro Re-orientation proposal, s.95 submission, p.10.
100 Snowy Hydro, Snowy Hydro Re-orientation proposal, s.95 submission, p.9-10.
101 Origin Energy, Snowy Hydro Re-orientation proposal, s.95 submission, p.1.
102 AER, Southern Generators proposal, s.95 submission, Attachment p.9.
103 AER, Southern Generators proposal, s.95 submission, Attachment p.9.
104 Westpac, Snowy Hydro Re-orientation proposal, s.95 submission, p.2.
105 Westpac, Snowy Hydro Re-orientation proposal, s.95 submission, p.2.

In its submission on the Southern Generators Draft Rule Determination, Westpac also stated that Snowy Hydro should not be allowed to choose when it should receive locational pricing.[106]

The Southern Generators accepted that a regional model did not necessarily fully expose all generators to the settlement impact of spot market prices. They stated that Snowy Hydro's Re-orientation proposal weakened the link between Snowy Hydro's market offers and market incentives based on market settlement, distorting the existing locational prices. This could create a scenario where a generator would be able to control not only the physical binding of a transmission flowpath, but also the node pricing the generation plant output.[107]

Reiterating a similar view in its submission on the Southern Generators Draft Rule Determination,[108] Snowy Hydro stated that because neither proposal would increase flows into NSW therefore not materially affecting dispatch in NSW, prices in NSW would not change. This, it said, was because it bid Tumut generation "to ensure the transmission lines [north of Tumut] are fully loaded, while ensuring they do not constraint." It said historical data "substantiate[d] this assertion".[109]

Snowy Hydro also stated that to see pricing impacts, the Commission needed to consider the impact of contracting positions on bidding strategies and pricing. Under its Re-orientation proposal, Snowy Hydro stated that Murray would not be exposed to low prices and therefore would not be incentivised to withdraw capacity or bid below short run marginal cost (SRMC) in order to manage NEMMCO intervention risk. Re-orientation would lead to more competitive outcomes in the Victorian spot price.[110]

Origin Energy stated that the Snowy Hydro Re-orientation proposal was consistent with principles of regional market design where generators did not generally receive the price at a node. Under re-orientation, Murray and the Victorian generators would observe the same price signals and thus, would have the same capacity to respond to those signals. It argued that if Murray offered its generation in at a low price because of its low marginal cost, those offers would affect the price it receives to the extent it displaces the dispatch of higher cost Victorian generators in the merit order stack. It stated there would be a partial mismatch between dispatch and pricing but that it would not be substantively different to that affecting other generators subject to a regional price.[111]

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106 Westpac, Southern Generators' proposal, s.99 submission, p.1.
107 Southern Generators, Snowy Hydro Re-orientation proposal, s.95 submission, p.2-3.
108 Snowy Hydro, Southern Generators' proposal, s.99 submissioin, p.4.
109 Snowy Hydro, Snowy Hydro Re-orientation proposal, s.95 submission, p2.
110 Snowy Hydro, Snowy Hydro Re-orientation proposal, s.95 submission, p.11-13.
111 Origin Energy, Snowy Hydro Re-orientation proposal, s.95 submission, p.1.

A4.4.4 Impact on the management of inter-regional trading risk

The Southern Generators stated that compared to the Southern Generators' proposal, the Snowy Hydro Re-orientation proposal may not increase the extent of inter-regional trading between Victoria and NSW. They stated there was a potential for a reduction in interconnector firmness similar to clamping.[112] Snowy Hydro responded to these comments in its s.99 submission on the Southern Generators' Draft Rule Determination (see above).

Snowy Hydro's submission stated that approaches that lower volatility should be preferred to approaches that leave market participants unable to effectively hedge risk at a reasonable cost. Re-orientation would ensure a firmer hedge market for all participants, whereas the Southern Generators' proposal would lower the firmness of hedges between the Snowy region and the NSW and Victorian regions. Snowy Hydro suggested that the Commission should consider the extent to which a proposal impacts the risk of inter-regional trading rather than just considering whether a proposal enhances opportunities for inter-regional trading.[113] Snowy Hydro reiterated these comments in its submission on the Southern Generators' Draft Rule Determination.[114]

Westpac stated in its submission that the Snowy Hydro Re-orientation proposal would introduce additional residue issues. The increment in payment to Murray would be "exactly balanced by a reduction in payment to SNOWY1 [Snowy-NSW IRSR] unit holders".[115]

Origin Energy stated that removing "clamping" lowered the inter-regional trading risk from all generators on the export side of the Murray-Tumut constraint. Under the Southern Generators' proposal, Origin argued that while there would be a lower risk for Victorian generators, there would be a higher risk for the Snowy generators, and lower value Snowy-NSW inter-regional settlement residues (IRSRs) for all participants. Re-orientation, on the other hand, would place the Snowy Hydro generators in regions with load, lowering their trading risks, and lowering contract costs for retailers supplying Victorian and NSW customers. This would increase the competition and liquidity of [contract] trade around the [Victorian] node.[116]

A4.4.5 Power system reliability and security

Snowy Hydro agreed with the Commission's view in the Southern Generators' Draft Rule Determination that neither the Southern Generators' nor Snowy Hydro Re-orientation proposals would materially affect reliability into NSW.[117]

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112 Southern Generators, Snowy Hydro Re-orientation proposal, s.95 submission, p.4.
113 Snowy Hydro, Snowy Hydro Re-orientation proposal, s.95 submission, p.12-14, 22.
114 Snowy Hydro, Southern Generators' proposal, s.99 submission, p.4.
115 Westpac, Snowy Hydro Re-orientation proposal, s.95 submission, p.2.
116 Origin Energy, Snowy Hydro Re-orientation proposal, s.95 submission, p.1.
117 Snowy Hydro, Snowy Hydro Re-orientation proposal, s.95 submission, p.14.

A4.4.6 Good regulatory practice

In their submission, the Southern Generators concurred with the Commission's draft decision favouring small incremental regulatory changes to take the market towards more efficient dispatch. They also stated that re-orientation requires intervention by NEMMCO, which may result in dispatch instability.[118]

In its submission on the Southern Generators' Draft Rule Determination, NEMMCO stated that while re-orientation would permit it to cease managing negative residues by restricting flows on the Victoria-Snowy interconnector, it would still require it to judge when to apply the alternate constraint formulation.[119]

In its submission on the Snowy Hydro Re-orientation proposal, NEMMCO reiterated its point stating that the proposal would require NEMMCO to intervene in the market and to exercise judgement when applying the re-orientation constraint during dispatch time-frame compared to no such intervention or discretionary judgement for implementing the Southern Generators' proposal.[120]

Snowy Hydro agreed with the Commission's view in the Southern Generators' Draft Rule Determination that the uncertainty associated with the status quo was regarded as poor regulatory practice. It proposed that either alternative would provide a higher and equivalent certainty.[121]

A4.4.7 Revenue adequacy

Snowy Hydro agreed with the Commission's Draft Rule Determination that the Southern Generators' proposal was in general revenue adequate, but it was not guaranteed under certain transmission outage conditions. Revenue adequacy was not a problem for its Re-orientation proposal.[122]

A4.4.8 Long term implications

Origin Energy stated that greater competition benefits would arise from changing the Snowy region boundaries, placing Murray in Victoria and Tumut in NSW. Because the Snowy Hydro Re-orientation proposal was closely aligned to that likely boundary change, it argued that similar benefits would apply to implementing it a short-term measure. This would provide a more appropriate transition path for participants than the Southern Generators' proposal, which was more ad hoc and arbitrary as a temporary fix.[123]

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118 Southern Generators, Snowy Hydro Re-orientation proposal, s.95 submission, p.2, 4.
119 NEMMCO, Southern Generators' proposal, s.99 submission, p.3.
120 NEMMCO, Snowy Hydro Re-orientation proposal, s.95 submission, p.2.
121 Snowy Hydro, Snowy Hydro Re-orientation proposal, s.95 submission, p.14.
122 Snowy Hydro, Snowy Hydro Re-orientation proposal, s.95 submission, p.14.
123 Origin Energy, Snowy Hydro Re-orientation proposal, s.95 submission, p.1-2.

Snowy Hydro agreed that incremental changes were desirable in isolation but such changes should not be contemplated if inconsistent with the desired longer term evolution of the market. Snowy Hydro stated that:

> "The Southern Generators' proposal would move towards nodal pricing for Murray. The reorientation proposal [was] effectively a dynamic change to the regional boundary. The reorientation proposal [was] more consistent with the MCE policy of evolution of the regional framework of the market, rather that its replacement with nodal pricing."[124]

In Snowy Hydro's view, its Re-orientation proposal is consistent with the long-term Snowy region boundary change solution.[125] Snowy Hydro also raised this view in its submission on the Southern Generators Draft Rule Determination.[126]

A4.4.9 Implementation

In its submission on the Southern Generators Draft Rule Determination, NEMMCO noted that beyond modifying its operating procedure, there would be "no additional implementation expenses for the Re-orientation proposal".[127]

In its submission on the Snowy Hydro Re-orientation proposal, NEMMCO stated that the proposal did not require a modification to market systems. It would, therefore, only require up to two weeks of implementation time to amend, publish, and revise procedures as required by the Final Rule.[128]

A5 Commission's considerations

As highlighted above, the Commission's assessment of the Southern Generators' and Snowy Hydro's Re-orientation Rule change proposals focuses on the following matters:

- Economic efficiency of dispatch;
- Spot market and contract pricing outcomes;
- Inter-regional trading (including revenue adequacy of the proposal);
- Power system security and reliability;
- Good regulatory practice;

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124 Snowy Hydro, Snowy Hydro Re-orientation proposal, s.95 submission, p.2.
125 Snowy Hydro, Snowy Hydro Re-orientation proposal, s.95 submission, p.4-5.
126 Snowy Hydro, Southern Generators' proposal, s.99 submission, p.1-2.
127 NEMMCO, Southern Generators' proposal, s.99 submission, p.3.
128 NEMMCO, Snowy Hydro Re-orientation proposal, s.95 submission, p.2.

- Long term implications; and
- Implementation.

The Commission's considerations on these matters are discussed below.

A5.1 Economic efficiency of dispatch

A5.1.1 Introduction

The Commission's assessment of the dispatch efficiency implications of the two proposals focuses on the direction and extent of likely changes to the variable costs of power production. Given the expected short duration of the proposal (less than one year), over which plant mix is unlikely to significantly change, the Commission did not consider it necessary to examine the dynamic investment effects of the proposal.

Economically efficient dispatch is achieved when demand is met by the least-cost combination of generation, taking into account any network limitations and other power system security constraints. In this context, cost refers to the costs that can be avoided in the period covered by the proposal – this is also known as the opportunity cost of production and most commonly referred to as short run marginal cost (SRMC).

The opportunity cost of thermal plant is reasonably well-known and largely comprises fuel costs and a small amount of other variable operating costs (e.g. lubricants, chemicals, water, and ash treatment, etc). By contrast, the opportunity costs of hydro plant are less transparent because they do not purchase the fuel (i.e. water) they use to generate electricity. The opportunity cost of the water used by a hydro plant to generate electricity at any given time is derived from the value of the power it could produce at the best alternative time. In a power system, a hydro plant with limited water supply will tend to use its water allocation when it can make most money. In the NEM these times are generally associated with peak demand periods. In the NEM when a hydro plant runs, it generally displaces the output of a thermal plant. Therefore, the opportunity cost of a hydro plant is the opportunity cost of the last unit of output by the thermal plant it displaces. By contrast, run-of-river hydro plant with no capability to store water may have an opportunity cost close to zero, because it cannot use its water to generate electricity at any alternative time – the alternative to generating is allowing the water to flow past unused.

A5.1.2 Conceptual analysis

The NEM dispatch algorithm will minimise the cost of dispatch based on participants' bids and offers and network and power system constraints. If bids and offers reflect opportunity costs, and constraints are properly taken into account, the

NEM dispatch engine (NEMDE) will produce economically efficient dispatch.[129] However, dispatch may not be efficient if either of the following occurs:

- intervention in the dispatch process, such as clamping (intervention); or
- bids and offers do not reflect opportunity costs (strategic bidding).

Both of these situations can be referred to as involving "distortions" to a theoretically efficient dispatch scenario.

The implication of this finding is that if only one form of distortion is present, the removal of that distortion should improve the efficiency of dispatch. For example, analysis undertaken for the Commission suggests that in an environment of competitive generator bidding,[130] the Southern Generators' proposal is likely to produce more efficient dispatch than either the Status Quo arrangements or the Snowy Hydro Re-orientation proposal.[131] This is because the Southern Generators' proposal involves the removal of the other remaining distortion (NEMMCO's interventions via clamping and re-orientation). In an environment of competitive bidding:

- the Status Quo leads to inefficiently high generation at Murray and inefficiently low output by the generators in the Southern regions (Victoria, South Australia and Tasmania) at times of northward flows;[132] while
- the Snowy Hydro Re-orientation proposal also leads to inefficiently high generation at Murray and inefficiently low output by the generators in the Southern regions at times of northward flows.[133] This is because the Snowy Hydro Re-orientation proposal involves (deliberate) mis-pricing at the Murray node, which is likely to lead to a degree of dispatch inefficiency as Murray responds to a price signal that does not reflect the true value of its output.

In fact, the Snowy Hydro Re-orientation proposal may lead to even less efficient dispatch than the Status Quo under certain conditions.[134]

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129 Part 3 Appendix B, paragraph 15.

130 This analysis required a number of other "benchmark assumptions" to be made, including: (b) that each generator faces its correct locational price for its output at its location; (c) the mathematical constraints in the NEMDE accurately reflect the true physical limits of the network; and (d) the only constraint that is binding (or threatening to bind) is the Murray-Tumut constraint. See Part 3 Appendix B, paragraph 13.

131 Part 3 Appendix B, paragraph 17 and paragraph 31.

132 Part 3 Appendix B, paragraphs 18-22.

133 Part 3 Appendix B, paragraphs 23-30.

134 Part 3 Appendix B, paragraphs 29-30. However, this conclusion does not follow where the opportunity cost of Murray generation exceeds the post-re-orientation Victorian price. In this case, Murray output may not be as high as it would be under the Status Quo arrangements and Re-orientation would be preferable to the Status Quo.

Moving on to the consideration of more realistic market conditions, the Commission's analysis shows that if *both* types of distortions are present (non-competitive bidding *and* NEMMCO intervention), there is no guarantee that removing only one (intervention) will lead to more efficient dispatch if the other (strategic bidding) remains in place. This conclusion was supported by the conceptual analysis undertaken for the Commission.[135] The remainder of this section discusses the Commission's assessment of the relative merits of the two Rule change proposals against the Status Quo and each other in an environment where generators may not price their offers equal to their opportunity cost of production.

The Commission's assessment of the impact of the Southern Generators' and Snowy Hydro Re-orientation proposals on dispatch efficiency is described below, separately for northward and southward flows, as the operation and effects of the alternative approaches are different depending on the flow direction.

For northward flows

Northward flows into NSW through the Snowy Region typically occur when demand and prices in the NSW region are high relative to demand and prices in the southern regions of Victoria, South Australia and Tasmania (Southern regions).

Status Quo

Under the Status Quo arrangements, Snowy Hydro has incentives to offer Murray generation in a way to cause the Murray-Tumut constraint to bind as frequently as possible. When this constraint binds, NEMMCO implements clamping, which allows the price at Murray (i.e. the Snowy regional price) to rise to the level of the (higher) NSW price. Therefore, Snowy Hydro has incentives to offer Murray generation at below its true opportunity cost in order to induce clamping. This is likely to lead to Murray being dispatched at an even higher level than under the competitive bidding scenario.[136]

Southern Generators' proposal

Implementation of the Southern Generators' proposal would lead to the elimination of NEMMCO clamping of the Victoria-Snowy interconnector when northward counter-price flows occurred. It would also avoid re-orientation at times of southward flows and binding constraints between Murray and Tumut.

As noted above, under competitive bidding conditions, such a proposal would promote dispatch efficiency.

However, in the presence of non-competitive bidding, it is not clear whether the Southern Generators' proposal would lead to more efficient dispatch than under the Status Quo. This is because Snowy Hydro has incentives to ensure the Murray-

135 Part 3 Appendix B, paragraphs 57-58.
136 Part 3 Appendix B, paragraphs 37-39.

Tumut constraint does not bind. If it does bind, the price at Murray (the Snowy region price) would fall and reduce the pool revenues earned by Snowy Hydro. Therefore, Snowy Hydro has incentives to offer Murray generation at a price above its opportunity cost (or withhold some of Murray's capacity from the market).[137] This could lead to an inefficiently low level of Murray output and an inefficiently high level of output by generators in the Southern regions of the NEM at these times.

Snowy Hydro's Re-orientation proposal

Under the Snowy Hydro Re-orientation proposal, the Snowy regional price would effectively be set at the Victorian regional price (leaving aside losses)[138] when accumulated negative settlement residues on the Victoria to Snowy interconnector reached $6,000 in a continuous series of dispatch intervals. This would overcome the risk of counter-price flows and the need for clamping.

As under the Southern Generators' proposal, under Re-orientation, Snowy Hydro has incentives to prevent the Murray-Tumut constraint from binding. This is because the Victorian price at times of northward flows and a binding Murray-Tumut constraint will be less than the uniform (unconstrained) price Snowy Hydro generation would otherwise earn. Therefore, as under the Southern Generators' proposal, Snowy Hydro has incentives to offer Murray output at a price in excess of its opportunity cost (or withhold Murray generation).[139] This could lead to inefficient dispatch in a similar way as under the Southern Generators' proposal.

However, if Victorian demand and prices are sufficiently high, Snowy Hydro may have incentives to switch strategies and offer Murray output at a price well below opportunity cost.[140] This is because instead of earning a high (unconstrained) price on a small proportion of Murray output, Snowy Hydro could earn a nearly-as-high Victorian price on a much larger proportion of its output. The latter outcome could be preferable if the Victorian price were also relatively high. This strategy could even lead to the Snowy region exporting both to NSW and Victoria.

The strategy Snowy Hydro chooses to adopt would depend on a range of factors, but these would include: the respective pool revenues that could be earned under the two strategies; and the balance of the contract portfolio between NSW and Victoria.

Consideration of network constraints north of Tumut

Another issue the Commission considered was the impact on dispatch (and pricing) of network constraints north of Tumut that prevented increased flows into NSW from Snowy and the Southern regions.

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137 Part 3 Appendix B, paragraphs 40-43.

138 More accurately, the Snowy RRN price would be set at the Dederang nodal price, which should equal the Victorian RRN subject to any constraints and losses between Dederang and the Victorian RRN.

139 Part 3 Appendix B, paragraphs 48-53.

140 Part 3 Appendix B, paragraphs 50-53.

In its Re-orientation Rule change proposal, Snowy Hydro stated that the:

> "Impact of [its and the Southern Generators'] proposals depends on Tumut's bidding behaviour. If Tumut is dispatched to use the available headroom [in transmission capacity across a cutset of lines] into NSW then it will not be possible to increase flows into NSW. However, if Tumut withholds capacity during high demand periods, then additional flows across the cutset would increase flows into NSW."[141]

Snowy Hydro noted that, over the 2005/06 summer, the average minimum 'headroom' on the 03/07 lines between Lower Tumut and Yass/Canberra was 58 MW at times when the NSW price exceeded $1000/MWh.[142] Hence, Rule changes that might be considered to increase flows into NSW at times of high NSW demand and prices would not actually have that effect – Snowy Hydro would simply adjust Tumut output (downwards) in order to prevent those limits being reached, so as to keep the Tumut and Murray prices aligned with the NSW price, in order to protect Snowy Hydro's contract position.

A key issue in determining whether Snowy Hydro's contentions on the impact of network limits north of Tumut are relevant to potential dispatch outcomes under the proposals is the way in which those limits are set. If network limits north of Tumut were fairly constant under most network conditions, it would suggest that the scope for additional flows into NSW is small. However, as those limits are dynamic and influenced by the level of Snowy Hydro's own output (in that terms involving output at Snowy appear in the right hand side of the transmission constraints), the fact that historically observed headroom is low may not imply that northward flows could not rise under one or both of the two Rule change proposals. This issue is discussed further below in the discussion of the market modelling analysis.

For southward flows

Southward flows through the Snowy region typically occur when demand and prices in Victoria, South Australia, and Tasmania (the Southern regions) are high relative to demand and prices in NSW.

Status Quo

Under the Status Quo arrangements, Murray generation faces a weaker incentive to generate than may be optimal. This is because under the Status Quo, when flows are southwards and the Murray–Tumut constraint binds, Murray generation receives the Dederang price — which is lower than the Murray price (See Box A2 above). This may lead to less than efficient dispatch if Murray generation responds by generating less than it would have generated had it received its local nodal price.

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141 Snowy Hydro, Re-orientation Rule change proposal, p.6.
142 Snowy Hydro, Re-orientation Rule change proposal, p.7.

Snowy Hydro Re-orientation proposal

Re-orientation is currently the mechanism NEMMCO uses for managing negative settlement residues on the Victoria-Snowy interconnector for southward flows.

Southern Generators' proposal

Under the Southern Generators' proposal, NEMMCO would no longer re-oriente the constraint to Dederang during counter-price flows. Instead, the negative residues on the Snowy-Victoria interconnector would be funded through a transfer of settlement residues from the NSW-Snowy interconnector. As a result, Murray generation would face its local nodal price and may generate more than it does under the Status Quo or Snowy Hydro's Re-orientation proposal. However, whether this is the case in practice depends on whether and to what extent Snowy Hydro finds it advantageous to offer Murray output at a price above its opportunity cost in order to push the Victorian, and hence Snowy price higher.

A5.1.3 Market modelling results

The conceptual analysis above suggests that the question of whether dispatch efficiency benefits result from either the Southern Generators' or Snowy Hydro Re-orientation proposals cannot be determined analytically. In this context, the Commission notes that NEMMCO's 2005 consultation process on the Tumut Pricing Derogation implementing the CSP/CSC trial was based on qualitative analysis alone and NEMMCO did not undertake any quantitative modelling. [143]

For these reasons, the Commission sought quantitative market modelling analysis to gain greater insight into the potential impacts of the two Rule change proposals.

The model used to test the Southern Generators' proposal and the Snowy Hydro Re-orientation proposal replicates the NEM dispatch engine's operation of dispatching the least-priced combination of generation to meet a given demand. When compared to the Status Quo, the changes in output under the Southern Generators' and Snowy Hydro Re-orientation proposals reflected a change in dispatched generation, and the underlying opportunity costs of that generation were used to determine whether dispatch efficiency had improved. Details of the modelling approach and assumptions can be found in Part 3 Appendix C.

An important aspect of the modelling approach is that it specifically examined the changes to generator bidding behaviour, and thus pricing and generator dispatch, resulting from the proposed Rule changes. The model achieved this by using game-theoretic solution techniques. This approach allowed the Commission to test the overall effects of the different proposals over a very wide range of bidding and contracting conditions.

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143 NEMMCO, *Revision to Procedures for Management of Negative Residues, Version No. 2, Final Determination*, 20 September 2005.

Southern Generators' proposal

The modelling undertaken for the Commission indicated that the Southern Generators' proposal could lead to a relatively small reduction in variable production costs across the NEM when compared to the Status Quo base case (as defined in Part 3 Appendix C (see Figure C12 and Table C6[144]). The proposal resulted in lower annual production costs than the Status Quo of approximately $1-3 million over one year, depending on the scenario. This result was primarily driven by lower production costs in the summer peak period. This result was consistent in all scenarios.

The lower summer peak production costs relative to the Status Quo base case appear to have been driven by a slightly higher Snowy Hydro summer peak output (particularly Tumut output) across most of the contracting scenarios. This would result in a greater displacement of thermal plant compared to the Status Quo at these times (see Figure C14).[145]

Importantly, the production costs savings of the Southern Generators' proposal do not involve any capital outlay or any appreciable operating costs, such as those would be required for an equivalent increase in the capacity of the interconnector. Achieving these efficiency savings simply involves changing which constraint equations NEMDE uses when negative settlement residues accrue on the Victoria-Snowy interconnector.

On the issue of whether there would be sufficient 'headroom' on the lines north of Tumut to allow greater imports into NSW at times of northward flows, the historical market analysis found wide variation in the absolute value of the Snowy to NSW interconnector export limit. In particular, when the NSW price exceeded $1,000/MWh, the limit varied from 2,400 MW to 3,100 MW (see Figure C9), while headroom generally remained less than 150 MW (see Figure C8). Therefore, even though observed headroom may be relatively low at these times, actual northward flows on the Snowy-NSW interconnector can vary substantially.

Snowy Hydro Re-orientation proposal

The market modelling undertaken for the Commission indicated that the Snowy Hydro Re-orientation proposal could also lead to a modest fall in the variable costs of production across the NEM. The modelling showed annual production costs that were lower than the Status Quo by approximately $1-3 million over one year (see Figure C12 and Table C6).

This represents a very similar outcome to that produced for the Southern Generators' proposal. Once again, the proposal appears to have led to primarily lower summer

144 Note: the Figures labelled Figure C"X" can be found in Part 3 Appendix C.

145 See p.C24 in Part 3 Appendix C for a description of the energy constrained modelling restrictions.

peak production costs, potentially driven by generally higher Snowy Hydro (especially Tumut) dispatch in place of thermal plant (see Figure C13).

A5.1.4 Commission's assessment

On balance, the Commission considers that both the Southern Generators' proposal and the Snowy Hydro's Re-orientation proposal may produce relatively small dispatch efficiency benefits compared to the Status Quo base case involving clamping, which supports the case for a change towards one or other of the proposals. These small gains in annual dispatch efficiency are consistent with the fact that clamping only occurs in a small percentage of hours in the year, so changes in productive efficiency at these times is only ever likely to create a relatively small change in annual dispatch efficiency. However, the Commission is aware that the modelling outcomes are sensitive to the assumptions adopted about generators' strategies, contracting levels and locations and transmission constraints elsewhere in the NEM. Further, the Commission notes that, based on the modelling analysis undertaken, there is little to distinguish between the two proposals from a dispatch efficiency perspective. For these reasons, the Commission has ensured that it has not placed undue weight on dispatch efficiency impacts in choosing between the two proposals.

A5.2 Spot market and contract pricing outcomes

A5.2.1 Introduction

The effect of the Southern Generators' and Snowy Hydro Re-orientation proposals on price outcomes in the NEM is a further consideration in the Commission's assessment of the two proposals.

Economic principles and competitive market experience indicates that resources will generally be allocated efficiently where prices equal the opportunity cost of supply. At this point, the price consumers pay to consume electricity will equal the cost generators incur to produce electricity.

Prices that are higher than the opportunity cost of supply imply that consumers are required to pay more than the cost of providing more electricity. Therefore, if a consumer values electricity above the cost of supply but below the price, he or she will choose not to consume electricity. This results in a loss of welfare in the electricity market equal to the difference between the consumer's value of electricity and the opportunity cost of supply.

Similarly, if prices are below the opportunity cost of supply, this implies that consumers are required to pay less than the cost of providing more electricity. Therefore, if a consumer values electricity below the cost of supply but above the price, he or she will choose to consume electricity. This results in a loss of welfare in the electricity market equal to the difference between the opportunity cost of supply and the consumer's value of electricity.

Therefore, a move to prices that more closely reflect the opportunity cost of supply would be likely to produce improvements in economic efficiency.

However, there are normally lags in the process of moving from more efficient spot prices to economic welfare gains. This is partly because very few, if any, consumers directly pay the spot price of electricity and many producers are partly or largely hedged against spot price movements in the short to medium term. Therefore, the impact of the proposals on spot prices is relevant to the NEM objective to the extent they flow through and are reflected in prices paid by consumers or received by producers. It is the change in consumption and production behaviour in response to the new prices that are the sources of efficiency gains (or losses). As indicated above, these gains arise from resources being allocated to their highest valued use as producers and consumers respond to price signals that more closely reflect the resource or opportunity costs of supply.

In the short term, lower spot prices may result in lower revenues for generators who have output that is unhedged. Even if generators are fully hedged, some contract types they have (e.g. cap and collar contracts) may not protect them against lower spot prices, depending on level at which prices change. This may result in an immediate response from generators. Under these circumstances, generators may be more inclined to sell more contracts and/or offer peak cap style contracts more cheaply than before.

To the extent that this contracting behaviour by generators emerges, this is likely to yield relatively immediate benefits to retailers. Their choice of contracts will probably be increased and the price at which they are offered will be lower than before. To the extent that retailers have locked-in customers at pre-proposal prices, lower electricity purchasing costs will be translated into higher returns for retailers. However, given the increasing competitiveness of the retail sector, these extra returns should be competed away progressively, over time, as retailers compete to retain or gain retail market share. In the medium term, retail customers should benefit from more competitive price offerings that reflect the trends in wholesale market spot and contract prices.

The nature of the response by consumers to lower electricity prices will vary from the short to long term. In the short term, lower electricity prices may not change consumption behaviour a great deal. This is because consumers tend to respond to higher or lower electricity prices over long time periods by altering the equipment they have that uses electricity. This is not to suggest that consumers cannot exploit the benefits of lower prices in the short term. For example, they can use the savings in lower electricity costs to purchase other goods or services that they could not afford before the change in prices. Consumers could also change how much power they use at different times of the day and the way they use their existing stock of electricity using equipment. However, these short term changes tend to be moderate compared to the longer term changes in consumption patterns.

Despite the presence of some lags in the translation of more efficient prices into changed behaviour, the Commission considers that, generally speaking, Rule changes that move prices closer to economically efficient costs should be encouraged.

The Commission has relied on a combination of conceptual analysis and market modelling to determine whether the Southern Generators and Snowy Hydro Re-orientation proposals are likely to lead to changes in regional spot prices.

A5.2.2 Conceptual analysis

The impacts of both the Southern Generators' and Snowy Hydro Re-orientation proposals on NEM spot prices should follow from the impacts of the proposals on dispatch outcomes. These effects can be summarised as follows:

Under conditions of competitive bidding and northward flows:

- The Status Quo base case should lead to inefficient over-generation by Murray, Tumut and NSW generators and inefficient under-generation in the Southern regions – therefore prices would be lower than under the Southern Generators' proposal in Victoria and higher than under the Southern Generators' proposal in Snowy and NSW;

- The Southern Generators' proposal should lead to efficient dispatch and hence an efficient set of prices at times of northward flows – these prices would be higher in NSW than in Victoria, in line with the assumed higher demand conditions in NSW; and

- The Snowy Hydro Re-orientation proposal should lead to inefficient over-generation by Murray, Tumut and NSW generators and inefficient under-generation in the Southern regions – therefore prices would be lower than under the Southern Generators' proposal in Victoria and higher than under the Southern Generators' proposal in Snowy and NSW.[146]

When the assumption of competitive bidding is relaxed, it becomes more difficult to make definitive comments on the likely price impacts of the proposals based on conceptual analysis alone. This is because the price impacts are driven by the levels of exports on the Snowy-NSW and Victoria-Snowy interconnectors, which in turn are driven by dispatch outcomes that are difficult to predict at a conceptual level. For a fuller discussion of this, see Part 3, Appendix B.

That said, the following hypothesises may provide a useful starting point for considering the market modelling analysis. When NEMMCO clamps the Victoria-Snowy interconnector at times of northward flows, this limits potential flows from Victoria to Tumut because maximum use is not made of the Dederang-Wodonga-Jindera-Wagga-Tumut part of the Snowy network loop. Snowy Hydro may then, ignoring the impact of contracting, have incentives to offer Tumut output at above opportunity cost (or withhold some Tumut generation) in order to force NSW (and hence Snowy) regional prices higher and earn greater pool revenues. Under both the Southern Generators' and Snowy Hydro Re-orientation proposals, flows from Victoria to Tumut may be higher and Murray output is likely to be lower due to the absence of clamping. This may reduce the ability of Tumut and NSW generators to push up NSW prices and may increase prices in the Southern regions due to greater

146 Part 3 Appendix B, Table B1.

effective demand (i.e. local regional demand plus net exports) for Southern region generation.

This conceptual chain of reasoning accords with the price impacts observed from the market modelling analysis (see below). However, this outcome may be contingent on the assumption that flows from the Snowy region to NSW are not already limited by constraints north of Tumut, as claimed by Snowy Hydro.[147]

At times of southward flows, the Southern Generators' proposal should lead to more output by Murray (because it receives its nodal price rather than the lower Victorian price) and hence a greater flow on the Victoria-Snowy interconnector compared to either the Status Quo or Snowy Hydro Re-orientation proposal. This should help dampen Victorian prices as well as NSW prices relative to the Snowy Hydro Re-orientation proposal.

A5.2.3 Market modelling

The modelling undertaken to assess the dispatch efficiency impacts of the Southern Generators' and Snowy Hydro Re-orientation proposals also produced average regional prices for summer peak, winter peak and the remainder of the year periods. A very wide range of bidding conditions and scenarios were modelled. The scenarios considered different patterns of hedging (which can affect, in the short term, bidding behaviour and prices), IRSR holdings and bidding choices (see Part 3 Appendix C).

The results of this modelling indicate that, relative to the Status Quo, implementation of the Southern Generators' proposal could result in a reduction in the time-weighted average annual wholesale spot prices in the NSW and Snowy regions of between $1.20 to $4.80/MWh, while prices in other regions generally fell by up to 50c/MWh or, in the case of Victoria, either fell or rose by no more than 10c/MWh (see Figure C22 and Table C8). However, there was no obvious relationship between different levels or locations of contracts and the magnitude of pricing impacts. For example, the smallest reduction in NSW prices was predicted for the scenario with high levels of Snowy Hydro contracting (80%), medium levels of other generators' contracting and a high proportion of Snowy Hydro contracts at the NSW node (70%) compared with the Victorian node (30%). The largest reduction in NSW and Snowy prices was predicted for the scenario with medium levels of contracting and 60% of Snowy Hydro contracts at the NSW node and 40% at the Victorian node. Intermediate NSW price reductions of about $2/MWh were predicted for other scenarios. Further, potential limitations on NSW imports due to constraints north of Tumut did not appear to influence the dispatch or pricing outcomes.

The Snowy Hydro Re-orientation proposal led to similar price impacts as the Southern Generators' proposal. However, the price falls in NSW under Re-

147 Snowy Hydro, Snowy Hydro Re-orientation proposal, s.95 submission, p.2

orientation were generally marginally greater than under the Southern Generators' proposal (about $1.25 to $5/MWh).

The source of the fall in the NSW price under the Southern Generators' and Snowy Hydro Re-orientation proposals is discussed in detail in Part 3 Appendix C. In summary, the modelling showed that in presence of clamping (i.e. the Status Quo) Snowy Hydro could pursue a strategy of withholding additional capacity at Tumut, resulting in lower flows on the Snowy to NSW interconnector and substantially higher NSW and Snowy prices. This alternative strategy could lead to outcomes with even higher prices than one of Snowy Hydro's current strategies, which involves maximising flows on the Snowy to NSW interconnector at times of relatively high NSW demand and relatively low Victorian demand. The modelling found that the "withholding strategy" under the Status Quo is not sustainable under both Rule change proposals, and hence the analysis indicates a possible relative price decrease in NSW and Snowy where either of those proposals are implemented.

An important modelling result arising from the Southern Generators' proposal was the reduction in the difference between prices in the NSW, Snowy, and Victoria regions, relative to the status quo. This reduction in the differentials between regional prices could reduce the risks of inter-regional trading (discussed further in Section A5.3).

A5.2.4 Commission's assessment

The Commission found that, in the presence of imperfect competition, it is not possible to come to definitive conclusions on the price impacts of the Southern Generators' and Snowy Hydro Re-orientation proposals on the basis of conceptual analysis alone. Assessment of the price impacts of both proposals under imperfect competition requires the use of quantitative market modelling. Based on the results of the modelling, the Commission considers that both the Southern Generators' and Snowy Hydro Rule change proposals may produce small but significant price falls in NSW compared to the Status Quo base case. The impacts in other regions were not anywhere near as large. Overall, this is likely to result in more cost-reflective spot prices in NSW and greater convergence of spot prices between the Southern and Northern regions of the NEM. These changes in spot market prices may eventually be passed on to customers in the form of more competitive and cost-reflective price structures, with consequential allocative and dynamic efficiency benefits. To the extent that the falls in NSW spot prices lead to greater convergence between Victorian and NSW prices, this could promote inter-regional contract trading (see below). These findings support the Commission's view that there is a case for a move away from the existing negative settlement residues arrangements towards one or other of the two proposed Rule changes.

However, the Commission is aware that the market modelling outcomes are sensitive to the assumptions adopted about generators' strategies, contracting levels and locations, and transmission constraints elsewhere in the NEM. Further, the Commission notes that, based on the market modelling analysis undertaken, there is little to distinguish the two Rule change proposals from a price impacts perspective. This indicates that while both proposals are likely to produce superior pricing outcomes compared to the Status Quo, the Commission has ensured that it has not

relied on the predicted pricing impacts of the proposals as a basis for choosing between them.

A5.3 Inter-regional trading risk (including revenue adequacy of the proposal)

A5.3.1 Introduction

This Section sets out the Commission's analysis of the likely impacts of the Southern Generators' and Snowy Hydro's Re-orientation proposal on hedging inter-regional trading risk, including an examination of the revenue adequacy of the Southern Generators' proposal.[148]

The impact of the different proposals on hedging is important because a large proportion of the revenues of participants in the wholesale electricity market derive from trading in hedging instruments. Hedging instruments therefore provide important signals for long-term investment and entry decisions by generators, retailers, and large loads.[149] For example:

- **Retail competition** – retailers tend not to enter the market without access to hedging instruments, as the risks of purchasing electricity in the (potentially volatile) spot market and selling it to consumers at fixed prices may be too great. Similarly, large loads purchasing power independently may be unwilling to invest without a means of gaining price certainty;

- **Generator investment** – generators are generally less inclined to commit funds to invest in new plant unless they have a degree of revenue certainty provided by contracts; and

- **Pricing efficiency** - in a market where all buyers and sellers pay and earn, respectively, the same spot price for electricity, hedging contracts (and customer supply contracts) provide a means for producers to charge different prices to customers with varying price sensitivities. This enhances efficiency as more customer demand can be met using a range of prices than a single price. Hedging contracts also offer a means of providing different customers with different degrees of exposure to changes in the wholesale spot price – for example, some customers may seek long term contracts to provide long term price certainty while other customers may be willing to renegotiate contracts more often in exchange for a lower premium over the expected future spot price.

IRSR units play a key role in allowing traders to arbitrage inter-regional differences in contract prices. IRSR units for a particular directional interconnector are considered fully "firm" where they provide a stream of revenue equal to the

148 Revenue adequacy is not a relevant consideration for the Snowy Hydro Re-orientation proposal.
149 Part 3 Appendix B, paragraph 71.

(positive) price difference between two regions multiplied by a fixed number – say 100 MW. Firm IRSR units allow a participant to arbitrage the differences in prices of swaps in two different regions without taking on any inter-regional risk. This helps improve the efficiency of hedge contract prices and thereby improves the incentives for appropriate longer-term decisions in the market (see Box A3).[150] While there are other means of hedging inter-regional price differences, fully firm IRSRs do not require the involvement of speculators to take on risk (and be compensated accordingly) and therefore may enable lower-cost, and hence more efficient, inter-regional trading.

Box A3: An example of IRSR units as a hedge contract arbitrage instrument

Suppose the future expected spot price in region A is $35, but swaps in region A sell for only $32. Similarly, suppose that the future expected spot price in region B is $45, but swaps in region B sell for $47. Suppose that the inter-regional settlement residue between these two regions is equal to the price difference between the regions times 100 MW. If the IRSR auction is competitive, these residues will sell at auction for their fair value, which is ($45-$35) times 100 = $1000. These residues allow the trader to perfectly hedge a transaction which involves purchasing the settlement residues, buying a 100 MW swap in region A and selling a 100 MW swap in region B. The resulting profit to the trader is $4700 - $3200 - $1000 = $500.

Since this transaction is profitable and carries no risk, such arbitrage will continue to the point where the price for swaps in region A increases to $35 and the price for swaps in region B declines to $45, which is their efficient price.

As this example shows, IRSRs, to the extent that they are firm, allow traders to arbitrage inter-regional differences in swap prices, thereby ensuring that swap prices reflect their underlying efficient value, which in turn ensures that the market receives the correct long-term price signals for investment or expansion.[151]

In theory, if IRSR units could be bought and sold at short notice and if it were possible to predict exactly when interconnector flows or limits were changed, even IRSR units that were not fully firm could be used by participants to eliminate inter-regional risk. However, participants typically acquire IRSR units up to 1 year in advance and seldom can predict when transmission limits will be reduced due to clamping or other reasons.

Therefore, under more realistic market conditions, actual settlement residues that accrue may be less than sufficient to allow IRSR units to provide a perfect inter-regional hedge. For example, if 1000 IRSR units equivalent to 1000MW are sold and interconnector flows are reduced to 500 MW due to a line outage, the actual residues attributable to each unit will be half what is necessary to hedge a 1MW inter-regional swap. Similarly, if, due to constraints on a network loop, interconnector flows deviate from expected flows, settlement residue per IRSR unit may differ from the inter-regional price difference. In other words, IRSR units tend to frequently provide

150 Part 3 Appendix B, paragraph 80.
151 Part 3 Appendix B, paragraphs 78-80.

less than a perfect hedge for inter-regional price differences. This will affect the willingness of participants to trade electricity contracts across regional boundaries.

Consequently, the impact of each of the Rule change proposals on the firmness of IRSRs is an important consideration for the Commission in determining which (if any) of the Rule change proposals is most likely to promote the NEM objective.

A5.3.2 Conceptual analysis

Under the Status Quo, Southern Generators' proposal, and Snowy Hydro Re-orientation proposal, it is theoretically possible to achieve a perfect inter-regional hedge using IRSR units, but analysis undertaken for the Commission reveals that the conditions required are strict.[152] Under the Status Quo during periods of northward flows, it would be necessary for participants to forecast exactly when clamping will occur as well as the level of flow on the Victoria-Snowy interconnector at those times.[153] In the case of the Snowy Hydro Re-orientation proposal, in addition to the other stringent conditions, participants must be able to perfectly forecast the output of generation in the Snowy region at the time of the re-orientation and acquire IRSRs accordingly.[154] This is virtually impossible for participants other than Snowy Hydro, and difficult for Snowy Hydro itself. For the Southern Generators' proposal, participants must be able to perfectly forecast when the Murray-Tumut constraint binds and for no other relevant constraints to be binding.[155] This suggests that on balance, the conditions required for IRSR units to act as a perfect hedge under the Snowy Hydro Re-orientation proposal are even stronger than those required under the Southern Generators' proposal.

From a practical perspective, by avoiding the need to "clamp" the Victoria-Snowy interconnector at times of northward flows, the Southern Generators' and Snowy Hydro Re-orientation proposals may enhance opportunities for inter-regional trading in two key ways:

- As noted above, clamping may be associated with larger spot price differentials between Victoria and NSW. This may increase the risk or cost of trading inter-regionally. Therefore, either of the Rule change proposals may help promote the trading of inter-regional contracts; and

- Other things being equal, both proposals reduce the importance of participants needing to accurately predict when the Murray-Tumut constraint will bind in order for IRSRs to provide a reasonable inter-regional price hedging instrument from Victoria to NSW.

The second point deserves more detailed discussion.

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152 Part 3 Appendix B, paragraphs 81-108.
153 Part 3 Appendix B, paragraphs 84-87.
154 Part 3 Appendix B, paragraph 96.
155 Part 3 Appendix B, paragraphs 88-90.

Both the Southern Generators' proposal and the Snowy Hydro Re-orientation proposal are likely to increase the combined value of the IRSR units on both the Victoria-Snowy and Snowy-NSW interconnectors. Under the present arrangements, when clamping is implemented, the Snowy regional reference price can rise towards the NSW regional reference price. This means that, practically speaking, the Snowy-NSW IRSRs provide an inadequate means of hedging Victoria-NSW price differences, while at the same time the Victoria-Snowy IRSRs have diminished value as a risk management tool due to clamping.[156]

By avoiding the need to clamp, both proposals allow (subject to transmission outages or deratings) Southern region participants holding an equal number of Victoria-Snowy and Snowy-NSW directional IRSR units to have a firmer inter-regional hedge against NSW-Victoria price differences than under the Status Quo. This additional firmness can arise in either of two ways:

- First, assuming the Murray-Tumut lines remain constrained:
    - Under the Southern Generators' proposal, counter-price flows would persist but the positive IRSRs on the Snowy-NSW interconnector would exceed the negative residues on the Victoria-Snowy interconnector. This should yield a net settlement residue per unit that approximates the NSW-Victoria price difference;[157] and
    - Under the Snowy Hydro Re-orientation proposal, re-orientation of the constraints would mean that counter-price flows would not arise. This means that a participant holding both Victoria-Snowy IRSR units and Snowy-NSW IRSR units should receive a combined payment per unit that approximates the NSW-Victoria price difference; [158] and
- Second, by reducing the incentive for Snowy Hydro to bid Murray generation at low prices to induce clamping, the proposal could lead to the Murray-Tumut constraint not binding in the first instance. This would lead to positive residues on both the Victoria-Snowy and Snowy-NSW interconnectors and avoid the need to transfer value from the Snowy-NSW directional IRSRs to the Victoria-Snowy directional IRSRs.

For southward flows, the Southern Generators' proposal would replace NEMMCO's current practice of re-orienting affected constraints to Dederang. The overall result should be little net change in the ability of NSW generators to hedge contracts

156 That is, assuming participants cannot accurately forecast when clamping will occur and to what extent Victoria-Snowy flows will be clamped.

157 The Commission recognises that the acquisition of both sets of units may not provide a perfect inter-regional price hedge due to the unpredictability of actual flows on the interconnectors.

158 The acquisition of both sets of units may not provide a perfect inter-regional price hedge due to the unpredictability of actual flows on the interconnectors.

written against the Victorian node. The Snowy Hydro Re-orientation proposal would not alter this approach for periods of southward flows.

For a participant based in the Snowy region, the implementation of the Southern Generators' proposal is likely to:

- Reduce the payments to Snowy-NSW IRSR unit holders, including those trading out of the Snowy region, relative to the case under the Status Quo arrangements, because of the transfer from the Snowy-NSW IRSR fund to the Victoria-Snowy IRSR fund;

- Create a level of unfunded difference payment risk on contracts that have been written based on the assumption of dispatch at high prices when clamping occurs; and

- Reduce the ability of those trading out of the Snowy region to closely align the Snowy region price with a high NSW price than is possible under clamping, because of the introduction of competitive pressures from Southern regions at times when clamping would otherwise have occurred.

However, participants trading out of the Snowy region are likely to have a wider range of tools for managing inter-regional trading risks than other participants, due to the unique characteristics of the Snowy region, and the Commission has taken this into account in assessing this issue.[159]

For a participant based in the Snowy region, the implementation of the Snowy Hydro Re-orientation proposal is likely to have the same three effects discussed above for the Southern Generators' proposal. However, the Snowy Hydro Re-orientation proposal also creates three effects that are likely to decrease the risks of inter-regional trading out of the Snowy region relative to the Status Quo or the Southern Generators' proposal, or both:

- Dampening the volatility in the price received by Murray generation when flows are northwards, relative to the Status Quo;

- Reducing the risks, relative to the Status Quo and Southern Generators' proposal, associated with offering contracts referenced to the Victorian reference node, under conditions of both northward and southward flows. In the northward flow case, the price received by Murray generation will be more closely aligned to the Victorian price than under the status quo or Southern Generators' proposal. In southward flow case, the price received by Murray generation will be unchanged from what is in the status quo (i.e.

159 For example, at various times, Snowy Hydro is likely to have the incentive and ability to readily align the Snowy regional reference price to the price in an adjoining region where its hedge contracts are referenced to.

aligned to VIC price), and more closely aligned to the Victorian price than under the Southern Generators' proposal;

- Providing protection from the financial risks, arising under both the Status Quo and Southern Generators' proposal, of having to make substantial contract difference payments at times when the Snowy RRP falls to low or negative levels. If the price is negative, generation exposed to the Snowy price is required to *pay* NEMMCO so that it can generate, rather being paid to do so.

The net effects of the Southern Generators' and Snowy Hydro Re-orientation proposals on the inter-regional financial risks and returns of a participant trading out of the Snowy region are difficult to gauge analytically because of the combination of effects that the proposals are likely to have. The extent of those impacts are also highly dependent on contracting positions, something the Commission does not know with certainty.[160] Nevertheless, the Commission considers that across the NEM as a whole, the proposals should improve the overall willingness of participants to enter contracts with counterparties based in other regions.

The positive effects of the Southern Generators' and Snowy Hydro Re-orientation proposals in reducing inter-regional trading risk are likely to have some side benefits. For example, to the extent that reduction in risk means that participants have a wider range of contract counterparties to trade with, this will allow participants to diversify credit risk and, potentially, reduce the costs of credit support.

On balance, the conceptual analysis indicates that both Rule change proposals enhance the ability of market participants to effectively manage inter-regional trading risks, relative to the Status Quo. However, using conceptual analysis alone, it is difficult to distinguish which proposal might offer more risk management benefits.

Given the complexity of the interactions between the effects noted above, and the potential for changed incentives on participants, the Commission considered it important to test the arguments and conclusions described above using quantitative modelling of portfolio risk.

A5.3.3 Risk modelling

The details of the modelling approach used to assess the nature of changes to inter-regional trading are described in more detail in Part 3 Appendix C. In summary, the approach involved establishing an experiment using Modern Portfolio Theory to determine the changes in contracting behaviour that are likely to occur under both

160 It is acknowledged that generators' contracting positions are not known with any certainty. The modelling assumes a position, and to compensate for the unknown factors, it includes a number of sensitivities.

the Southern Generators' proposal and Snowy Hydro's Re-orientation proposal. The aim of the experiment was to determine whether generators in Victoria would find it more efficient (at minimum risk as measured by the standard deviation of returns) to buy IRSR units to meet a fixed load (100 MW) in NSW or sell to the load at spot prices. The converse was tested for NSW generators selling to a load in Victoria and for Snowy region generators selling into either NSW or Victoria.

This risk modelling showed that, under both the Southern Generators' and Snowy Hydro Re-orientation proposals, there would be a greater propensity for Southern region generators to trade inter-regionally using IRSR units to hedge a contract referenced to NSW (See Figure C28). As indicated above, this result can be explained by a combination of the greater firmness of the Victoria-Snowy directional IRSR units and lower expected price differentials between the Victorian and NSW regions. The risk modelling showed very little difference between the two Rule change proposals across the broad spectrum of contracting assumptions.

When NSW generation is used to cover a Victorian hedge, the results show a very slight, and similar, decrease in the attractiveness of inter-regional contract trading (see Figure C29) under both the Southern Generators' and Snowy Hydro Re-orientation proposals. This may be due to declines in the value of NSW-Snowy directional IRSRs at those times when NSW-Snowy IRSRs are used to fund settlement residue deficits on the Snowy-Victoria directional interconnector.

For Snowy Hydro using its Snowy region capacity to hedge loads in adjoining regions, there is a slight decrease in the attractiveness of hedging loads in NSW, but an increase in the attractiveness of hedging loads in Victoria (see Figures C30 and C31). These changes may have the potential to result in a rebalancing of Snowy Hydro's contract portfolio, such that a greater share of its contracts are referenced to the Victorian node if hedging was assumed to be the only or main way of managing inter-regional basis risk. Again, the risk modelling results of the Southern Generators' and Snowy Hydro Re-orientation proposals relative to Status Quo are similar and it is difficult to favour one proposal over the other based on these results. Overall, the results of the modelling indicate that implementation of either the Southern Generators' proposal or the Snowy Hydro Re-orientation proposal is likely to increase the extent of inter-regional trading between the largest regions in the NEM - NSW and Victoria. The increased competition in NSW appears likely to stem from generators in the Southern regions being able to offer more contracts into NSW, thereby competing with other suppliers of contracts in NSW. Competition for Victorian reference node contracts appears likely to increase if Snowy Hydro increases the share (and/or volume) of its contracts referenced to the Victorian node.

A5.3.4 Revenue adequacy

Southern Generators' proposal

An important question for the Southern Generators' proposal that needs to be addressed is whether it is self-funding: that is, whether the positive residues accruing on the Snowy-NSW interconnector are sufficient to cover the negative residues accruing on the Victoria-Snowy interconnector, for both northward and southward flows. As noted above, the revenue adequacy proofs submitted by the Southern Generators are based on a single constraint binding (the Murray-Tumut constraint) under system normal conditions. The pricing relationship that underpins the proofs

is representative of the relationship between dispatch interval prices produced by NEMDE given those conditions, and these proofs support revenue adequacy on a five-minute or dispatch interval basis.

However, the Commission notes that there are several limitations with the analysis. For instance, both proofs assume a particular relationship between regional prices that occur during particular market conditions, e.g. a single binding constraint and normal operating conditions. If operating conditions were not normal (e.g. there is a network outage), it may be necessary for NEMMCO to invoke an alternative constraint. This could change the assumed relationship between regional prices at times when the Murray-Tumut constraint binds. These proofs of revenue adequacy may not hold under these conditions.

In addition, while the proofs hold on a five-minute or dispatch interval basis, they may not necessarily hold on a thirty-minute, or trading interval basis, the period over which NEMMCO calculates settlement residues in the NEM. In particular, when only some of the dispatch intervals in a trading interval have binding Snowy constraints, the assumed relationship between regional prices does not hold over the trading interval and the revenue adequacy condition may not hold. It is possible to demonstrate this using a simple example where flows between Victoria and NSW through Snowy switch from northward to southward within a trading interval. This example includes a number of (potentially unrealistic) assumptions such as low or limited generation from Tumut and Murray power stations during the period of southward flows.

The Commission considers that the Southern Generators' proposal is likely to be revenue adequate in most operating situations but recognises they may not hold in all conceivable situations. However, the Commission does not consider that revenue adequacy in all circumstances is a necessary requirement for the implementation of the Southern Generators' proposal. This conclusion is made in light of the other potential benefits of the proposal, including improvements in the level of competition, dispatch efficiency, and inter-regional trading.

Should revenue adequacy not hold continuously, the Rules currently provide NEMMCO with a mechanism for recovering outstanding net negative residues. The Commission's intention would be that NEMMCO would recover any outstanding net negative residues in accordance with clause 3.6.5(a)(4A) of the Rules.

Snowy Hydro Re-orientation proposal

The revenue adequacy of the Snowy Hydro Re-orientation proposal is not likely to be a problem as this proposal aims to eliminate the possibility of settlement residues emerging in the first place rather than using an offset mechanism like that proposed in the Southern Generators' proposal. However, revenue adequacy in all circumstances is not a necessary requirement for the implementation of the proposal because NEMMCO has other means available to recover outstanding net negative settlement residues, as discussed above.

A5.3.5 Commission's assessment

The conceptual analysis and modelling results provide support for the proposition that the Southern Generators' and Snowy Hydro Re-orientation proposals can be

expected to, on balance, promote inter-regional contract trading and competition in the NEM compared to the Status Quo.

Overall, the Commission considers that both proposals will:

- decrease inter-regional price differentials which may increase participants' preparedness to enter into inter-regional trades;

- by removing NEMMCO clamping and enabling IRSR units to be a firmer instrument for inter-regional price hedging from Victoria to NSW, reduce the risks and complexity of inter-regional contract trading.

In combination, these expected changes are likely to have a net positive effect on the market by enabling risk to be better managed and enhancing the competition and efficiency of contract pricing in the NEM.

Finally, the Commission considers that the Southern Generators' proposal is likely to be revenue adequate in most operating situations. However, the Commission does not consider that revenue adequacy in all circumstances is a necessary requirement for the implementation of the Southern Generators' proposal and that in any case, the Rules currently provide NEMMCO with a mechanism for recovering outstanding net negative residues.

The Commission does not view revenue adequacy as an issue for the Snowy Hydro Re-orientation proposal. Revenue adequacy is only a potential issue for the Southern Generators' proposal and the Commission is satisfied that any potential revenue adequacy issues with the Southern Generators' proposal are not material enough to warrant favouring the Snowy Hydro Re-orientation proposal over the Southern Generators' proposal.

A5.4 Power system security and reliability

A5.4.1 Introduction

The NEM objective emphasises the need for market reforms to serve the long-term interests of consumers, including with respect to the reliability and security of electricity supply.

NEMMCO is obliged under the Rules to operate the power system in a secure and reliable manner. An assessment is necessary of whether changes to the way NEMMCO manages counter-price flows, as proposed by the Southern Generators, could have implications for the reliability of supply

Southern Generators' proposal

The Southern Generators' proposal is effectively a change to the settlement arrangements in the NEM. As such, it is not expected to change the underlying network transfer limits between Victoria, Snowy and NSW, although it will change the commercial incentives that drive participants' generation offers. The implications for supply reliability are examined below.

Reliability of supply in NSW

As discussed earlier, at times of northward flows through the Snowy constraint, Murray generation exerts greater pressure on the constraint than does the Victorian interconnector. Therefore, increasing the flow on the Victoria-Snowy interconnector relative to Murray generation would allow a greater flow of power to NSW from Murray/Southern region generators, subject to any interconnector limits in NSW. Conversely, when NEMMCO intervenes by restricting interconnector flows and Murray generation is high relative to Victorian exports, transfer through the constrained loop to NSW may be reduced.

However, the derogation in Chapter 8A Part 8 of the Rules requires that NEMMCO not "[prejudice] its obligations to maintain power system security" when it intervenes to manage counter price flows.[161] Furthermore, following discussions with NEMMCO, the Commission understands that generation will be dispatched to meet demand even if it is necessary to divert from the dispatch merit order expressed in offer prices, subject to use of the fully optimised constraint form in the dispatch process regardless of the nominated mechanism to manage counter price flows. The Rules also empower NEMMCO to direct generation to achieve either supply reliability or power system security.

The Commission notes the comments in Snowy Hydro's submission that Tumut generation and Victorian/South Australian generation are substitutes on the northern side of the constraint. Snowy Hydro went on to suggest that the Southern Generators' proposal would not improve supply reliability in NSW. This comment was described more fully in Snowy Hydro's Re-orientation Rule change proposal.[162]

Snowy Hydro also commented that it would have an incentive to withhold Murray generation under the Southern Generators' proposal. Snowy Hydro described this strategy more fully in its Re-orientation Rule change proposal.[163] The Commission agrees that Murray generation would have an incentive under the Southern Generators' proposal to keep the Murray-Tumut constraint from binding, but considers that mechanisms are available to NEMMCO to dispatch generation if necessary to maintain power system security.

Reliability of supply in Victoria

In late August 2006, the Commission received correspondence from Snowy Hydro contending that the implementation of the Southern Generators' proposal instead of its own Re-orientation proposal (or maintenance of the Status Quo arrangements) would create reliability risks for Victoria over the forthcoming 2006/07 summer. [164] These risks would arise from the impact of the proposal on Snowy Hydro's

161 Clause (c), Chapter 8A, Part 8, National Electricity Rules.

162 Snowy Hydro Limited, "Rule change proposal for: Management of Negative Residues in the Snowy Region by reorientation of constraints", p.5-6.

163 Snowy Hydro, Re-orientation Rule change proposal, p.8-11.

164 Letter from R. Whitby, Executive Officer – Trading, Snowy Hydro to Dr J. Tamblyn, Chairman, AEMC, 28 August 2006.

commercial incentives regarding the management of its water storages at Geehi reservoir and the operation of Murray generation. The Commission requested additional information from both Snowy Hydro and NEMMCO to understand the veracity of Snowy Hydro's contentions. Part 3 Appendix D presents the Commission's analysis and assessment of the question of whether supply reliability to Victoria would be affected by adoption of the Southern Generators' proposal.

Snowy Hydro Re-orientation proposal

Although the Snowy Hydro Re-orientation proposal seeks to amend Part 8 of Chapter 8A of the Rules, it will not affect NEMMCO's ability to meet its obligation to maintain power system security as set out in paragraph (c) of Part 8. The Snowy Hydro Re-orientation proposal would not alter or impede this obligation. This suggests that there is no reason for believing that adoption of the Snowy Hydro Re-orientation proposal would have any negative implications for NEM power system security or supply reliability in either NSW or Victoria.

A5.4.2 Commission's assessment

The Commission considers that while both the Southern Generators' and Snowy Hydro Re-orientation proposals may influence participants' operational behaviour in the market, the change in behaviour under either proposal would be unlikely to have a material impact on power system security or supply reliability as compared to the Status Quo base case.

Having considered Snowy Hydro's correspondence and presentation, NEMMCO's advice and its own analysis, the Commission has concluded that, on balance, adoption of the Southern Generators' proposal would not materially increase the risk of supply shortfalls in Victoria and NSW over the summer of 2006/07.

Therefore, the Commission has proceeded with its Final Rule Determination on the Southern Generators' proposal and its Draft Rule Determination on the Snowy Hydro Re-orientation proposal on the basis that the NEM supply reliability implications of the Southern Generators' proposal are not substantially different to those of the Snowy Hydro Re-orientation proposal and the Status Quo arrangements.

A5.5 Good regulatory practice

A5.5.1 Introduction

As noted in Part 2 Section 2.5, the Commission considers that the concept of good regulatory practice is intimately linked to the NEM objective.

More particularly, the Commission believes that good regulatory practice requires that:

- Regulatory interventions minimise distortions – regulatory interventions that distort the operation of competitive markets should be avoided or minimised, particularly where the objective can be achieved by alternative non-distorting means;

- Wealth transfer impacts do not jeopardise the stability of the market and regulatory arrangements;

- Regulatory interventions are consistent with other forms of regulation; and

- Regulation should attempt to standardise the exercise of bureaucratic discretion, so as to reduce discrepancies between government regulators, reduce uncertainty and lower compliance costs.

In this context, the following factors are relevant to the analysis of good regulatory practice.

- The Status Quo requires NEMMCO to impose discretionary constraints on the Victoria-Snowy interconnector when negative settlement residues are expected to reach $6,000 in a continuous series of dispatch intervals. The imposition of these constraints reduces interconnector flow by approximately 50MW per dispatch interval, meaning that accumulated negative settlement residues may significantly exceed $6,000 over a continuous series of dispatch intervals. NEMMCO is required to remove the discretionary constraints when such removal will not lead to counter-price flows. In short, NEMMCO judgment is required as to precisely when and for how long the discretionary constraints are to be applied based on the accumulation of negative settlement residues to date and the rate of change of the accumulation. It is understood that NEMMCO is planning to consult on raising the $6,000 trigger threshold to $100,000 based on the recent Rule change allowing NEMMCO to recover accumulated negative settlement residues;[165]

- The Snowy Hydro Re-orientation proposal requires NEMMCO to impose the re-orientated form of constraints when accumulated negative settlement residues reach $6,000 in a continuous series of dispatch intervals.[166] This would have the impact of directly altering the Snowy region price and consequently, NEM settlements. This option involves less NEMMCO judgment than the existing arrangements, but still requires NEMMCO to make a decision as to when and for how long the re-orientated form of constraints should apply. This option also involves a degree of uncertainty as to precisely when the re-orientated form of constraints would be implemented, due to lags between the decision to impose the constraints and the actual application of those constraints;

- The Southern Generators' proposal does not require any NEMMCO intervention in dispatch *or* price-setting. It operates solely through an *ex post*

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165 See NEMMCO, "Review of the Trigger Level for the Management of Negative Settlement Residues", Draft, 5 September 2006, available on the NEMMCO website at www.nemmco.com.au.

166 This would also presumably be subject to NEMMCO's intended consultation process on the $6,000 intervention trigger figure.

adjustment to the amounts payable to certain IRSR unit holders (those holding IRSR units for interconnectors between Victoria and Snowy and between Snowy and NSW).

A5.5.2 Regulatory interventions should minimise distortions

By removing clamping of the Victoria-Snowy interconnector, both the Southern Generators' proposal and the Snowy Hydro Re-orientation proposal would have the effect of removing a potential distortion in the operation of the market. As discussed in the preceding sections, this intervention can affect dispatch, pricing, and settlement.

While both Rule change proposals would do away with the need for clamping, they involve other interventions. However, while the Southern Generators' proposal involves only an *ex post* change to NEM settlement (i.e. payments to certain IRSR unit holders), the Snowy Hydro Re-orientation proposal involves real-time changes to NEM pricing (and hence settlement).

In addition, the Snowy Hydro Re-orientation proposal extends the existing 'deliberate mis-pricing' of Murray generation at times of southward flows to times of both southward and northward flows. The deliberate mis-pricing involves effectively setting the Snowy RRN upon which Murray generation is settled equal to the locational price at a different electrical location, Dederang.

A5.5.3 Regulatory interventions are consistent with other forms of regulation

Both the Southern Generators' and Snowy Hydro Rule change proposals seek to amend Chapter 8A Part 8 of the Rules. In particular, they both seek to amend the current partial trial of a Constraint Support Pricing/Constraint Support Contract (CSP/CSC) arrangement (also known as the "Snowy Trial").[167]

As it currently stands, the Snowy Trial only relates to the interconnector between Snowy and NSW and pricing for generation at the Tumut node in the Snowy region. It does not currently address the issue of negative settlement residues arising between the Victorian and Snowy regions due to counter-price flows. Both the Snowy Hydro and Southern Generators' proposals seek to overcome the need for NEMMCO intervention in dispatch and/or pricing in response to the prospect of negative settlement residues arising in this manner.

The rationale for the Snowy Trial was the provision of an efficient price for Tumut generation at times of congestion on the Murray-Tumut constraint in order to promote more efficient dispatch. The Southern Generators' proposal effectively ensures that Murray generation is paid its correct locational price when the constraint binds, thus promoting more efficient dispatch of Murray generation at

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167 See Part 3 Appendix E for a more detailed explanation of the current CSP/CSC trial and how the two proposals interact with the trial.

those times. Such pricing of congestion is in accordance with the objective of the CSP/CSC instrument (see Part 3 Appendix E). By contrast, as noted above, the Snowy Hydro Re-orientation proposal would extend the deliberate mis-pricing of Murray generation by settling Murray generation at the locational price at Dederang. This would be a departure from the Snowy Trial's aim of refining pricing signals to promote efficient dispatch.

A5.5.4 Regulation should attempt to standardise the exercise of bureaucratic discretion

The operation of clamping is defined through a NEMMCO operating procedure. As noted above, the implementation of clamping requires NEMMCO to decide both whether to intervene and, if so, the timing, extent and duration of such intervention.

The Snowy Hydro Re-orientation proposal would also require the exercise of judgement by NEMMCO as to when negative residues may occur and whether to impose and remove the re-oriented form of constraints, thereby changing the price-setting arrangement. While, in theory, it may be possible to 'automate' this process, the Commission must assess the proposal as it has been submitted.

By contrast, the Southern Generators' proposal implementation mechanism would involve an automatic *ex post* adjustment to the settlement procedure to net off negative residues on the Victoria to Snowy interconnector with the positive residues on the Snowy to NSW interconnector. This would avoid the need for NEMMCO to exercise judgement or directly intervene in the market dispatch process or pricing arrangements.

A5.5.5 Commission's assessment

The Commission has concluded, on the basis of these differences between the proposals and comparison to the Status Quo, that the Southern Generators' proposal is more consistent with the principles of good regulatory practice compared to the current arrangements and the Snowy Hydro Re-orientation proposal. This is because the Southern Generators' proposal:

- Involves intervention only at the settlements stage of NEM operation – only payments to certain IRSR unit-holders are affected whereas the Snowy Hydro Re-orientation proposal requires real-time changes to be made to pricing (and consequently settlements);

- Removes uncertainty of when, by how much and how long NEMMCO will either restrict flows over the Victoria-Snowy interconnector or impose the re-oriented form of constraints. The Southern Generators' proposal reduces current uncertainty by adopting a clear and transparent mechanism that can be consistently applied for the duration of the derogation that it amends. The operation of the proposal will be clearly defined in the Rules and implemented through the NEM settlement procedures. By contrast, the Snowy Hydro Re-orientation proposal maintains a higher degree of uncertainty as to exactly when NEMMCO will intervene in NEM pricing through the re-orientation of the relevant constraints;

- Provides an efficient locational price at the Murray node at times when the constraint binds, while the Snowy Hydro Re-orientation proposal extends an existing deliberate mis-pricing of Murray generation. The Snowy Trial was introduced to provide efficient locational price for Tumut generation at times of congestion. By extending the efficient locational pricing to Murray generation when the constraint binds, the Southern Generators' proposal is more consistent with the intent behind the CSP/CSC instrument employed for the Snowy Trial than the Snowy Hydro Re-orientation proposal.

In sum, the Southern Generators' proposal offers greater clarity, predictability, and transparency in dealing with negative settlement residues in the NEM, which should enhance the confidence of investors and improve dynamic efficiency.

A5.6 Long term implications

A5.6.1 Consistency with the appropriate development of the NEM

Both the Southern Generators' and Snowy Hydro's Re-orientation Rule change proposals appear to be consistent with its general direction for the development of the market. This direction involves the adoption of incremental changes that promote the competitive process, result in greater productive efficiency, promote inter-regional contract trading and align prices to costs.

It is important for the Commission to provide a clear signal of the direction it will take in modifying the market Rules that determine the pool revenues received by market participants from their investments. Thus, even though both of the present Rule change proposals are intended to operate for a relatively short period, they should take the market in a direction that is consistent with a longer-term trajectory of change.

In this context, the Southern Generators' proposal has the advantage that it would extend the current Snowy CSP/CSC trial to Murray generation and in this way potentially contribute towards the market's understanding of the CSP/CSC instrument. This could be valuable in relation to the considerations of the Congestion Management Review.

At the same time, the decision on these proposals should not foreshadow any particular position in respect of its broader consideration of the "Congestion Management Regime" or the question over the appropriate boundaries for the Snowy region. The Commission's "Congestion Management Program – Statement of Approach" provides information about the co-ordination of a number of congestion related matters under consideration by the Commission, leading to the development of a comprehensive "Congestion Management Regime" for the NEM in the longer-term.

A5.6.2 Commission's assessment of long term implications

The Commission considers that both Southern Generators' and Snowy Hydro Re-orientation proposals represent an incremental improvement over the current arrangement in that they both offer the potential for relative competition and efficiency benefits. However, by offering greater advantages on the criterion of good regulatory practice, the Commission considers that the Southern Generators'

proposal sends more appropriate signals to market participants about the approach the Commission will adopt to Rule change proposals in the future relative to the Snowy Hydro Re-orientation proposal. In addition, without pre-empting the considerations of the Congestion Management Review, the Commission considers that the Southern Generators' proposal may contribute to the Commission's assessment of the Snowy Trial and understanding of the CSP/CSC instrument.[168]

A5.7 Implementation issues

A5.7.1 Introduction

This Section considers issues associated with implementing the Southern Generators' and Snowy Hydro Re-orientation proposals. These issues include the way in which NEMMCO could integrate the proposal into its Market Management Systems (MMS), the likely time this would take and the impact on settlement residue distribution units for the interconnectors between the Victorian, Snowy, and NSW regions.

The Commission sought input from NEMMCO, as the market and system operator, regarding the implementation timing for both the Southern Generators' and Snowy Hydro Re-orientation proposals. NEMMCO's response is published on the Commission's website. NEMMCO identified two implementation processes that would influence a final Rule's start date:

- Necessary changes to the Market Management System (MMS); and
- Requirements under the Settlement Residue Auction Participation Agreements.

A5.7.2 Changes to the Market Management System

NEMMCO has expressed a preference for implementation of the Southern Generators' proposal by incorporating necessary changes into the MMS directly rather than through an independent system. NEMMCO indicated that it was currently integrating the external management system for the CSP/CSC trial into the MMS with a view to having the integrated system ready for the summer of 2006/07.[169] In order to be able to incorporate any implementation of the Southern Generators' proposal with the CSP/CSC trial into the MMS, NEMMCO indicated it could commence work to develop the design on the basis of the Draft Rule Determination.

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168 The Commission is reviewing the Snowy CSP/CSC Trial as part of its Congestion Management Review.

169 The CSP/CSC process for the Snowy region is currently performed by a specialised process that was developed external to the main MMS due to the tight deadlines required for implementation of the Snowy trial and the uncertainty as to whether it was to be implemented.

Assuming there were no substantial changes between the Commission's Draft and Final Rule Determination's, NEMMCO anticipated the Southern Generators' proposal could be incorporated into the MMS on 1 December 2006. This would be in line with the MMS release cycle, which includes an established process with NEM participants to change the MMS across the market on a six-monthly cycle.

If the Final Rule Determination required a change to NEMMCO's design based on the Draft Rule Determination, NEMMCO considered that implementation would slip to 1 June 2007, only two months before the relevant derogation expires.

If the final Rule involved a significant change from the process defined in the draft Rule, and implementation was required before 1 June 2007, NEMMCO considered that could only be achieved by developing an external ad hoc system. NEMMCO expressed the concern that implementation in systems outside the main MMS involves increased risk of audit and stability issues. NEMMCO believed the earliest an independent system approach could implement the Rule would be mid-February 2007.

In a subsequent meeting with the Commission, NEMMCO clarified that implementation of the Southern Generators' proposal prior to 1 December 2006 would necessitate the use of interim or temporary approaches.

On the other hand, NEMMCO stated that to implement Snowy Hydro's Re-orientation proposal, no changes to the MMS were necessary. NEMMCO would only need to amend its operating procedures as required by the Commission's final decision. This was because the re-orientation procedure is currently in place and described in NEMMCO's Dispatch Operating Procedure (SO_OP3705) for southward flows on the Victoria to Snowy directional interconnector. [170]

NEMMCO estimates that it would require two weeks to amend, publish, and revise procedures as required to implement Snowy Hydro's Re-orientation proposal.

A5.7.3 Settlement Residue Auction Participation Agreements

If a Rule or process Rule change affects the method of calculating settlements residues, the Auction Participant Agreement enables auction participants to terminate any IRSR units they hold with respect to impacted future periods.[171] NEMMCO anticipates that the implementation of either the Southern Generators' or Snowy Hydro Re-orientation proposals would constitute such a change for the VIC-Snowy, Snowy-VIC, Snowy-NSW, and NSW-Snowy directional interconnectors.

If auction participants terminate and return their units to NEMMCO with sufficient notice, NEMMCO would be able to re-auction those returned units along with any new units being offered. The settlement residue auction rules require NEMMCO to

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170 NEMMCO, "Operating procedure: Dispatch: SO_OP3705", V40, 21 June 2006, p.34.
171 NEMMCO, section 13.5, "Auction Participant Agreement", 1 September 2004, p.13.

notify units for sale at least ten business days before the auction.[172] If the implementation date for the proposal did not allow for sufficient time to re-auction terminated units, NEMMCO would retain those unsold units and would pass on to the relevant Transmission Network Service Provider the settlement residue allocated to those unsold units.[173]

As discussed in Section A5.3, the combined value of IRSR units for both the northern and southern interconnectors is likely to increase, improving their value as a tool to manage inter-regional trading. The Commission notes that some IRSR units holders may decide to terminate their holdings. However, given the potential improvement in the units as a hedging tool, it is possible that only a small portion of units would be surrendered.

A5.7.4 Commission's assessment

Given the short-term nature of both these proposals, the Commission considers it important to implement a proposal as soon as realistically possible. The Commission notes that its preferred 1 November 2006 commencement date would not allow sufficient time to re-auction any surrendered IRSR units. While re-auctioning any terminated IRSR units may be preferable, the Commission does not consider that any benefits from delaying implementation to enable the re-auctioning the units are likely to outweigh the other benefits from implementing the proposal as soon as practicable.

While the Snowy Hydro Re-orientation proposal appears to be less complicated to implement compared to the Southern Generators' proposal, the Commission considers that both proposals could be in place by 1 November 2006 and, therefore, in time for summer 2006/2007. The Commission's implementation assessment criterion is therefore not a differentiating factor between the two proposals.

172 NEMMCO, section 4.6, National Electricity Market Settlement Residue Auction Rules, 1 September 2004, p.8.

173 This process is explained in clause 3.18.4(a)(2) of the National Electricity Rules.

Appendix B: Conceptual Assessment of the Southern Generators' and Snowy Hydro Re-orientation Proposals[1]

1. This appendix presents the results of a conceptual or qualitative assessment of dispatch, pricing and hedging impacts of the Snowy re-orientation proposal and the Southern Generators' proposal in comparison with the status quo.[2]

B1 What exactly is the problem?

2. In the National Electricity Market (NEM), electrical power normally flows from lower-priced regions to higher-priced regions, so NEMMCO, which purchases power in the lower-priced regions and sells it in higher-priced regions, makes a "profit", or "surplus" from its inter-regional trading activities. NEMMCO, in turn, sells this surplus back to the market in the form known as "inter-regional settlement residues".

3. On occasion, however, power flows from higher-priced regions to lower-priced regions. In this case, NEMMCO makes a loss or a deficit on its inter-regional trading activities. This is known as the problem of "negative settlement residues". Since, under the current market arrangements, NEMMCO has a limited means for funding large negative residues, NEMMCO is forced to take action in the market to prevent the accumulation of negative settlement residues when they arise.

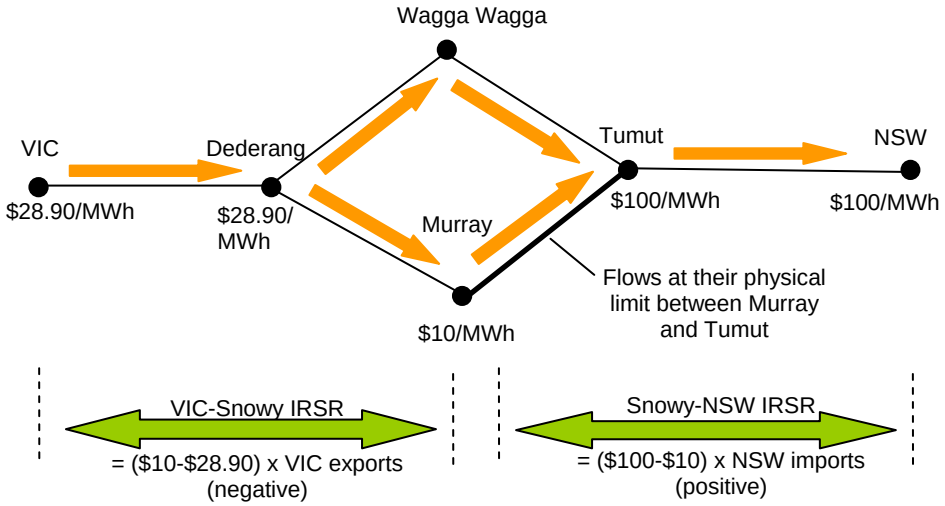
4. There are two circumstances under which negative settlement residues can arise: in the presence of an intra-regional constraint and in the presence of a constraint on an electrical loop between regions.[3] One such electrical loop arises in the Snowy region of the NEM. Power can flow from northern Victoria to southern NSW along two electrical paths. One path passes through the Snowy mountains region, passing along a transmission line between the Murray and Tumut generating stations. The other path bypasses the Snowy mountain region altogether, passing through Wagga Wagga in NSW. This loop is illustrated in the simplified diagram below (Figure B1):

1 This appendix was prepared with input from Darryl Biggar, a consultant to the AEMC and AER.

2 For a description of the two proposals and the status quo, see paragraphs 8 and 9 below or Part 3 Appendix A, Section A1.1 to A1.3.

3 Further information on when negative settlement residues can arise in the NEM is set out in Appendix 5 of the AEMC's Congestion Management Review Issues paper and the AER submission to the AEMC on the Congestion Management Review.

Figure B1: Stylised diagram of power flows and prices in the Snowy region at the time of binding Murray-Tumut constraint (northerly direction)



5. As long as none of the transmission line constraints in this loop are binding, the locational price for electrical power is the same (ignoring losses) at all the points on this loop. However, at times of high power flow across the Snowy region, the flow on the transmission line between Murray and Tumut often reaches its physical limit. When the Murray-Tumut constraint binds, different prices for electricity arise at different locations around the loop.

6. Specifically, when the Murray-Tumut constraint is binding in the northerly direction, the price at the Murray node is the lowest on the loop (say, $10/MWh). Prices increase around the loop in a clockwise direction, reaching their highest point at the Tumut node (say, $100/MWh). Since the price at Dederang in Victoria must therefore be higher than the price at Murray in the Snowy region, power is flowing from a higher-priced region to a lower-priced region, as illustrated in Figure B1. These are known as "counter-price flows". Counter-price flows give rise to negative settlement residues. NEMMCO, which cannot afford to accumulate substantial negative settlement residues, will usually be forced to intervene under the current Rules.

7. It is often noted that negative settlement residues are not necessarily evidence of a fundamental flaw in the design or operation of the market. In particular, negative settlement residues are not (at least not in this case) the result of the "regional" (as opposed to nodal) pricing approach of the NEM and are not merely a consequence of market power. Indeed, negative settlement residues will arise even in a market in which there is full locational pricing for generators and effective competition at every node on the network. Negative settlement residues are a "natural" consequence of the physics of power flows when a binding constraint arises in an electrical loop.

8. Nevertheless, as already observed, under the present market design, negative settlement residues are not easily tolerated. Under the present market arrangements when the Murray-Tumut constraint binds, NEMMCO intervenes in the market in two ways:

a) In the case of northerly flows, when the Murray-Tumut constraint binds, NEMMCO limits exports from Victoria, thereby alleviating the Murray-Tumut constraint and eliminating the negative settlement residues; and

b) In the case of southerly flows, NEMMCO intervenes by changing the way it represents the Murray-Tumut constraint in its computer systems. This so-called "re-orientation" of the constraint equation has the effect of setting the price in the Snowy region equal to the price at Dederang in the Victorian region, equalising the Victorian and Snowy region prices, and eliminating the negative residues.

Box B1: The mathematics of loop flows in the Snowy Region

The network limitation between Murray and the Tumut nodes is reflected in the NEM dispatch engine in a group of constraint equations which all have the naming prefix "H>>H-64". One such equation is the constraint equation known as "H>>H-64_B". In its normal formulation (that is, oriented towards Murray as the regional reference node), during the period November 2003 – December 2005, this constraint equation had the following form:

$$0.79F_{SN\to NSW} - 0.164F_{VIC\to SN} - 0.81Q_{LT} - 0.792Q_{UT} \le RHS \qquad \ldots(1)$$

Where: $F_{SN\to NSW}$ is the flow on the (notional) interconnector from Snowy to NSW, $F_{VIC\to SN}$ is the flow on the interconnector from VIC to Snowy, Q_{LT} is the output of the Lower Tumut power station, Q_{UT} is the output of the Upper Tumut power station and RHS is the physical network limit (the constraint "right hand side").

Suppose that this constraint is the only binding constraint and has a constraint marginal value equal to λ. Ignoring inter-and intra-regional losses, it is straightforward to show that this implies that the price difference between NSW and Snowy and between Snowy and VIC must satisfy the following:

$p_{SN} - p_{VIC} = -0.164\lambda$ and $p_{NSW} - p_{SN} = 0.79\lambda$

Where p_{SN}, p_{VIC} and p_{NSW} is price at the Snowy, VIC and NSW regional reference nodes respectively. Similarly, the price-difference between Snowy regional reference node and the Lower Tumut and Upper Tumut connection points must be given by:

$p_{SN} - p_{LT} = -0.81\lambda$ and $p_{SN} - p_{UT} = -0.792\lambda$

Eliminating the marginal value λ from the first two of these equations we find that when this constraint is binding, the prices in Snowy, VIC and NSW must bear the following relationship to each other:

$$p_{VIC} = \frac{0.164}{0.79} p_{NSW} + (1 - \frac{0.164}{0.79}) p_{SN} = 0.21 p_{NSW} + 0.79 p_{SN} \ldots(2)$$

In other words, in fully efficient dispatch with this constraint the only binding constraint, the price at the VIC node *must* be a weighted average of the price at the NSW and Snowy nodes, with 21% weight given to the NSW price and 79% given to the Snowy price.

For example, if the price in NSW is $100, and the price in VIC is $28.90, the price in Snowy must be $10. This is known as the "spring-washer" effect

B2 How should we go about assessing these proposals?

9. The AEMC has been asked to consider two alternative changes to the Rules to improve the handling of negative settlement residues:

a) A group of Southern Generators has proposed that, when the Murray-Tumut constraint binds, NEMMCO use funds from the Snowy-NSW settlement residues to offset negative VIC-Snowy settlement residues (or vice versa); and

b) Snowy Hydro has proposed that, when the Murray-Tumut constraint binds in the northerly direction, NEMMCO "re-orientate" the relevant constraint equations (as is currently done when the Murray-Tumut constraint binds in the southerly direction) to, in effect, change the price paid to generation in the Snowy region to the price at the Dederang node in Victoria.

10. The AEMC is required to consider whether or not a rule change promotes the NEM Objective. The NEM Objective is closely related to the notion of economic efficiency. Economic efficiency can be broken down into three components: productive, allocative, and dynamic efficiency. For our purposes, productive efficiency relates primarily to short-term dispatch efficiency, allocative efficiency relates primarily to efficient spot pricing and dynamic efficiency relates primarily to the long-term incentives for investment. The long-term incentives for investment are, in turn, related primarily to the pricing of hedge contracts and the impact of the proposals on inter-regional hedging. The assessment below therefore attempts to forecast the implications of these proposals on dispatch cost, pricing, and the effectiveness of inter-regional hedging.

11. Unfortunately, however, like many markets, the NEM is complex. The outcomes in the market depend on the interaction of a large number of factors, such as the incentives and ability of different generators to exercise market power and the number and location of binding constraints. A proposal which is optimal under one set of assumptions may appear undesirable under a different set of assumptions.

12. In analysing these proposals, therefore, it is useful to follow a step-by-step process. In the first step the Commission will analyse the Rule change proposals under a set of "benchmark" assumptions reflecting a stylized market with no market power. In the second step, the assumption of no market power will be relaxed to observe the implications for the proposals.

13. The first step is to exam the implications of these proposals under a set of assumptions which represent a hypothetical "perfect market" or "benchmark" case. These assumptions are set out below:

a) There is effective competition between generators at each generation node in the network;

b) Each generator faces its correct locational marginal price for its output at its location;

c) The mathematical constraints in the NEM dispatch engine accurately reflect the true physical limits of the network; and

d) The only constraint which is binding (or threatening to bind) is the constraint on flows between Murray and Tumut.

B3 What are the implications of the proposals in the no-market-power case?

14. In the NEM, the output of each generator[4] is determined by the NEM computer known as the "dispatch engine". Every five minutes of every day the dispatch engine takes information from generators as to how much they are willing to produce at a range of different prices. The dispatch engine then finds the combination of outputs of every generator which minimises the cost of producing sufficient electricity to meet demand, as reflected in the generator offer curves, subject to not exceeding the physical limits on the transmission limits, as reflected in the constraint equations.

15. The dispatch engine is designed to deliver the economically efficient prices and output of each generator provided that each generator's offer reflects its short-run marginal cost and the constraint equations faithfully represent the real physical limits in the transmission network. If there is adequate competition at each location in the network and adequate locational pricing of electricity (the first two assumptions above) each generator has an incentive to submit an offer curve which reflects its own short-run marginal cost. By the third assumption above the constraint equations in NEMMCO's computers reflect only the underlying physical limits of the transmission network. It therefore follows that under the assumptions above, the dispatch targets chosen by the dispatch engine perfectly achieve short-term productive and allocative efficiency.

16. However, as noted in the previous sections, the pricing and dispatch outcomes that arise under the economically efficient dispatch given rise to negative settlement residues on the VIC-Snowy interconnector.

17. Under the **Southern Generators' proposal**, these negative residues are addressed through a reallocation of the residues. As long as there are enough residues on the Snowy-NSW interconnector to offset the negative residues on the VIC-Snowy interconnector (which will be the case except in a few unusual situations) there is no need for any intervention in pricing or dispatch to eliminate these settlement residues. Therefore, under the assumptions set out above, it follows from the design of the NEM dispatch engine that the Southern Generators' proposal achieves perfect short-run efficiency of dispatch and efficient pricing. As the Southern Generators argue, under the assumptions above, their proposal would result in:

> "economically efficient pricing signals by eliminating the significant problems created by the action taken by NEMMCO to avoid negative settlement residues in the Snowy region".[5]

18. Under the **status quo**, when the Murray-Tumut constraint binds, NEMMCO reduces the flow on the VIC-Snowy interconnector by introducing new constraints into the dispatch engine which limit the VIC-Snowy flow to a level below its physical capability. Since assumption (c) above is violated, the resulting outcomes of the dispatch engine no longer achieve productive or allocative efficiency.

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4 Strictly speaking, each "scheduled generator" which includes all of the largest generators in the NEM and each scheduled load.

5 Southern Generators, Rule change proposal, p.4. These conclusions do not hold in the context of market power.

19. Instead, the primary effect of clamping is to reduce generation in the southern parts of the NEM (VIC, TAS, SA) and to increase generation at Murray (and also, to a lesser extent, at Tumut and the northern parts of the NEM – NSW and QLD). As a result, under the status quo, the output in the southern parts of the NEM is too low, the output at Murray is too high relative to the efficient level. The implications for pricing are similar - under the status quo, clamping raises the price at Murray and lowers the price in the southern part of the NEM relative to the efficient level.

20. There is widespread agreement that the current approach to managing negative settlement residues is inefficient. The Southern Generators note that NEMMCO's clamping intervention results in a:

> "distortion of efficient dispatch and thus degrades the performance of the market in relation to the objectives."[6]

21. Origin Energy notes that NEMMCO's current intervention "interferes with what was previously an efficient dispatch."[7] Snowy Hydro, in its submission on the re-orientation proposal, notes that "both the Southern Generators' and Snowy Hydro's proposal recognise that the current treatment of negative settlement residues is inefficient."[8]

22. The AEMC's Draft Rule Determination on the Southern Generators' proposal concluded:

> "Assuming bids and offers reflect opportunity costs, elimination of NEMMCO's clamping can be expected to increase the economic efficiency of dispatch due to increased use of lower-priced southern generation."[9]

23. Under the **re-orientation proposal** there is no intervention in the market to change the constraint equations. The constraint equations can continue to represent the real physical limits on the network. But, a new problem is introduced - generation at the Murray node is no longer paid the correct locational price for generation output at that node, violating assumption (b) above.

24. Under the re-orientation proposal, output at Murray is paid a price which is equal to the locational price for generation at the Dederang node in Victoria. In the absence of any other binding constraints between Dederang and Melbourne (and ignoring losses), the price at the Dederang node is the same as the price at the Victorian Regional Reference Node (located near Melbourne).

25. But, as discussed above, when the Murray-Tumut constraint is binding, the "correct" locational price for output at Murray is **below** the price paid for output in Victoria. As a result, under the re-orientation proposal, generation at Murray is paid the Victorian price but is dispatched for a level of output on its offer curve corresponding to a lower price. As a result, generation at Murray will be dispatched

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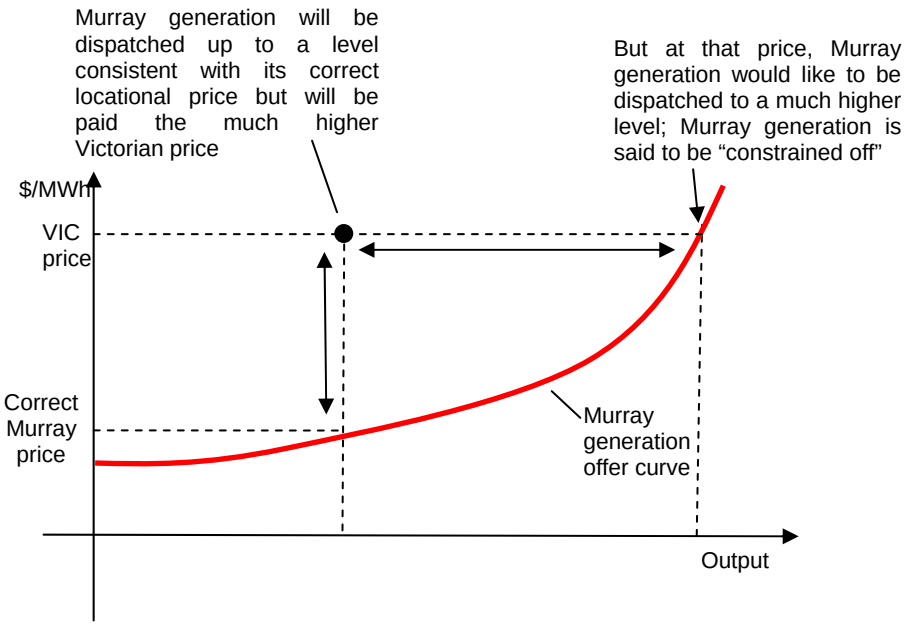
6 Southern Generators, Rule change proposal, p. 4
7 Origin Energy, s.95 submission on Southern Generators' proposal, p.1
8 Snowy Hydro, s.95 submission on re-orientation proposal, p.2
9 AEMC 2006, Management of negative settlement residues in the Snowy region, Draft Rule Determination 6 June 2006, Sydney, p.20

at a price-output combination which is **above** its offer curve. That is, generation at Murray will be "constrained off" relative to the Victorian price.[10] This is illustrated in Figure B2 below.

Figure B2: Under the re-orientation proposal Murray generation is "constrained off" and has an incentive to offer its output below its true cost



26. Where there are many generators which are constrained off, such generators compete by under-cutting each other, lowering their offer curve in an attempt to increase the amount for which they are dispatched. In fact, if there is effective competition between such generators, each such generator will offer all of its capacity at the price floor in the NEM, which is $-1000:

> "If Murray generation were paid at the higher Victorian price, it will no longer have that critical linkage between its bid and settlement price. The result is that its actual bid price is no longer seen as relevant to its marginal cost, except as a tool to adjust output. The profit-maximising behaviour is likely to be that whenever the VIC price exceeds its marginal cost, to bid at whatever price maximises volume. This would appear to be the market floor price upon its entire capacity. If that were to occur, the result would then be to actually reverse flows back into Victoria by about 200 MW."[11]

27. As noted in the above quote, the NEM dispatch engine, observing a large volume of low-cost ($-1000) generation at the Murray node, will increase the dispatch of generation at Murray above the efficient level, and will correspondingly reduce output in the southern part of the NEM. As under the status quo, the resulting dispatch is inefficient.

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10 A longer exposition of the incentives on a generator which is "constrained on" or "constrained off" can be found in the AER submission to the AEMC on the Congestion Management Review.

11 Southern Generators, s.95 submission on re-orientation, p.4

28. Snowy Hydro recognises that its proposal will have implications for the efficiency of dispatch:

> "The reorientation proposal would effectively locate Murray in Victoria when the Murray-Tumut line was constrained on northward flows. In common with all approaches which adopt regional rather than nodal pricing, this can reduce the incentives for bids to reveal marginal cost, with possible resulting dispatch inefficiencies."[12]

29. In fact, the resulting dispatch is less efficient, even, than under the status quo. Under the status quo, NEMMCO has no need to reduce the output of southern generation below the point at which the flow from VIC-Snowy reduces to zero (at this point the settlement residues are zero).[13] However, under the re-orientation proposal it is theoretically possible that NEMDE, observing a large volume of low cost generation at Murray, will increase the output at Murray and reduce the output in the southern region of the NEM, to the point where the flow between VIC and Snowy actually reverses, leading to flows southwards into VIC. In other words, the re-orientation proposal may, in certain cases, lead to higher output at Murray and lower output in the southern NEM than the status quo.[14]

30. This observation – that the impact of the re-orientation proposal under these assumptions will lead to an even greater distortion than the status quo – is echoed by NEMMCO who concluded its 2005 consultation on this issue by noting:

> "The effect under the proposed change (reorientation)…could be more pronounced than under the current arrangement since flow from Victoria to Snowy could become negative under the proposed change, which would not be the case under the current arrangements. Having re-examined the position in the light of these submissions, NEMMCO concludes that the proposed reorientation approach could create under a range of likely scenarios incentives to maximise Murray output. This could then result within a short space of time in dispatch outcomes similar to, or more pronounced, than those arising through the current method of managing negative residues by constraining flow from Victoria to Snowy."[15]

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12 Snowy Hydro, Re-orientation Rule change proposal, p.11

13 In fact, NEMMCO may not even need to reduce VIC-Snowy flows to zero – it need only reduce them to the point where the Murray-Tumut constraint is no longer binding.

14 This conclusion - that reorientation will lead to a large increase in Murray generation, larger even than under the status quo - depends on the assumption that the opportunity cost of Murray generation is sufficiently low such that Murray generation will have an incentive to continue to produce even with low VIC prices. Under this assumption, reorientation will lead to a "flooding of the market" with apparently low-cost Murray generation. More generally, it does not make sense for Murray generation to expand output beyond the point where the VIC price is driven down to the Murray opportunity cost. The increase in Murray output necessary to drive the VIC price down to this point may be quite small, and might be smaller than the increase in Murray output which occurs under the status quo. In this case reorientation is preferred to the status quo.

15 NEMMCO, Revision to procedures for Management of Negative Residues: Final Determination: 20 September 2005, p.11

31. These conclusions must be modified in the presence of market power. However, for now it is worth summarising the key results as follows: Under the assumptions of (a) effective competition at each generation node and (b) no other binding constraints:

- The Southern Generators' proposal allows each generator to be paid its correct locational price and allows the constraint equations in the dispatch engine to reflect only the physical limits of the network. Therefore, by the design of the dispatch engine, the resulting dispatch achieves perfect short-run productive efficiency.

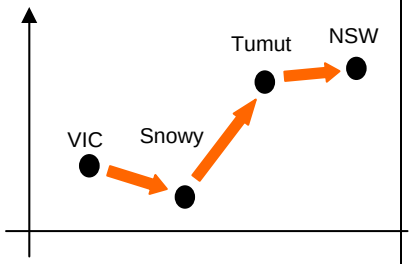
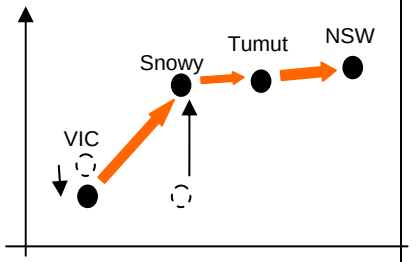
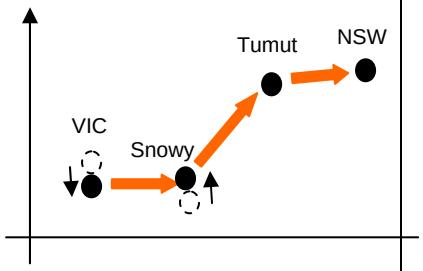
- Under the status quo, the "clamping" constraints impose by NEMMCO restrict the range of outcomes allowed to the dispatch engine by more than is necessary to meet the underlying physical limits, thereby lowering productive efficiency (more expensive generation must be turned on to meet demand when less expensive generation is available). The output and price at Murray is inefficiently high and the output and price in the southern NEM inefficiently low relative to the efficient level.

- Under the Snowy re-orientation proposal, generation at Murray is not paid its correct locational price and is "constrained off". It has an incentive to submit an offer curve below its true marginal cost curve, thereby expanding its output and reducing the efficiency of dispatch relative to the efficient level. Since the distortion to dispatch is potentially larger under the re-orientation proposal than under the status quo, the efficiency of dispatch is lower than under the status quo.

32. Under the benchmark assumptions set out above it is possible to rank the proposals in order of their impact on dispatch efficiency: the Southern Generators' proposal yields the highest dispatch efficiency, followed by the status quo, followed by the re-orientation proposal. As we will see, these conclusions need to be modified somewhat in the presence of market power. These results are summarised in the Table B1 below.

Table B1: Summary of dispatch and efficiency outcomes in the no market power case:

Assumptions: No market power (effective competition at every node), locational pricing at Tumut and no other binding constraints

	Bidding behaviour	Dispatch and constraint outcomes	Pricing outcomes
Southern Generators Proposal	All generation, including Murray generation, offered to the dispatch engine at the efficient level (short-run marginal cost).	Efficient dispatch Efficient frequency of Murray-Tumut constraint	Efficient prices 
Status Quo (SQ)	All generation, including Murray generation, offered to the dispatch engine at the efficient level (short-run marginal cost).	Output in the southern NEM reduced below the efficient level by clamping; Murray output increases above efficient level. Output at Tumut and the northern part of the NEM above efficient level. Efficient frequency of clamping (assuming clamping occurs when and only when the Murray constraint would bind)	Inefficiently high price at Murray and (to a small extent) inefficiently high prices at Tumut and NSW; inefficiently low prices at VIC. 
Re-orientation Proposal	When Murray-Tumut constraint binding, Murray output bid significantly below true cost (at $-1000). All other generation offered to the dispatch engine at the efficient level.	Murray output increases above the efficient level (and above the level in the SQ) Southern NEM output reduced below the efficient level (and below the level in the SQ) Output at Tumut and the northern part of the NEM above efficient level (and above the level in the SQ) Efficient frequency of reorientation (assuming reorientation occurs when and only when the Murray-Tumut constraint is binding)	Inefficiently high price at Murray and (to a small extent) inefficient low price in VIC. 

B4 What are the implications of the proposals in the market-power case?

34. The "benchmark" assumptions considered above are a useful starting point but do not accurately reflect key features of the NEM. In particular, it is likely that Snowy Hydro, at least, has a degree of influence over the Murray price through its control over Murray generation – that is, it is likely that Snowy Hydro has a degree of market power.[16]

35. Allowing for the possibility of market power significantly complicates the analysis. The predicted outcomes are highly sensitive to assumptions about the location and extent of that market power, the nature and extent of hedging of each generator, and the nature and the extent of the use of inter-regional settlement residues as a hedging device. Nevertheless it is possible to draw out some important qualitative (if not quantitative) conclusions.

36. For this analysis, the key market power incentives to analyse are the market power incentives on Murray and Tumut generation – particularly, in this section, the incentives on Murray generation.

37. In the **status quo** case, when the Murray-Tumut constraint binds, NEMMCO intervenes to clamp flows from VIC-Snowy, unbinding the constraint. Since this causes the Murray price to increase up to the level of the (higher) NSW price, this outcome is strongly in the interests of Snowy Hydro.

38. As a consequence, Snowy Hydro has an incentive to offer Murray output at a low price (such as one cent), in order to increase Murray output, to increase the flow on the Murray-Tumut lines, and to increase the frequency with which the Murray-Tumut constraint binds.

39. In this case, therefore, the impact of market power at Murray is to increase the frequency with which the constraint binds, to increase the average output at Murray, and to increase the average price at Murray relative to the no-market-power case. In the same way, the impact of the market power at Murray is to further decrease the average price and output in the southern part of the NEM. Overall, the resulting dispatch and pricing outcomes will be even less efficient than the no-market-power case above.[17]

40. Now, a key feature of the **Southern Generators' proposal** is that, when the Murray-Tumut constraint binds, the price paid to Murray generation decreases below the NEM-wide price when the constraint is not binding– perhaps significantly.

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16 A firm can be said to have market power if it can, by varying the output of one or more of its plants, affect the price it receives.

17 As an aside, note that, given the inherent uncertainty in operating the market, NEMMCO is seldom able to operate the clamp perfectly – that is, to clamp just enough to prevent the Murray-Tumut constraint binding, but no more. In practice, the Murray-Tumut constraint still binds on occasions when clamping is in place. On these occasions, the Murray price will drop significantly – below the efficient level. This results in significant price volatility at the Murray node. As noted by Origin Energy, NEMMCO's intervention can: "create significant volatility in prices at [the] Murray [node] due to the imprecise nature of [NEMMCO's] flow capping process". Origin Energy, s. 95 submission on Southern Generators' proposal, p.1.

41. Since a drop in the Murray price is not in the interests of Snowy Hydro[18], Snowy Hydro has an incentive to bid in such a way as to prevent the Murray-Tumut constraint from binding. Snowy Hydro can achieve this by offering Murray capacity at a higher-than-efficient price, reducing Murray output, and reducing the flows on the Murray-Tumut lines.

42. The resulting dispatch and prices are no longer efficient (as they were in the no-market-power case). Offering Murray capacity at a price above its true cost, increase the prices and reduces the output at Murray, increases the price and increases the output in the southern part of the NEM and (to a lesser extent) decreases the price and reduces the output at Tumut and the northern part of the NEM, relative to the efficient level. The overall productive efficiency of dispatch is reduced, and the Murray-Tumut constraint binds less frequently than is efficient.

43. If Snowy Hydro has sufficient market power at Murray, it will be able to withdraw output to the point where the Murray-Tumut constraint does not bind at all, leading to a uniform NEM-wide price.

44. There seems to be a broad consensus that Snowy Hydro would have strong incentives to withhold Murray generation under the Southern Generators' proposal. Snowy Hydro states:

> "The Southern Generators' proposal would expose Murray to price risk. As Murray would be unable to hedge this risk, it would be obliged to manage it physically through ensuring the Murray to Tumut line was not constrained. This requires Murray to keep its generation down to around 240 MW. The result would be a significant substitution of Victorian generation (probably gas-fired) for Murray generation…
>
> The scale of the withholding, and so impact on competition, is major. If Snowy Hydro's response to the risk it faces under the Southern Generators' proposal was to ensure the Murray-Tumut line was unconstrained, Murray would need to withhold around 1,250 MW of generation."[19]

45. Similarly, the Southern Generators argue that:

> "By not having the threat of NEMMCO intervention, the commercial motive does not exist to offer Murray generation at zero cost. The transfer [from Snowy-NSW residues to VIC-Snowy residues] may never actually be used in practice, because its existence defeats its necessity."[20]

46. Snowy Hydro argues that, because of these incentives, the Southern Generators' proposal would result in a reduction in output at Murray and an increase in (high cost) peaking generation in VIC. Snowy Hydro argues that this is inefficient and that the Southern Generators' proposal would:

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18 A reduction in the Murray price either reduces Snowy Hydro's profit or, if Snowy Hydro is fully hedged, increases the cost of renewing that hedge.

19 Snowy Hydro, s.95 submission on re-orientation proposal, p.9-10

20 Southern Generators, presentation to the AEMC on 3 February 2006, p.22

> "introduce transparent and blatant generation dispatch inefficiencies as marginally more expensive gas plant in Victoria/SA [would be] operated ahead of marginally cheaper Murray generation…this [would be] an inefficient outcome as the lowest marginal cost plant in the market [would be] displaced by the highest".[21]

47. Snowy Hydro is probably correct that this outcome is inefficient however it is incorrect that Murray generation is the "lowest marginal cost plant in the market" as it is necessary to take into account the opportunity cost of water used for hydro generation which is greater than zero.

48. Finally, under the **re-orientation proposal**, the incentive on Snowy Hydro as to how it exercises its market power at Murray depends on whether or not Snowy Hydro is willing to prevent the Murray-Tumut constraint from binding.

49. Recall that the effect of re-orientation is to set the Murray price equal to the price in Victoria for as long as the Murray-Tumut constraint is binding. This price is likely to be lower than the uniform NEM-wide price that would prevail if the Murray-Tumut constraint were not binding. Snowy Hydro is likely to seek to prevent the Murray-Tumut constraint from binding as long as it is able to do so. Under the Southern Generators' proposal, Snowy Hydro is likely to offer Murray generation at a price **above** its true cost in order to limit Murray output and to reduce Murray-Tumut flows, for as long as Snowy Hydro believes it can prevent the Murray-Tumut constraint from binding.

50. But what if Snowy Hydro is no longer willing to "hold back the tide"? What if the Murray-Tumut will still bind despite a very large withdrawal of output at Murray? In this case, as seen in the no-market-power case, Snowy Hydro has an incentive to offer Murray output at a price well **below** its true cost, in order to increase its output to a level consistent with the (VIC) price it is paid.[22]

51. In other words, under the re-orientation proposal, there are two potential outcomes: As long as Snowy Hydro has the ability to prevent the Murray-Tumut constraint from binding, it has an incentive to use its market power to bid Murray output above its true cost, to reduce the chance that the Murray-Tumut constraint will bind, as in the Southern Generators' case. However, if Snowy Hydro is not willing to prevent the constraint from binding, it has an incentive to bid Murray output below its true cost in order to increase the output at Murray, as in the status quo.

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21 Snowy Hydro, s. 95 submission on Southern Generators' proposal, p.3

22 In contrast, as noted above, Snowy Hydro does not have an incentive to offer all of Murray capacity at the price floor – as Snowy Hydro lowers the price at which it offers Murray generation, Murray generation is dispatched to higher levels (as it displaces more and more generation in the southern part of the NEM) and the price in Victoria declines. Eventually Murray generation will be dispatched to level and paid a price, which are profit-maximising for Snowy Hydro. Although it is possible that it will be profit-maximising for Snowy Hydro to drive Murray output to its maximum, possibly even reversing flows on the VIC-Snowy interconnector, this will not necessarily arise.

52. Snowy Hydro, in its re-orientation proposal, notes that this sort of behaviour could arise. It argues that Snowy Hydro would have two possible bidding strategies[23]:

- "Snowy could withhold generation at Murray to ensure that the transmission lines between Murray and Tumut remain unconstrained. Murray could only generate 240 MW, and would withhold 1,260 MW of generation…The impact of withholding this large volume of generation would be similar prices across Victoria, Snowy and New South Wales, and dramatically higher prices in Victoria than under the status quo.

- Snowy could bid a higher level of generation at Murray and constrain the Murray to Tumut transmission line."[24]

53. The analysis here shows that Snowy Hydro is correct in distinguishing these two different types of behaviour, but in contrast to the Snowy Hydro claims, only the first behaviour (withholding at Murray) is likely to be associated with the Southern Generators' proposal. The analysis here shows that both types of behaviour would arise under the re-orientation proposal.

54. Origin Energy argues that a key benefit of the re-orientation approach is that it:

> "Removes the incentive for [Snowy Hydro] to engage in strategic bidding, since it has no control over its own pricing node. The Southern Generators' proposal would in fact increase incentives for strategic behaviour of Snowy generation".[25]

55. In contrast, the analysis here has shown that Snowy Hydro has incentives for strategic bidding under all of the proposals. Reorientation cannot be clearly distinguished from the Southern Generators' proposal on these grounds.

56. In summary, when allowing for market power at the Murray node, the key conclusions include:

- Under the Southern Generators' proposal, Snowy Hydro will exercise whatever market power it has at Murray to prevent the Murray-Tumut constraint from binding, by offering Murray generation at a price above its true cost, reducing the output at Murray and increasing output in the southern NEM, and reducing the efficiency of dispatch relative to the (efficient) no-market-power case above.

- Under the status quo, Snowy Hydro will exercise its market power at Murray to make the Murray-Tumut constraint bind as frequently as possible. Murray generation will be offered at a price below its true cost, further increasing the

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23 Snowy Hydro distinguishes these two bidding strategies in the context of its assessment of the Southern Generators' proposal.

24 Snowy Hydro, Re-orientation Rule change proposal, p.9

25 Origin Energy, s.95 submission on re-orientation, p.1

average output of Murray relative to the no-market-power case and further reducing the efficiency of dispatch.

- Under the re-orientation proposal, the bidding behaviour at Murray will depend on whether or not at a given date and time in the market, Snowy Hydro believes it can prevent the Murray-Tumut constraint from binding without having to sacrifice too much output at Murray. If Snowy Hydro believes it can prevent the Murray-Tumut constraint from binding with only a modest reduction in Murray output, it will offer Murray output at a high price, with some resulting efficiency loss. If Snowy Hydro believes it cannot prevent the Murray-Tumut constraint from binding without a very large reduction in Murray output, it will offer Murray output at a low price. The overall average efficiency consequences of this approach are difficult to assess qualitatively.

57. An overall assessment of which of these three alternatives is likely to lead to the most efficient dispatch is difficult. None of the three alternatives will yield perfectly efficient dispatch outcomes under the present assumptions. The direction of the distortion in dispatch is quite different – with output at Murray increased, relative to the efficient level under the status quo, and decreased under the Southern Generators' proposal, and somewhat unclear overall under the re-orientation proposal.

58. Previous section discussed that, under the assumption of no generator market power, the Southern Generators' proposal, which achieved efficient dispatch, was preferred over the status quo, which, in turn, was preferred over the re-orientation proposal. However, in the context of market power at the Murray node, it seems to be no longer possible to make a simple ranking of the options in this way. Table B2 below summarises the dispatch and efficiency outcomes assuming the ability to exercise market power at the Murray node.

Table B2: Summary of dispatch and efficiency outcomes under the following assumptions:

Assumptions: Market power exercised at the Murray node, other generators behave in a competitive manner, no other constraints are binding.

	Bidding behaviour	**Dispatch and constraint outcomes**	**Pricing outcomes**
Southern Generators Proposal	Murray generation bid above its true cost; other generation bid in a way which reflects its true cost.	Murray output too low; Southern output too high; and Tumut and northern output too low (slightly) relative to efficient level. Frequency of binding constraints too low. Efficiency reduced relative to no-market-power case.	Since the M-T constraint binds less frequently, the average Murray price is higher than in the no-market-power case.
Status Quo	Murray generation bid below its true cost; other generation bid in a way which reflects its true cost.	Murray output too high; southern output too low and Tumut and northern output too high relative to efficient level. Distortion in dispatch is larger than in the no-market-power case. Frequency of clamping too high.	Since the M-T constraint will bind more frequently, the average price at Murray is even higher than the no-market power case; the average price in the southern NEM is even lower.
Re-orientation Proposal	Murray generation bid above its true cost as long as Snowy Hydro can prevent the Murray-Tumut constraint from binding, otherwise Murray generation bid below its true cost; other generation bid in a way which reflects its true cost.	Overall impact on dispatch difficult to assess. If Snowy Hydro has substantial control over Murray-Tumut flows, the predominant effect is likely to be a reduction in output at Murray, and an increase in output in the southern NEM, relative to the efficient level. Frequency of reorientation likely to be too low.	Overall impact on price difficult to assess. Predominant effect may be an increase in the average Murray price relative to the no-market power case.

B5 What is the impact of relaxing the other assumptions?

60. The analysis of the previous sections was carried out under the assumption (assumption (d) in the list above) that there are no other relevant binding constraints. But this might not be the case. In particular, there are two other sets of constraints which might affect our assessment of these proposals:

a) Constraints between Tumut and NSW, which might affect the behaviour of Tumut generation at times of northerly flows; and

b) Constraints between VIC and Murray, which might affect the behaviour of VIC or Murray generation.

61. First the analysis considers the implications of additional constraints north of Tumut, which might limit flows north from the Snowy region into NSW. Snowy Hydro have emphasised strongly in their submission that, at least at times of high Murray-Tumut flows, network limits north of Tumut limit the maximum possible flows into NSW.

62. When these constraints bind there would arise price separation between the Snowy region (and the rest of the southern part of the NEM) and NSW. Snowy Hydro argues that it is not in their interest to allow such price separation – that is, to allow the Snowy price to drop below the NSW price. Snowy Hydro claims that it adjusts the output at Tumut in such a way as to prevent these constraints from binding. In effect, Snowy Hydro is making two claims:

a) That there are constraints north of Tumut which isolate or insulate market outcomes in NSW and QLD at these times from any changes in pricing or dispatch that may arise from these proposals; and

b) These constraints are not immediately apparent from examination of the market outcomes because Snowy Hydro adjusts Tumut output so as to prevent these constraints from binding.

63. Snowy Hydro specifically points to physical limits on the 03 (Lower Tumut to Yass) and 07 (Lower Tumut to Canberra) lines:

> "The headroom on these lines was the limiting factor to getting more physical flow into NSW. Secure dispatch requires that either of these lines be capable to carrying the load in the event that the other trips…The average minimum headroom on either the 03 or 07 lines was 58 MW. This low level of headroom shows that Tumut was bid to ensure a high level of dispatch so that these lines were fully loaded, but allowing a 'noise' margin for sporadic fluctuations in the power system to avoid constraining the lines from Tumut to NSW and creating a price separation…[T]his data on actual dispatch outcomes…shows that additional flows across the cutset cannot displace generation in NSW.

> Changes in flow across the cutset will lead to opposite and offsetting changes in generation at Tumut."[26]

64. This point is reiterated by Snowy Hydro in its submission on its re-orientation proposal:

> "When there are high prices in New South Wales and high flows into New South Wales, Tumut is bid to ensure the transmission lines are fully loaded, while ensuring they do not constrain. Analysis has been performed on historical data that substantiates this assertion. As a result, neither proposal would materially affect dispatch in NSW…There will be no increase in flows into New South Wales and hence no impact on pricing."[27]

65. If there were constraints north of Tumut which limit flows into NSW, it is plausible that Snowy Hydro would exercise its market power at Tumut in such a way as to prevent these constraints from binding. Snowy Hydro could maintain a constant loading on the transmission lines north of Tumut (near their operating limit), by offsetting any increase in net output in the southern part of the NEM and Murray by a reduction in output at Tumut. As Snowy Hydro notes:

> "The Southern Generators' proposal could lead to an increase of up to 100 MW in flows across the cutset. Tumut has to bid to ensure that it does not constrain lines into NSW. As a result, this 100 MW increase in flows from the South will only displace Tumut generation."[28]

66. As long as there are constraints north of Tumut which are binding or near binding at all the relevant times, it follows that the proposals cannot lead to an increase in flow into NSW, and therefore will not change the dispatch, pricing and efficiency implications in NSW (and the rest of the northern part of the NEM). In this case, it would be expected that a change from the status quo would have no impact on prices in NSW. For this reason, Snowy Hydro disputes the modelling results reported in the draft Rule determination for the Southern Generators' proposal, which show that it will lead to a decline of several dollars in the average annual NSW price. Instead, Snowy Hydro argues:

> "Assuming bidding behaviour by Tumut which aims to maximise the loading on the lines into NSW, under both the Southern Generators and the reorientation proposals there will be no additional flows into NSW and no material impact on prices in NSW."[29]

67. Overall, it is difficult to draw conclusions about the impact of constraints north of Tumut and Tumut market power at the level of a conceptual, qualitative analysis. Whether or not (a) there are constraints north of Tumut which threaten to bind at all the relevant times and (b) the economic impact of Snowy Hydro's action to prevent these constraints binding, are empirical questions, which cannot be resolved through

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26 Snowy Hydro, Re-orientation Rule change proposal, p.7
27 Snowy Hydro, s.95 submission on re-orientation proposal, p.2
28 Snowy Hydro, s.95 submission on re-orientation, p.8-9
29 Snowy Hydro, s.95 submission on re-orientation, p.11

a qualitative analysis alone. The Commission has revised the quantitative modelling reported in the draft Rule determination for Southern Generators' Rule change proposal to address the matters raised by Snowy Hydro in their submissions. This is discussed in detail in Part 3 Appendix C.

68. However, it is worth noting that the exercise of market power by Snowy Hydro at Tumut will, other things equal, reduce the efficiency of the overall dispatch. For example, when Tumut reduces its output in response to an increase in production in the southern part of the NEM, it may be that the output of lower cost Tumut generation is being replaced by higher-cost peaking generation in the southern part of the NEM, increasing the overall dispatch cost. It is unlikely that allowing for the exercise of market power at the Tumut node will improve the overall efficiency of dispatch. In any case, the analysis in the previous sections on the implications of the proposals for dispatch and pricing efficiency in the southern part of the NEM remains valid whether or not there are constraints north of Tumut.

69. Snowy Hydro also disputes another element of the modelling results in the draft Rule determination, which show only a modest increase in the price in the Victorian region under the Southern Generators proposal.

> "The AEMC has concluded that under the Southern Generators' proposal, prices in the Victorian region will increase by up to $0.30 MWh. We consider this likely to be a significant underestimate. We have previously stated that the commercial behaviour for Murray generation under the Southern Generator's proposal would be to withhold generation and ensure that the Murray to Tumut intra-regional constraint is not constrained thereby aligning the Snowy price with the NSW price. Under this probable scenario the Victorian price would rise to approximately the Snowy price under high northerly flow/High NSW price scenarios. Snowy Hydro modelling indicates an average annual Victorian spot price increase of the order of $6/MWh."[30]

70. Again, at the level of a conceptual analysis it is difficult to draw any firm conclusions one way or another regarding this matter. As noted above, the Commission has undertaken additional quantitative modelling to address these matters, which is presented in Part 3 Appendix C.

B6 What are the implications for the effectiveness of inter-regional hedging?

71. The previous sections analysed the implications of the various proposals on the spot market pricing and dispatch outcomes. However, a large proportion of the revenues of participants in the wholesale electricity market come from trading in hedging instruments. It is important, therefore, to analyse the impact of the proposals on hedge prices.[31] Hedge prices are important due to their impact on long-term investment and expansion decisions. Accurate pricing of hedging instruments is critical for efficient long-term investment and expansion decisions in

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30 Snowy Hydro, s.95 submission on re-orientation, p.12

31 Westpac stated in their submission to the reorientation proposal: "Clearly … it is the net economic benefit to all participants (both physical and financial) which is important, rather than an artificially selected subset"

the network – whether those decisions are taken by generators, large loads, and merchant transmission companies.

72. There are a very large range of hedge products available in the NEM. All of these products are financial contracts whose payout at a future date and time is linked in some way to the spot market price over some specified period. These vary from simple products with a fixed price and volume (such as swaps), to products with a volume that varies with the spot price (such as caps), to products whose volume varies according to demand, or according to temperature.

73. For the purposes of the analysis here, the focus will be on using swap contracts as a hedging device. A swap contract is a simple fixed-for-floating transaction under which one party pays the other the difference between an agreed fixed price and the wholesale spot price at a given date and time. Generators, which naturally have a "long" position with respect to the spot price, can reduce their risk by selling some of their output through swap contracts in their region. Conversely, retailers, which have a natural "short" position with respect to the spot price, can reduce their risk by buying swap contracts in their region.

74. The actuarially fair or "neutral" price for a swap contract is the expected or average forecast spot price over the same period, but demand and supply conditions in the market for swaps may lead to a price for swaps which is above or below this actuarially fair or neutral value. If the price for swaps deviates too far from the underlying future expected spot price, traders will act to arbitrage these price differences. But such traders must take on risk, for which they must be compensated. It is not possible to rely solely on traders to restore hedge prices to their actuarially-fair levels.

75. In an exporting region, there is (by definition) more electricity being produced than the local demand for electricity. Since (in the absence of any other mechanism) the local supply of swaps in such a region would also exceed the local demand, the supply of swaps will tend to be depressed below the actuarially fair or neutral price. Conversely, in an importing region, there will tend to be a greater local demand for swaps (and other hedging instruments) than local generators can supply. As a result, local swaps will tend to sell at a premium to the actuarially fair price.

76. The problem is that long-term economic efficiency requires that investment decisions are based on an accurate assessment of future expected spot prices. In the absence of any mechanism for facilitating inter-regional trade (or arbitrage) of swap contracts, swap prices will tend to be depressed below efficient levels in exporting regions and elevated above efficient levels in importing regions. These distorted hedge prices will send inefficient signals to decision-makers about the appropriate location for future investment.

77. However, inter-regional settlement residues play a key role in allowing traders to arbitrage inter-regional differences in hedge prices without taking on any risk. Suppose that the inter-regional settlement residues were fully "firm" – that is, suppose the inter-regional settlement residues on an interconnector were equal to the price difference between two regions times a fixed number – say 100 MW. In this case, those inter-regional settlement residues would allow a trader to arbitrage the differences in prices of swaps in two different regions without taking on any risk.

78. For example, suppose the future expected spot price in region A is $35, but swaps in region A sell for only $32. Similarly, suppose that the future expected spot price in region B is $45, but spot prices in region B sell for $47. Suppose that a trader can purchase 100MW of the inter-regional settlement residues at the price of, say, ($45-$35 times 100 = $1000). These residues allow the trader to perfectly hedge a transaction which involves purchasing the settlement residues, buying a 100 MW swap in region A and selling a 100 MW swap in region B. The resulting profit to the trader is $4700 - $3200 - $1000 = $500.

79. Since this transaction is profitable and carries no risk, such arbitrage will continue to the point where the price for swaps in region A increases to $35 and the price for swaps in region B declines to $45, which is their efficient price.

80. As this example shows, inter-regional settlement residues, to the extent that they are firm, allow traders to arbitrage inter-regional differences in swap prices, thereby ensuring that swap prices reflect their underlying efficient value, which in turn ensures that the market receives the correct long-term price signals for investment or expansion.

81. Do the proposals under consideration by the AEMC allow the inter-regional settlement residues to be used to effectively arbitrage differences in the prices of hedge contracts across regions? Or, more precisely, under what conditions or assumptions is such arbitrage possible?[32]

82. As discussed below, each of the proposals considered here would require some different hedging strategy to be adopted when the Murray-Tumut constraint binds compared to the case when the Murray-Tumut constraint does not bind. Therefore, if that arbitrage is to be fully effective, it follows that market participants must be able to forecast when the Murray-Tumut constraint is binding or threatening to bind.[33]

83. Under each of the proposals, achieving perfect arbitrage is still possible, but only under certain assumptions. The analysis that follows will comment on which of these sets of assumptions is the most plausible.

84. Under **the status quo**, which involves clamping, it turns out that market participants can achieve a perfect arbitrage using the existing inter-regional settlement residue instruments provided:

a) The participant can perfectly forecast when clamping will occur; and

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32 The appears that all three of these proposals only impact on the inter-regional settlement residues when the Murray-Tumut constraint binds (or, is threatening to bind forcing NEMMCO intervention). At all other times, the inter-regional settlement residues would play exactly the same role in allowing arbitrage of hedging products as they do now. As has been pointed out in submissions on the Congestion Management Review, the inter-regional settlement residues, as they are currently defined, are not a fully firm instrument – that is, they do not allow for full arbitrage of differences in inter-regional hedge prices without taking on some risk – in the presence of intra-regional constraints or loop flows in the network. However, addressing these issues (outside of those times when the Murray-Tumut constraint is binding or threatening to bind) is beyond the scope of the present Rule change considerations.

33 Assuming of course that there is some probability it will bind.

b) The participant can perfectly forecast the level of the flow that will arise on the VIC-Snowy interconnector at the time the clamping is in place.

85. If market participants can predict when clamping will occur and the flow that will arise at that time, they can determine what share of the inter-regional settlement residues to purchase in order to arbitrage a given volume of swap contracts – in the same way that, if market participants know that an interconnector capacity will be reduced for a given period of time for, say, an outrage, they can adjust their purchases of the inter-regional settlement residues accordingly. Under these assumptions, the inter-regional settlement residues allow for perfectly hedging inter-regional differences in hedge prices.[34]

86. Snowy Hydro claims that:

> "Victorian participants have a reduced ability to manage inter-regional price risks, as there are little or no settlement residues between Victoria and Snowy when NEMMCO clamps…At present settlement residues between Victoria and Snowy fall to low levels, or zero, when the clamp is imposed. This means that the SRAs are a much less effective instrument for managing the risk of price separation between Victoria and New South Wales".[35]

87. It is correct that the settlement residues between Victoria and Snowy are likely to be (but will not necessarily be) smaller when NEMMCO clamps. But this does not in itself reduce the effectiveness of the settlement residues as a hedging instrument – the flow on the interconnector is also smaller at this time and only a smaller volume of residues is needed to hedge the smaller flow. Any inter-regional arbitrage problems that arise as a result of clamping are not due merely to the *reduction* in residues – rather they are due to the difficulty of forecasting when clamping will be applied and/or the flow on the interconnector when clamping is in force.

88. Under the **Southern Generators' proposal**, at times when the Murray-Tumut constraint binds, the positive settlement residues on the Snowy-NSW interconnector are used to offset the negative settlement residues on the VIC-Snowy interconnector. But can the remaining residues can be used to hedge VIC-Snowy and Snowy-NSW price differences?

89. Of course, as noted earlier, since Snowy Hydro has, under this proposal, a strong incentive to prevent the constraint binding, this problem of hedging when the Murray-Tumut constraint arises may never arise.

90. It is possible to show that there is a mathematical relationship between the remaining Snowy-NSW residues and the VIC-Snowy and Snowy-NSW price differences provided the following conditions are satisfied:

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34 As an aside, note that this does not imply that those hedge prices will be economically efficient (as noted earlier, clamping distorts the spot prices at different nodes in the NEM) – but there will be no additional distortion to those hedge prices as a result of an inability to arbitrage inter-regional differences in prices.

35 Snowy Hydro, re-orientation Rule change proposal, p.12

a) The participant can perfectly forecast when the Murray-Tumut constraint will bind;

b) There are no other constraints binding which affect the VIC, Snowy or NSW prices.[36]

91. Snowy Hydro argues that perfect hedging is not possible under the Southern Generators' proposal. Specifically, it argues:

> "The Snowy to NSW SRAs would provide a partial hedge against price separation into NSW. However, they would not fully cover the risk. The Snowy to NSW SRA's would be only partially funded due to transfer of funds from these SRAs to fund the negative residues on the Victoria to Snowy link. Snowy Hydro would have a much reduced ability to hedge inter-regional price risk. The risk of price separation would be increased compared with the status quo. The effectiveness of the Snowy to NSW SRAs would be reduced."[37]

92. It is true, of course, that the volume of funds in the Snowy to NSW SRAs would be reduced by this proposal. However, it is possible to show that under the conditions set out above, the Snowy to NSW SRAs under the status quo are "too high" by precisely an amount equal to the deficit on the Victoria to Snowy SRAs. Reducing the Snowy-NSW residues does not, in any case, necessarily reduce their effectiveness as an arbitrage instrument. As pointed out above, it is possible to obtain a perfect hedge – both from Vic-Snowy and from Snowy-NSW, using the reduced residues under the Southern Generators' proposal, but only under certain conditions.

93. It is not clear that these conditions are any more or less stringent than the conditions for perfect arbitrage under the status quo. However, as already noted, it is likely that there will be a significant reduction (or even elimination) of the times when the Murray-Tumut constraint is binding – thereby eliminating the need for making separate hedging arrangements when the Murray-Tumut constraint binds. On this basis it seems likely that under the Southern Generators' proposal, inter-regional trading would be significantly more effective at arbitraging inter-regional hedge price differences than under the status quo.

94. Now, under the **re-orientation proposal**, the Vic-Snowy residues are zero (or close to zero). As before, the question to address is whether or not the Snowy-NSW residues can be used to hedge VIC-Snowy and Snowy-NSW price differences.

95. Again, it is important to note that Snowy Hydro has an incentive, under this proposal to prevent the constraint binding. As with the Southern Generators' proposal, if Snowy Hydro is successful in preventing the constraint from binding, this problem of hedging when the Murray-Tumut constraint binds may never arise.

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36 In addition, taking into account the impact of losses on the interconnectors, there needs to be the condition that the participant can perfectly forecast the level of the flow that will arise on the VIC-Snowy interconnector at the time the Murray-Tumut constraint is binding.

37 Snowy Hydro, Re-orientation Rule change proposal, p.12

96. Again, it is possible to show that there is a mathematical relationship between the Snowy-NSW inter-regional residues and the VIC-Snowy and Snowy-NSW price differences provided the following conditions are satisfied:

a) The participant can perfectly forecast when re-orientation will occur;

b) There are no other constraints binding which affect the VIC, Snowy or NSW prices; and

c) The participant can perfectly forecast the output of generation in the Snowy region at the time of the re-orientation.[38]

97. When these conditions are satisfied, it is possible to perfectly arbitrage VIC-Snowy or Snowy-NSW hedge price differences.

98. NEMMCO, in its submission, highlights the fact that:

> "the Re-orientation proposal would require NEMMCO to exercise judgment when applying the re-orientation constraint during the dispatch time-frame, while no dispatch time-frame judgment would be required for the Southern Generators' proposal."[39]

99. While NEMMCO's comment is correct, the Southern Generators' proposal does involve intervention in the mechanism for determining settlement residues and therefore requires traders to change the way they use inter-regional settlement residues to arbitrage inter-regional hedge price differences. From the perspective of the hedging in the market, it is not clear whether it is easier to forecast when the Murray-Tumut constraint will bind (as required under the Southern Generators' proposal) or when reorientation will occur (as required under the reorientation proposal). If NEMMCO were perfectly able to forecast when the Murray-Tumut constraint will bind, then re-orientation would only be applied when the Murray-Tumut constraint would otherwise bind. In this case it is not clear that there would be any difference at all between these proposals in how hard it is to predict when the proposals will have an effect.

100. Furthermore, if NEMMCO exercises its discretion when to apply re-orientation in a mechanistic manner, it is even arguable that it may be easier to predict when reorientation will be applied than when the Murray-Tumut constraint would bind (under the Southern Generators' proposal). However, the other conditions above for perfect hedging under the reorientation proposal are even more stringent than under the Southern Generators' proposal, making perfect hedging unlikely.

101. Snowy Hydro argues that the re-orientation proposal will give participants a better ability to manage inter-regional price risk than the other proposals. Specifically, it argues:

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38 In addition, taking into account the impact of losses on the interconnectors, there needs to be the condition that the participant can perfectly forecast the level of the flow that will arise on the VIC-Snowy interconnector at the time the Murray-Tumut constraint is binding.

39 NEMMCO, s.95 submission on re-orientation proposal, p.2

> "Under Snowy [Hydro's] re-orientation proposal, there would be no price separation between Victoria and the Snowy region when the reorientation was applied. SRAs between Victoria/Snowy and NSW would be fully funded. This would give the Victorian participants a better ability to manage inter-regional price risk than either the status quo or the Southern Generators' proposal. The reorientation proposal would perform better than the status quo and the Southern Generators' proposal in ensuring efficient management of inter-regional price risks."[40]

102. In contrast, analysis shows that, under the re-orientation proposal, the Snowy-NSW residues would not be "fully funded" (although that term is not defined). In fact, these residues are reduced precisely by the increased amount that must be paid to Snowy region generation as a result of the re-orientation. (As discussed earlier, re-orientation results in Snowy generation being paid the Victorian price rather than the lower Murray nodal price. The increase in revenue to Snowy generation is precisely offset by an equivalent reduction in the Snowy-NSW residues).

103. As already noted, the conditions above are, if anything, even more stringent than the conditions necessary for perfect arbitrage under the Southern Generators' proposal. It would appear that it is less likely that there will be effective inter-regional arbitrage of hedge prices under the re-orientation proposal. However, as already noted, under the re-orientation proposal Snowy Hydro has an incentive to prevent the Murray-Tumut constraint from binding. Therefore, it is possible that the need to invoke special hedging arrangements when the Murray-Tumut constraint binds will not arise.

104. Origin Energy, in commenting on the hedging implications, notes that the re-orientation proposal:

> "reduces inter-regional trading risk for all generators on the export side of the Murray-Tumut constraint. The Southern Generators proposal reduces risk for Victorian generators but increases it for Snowy generation. It also reduces the value of the Snowy-NSW settlement residues for all participants".[41]

105. As noted above, a reduction in the value of residues does not necessarily reduce (and may indeed improve) the value of settlement residues as a hedging device. The Southern Generators' proposal affects both southern generators and Snowy Hydro equally in that both groups have to modify their hedging arrangements (in similar way) when the Murray-Tumut constraint binds. The analysis above demonstrated that the re-orientation proposal is unlikely to effectively reduce inter-regional trading risk.

106. In summary, to the extent that both the Southern Generators' and the re-orientation proposals result in a lower frequency of Murray-Tumut constraint binding (or threatening to bind) the need for out-of-the-ordinary arrangements to achieve perfect inter-regional arbitrage is reduced. It is possible to obtain a perfect

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40 Snowy Hydro, Re-orientation Rule change proposal, p.12-13

41 Origin Energy, s.95 submission on re-orientation, p.1

hedge under the status quo arrangements, but only under certain fairly strict conditions. Compared to the status quo (under which Snowy Hydro has an incentive to induce constraints), both the Southern Generators' and the re-orientation proposals would seem to deliver more effective inter-regional arbitrage on a more reliable basis.

107. Is it possible to distinguish between the Southern Generators' and the re-orientation proposal? Under both approaches, it is theoretically possible to achieve perfect arbitrage under both approaches, but the conditions required are strict and, in the case of the re-orientation proposal, virtually entirely implausible. Overall, therefore, the Southern Generators' proposal seems slightly more likely to facilitate effective inter-regional arbitrage of hedging instruments.

108. These conclusions are summarised in Table B3 below.

Table B3: Summary of conclusions

	Conditions to obtain a perfect hedge	**Frequency of constraint binding (therefore the frequency of the need to alter hedging arrangements to address this constraint)**
Status Quo	Must be able to forecast when the constraint is binding (and therefore when clamping is imposed) and the flow on the VIC-Snowy interconnector at the time of clamping.	Snowy Hydro has incentive to bind the constraint more frequently than is efficient.
Southern Generators Proposal	Must be able to forecast when the constraint is binding and there must be no other constraints binding at the same time (and possibly must be able to forecast flows).	Snowy Hydro has an incentive to make sure this constraint does not bind, therefore there may be no need to invoke special hedging arrangements.
Re-orientation Proposal	Must be able to forecast when the constraint is binding, there must be no other constraints binding at the same time, and must be able to forecast total Snowy region generation output (and possibly must be able to forecast flows).	Snowy Hydro has an incentive to make sure this constraint doesn't bind, therefore there may be no need to invoke special hedging arrangements.

B7 What can we conclude about the merits of these proposals?

109. A conceptual analysis sheds some light on the likely behaviour of Snowy Hydro and the likely market outcomes under the different proposals. None of the proposals achieves full marks on all of the criteria. As discussed, in a hypothetical no-market-power market the Southern Generators' proposal achieves efficient pricing and dispatch outcomes – but this is not likely to be the real world of the NEM. In this no-market-power world, the re-orientation proposal may lead to outcomes which are even worse (on pricing and dispatch) from the status quo. When allowing for market power, none of the proposals achieve theoretical pricing or dispatch efficiency and therefore ranking them is more difficult.

110. When taking into account the impact of the various proposals on the effectiveness of inter-regional hedging, under all of the proposals it remains possible to use the inter-regional settlement residues as a hedge for inter-regional differences in swap prices – but in every case an inter-regional trader would need to forecast when the Murray-Tumut constraint is binding, so as to make the necessary adjustments to the hedge portfolio. Overall, although none of the proposals under consideration guarantees fully effective inter-regional arbitrage of hedge price differences under all circumstances, the Southern Generators' proposal seems to emerge as the proposal that is most likely to allow for effective arbitrage in the widest range of conditions.

111. These proposals are for an interim solution to an immediate problem in the NEM. The search for long-term effective solutions should continue. This conceptual, qualitative analysis has not found clear and unambiguous theoretical grounds for favouring one approach over another. In choosing between these proposals, it appears that the Southern Generators' proposal emerges as the proposal which, on balance, is most likely to serve the objectives of dispatch and pricing efficiency and ensuring the effectiveness of inter-regional hedging.

Appendix C – Modelling

This Appendix describes the approach, assumptions, and data sources used in the modelling undertaken by the Commission's consultants in considering the Southern Generators' Rule change proposal and subsequently, the Snowy Hydro Reorientation proposal. The Appendix begins by discussing the approach the Commission adopted to consultation, before outlining the modelling framework. It then discusses the analysis of historical data before considering the methodology, assumptions, results, and conclusions for the both the forward-looking dispatch modelling and the forward-looking risk modelling in turn. Additional quantitative modelling was undertaken following the June 2006 release of the Commission's Draft Rule Determination on the Southern Generators' Rule change proposal. The details of this additional modelling and the analysis of its results are discussed below.

C1 Process

The Commission recognises the importance of ensuring that the assumptions and data sources used in the modelling are as accurate as possible. To this end the Commission established an expert panel drawn from industry (the Congestion Management Technical Reference Group or Technical Reference Group). The Technical Reference Group was invited to comment on the:

- questions the modelling was seeking to answer;
- approach to the modelling task; and
- proposed assumptions for the modelling.

The following industry representatives on Technical Reference Group attended a meeting at the AEMC office on 5 April 2006:

- Col Parker – TransGrid;
- Roger Oakley – LYMMCO;
- Russell Skelton – Macquarie Generation;
- Nenad Tufegdzic – Snowy Hydro;
- John Barbera – CS Energy; and
- Greg Jarvis – Origin Energy.

David Bones (NEMMCO) did not attend, but was subsequently briefed by the AEMC staff. The meeting was chaired by Tendai Gregan (AEMC), with Scott Stacey (AEMC) also in attendance.

The comments made by the Technical Reference Group on each of these points were taken into account in the modelling.

Following consultation with the Technical Reference Group, the Commission released a public description of the modelling approach adopted for the Southern

Generators' Rule change proposal. The Information Disclosure Statement was published on the Commission's website on 9 May 2006 and set out the analytical framework, modelling methodology and assumptions for the information of interested parties, prior to the release of this Draft Rule Determination.

The results of the modelling analysis were not made available to any external party, nor members of the Technical Reference Group. The Draft Rule Determination was the first release of the results of the modelling analysis. Since the Draft Rule Determination was published, the quantitative modelling has been revised and extended. This Final Rule Determination is the first release of the revised modelling analysis.

The changes to the modelling since the Draft Rule Determination was published have been directed towards better understanding the relative merits of the Southern Generators' proposal and the Re-orientation proposal, when assessed against the status quo. The Draft Rule Determination on the Southern Generators' proposal modelled a "re-orientation counterfactual" for a limited number of contract scenarios and indicated that further analysis of re-orientation would be undertaken following receipt of Snowy Hydro's formal Rule change proposal on re-orientation.

This appendix includes a more comprehensive modelling analysis of the competing Southern Generators' and Re-orientation Rule change proposals. Three significant contract modelling extensions were implemented and investigated:

1. Re-orientation was modelled across the full range of contract scenarios that appeared in the Southern Generators Draft Rule Determination, rather than just a limited number of "counterfactual" cases;

2. The spectrum of contract scenarios was widened to include cases where Snowy Hydro had a higher overall level of contracting — 80% of installed capacity, which is similar to other generators who are not subject to the NSW Government's ETEF arrangements — and there was greater weighting of its contract portfolio towards the NSW node and less towards the Victorian node (i.e. the VIC;NSW contract ratio split was assumed to be 30:70); and

3. The composition of contract types in Snowy Hydro's contract portfolio was modified to be 100% cap contracts, rather than the mixture of swaps and caps.[1] The modelling here includes, as a sensitivity, a 100% swap contract portfolio for cases where Snowy Hydro's portfolio structure is assumed to have 80% of capacity contracted, with a split of V30:N70.

The second and third extensions were undertaken in light of comments made by Snowy Hydro following the release of the Southern Generators Draft Rule Determination.

1 In contrast, the modelling in the Southern Generators Draft Rule Determination had Snowy Hydro's portfolio having all swaps in NSW and all caps in Victoria

In brief, the contracting level extension (2) was justifiable based on:

- The greater transfer capacity (and greater number of lines) from Snowy to NSW compared to Snowy to Victoria;

- NSW cap premiums being higher than Victorian cap premiums, making the sale of caps to NSW customers more attractive; and

- Snowy Hydro's level of contracting should be similar to other generators not covered by the NSW ETEF scheme and should reflect potentially higher-levels of inter-regional price volatility than what other generators face.

The contract cap extension (3) was justifiable based on the following considerations:

- Snowy Hydro would tend to sell mainly insurance-type products, which are caps; and

- While Snowy Hydro would probably sell some swaps as well as caps, the 100% swaps sensitivity was undertaken to provide an indication of the maximum potential impact of swaps being sold instead of caps.

C2 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 the Southern Generators' Rule change proposal 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 avoidable generation 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 either the Southern Generators' proposal or the re-orientation counterfactual; and, if so, how large this reduction is likely to be over the period of the Rule change (i.e. until the expiry of the CSP/CSC trial). 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; 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 IRSRs are "firmed up" by either the Southern Generators' proposal or the re-orientation counterfactual, and 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.

As a starting point for the modelling analysis, an analysis of **historical data** was undertaken. The analysis of historical market outcomes is useful for two reasons:

- First, it helps identify the nature and timing of NEMMCO intervention to limit counter-price flows on the Victoria-Snowy interconnector (referred to as "clamping"). Clamping is the catalyst for what the Southern Generators claim create the problems which have led to their Rule change proposal; and

- Second, it helps guide the forward-looking market modelling of the potential impacts of the proposal assuming strategic bidding of relevant participants.

The analysis of historical data is discussed in Section C3 below.

The proposed Rule change potentially gives rise to complex behavioural changes in the market, which means that it is not possible to draw conclusions as to the likely effect of the Southern Generators' proposal 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 removing clamping on the economic efficiency of dispatch and the firmness of IRSRs. There are two key parts to the forward-looking modelling analysis:

- **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 resulting from implementation of the proposal and the differences in dispatch, price and revenue outcomes relative to the status quo and/or other counterfactuals; and

- **Risk modelling** to consider the risk management implications for market participants. In particular this aims to examine whether the proposal increases or decreases the extent 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.

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

- **a base case**, which reflects the existing Rules including the Chapter 8A, Part 8 derogation enabling the Tumut CSP/CSC trial. In this case NEMMCO manages counter price flows at times when there are northward flows on the Victoria-Snowy interconnector by clamping and when there are southward flows on the Victoria-Snowy interconnector by re-orientating relevant Snowy constraints to Dederang;

- **a Southern Generators' case**, which reflects the Southern Generators' Rule change proposal. In this case, NEMMCO does not clamp northward flows on the Victoria-Snowy interconnector to manage counter price flows. Instead, any negative settlement residues that accrue on the Victoria-Snowy interconnector are funded by positive residues on the Snowy-NSW interconnector; and

- **a Re-orientation case**, which reflects Snowy Hydro's Re-orientation Rule change proposal.[2] The re-orientation proposal involves setting the Snowy regional reference price to the Dederang nodal price during times of northbound and southbound constraint. The way this is done in practice is discussed in more detail in the modelling assumptions. Snowy Hydro proposed re-orientation in its initial submission on the Southern Generators' proposal[3] and subsequently lodged a Rule change proposal. Therefore, a Re-orientation case was modelled as part of the evaluation of the Southern Generators' proposal because it is an alternative and competing solution to the issue the Southern Generators' proposal is seeking to address. This Appendix seeks to empirically test hypotheses, developed in conceptual analysis, concerning the impact of the two proposals on economic efficiency, pricing and inter-regional trading. The modelling also seeks to give an indication of relative advantages and disadvantages of the Southern Generators' and Re-orientation proposals relative to the base case and each other.

The approach to each of these types of modelling, including a brief description of the models used, is discussed in Sections C4 and C5 below. Those Sections also present the modelling assumptions, sensitivities, results, and conclusions for each of the scenarios.

C3 Historical analysis

This section highlights some of the key findings from the historical analysis for the period 7 August 2004 to 3 March 2006 (see below). This period from 7 August 2004 was chosen because it was the date of the first recorded intervention to manage counter price flows according to the data series provided by NEMMCO. The CSP/CSC trial began on 1 October 2005.

The analysis of historical market outcomes also separately considered the following periods in respect of each episode of NEMMCO clamping:

- The periods of 6 hours prior to the implementation of clamping (referred to as the "pre-clamping" period) – these were typically periods when the Murray-Tumut constraint bound, resulting in counter-price flows but before NEMMCO intervened to address them; and

- The periods in which clamping applied.

The key findings of the historical analysis were as follows:

- the vast majority of clamping interventions to manage counter price flows were on the Victoria-Snowy interconnector at times of northward flows. This usually occurred at peak times in the spring and summer months and times of high NSW demand;

2 Snowy Hydro Limited, *Rule change proposal for: Management of Negative Residues in the Snowy Region by reorientation of constraints*, Rule change proposal, received 24 May 2006. Published on the Commission's website.

3 Snowy Hydro, Southern Generators' proposal, s.95 submission, 10 February 2006. Published on the Commission's website.

- the imposition of clamping at times of northward flows tended to coincide with widening price differences between NSW and Victoria;
- northward flows across the Snowy-NSW interconnector appeared to be higher after clamping commenced than immediately before clamping;
- the Victoria-Snowy interconnector was relatively non-firm at times of northward flows compared to the Snowy-NSW interconnector; and
- in line with anecdotal accounts, Snowy Hydro output during both pre-clamping and clamping periods has been higher since the trial began, while the Southern Generators' output has been lower.

Notwithstanding these observations, it is difficult to make definitive statements about clamping being the "cause" of changes such as widening inter-regional price differences or changes to Snowy Hydro output. This is because market conditions such as levels of demand change over time. This means it may not be appropriate to attribute the cause of changes solely to clamping.

Hours of counter-price flows and counter price flow management

Figure C1 shows that counter-price flows and clamping have usually arisen during times of northward flows from Victoria to NSW and that this has mostly often been during the spring/summer months (Q4 and Q1).

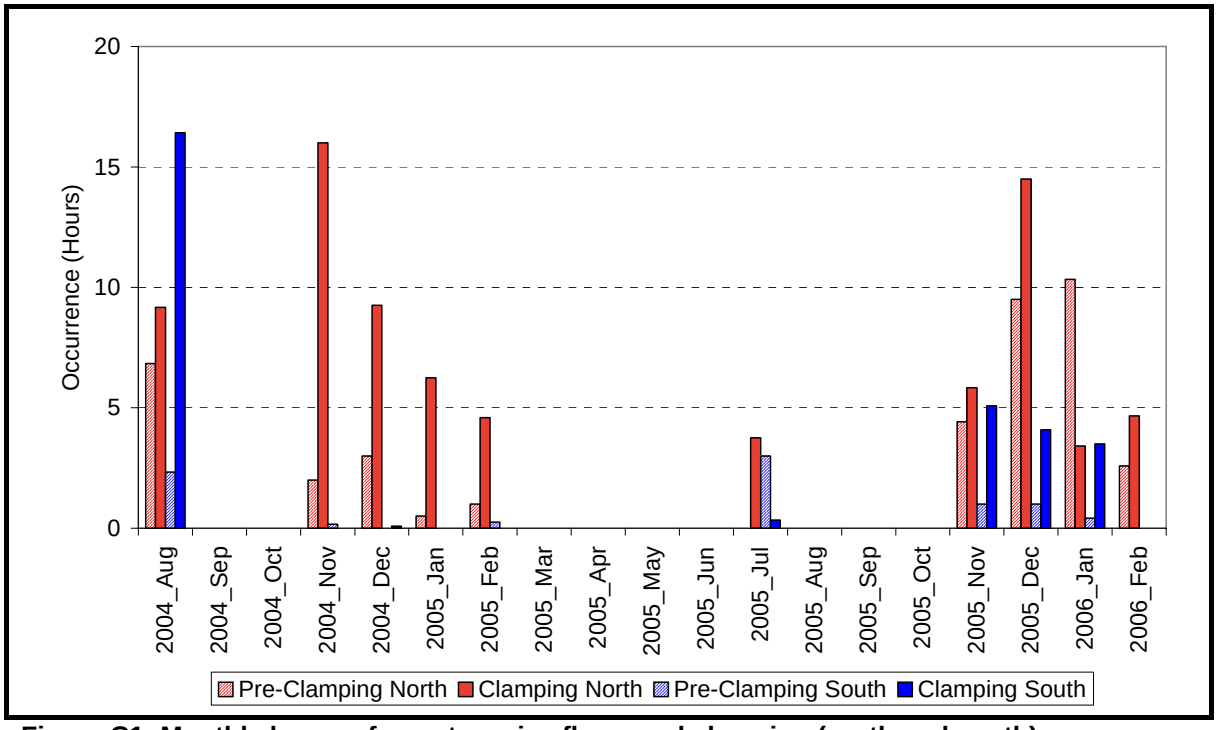

Figure C1: Monthly hours of counter-price flows and clamping (north and south)

Clamping during southward flows occurred in August 2004, but on few occasions since then. This is likely to be at least in part because NEMMCO amended its procedure[4] to allow for re-orientation to manage counter price flows on the Snowy-

4 NEMMCO, Operating Procedure: Dispatch, SO_OP3705, v36, 30 September 2005

Victoria interconnector when flows are southward from NSW to Victoria.[5] Re-orientation is discussed in more detail later in this Section.

NSW demand and prices prior to and during clamping

It would be expected that clamping of the Victoria-Snowy interconnector would generally take place at times of high NSW demand. This is because these are the times when the constraint between Murray and Tumut would be expected to bind in a northward direction, resulting in a "springwasher effect" around the network loop passing through the Snowy region (the springwasher effect is what leads to Snowy prices being lower than Victorian prices at times of northward flows, thereby inducing NEMMCO to implement clamping). Figure C2 shows that NSW demand at times of northward counter-price flows and clamping tends to be relatively high both at pre-clamping and clamping times. Consistent with this finding, separate analysis shows that NSW prices tend to be higher than average at times of northward flows and clamping.

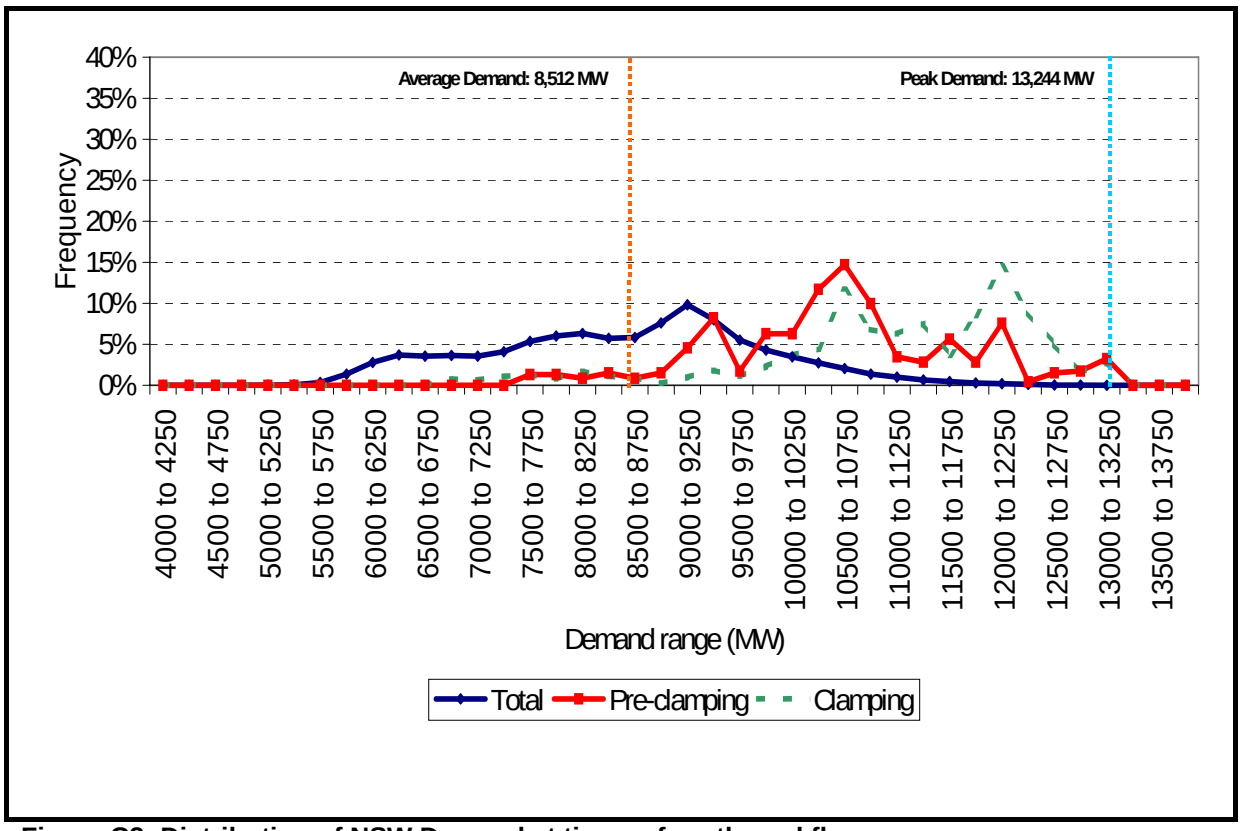

Figure C2: Distribution of NSW Demand at times of northward flows

The analysis also shows that since the CSP/CSC trial commenced, clamping appears to occur at slightly higher demand levels than it did before the trial. However, this may be due to higher demand generally since the trial began.

5 See Section 2 of the Southern Generators Draft Rule Determination.

NSW-Victoria price differences and northward flows

Figure C3 shows that NSW-Victoria price differences tend to be relatively small at times of northward counter-price flows (i.e. during pre-clamping periods) but are relatively wide at times of clamping. This is consistent with the notion that clamping gives rise to greater price separation. However, once again, attributing causation is difficult due to higher NSW demand prevailing at times of clamping compared with pre-clamping periods.

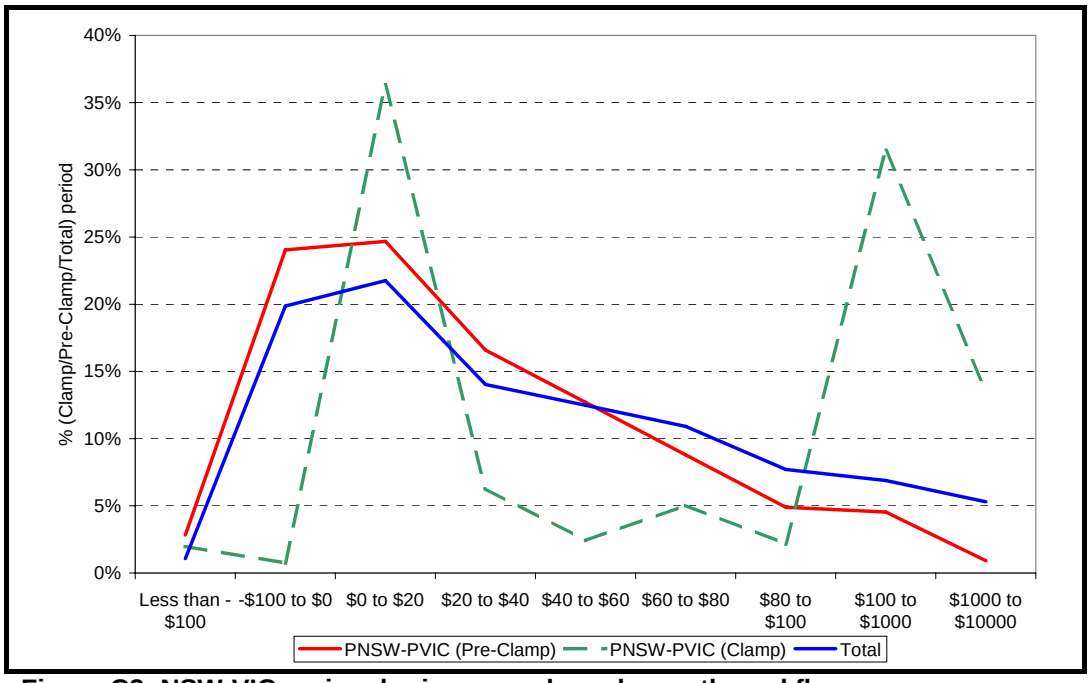

Figure C3: NSW-VIC regional price spreads under northward flows

Snowy-NSW northward interconnector flows during pre-clamp and clamping

One important matter of dispute in relation to the Southern Generators' proposal was whether clamping led to reduced flows from Snowy to NSW.

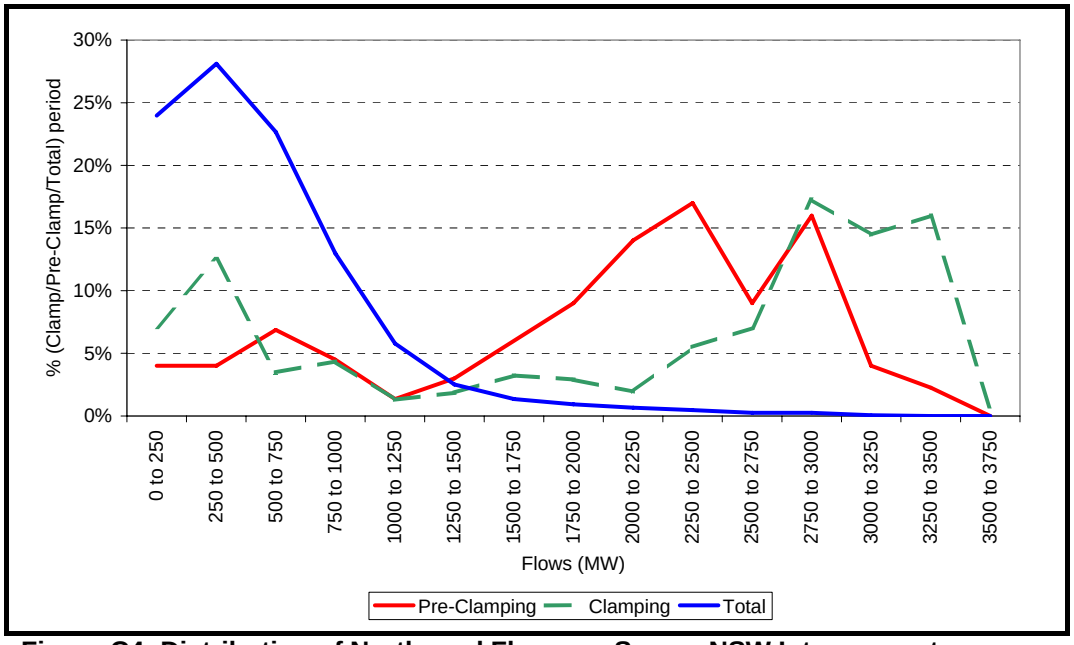

Figure C4: Distribution of Northward Flows on Snowy-NSW Interconnector

Figure C4 shows that northward flows on the Snowy-NSW interconnector have generally not fallen from pre-clamping to clamping periods. However, the analysis does not control for levels of NSW demand, which is higher in clamping periods than pre-clamping periods. Therefore, the analysis cannot demonstrate that clamping does not reduce Snowy-NSW interconnector flows compared to what would have been the case without clamping.

Counter price flows and Re-orientation

NEMMCO's procedure allows for re-orientation to manage counter price flows on the Snowy-Victoria interconnector when flows are southward from NSW to Victoria. Figure C5 reveals that re-orientation tends to occur at times of relatively high Victorian prices compared with NSW prices. This is the outcome one would expect given that these are the times the constraint between Tumut and Murray would be expected to bind in a southward direction.

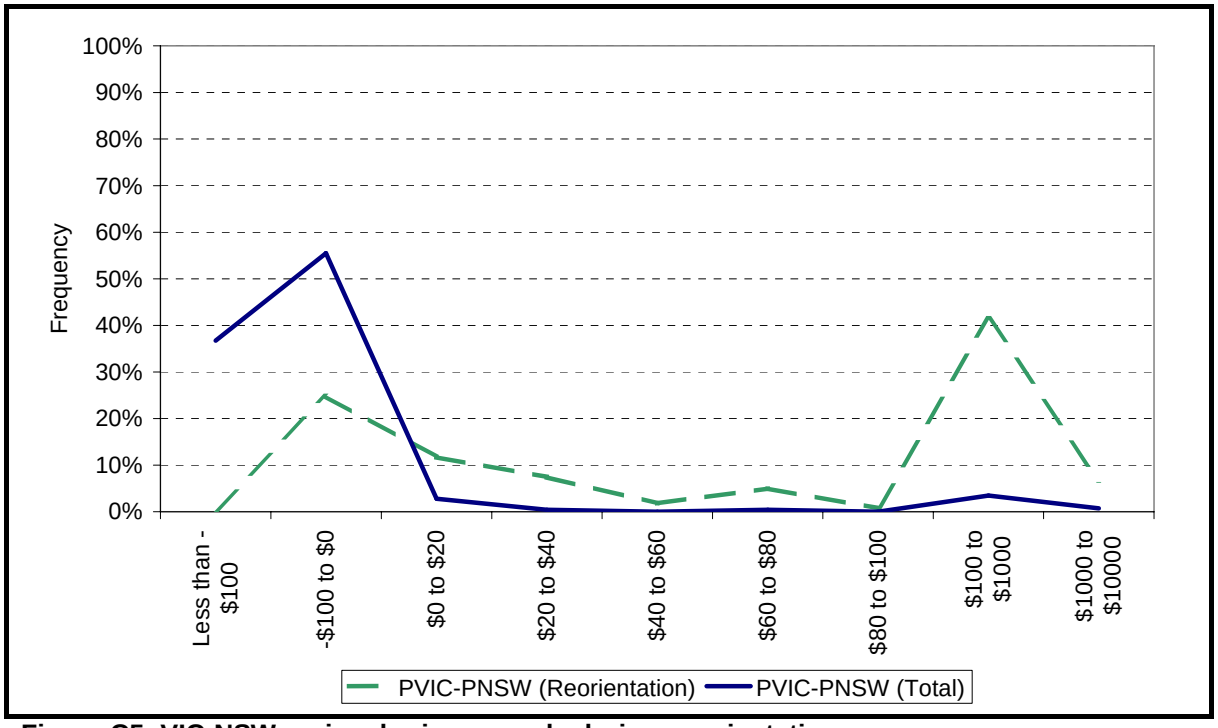

Figure C5: VIC-NSW regional price spreads during re-orientation

Firmness of SRAs

In terms of the impact of clamping on inter-regional trading, a key question is the extent to which the IRSRs have provided a 'firm' hedge to participants to manage inter-regional price differences. This particularly applies to the Victoria-Snowy IRSRs. If clamping means that these IRSRs have a low level of firmness, they may deter Victorian generators entering contracts with retailers in NSW. This may in turn:

- discourage generation investment in Victoria because of the difficulty of trading power from Victorian plant to customers in other regions; and/or
- reduce retail competition in NSW by dampening competition in the NSW hedge contract market and increasing retailers' costs of managing counter-party risk. NSW retailers may have fewer potential counterparties, which could lead to higher contract prices. The lack of potential counterparties could also increase retailers' credit support costs because of higher counter-party credit risks in dealing with a smaller number of generators.

Table C1 shows the number of hours that flows on the interconnector are limited (i.e. there is a binding constraint), and the proportion of these hours where the binding limit (in MW) is less than the maximum available number of IRSR units. This may be because of NEMMCO intervention to manage counter price flows or because of a transmission outage.

The table shows that in respect of northbound flows, IRSRs on the Victoria-Snowy interconnector are virtually always non-firm. That is, most of the time when the limit binds it does so at an amount less than the IRSR unit volumes sold at auction. In contrast, most of the time when the limit binds on the Snowy-NSW interconnector the volume transferred is greater than the maximum IRSR unit volumes sold, implying that these IRSR units are relatively firm.

In all cases the proportion of time when the interconnector binds at less than the SRA volumes is relatively small (less than 1% in most cases). However, the previous analysis demonstrated that intervention tends to occur at times of relatively high demand and large inter-regional price spreads, and may therefore have a disproportionate effect on market outcomes and participant positions.

	Vic-Snowy	Snowy-NSW
South		
No. binding hours	127	26
No. binding hours less than SRA Volumes	127	7
% of constrained hours when the interconnector is binding at less than SRA volumes	100%	27%
% of total sample period when the interconnector is binding at less than SRA volumes	0.92%	0.004%
North		
No. binding hours	349	5
No. binding hours less than SRA Volumes	335	2
% of constrained hours when theinterconnector is binding at less than SRA volumes	96%	38%
% of total sample period when the interconnector is binding at less than SRA volumes	2.44%	0.01%

Table C1: Firmness of interconnectors

Output at times of intervention

In addition to the analysis of demand, prices, and residues at times of intervention, it is also useful to consider patterns of generator output. Analysis of generator outputs can provide further insight into the behaviour emerging during episodes of intervention. The figures below focus on outputs of the major generators north and south of the constraint at times of northward flows. The generators considered are:

- *Snowy Hydro* - Snowy Hydro's Murray, Guthega, Upper Tumut and Tumut 3 generators;
- *Southern Generators (SG)* - AGL, Energy Brix, International Power, Loy Yang Power, NRG and SECV; and
- *Northern Generators (NG)* - CS Energy, Delta Electricity, Enertrade, Eraring Energy, InterGen, Macquarie Generation, Origin Energy, Redbank, Sithe, Stanwell, Tarong Energy and Wambo.

Figure C6 shows that in both pre-clamping and clamping periods, Snowy Hydro output is generally higher than it was before the CSP/CSC trial commenced. Closer inspection of the data reveals that both Murray and Tumut have been generating more during these periods since the Snowy CSP-CSC trial (Snowy trial) commenced. Importantly, this analysis does not control for demand or price.

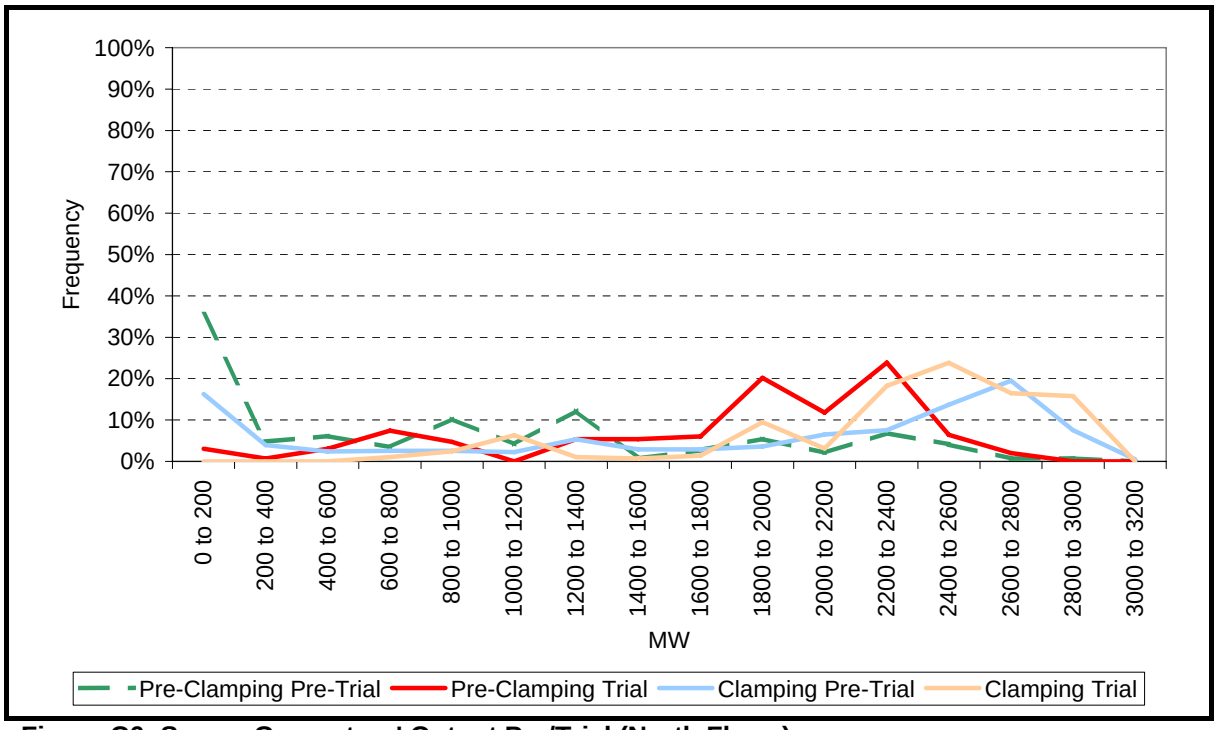

Figure C6: Snowy Generators' Output Pre/Trial (North Flows)

Figure C7 shows that while the Southern Generators have been generating at least as much in pre-clamping periods following the start of the Snowy trial, their output in periods of clamping has fallen significantly. This accords with anecdotal accounts of recent market outcomes. In short, it appears that Snowy region output has been substituting for Southern Generators' output at clamping times since the trial began.

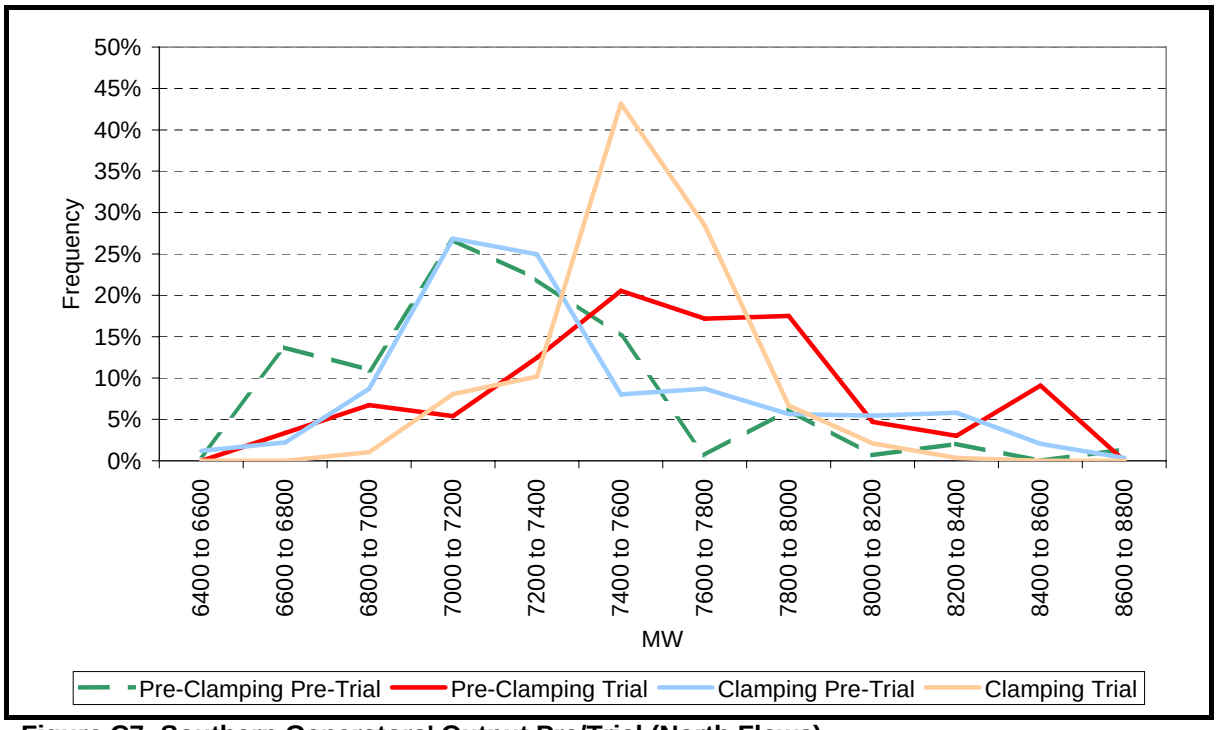

Figure C7: Southern Generators' Output Pre/Trial (North Flows)

The data for the Northern Generators show that they have been generating substantially more during pre-clamping periods and slightly more during clamping periods since the trial began.

Scope for higher flows into NSW

The final question to be answered by the historic analysis is whether more power could have been delivered to NSW from Snowy/Victoria during clamping events. This would have required more power to flow on the Snowy-NSW interconnector.

In order for more power to flow north on the Snowy-NSW interconnector, the historical flow would have needed to be below the export limit of the interconnector, such that there was some 'headroom' between potential and actual flows on the line. Figure C8 shows the distribution of headroom on the Snowy-NSW interconnector during times of clamping for the period November, 2005 to February 2006 inclusive. Distributions for three NSW price bands are depicted: less than $100/MWh; greater than $100/MWh and less than $1000/MWh; and, greater than $1000/MWh and less than VoLL.

The chart shows that for last summer, when NSW prices are greater than $100/MWh and clamping was in effect, there was rarely more than 150 MW of headroom on the Snowy-NSW interconnector. However, when NSW prices are less than $100/MWh and clamping was in effect, there were times with significantly greater headroom levels, up to 2,500MW.

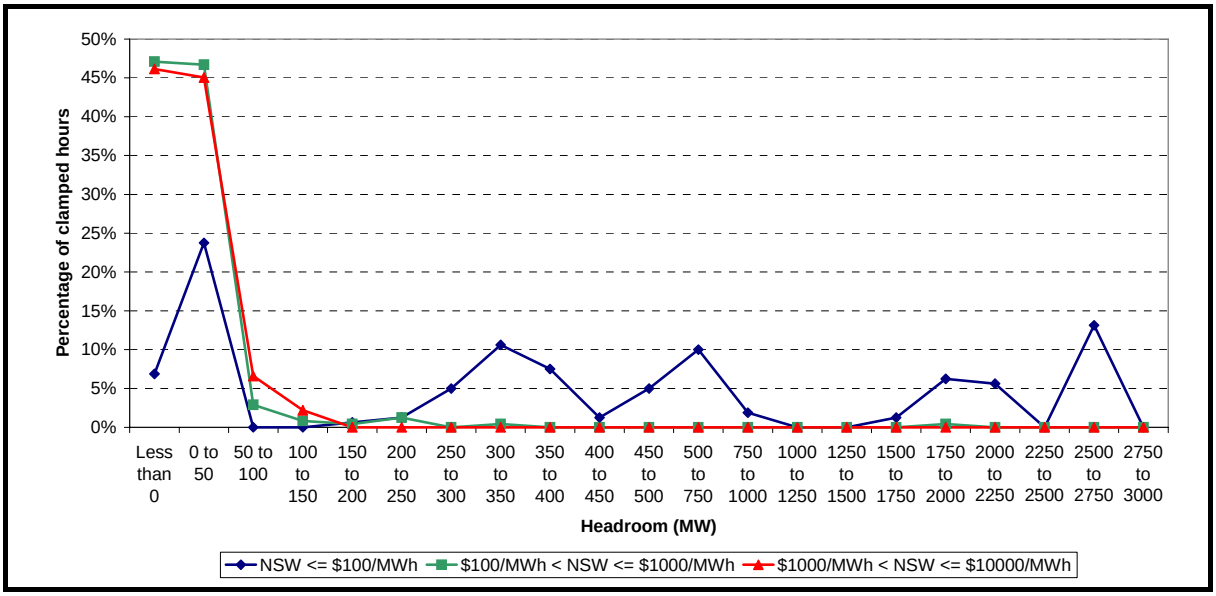

Figure C8: Distribution of headroom on Snowy->NSW during clamping events (Nov. 2005 to Feb. 2006 inclusive) for different price bands

The analysis shows that Snowy Hydro's assertion regarding bidding behaviour of the Tumut power stations and resulting level of headroom on the Snowy to NSW interconnector are generally consistent with observed historical outcomes over last summer. However this behaviour is not observed in all instances; for example, for NSW prices below $100/MWh, the historical analysis normally shows significantly higher levels of headroom.

However, it should be noted that flow limits on interconnectors are set dynamically via system constraints. Figure C9 shows the distribution of the absolute value of the Snowy to NSW interconnector export limit. Comparing the Headroom data in Figure C8 to the corresponding interconnector flow data in Figure C9 shows that although headroom remains low (less than 200 MW) at times when prices are above $100/MWh the value of the limit in Figure C9 varies significantly. When prices are greater than $1000/MWh the limit value ranges from 2,400 MW to 3,100 MW, (Figure C9) headroom at these times is less than 150 MW (Figure C8). Therefore, even though observed headroom is typically relatively low at these times, actual northward flows on the Snowy-NSW interconnector can vary substantially.

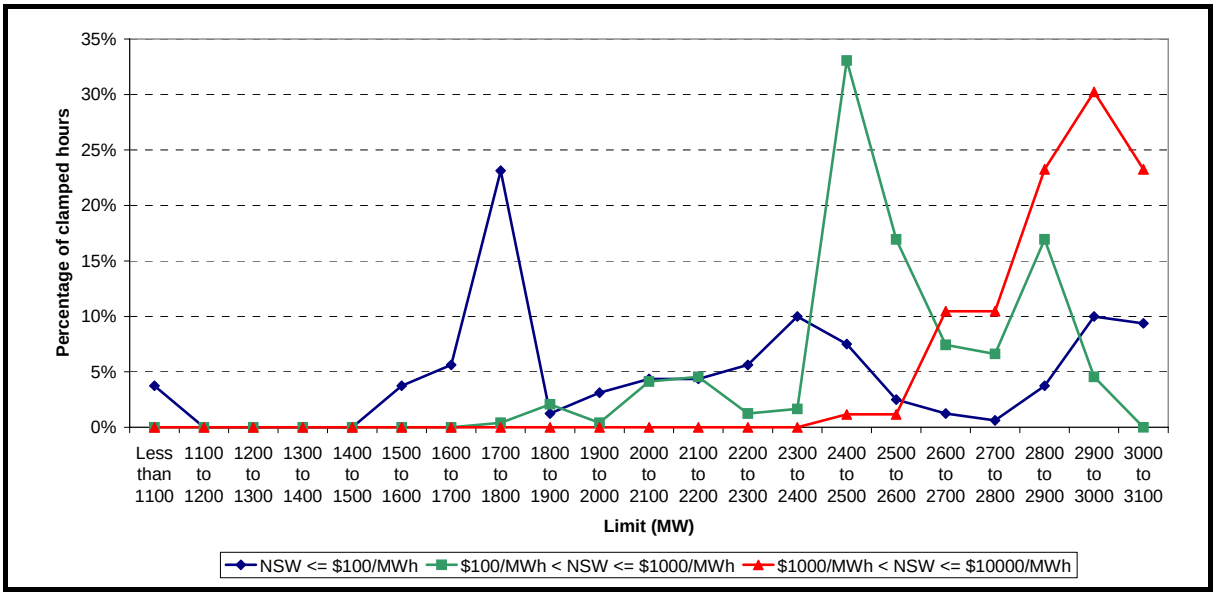

Figure C9: Distribution of export limit on Snowy->NSW during clamping events (Nov. 2005 to Feb. 2006 inclusive) for different price bands

The forward-looking dispatch modelling (see below) demonstrates similar levels of headroom on the Snowy to NSW interconnector. That is, that while levels of headroom can remain low on the interconnector, the flows and associated limits can vary significantly.

C4 Forward-looking dispatch/price modelling

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

Approach

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 this model before discussing the methodology used to calculate the dispatch and price implications of the Southern Generators' proposal and the counterfactual of re-orientation.

Key features of SPARK

SPARK incorporates a representation of the physical system and 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 constraints within and between regions;
- the ability to model systems from a single region down to full nodal pricing; 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.

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 model portfolios of generators within and across regional 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.

Methodology

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 the Southern Generators' Rule change proposal and Snowy Hydro's Re-orientation proposal.

The first step in the methodology is to describe the base case against which market design changes can be compared. This allows comparison of the base case with the alternatives, namely the Southern Generators' proposal and the Re-orientation case. Each of these cases is briefly outlined below. Detailed modelling assumptions are discussed in the following section.

Base case

The base case includes:

- **CSP/CSC trial** – consistent with the Chapter 8A, Part 8 derogation in the Rules. Under the arrangements transfers are made between Snowy Hydro and the Snowy-NSW IRSR funds to reflect CSP and CSC payments. CSP payments are based on the dual (or shadow) price of the relevant binding Snowy constraint, consistent with the derogation. CSC payments are modelled by allocating Snowy Hydro a 41% (550/1350) share of NSW-Snowy (i.e. southward) IRSRs at times when there is a binding constraint from Tumut to Murray; and
- **NEMMCO clamping** – in accordance with NEMMCO, Operating Procedure: Dispatch, Document Number SO_OP3705. This includes reducing flows on the Victoria-Snowy interconnector (i.e. "clamping") to manage counter price flows at times of northward flows and re-orientation of the constraints to Dederang to manage counter price flows at times of southward flows. Clamping is modelled assuming perfect foresight: That is, setting the Victoria-Snowy interconnector limit to zero when there would otherwise have been negative settlement residues on the interconnector for northward flows.

Southern Generators' case

In the Southern Generators' case, negative settlement residues on the Victoria-Snowy interconnector are funded by positive settlement residues on the NSW-Snowy interconnector (after adjusting for CSP/CSC allocations). Because of this, clamping is not used to prevent counter-price flows at times of northward flows and re-orientation is not used to prevent counter-price flows at times of southward flows.

Re-orientation case

In the Re-orientation case, the re-oriented forms of constraints pertaining to northward flows are included in the model. The re-orientated constraints for the management of northward counter price flows are taken from *NEMMCO, Constraint List for the Snowy CSP/CSC trial, March 2006*. Under the Re-orientation case, the Snowy regional reference price is effectively set equal to the nodal price at Dederang in Victoria at times of northward (as well as southward) constraints between Murray and Tumut. This means that counter-price flows between the Victorian and Snowy regions are unlikely to arise at either of these times because the Dederang price will typically be nearly identical to the Victorian reference price (i.e. separated only by losses) and hence the need for clamping does not arise.

Required steps

After establishing each of the cases for examination (base case, Southern Generators' proposal and Re-orientation proposal), the dispatch modelling analysis was progressed in three main steps:

- first, SPARK is 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) are dispatched at those times and in those quantities that minimise the variable dispatch cost of all thermal plant in the system. However, while strategic hydro plant (such as Snowy Hydro) are not restricted to this pattern of dispatch in future scenarios, the pattern of dispatch for all non-strategic hydro plant are not altered for the remainder of the analysis;

- second, SPARK is used to model the dispatch and pricing outcomes of a strategic bidding scenario. Snowy Hydro and key thermal generators in other regions are allowed to bid strategically. The modelling focuses on a number of key demand levels when counter price flows are most likely to occur – i.e. peak demand times in summer and winter; and

- finally, a number of demand levels representing the remainder of the year are modelled under the assumption of competitive dispatch, where the output of the hydro generators is energy constrained to ensure that their output over the year reflects energy limitations.

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

Modelling assumptions

The specific modelling assumptions used for the analysis of the Southern Generators' proposal and the re-orientation proposal were as follows.

Generation capacity

Existing and committed generation capacities for scheduled generators were taken from NEMMCO, Statement of Opportunities for the National Electricity Market, October 2005 (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.

Generator bids

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. There are an infinite number of bidding strategies and, obviously, it is not possible to model all of these.

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. A number of methods are 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.

The strategic participants and their strategic power stations used in this analysis are shown in Table C2. 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 offer 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 their strategic power stations at or near SRMC and the remainder at VoLL.

Given the importance of understanding the effect of the Southern Generators' proposal and the Re-orientation proposal on the incentives for Snowy Hydro, Snowy Hydro was allowed a relatively large number of 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 is anecdotally observed, such as bidding Murray at close to $0/MWh.

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.

Table C2: Strategic participants

Strategic participant	Strategic stations	Bidding strategies (proportion of capacity offered at or close to SRMC)
Snowy Hydro	Tumut, Murray	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. Therefore, Hydro Tasmania was treated as any other non-strategic hydro plant – its pattern of dispatch was determined through the competitive SPARK runs.

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 $100-1500/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 computes prices, outputs, interconnector flows, etc, for nearly 500,000 bidding combinations for

each year modelled. The Nash Equilibria are found from the output of these model runs.

Thermal generation SRMC were taken from *ACIL, 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.

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.

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

1. *Overall levels of contracts in the market* – strategic players were assumed to sell contracts equal to 'high', 'medium' and 'low' percentages of their installed capacity (see Table **C3** below). Following Snowy Hydro's comments on the modelling for the Southern Generators Draft Rule Determination[6], a 'SH revised' contracting case was considered, with Snowy Hydro contracted to 80% of its capacity and other generators contracted at 'medium' levels;

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

3. *Split of Snowy'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. The cases considered were V40/N60 (40% of contracts at the Victorian node and 60% at the NSW node), V50/N50 and V60/N40. Following Snowy Hydro's comments on the modelling for the Southern Generators Draft Rule Determination, a V30/N70 split was considered; and

4. *Type of contracts held by Snowy* – Snowy Hydro was assumed to hold either all cap contracts with $300/MWh strike prices or all swap contracts at $35/MWh.

Table **C3** summarises the combinations arising from the first two contracting scenarios considered. NSW strategic generators have been assumed to contract to a lower level than players in other regions to account for the effect of the ETEF arrangement.

6 See "Snowy Hydro Ltd Presentation on Modelling to AEMC, 21 June 2006" (published on the Commission's website).

Table C3: Contracting cases

Contracting case	Snowy contract level	Snowy IRSR units	NSW players	Other players
Medium	60% of capacity	Equal to contract level	65% of capacity	75% of capacity
Low	50% of capacity	Equal to contract level	55% of capacity	65% of capacity
High	65% of capacity	Equal to contract level	70% of capacity	80% of capacity
Over	60% of capacity	20% *above* contract level	65% of capacity	75% of capacity
Under	60% of capacity	20% *below* contract level	65% of capacity	75% of capacity
SH revised	80% of capacity	Equal to contract level	65% of capacity	75% of capacity

The base case, Southern Generators' and Reorientation proposals were modelled for all contracting cases and a range of Snowy interregional contracting splits and contract types. This resulted in a total of 27 different model runs. These runs are listed in
Table **C4** below:

Table C4: Scenarios modelled

Scenario	Constraint regime	Snowy contract type	Snowy split	Contracting case
1	Base case	Cap	V30/N70	SH revised
2	Re-orientation (ReOrient)	Cap	V30/N70	SH revised
3	Southern Generators (SG)	Cap	V30/N70	SH revised
4	Base case	Cap	V40/N60	medium
5	ReOrient	Cap	V40/N60	medium
6	SG	Cap	V40/N60	medium
7	Base case	Cap	V50/N50	high
8	ReOrient	Cap	V50/N50	high
9	SG	Cap	V50/N50	high
10	Base case	Cap	V50/N50	low
11	ReOrient	Cap	V50/N50	low
12	SG	Cap	V50/N50	low
13	Base case	Cap	V50/N50	medium
14	ReOrient	Cap	V50/N50	medium
15	SG	Cap	V50/N50	medium
16	Base case	Cap	V50/N50	over
17	ReOrient	Cap	V50/N50	over
18	SG	Cap	V50/N50	over
19	Base case	Cap	V50/N50	under
20	ReOrient	Cap	V50/N50	under
21	SG	Cap	V50/N50	under
22	Base case	Cap	V60/N40	medium
23	ReOrient	Cap	V50/N50	medium
24	SG	Cap	V60/N40	medium
25	Base case	Swap	V30/N70	SH revised
26	Re-orientation (ReOrient)	Swap	V30/N70	SH revised
27	Southern Generators (SG)	Swap	V30/N70	SH revised

Modelling period

The Southern Generators' and Snowy Reorientation proposals cover the period from late 2006 to mid 2007. Therefore the modelling was conducted for the financial year 2006/07.

Demand

To streamline the modelling the analysis focused on 62 representative demand points (ie; load blocks) 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 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 for 2006/07 was based on the medium growth, 50% probability of exceedence (POE) forecasts from NEMMCO's 2005 Statement of Opportunities (SOO) and was characterised using 62 representative demand points. The demand profile was based on the 2004/05 load profile.

The first 27 points focused on levels of NSW and Victorian demand that led to clamping (as informed by the historic analysis) during summer peak hours. These points accounted for 250 hours of the year. Another 15 points were allocated to 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 in Figure C10 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.

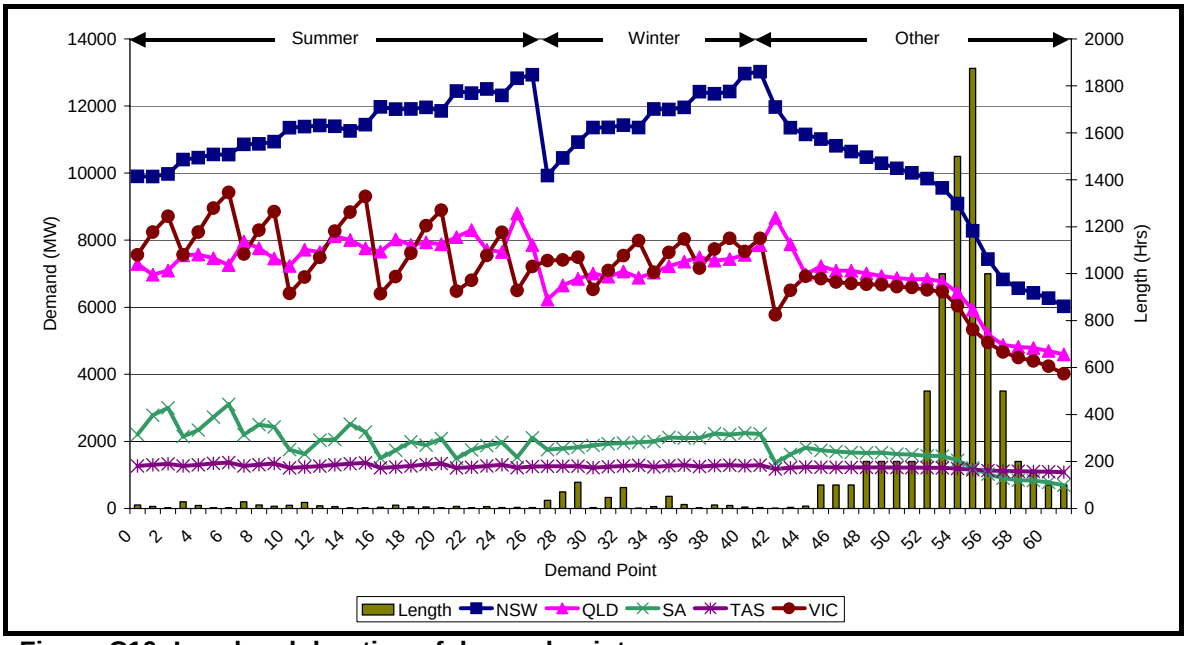

Figure C10: Level and duration of demand points

Loss factors and equations

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*.

Constraint equations

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

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.

Interconnectors

This analysis used a six region representation of the NEM: Queensland, NSW, Snowy, Victoria, South Australia and Tasmania. 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 2005 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.

Outages

The modelling was conducted on a system normal basis, meaning it did not include any 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 summer months, which were the focus of the modelling analysis. Random or forced outages were excluded from the analysis for simplicity. While this will understate dispatch costs the comparison between the base case and the Rule change proposal will not be influenced by this simplification as the pattern of outages should not be any different between the base case and the proposals and between the proposals.

Energy constrained plant

Hydro plant were modelled to reflect energy limitations. This means that 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 it is optimal (i.e. most valuable).

Snowy Hydro indicated that they have the ability to manage their water reserves between years. To the extent that either of the proposals increase Snowy's output over the entire year relative to the base case we would observe higher production costs savings due to increased hydro output displacing thermal plant. However, for the purposes of this review, Snowy was assumed to have an energy budget of 4.9 TWh p.a. as reported in NEMMCO's 2005 SOO.

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 self regulation by generators. Generators will 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 prices substantially less than the VoLL but nevertheless high prices compared to the average.

It is difficult to conceive of a systematic approach for incorporating this self regulation in this or any market modelling. There are two key choices for managing this issue: explain that this behaviour exists and take no account of its effects, or accept its reality and adjust for its effects. In this modelling exercise it has been decided to reflect the reality of this 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). The same adjustment approach was used for all modelling scenarios and therefore ought not distort any comparison of the results.

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 includes:

- Production costs – annual NEM-wide variable electricity production costs in the summer peak period, winter peak period and remaining ('Other') times of the year;

- Generator outputs – Snowy output, Southern Generators' output and Northern Generators' output in the summer peak period, winter peak period and other times of the year;

- Interconnector outcomes – interconnector flows into NSW, hours of transmission constraints and hours of clamping, as well as confirming revenue adequacy on the Snowy-NSW interconnector to ensure deficits on the Victoria-Snowy interconnector can be fully funded; and

- Annual Regional (time-weighted) prices for Queensland, NSW, Snowy, Victoria, South Australian, and Tasmania.

Each of these results is discussed in turn below.

Production costs

As discussed above, savings in variable production costs represent the dispatch efficiency benefits of a change in the market design. Figure C11 illustrates the annual production costs from each scenario, while Figure C12 focuses on summer and winter peak times only.

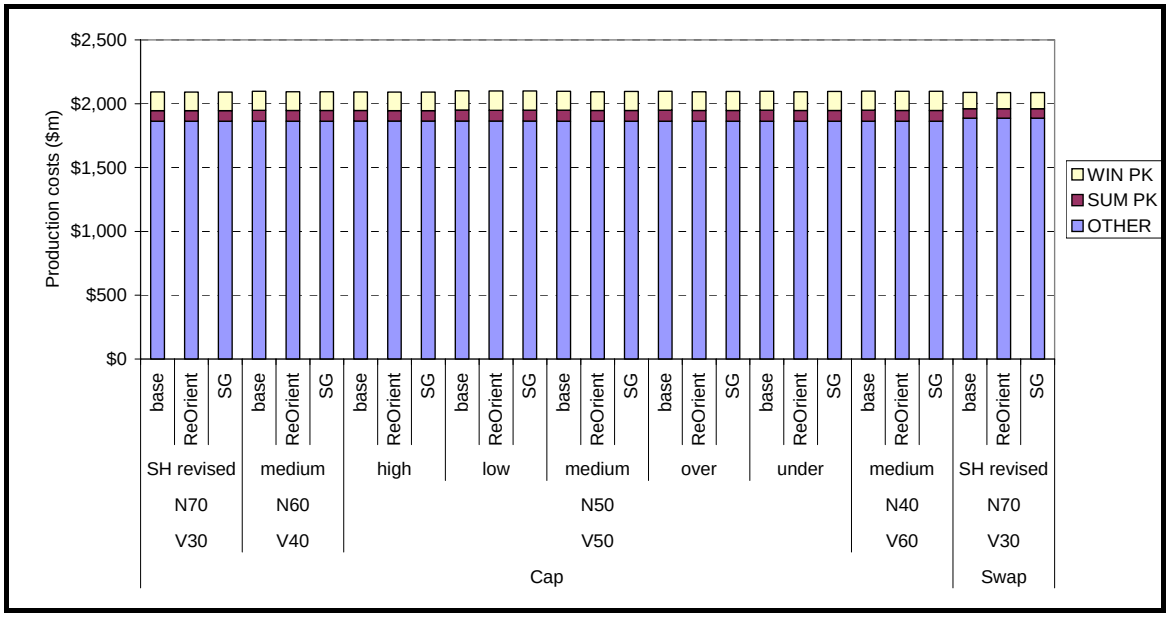

Figure C11: Annual production costs ($m)

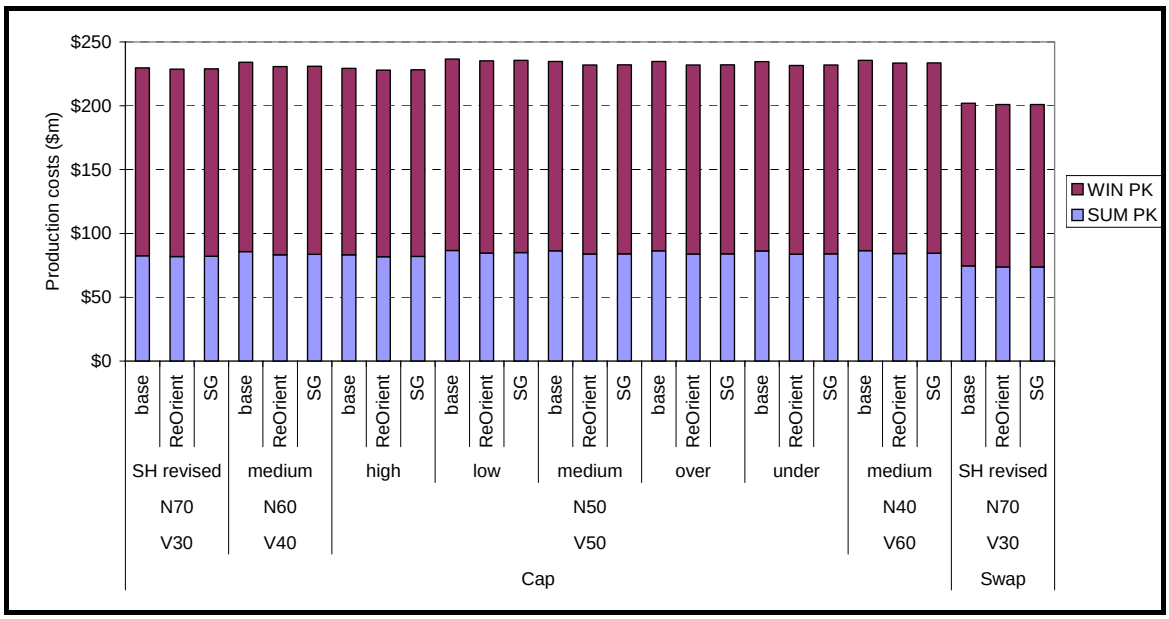

Figure C12: Peak period production costs ($m)

Table C5 below confirms that the production costs for each modelling scenario were very similar over peak and off-peak seasons, as well as on an annual basis.

Table C5: Production costs by scenario ($m)

Scenario	Snowy contract type	Split	Contracting case	Management regime	OTHER	SUM PK	WIN PK	Total
1	Cap	V30/N70	SH revised	base	$1,864	$83	$147	$2,093
2				ReOrient	$1,864	$82	$147	$2,092
3				SG	$1,864	$82	$147	$2,092
4		V40/N60	medium	base	$1,863	$86	$148	$2,097
5				ReOrient	$1,864	$83	$147	$2,094
6				SG	$1,863	$84	$147	$2,094
7		V50/N50	high	base	$1,864	$83	$146	$2,093
8				ReOrient	$1,864	$82	$146	$2,092
9				SG	$1,864	$82	$146	$2,092
10			low	base	$1,864	$87	$150	$2,101
11				ReOrient	$1,864	$85	$151	$2,100
12				SG	$1,864	$85	$151	$2,100
13			medium	base	$1,863	$86	$148	$2,098
14				ReOrient	$1,863	$84	$148	$2,095
15				SG	$1,863	$84	$148	$2,095
16			over	base	$1,863	$86	$148	$2,098
17				ReOrient	$1,863	$84	$148	$2,095
18				SG	$1,863	$84	$148	$2,095

Scenario	Snowy contract type	Split	Contracting case	Management regime	OTHER	SUM PK	WIN PK	Total
19			under	base	$1,863	$86	$148	$2,098
20				ReOrient	$1,864	$84	$148	$2,095
21				SG	$1,863	$84	$148	$2,095
22		V60/N40	medium	base	$1,863	$87	$149	$2,099
23				ReOrient	$1,863	$84	$149	$2,097
24				SG	$1,863	$84	$149	$2,097
25	Swap	V30/N70	SH revised	base	$1,888	$75	$127	$2,090
26				ReOrient	$1,888	$74	$127	$2,089
27				SG	$1,888	$74	$127	$2,089

The results above show the total production costs for each scenario. Table C6 focuses on production cost *differences* yielded by the Southern Generators' and Re-orientation proposals compared to the contractually-equivalent base case. Reductions in production costs (i.e. production cost savings) are shown as positive values.

Table C6: Production cost savings relative to a base case under a new regime ($m)

Scenario	Snowy contract type	Split	Contracting case	Management regime	OTHER	SUM PK	WIN PK	Total
2	Cap	V30/N70	SH revised	ReOrient	$0.03	$0.63	$0.24	$0.90
3				SG	$0.09	$0.47	$0.24	$0.81
5		V40/N60	medium	ReOrient	-$0.21	$2.50	$0.86	$3.15
6				SG	-$0.01	$2.19	$0.86	$3.04
8		V50/N50	high	ReOrient	-$0.15	$1.44	-$0.05	$1.24
9				SG	-$0.04	$1.23	-$0.05	$1.14
11			low	ReOrient	-$0.03	$1.98	-$0.59	$1.36
12				SG	$0.11	$1.55	-$0.59	$1.06
14			medium	ReOrient	-$0.26	$2.58	$0.32	$2.64
15				SG	-$0.18	$2.42	$0.32	$2.55
17			over	ReOrient	-$0.19	$2.51	$0.32	$2.64
18				SG	-$0.07	$2.35	$0.32	$2.60
20			under	ReOrient	-$0.18	$2.55	$0.32	$2.69
21				SG	-$0.13	$2.29	$0.32	$2.48
23		V60/N40	medium	ReOrient	-$0.06	$2.22	-$0.08	$2.08
24				SG	$0.09	$2.02	-$0.08	$2.03
26	Swap	V30/N70	SH revised	ReOrient	-$0.11	$0.78	$0.27	$0.94
27				SG	-$0.03	$0.71	$0.27	$0.95

These results are summarised graphically in Figure C11 below.

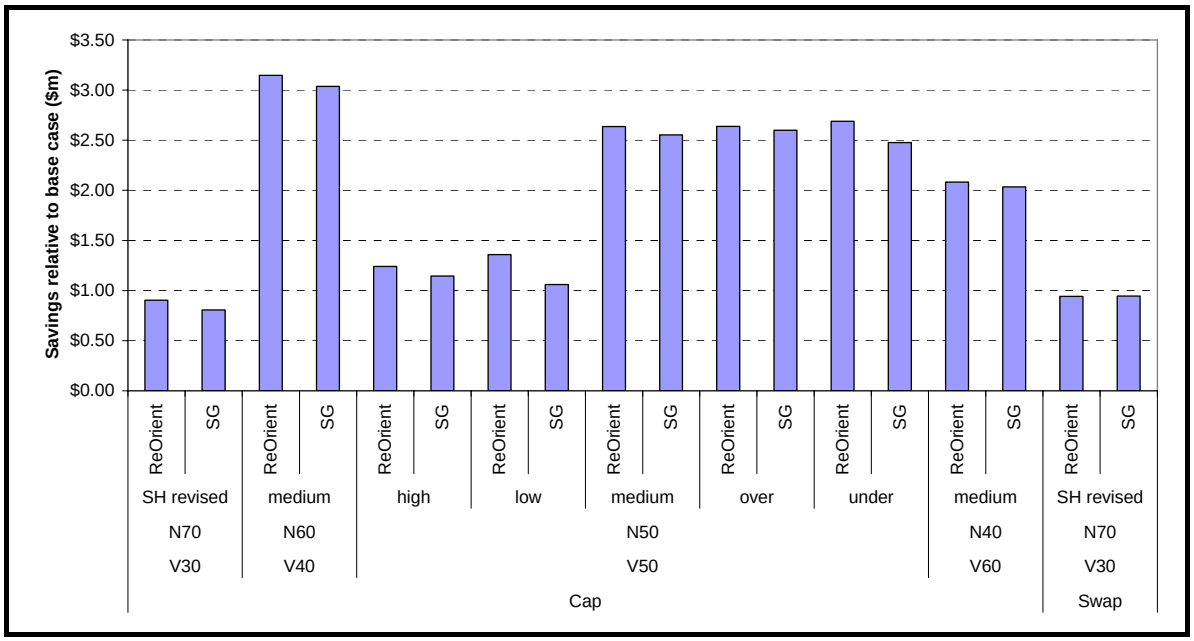

Figure C13: Annual production cost savings relative to the base case ($m)

Generally speaking, both the Southern Generators' and Reorientation proposals (compared to the base case) led to:

- slightly lower production costs in the peak summer period; and
- slightly higher production costs in the peak winter period; with
- overall production costs falling marginally over the year.

In all cases, the proposals led to an expected annual production cost saving of $3.15 million or less. Such a relatively small cost reduction (relative to the total NEM costs of production) is expected given the relatively small proportion of hours in the year in which clamping or reorienting occurs.

The changes in production costs results from a change in the timing of Tumut and Murray output at peak summer times, and hence the change in the pattern of production from other (thermal) plant (discussed in more detail in the following section).

In all cases the Re-orientation proposal yielded a fractionally larger production cost saving than the Southern Generators' proposal, except where Snowy was assumed to hold swap cover where the savings where approximately the same. The maximum absolute difference of $111,000 was observed for the V40/N60 medium case. The maximum percentage difference of 28% of the production cost savings occurred for the V50/N50 low case.

Generator outputs

Patterns of generator output are discussed for Snowy Hydro, the Northern Generators, and the Southern Generators in turn below.

Snowy Hydro

As Snowy Hydro's hydro plants are all energy constrained, its *annual hydro* output was not affected by the contracting scenario or the congestion management option in place. That is, Snowy Hydro produces the same quantity of energy in all modelling scenarios. However, the output of Snowy Hydro's hydro plants varies *across* the year and this change in the pattern of production of these plants, which changed the pattern of production by thermal generators, resulted in the costs savings.

Indeed, the lower peak summer production costs relative to the base case noted above appears to have been driven by slightly higher Snowy Hydro summer output across most contracting scenarios under the Southern Generators proposal, which led to greater displacement of thermal plant compared to the base case at these times (see Figure C14). Within the peak summer results, it is noticeable that Tumut generated slightly more under the Southern Generators' proposal (or the re-orientation counterfactual) compared to the base case, while Murray generated slightly less.

Note that in the cases where Snowy is assumed to hold a high level of swap contracts they act more competitively and their output is higher at these peak times and the incidences of constraints declines. This indicates that Snowy Hydro's strategic behaviour may be a key for the incidence of constraints in the Snowy region.

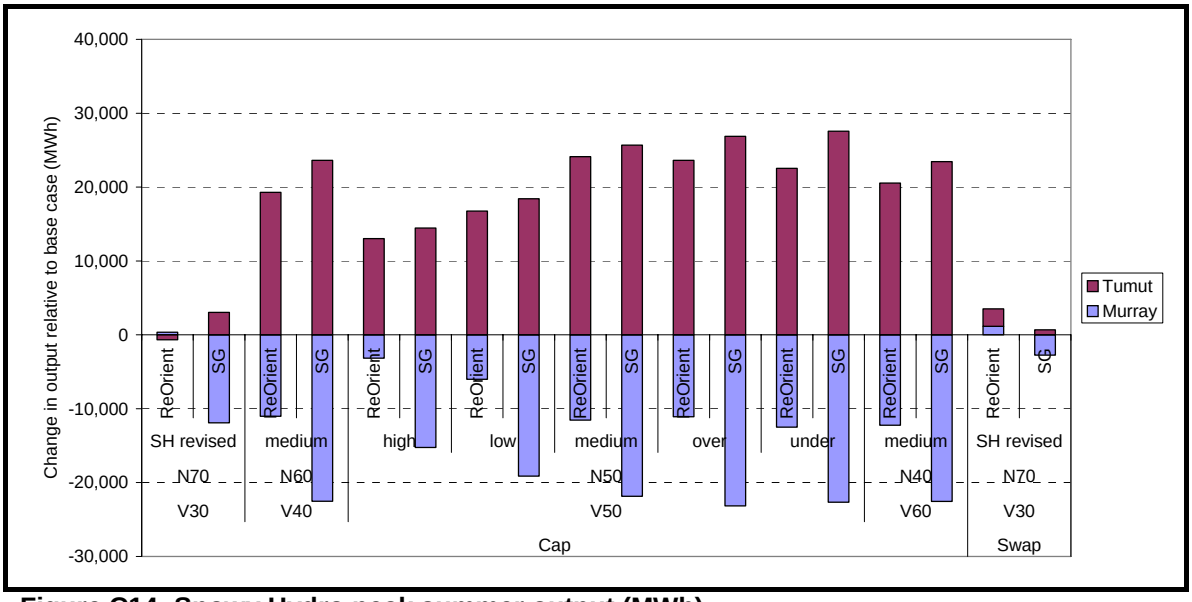

Figure C14: Snowy Hydro peak summer output (MWh)

This behaviour by Snowy Hydro is commercially logical from their point of view as they have an incentive to bid Murray to be dispatched at times of high demand to induce NEMMCO clamping of the Victoria-Snowy interconnector to maximise the pool revenue received across the entire Snowy portfolio. Under the Southern Generators' or Snowy Hydro re-orientation proposals, Murray's incentives to generate high quantities to induce clamping are not as strong (because they are now not rewarded by the higher NSW price for doing so). With the Victoria-Snowy interconnector now flowing more freely NEMMCO has a wider range of (cheaper) plant available for dispatch. In particular, cheaper Victorian plant can now be dispatched more and more expensive northern plant dispatched less.

The higher winter production cost is driven by slightly lower Snowy Hydro winter output compared to the base case (see Figure C15).

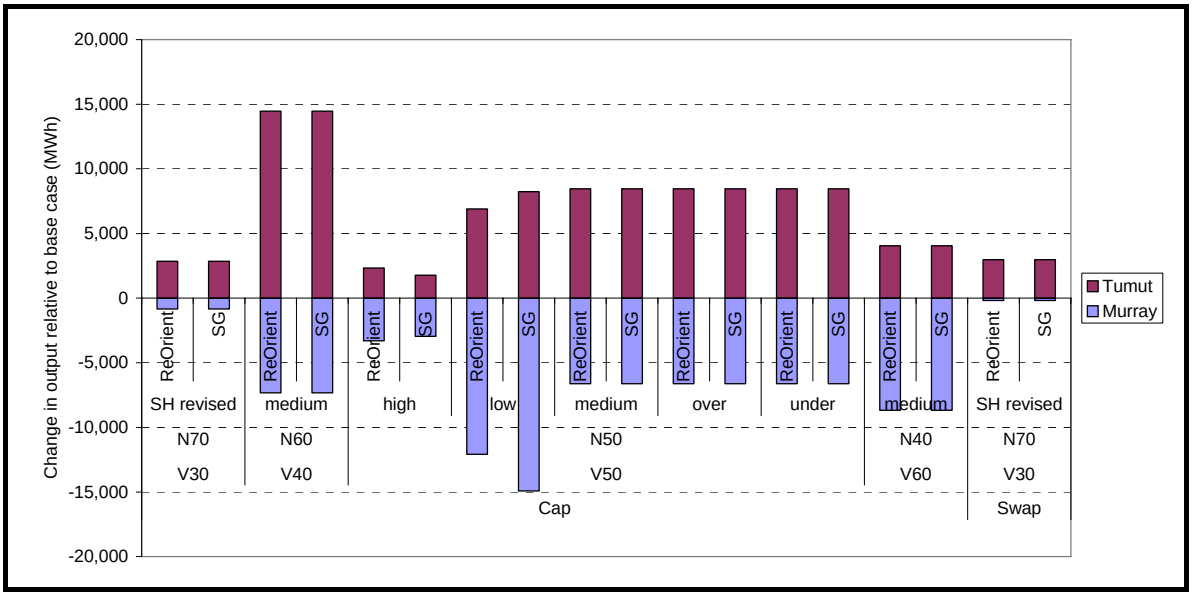

Figure C15: Snowy Hydro peak winter output (MWh)

Southern and Northern Generators' output

Table C7 below details the output of southern and northern generators under a range of scenarios. The differences in outputs occurring under different scenarios are small, particularly when compared to annual outputs in GWh. For example, in the second scenario (Re-orientation, SH revised contracting, V30/N70), the southern generators reduced summer and winter output by 2 GWh against an annual output of nearly 70,000 GWh when compared to the corresponding base case.

Table C7: Output by generator group (GWh)

Scenario	Snowy contract type	Split	Contracting case	Management regime	Other		Summer peak		Winter Peak		Annual	
					NG	SG	NG	SG	NG	SG	NG	SG
1	Cap	V30/N70	SH revised	base	118,738	62,596	4,549	2,438	8,443	4,497	131,730	69,531
2				ReOrient	118,727	62,610	4,551	2,436	8,443	4,495	131,721	69,541
3				SG	118,717	62,610	4,557	2,438	8,443	4,495	131,718	69,543
4		V40/N60	medium	base	118,732	62,588	4,554	2,449	8,442	4,508	131,728	69,544
5				ReOrient	118,734	62,597	4,550	2,445	8,443	4,500	131,728	69,542
6				SG	118,722	62,597	4,554	2,447	8,443	4,500	131,719	69,544
7		V50/N50	high	base	118,749	62,610	4,562	2,444	8,408	4,490	131,719	69,544
8				ReOrient	118,784	62,591	4,556	2,441	8,408	4,491	131,748	69,523
9				SG	118,777	62,591	4,561	2,445	8,408	4,491	131,746	69,526

Table C7 (cont'd): Output by generator group (GWh)

Scenario	Snowy contract type	Split	Contracting case	Management regime	Other		Summer peak		Winter Peak		Annual	
					NG	SG	NG	SG	NG	SG	NG	SG
10			low	base	118,781	62,596	4,561	2,434	8,427	4,465	131,770	69,495
11				ReOrient	118,774	62,610	4,555	2,431	8,426	4,470	131,756	69,510
12				SG	118,773	62,596	4,561	2,435	8,426	4,471	131,761	69,503
13			medium	base	118,689	62,610	4,557	2,452	8,442	4,508	131,688	69,570
14				ReOrient	118,704	62,610	4,549	2,447	8,442	4,507	131,696	69,564
15				SG	118,700	62,606	4,555	2,449	8,442	4,507	131,698	69,562
16			over	base	118,719	62,589	4,557	2,452	8,442	4,508	131,718	69,549
17				ReOrient	118,725	62,597	4,549	2,448	8,442	4,507	131,716	69,552
18				SG	118,719	62,595	4,555	2,450	8,442	4,507	131,716	69,552

Table C7 (cont'd): Output by generator group (GWh)

Scenario	Snowy contract type	Split	Contracting case	Management regime	Other		Summer peak		Winter Peak		Annual	
					NG	SG	NG	SG	NG	SG	NG	SG
19			under	base	118,735	62,588	4,549	2,450	8,442	4,508	131,726	69,546
20				ReOrient	118,740	62,591	4,544	2,446	8,442	4,507	131,726	69,543
21				SG	118,742	62,588	4,546	2,448	8,442	4,507	131,730	69,543
22		V60/N40	medium	Base	118,719	62,586	4,550	2,451	8,446	4,518	131,715	69,555
23				ReOrient	118,719	62,588	4,543	2,450	8,447	4,521	131,709	69,560
24				SG	118,716	62,588	4,547	2,452	8,447	4,521	131,711	69,561
25	Swap	V30/N70	SH revised	Base	120,140	62,669	4,238	2,392	7,570	4,389	131,948	69,450
26				ReOrient	120,147	62,669	4,237	2,390	7,569	4,386	131,953	69,446
27				SG	120,140	62,669	4,241	2,392	7,569	4,386	131,950	69,448

Figure C16 shows the change in output in the Southern Generators' and Re-orientation cases relative to the corresponding base case for the summer peak times, a positive value indicates that output has increased relative to the base level. The majority of cases show a clear trend of Snowy Hydro increasing output at the expense of northern generation and, to a lesser extent, southern generation. The notable exception to this trend is the Southern Generators', SH revised, V30/N70 case. In this scenario the modelling showed a reduction in Snowy Hydro output since it was more profitable to withdraw slightly more capacity in the Southern Generators' case relative to the BAU base case (and Re-orientation case) for some of the summer demand points. This reduction was offset by northern generators.

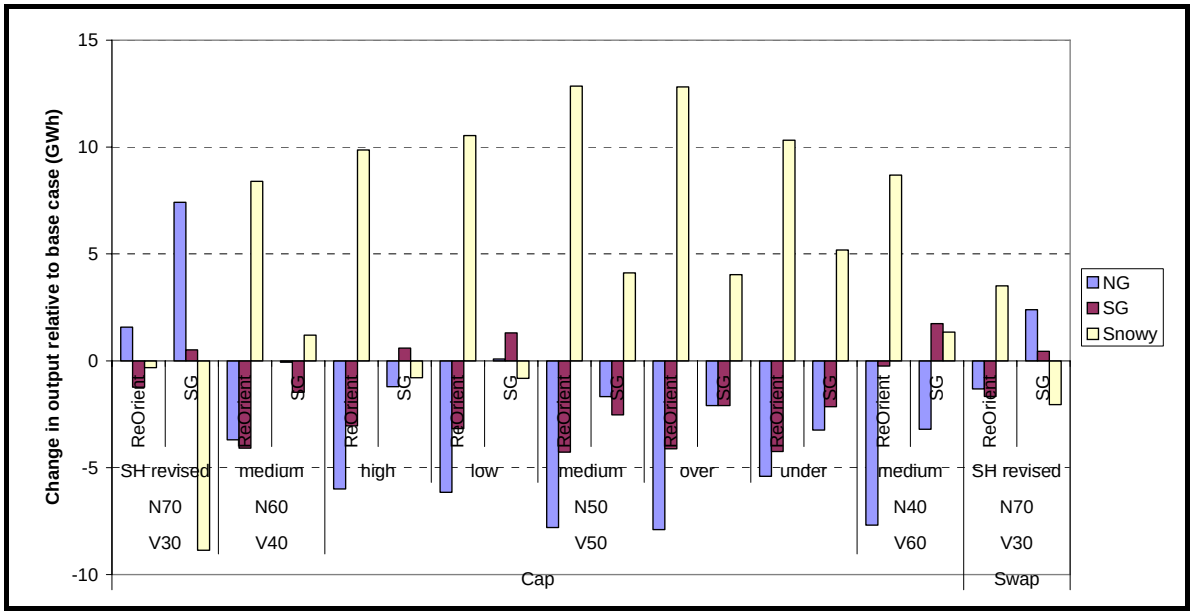

Figure C16: Change in output relative to base case – Summer peak

Figure C17 shows the change in output for the winter peak times. There is less of a clear trend at these times, and the magnitude of the effect is lower than for the summer peak times. The majority of cases still show Snowy Hydro producing more output relative to the corresponding base case. There is very little difference between the Re-orientation and Southern Generators' case results, reinforcing the fact that the majority of differences are observed during summer peak times.

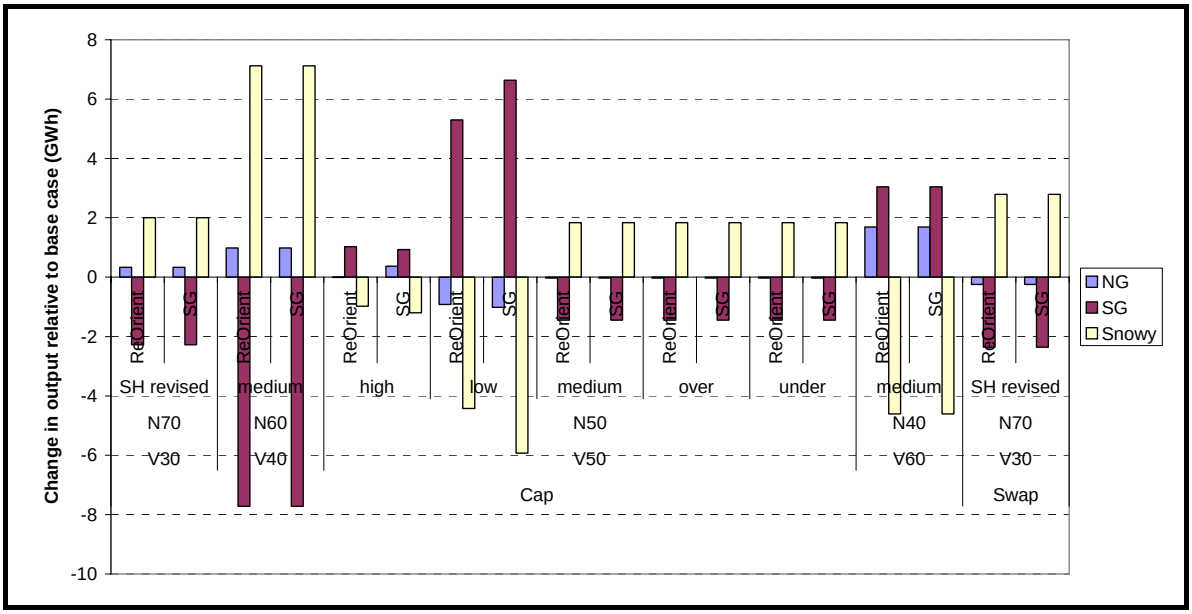

Figure C17: Change in output relative to base case – Winter peak

Changes in output for the rest of the year (i.e. not in summer and winter peaks) are shown in Figure C18. Given that Snowy Hydro always generates to its defined energy budget a reduction or increase in output in one period is offset by an opposite change in output at other times. That is, if Snowy Hydro output over the summer and winter peak times was greater in the Southern Generators' case relative to the base case, then production at other times of the year will be lower.

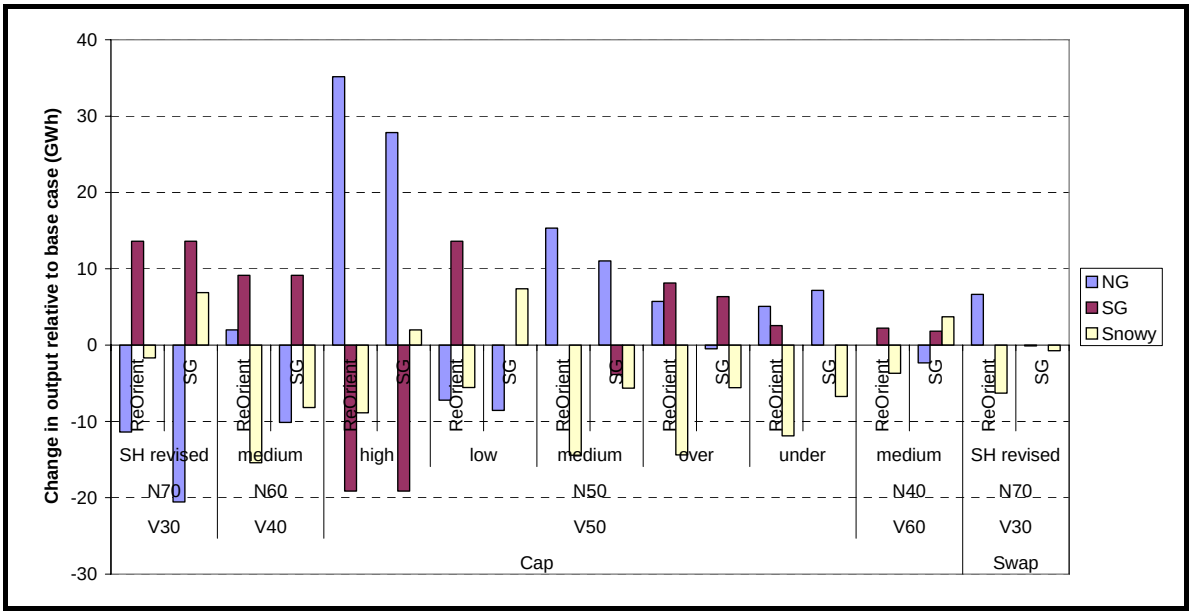

Figure C18: Change in output relative to base case – other times

Interconnector outcomes

The modelling results show the frequency and duration of clamping on the Victoria-Snowy interconnector for northward flows under the base case in each of the contracting scenarios. In each base case, clamping was estimated to occur between 5 to 32 hours annually (see Figure C19 below). The bulk of clamping incidences were estimated to occur in during summer peak times, as has occurred in practice.

The modelling showed the lowest level of clamping in the scenarios where Snowy Hydro has the highest levels of contracts. That is, high contract undermines Snowy's incentives to engage in strategic bidding behaviour that causes clamping. This again highlights the importance of strategic bidding behaviour and the frequency and duration of clamping. The removal of NEMMCO clamping undermines the ability of Snowy to profitably engage in strategic bidding behaviour – this will make prices more efficient and allow customers across the NEM to have greater access to cheaper generation. It is noted that the high Snowy contracting scenarios were suggested by Snowy Hydro.

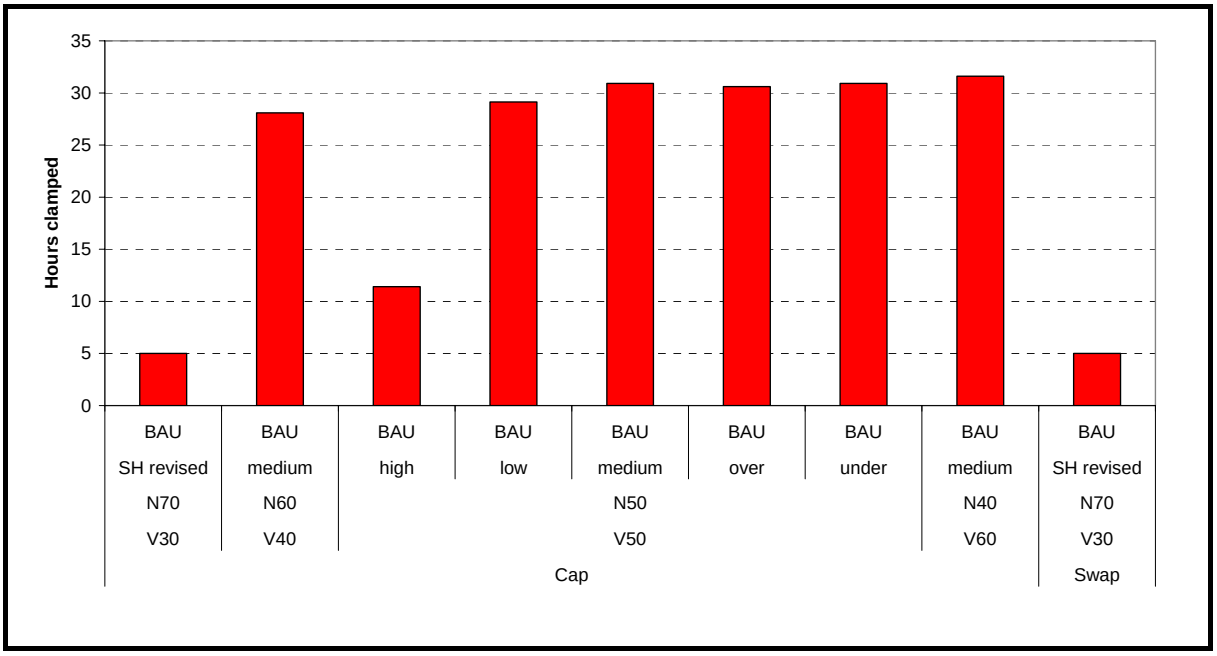

Figure C19: Annual incidence of clamping of V-SN exports

Figure C20 shows the northbound flows on the Snowy-NSW interconnector during peak summer times. This reveals that the Southern Generators' and Re-orientation proposals led to *slightly* higher flows into NSW compared with the base case in most of the contracting scenarios. This result is consistent with the changes in output by northern and southern generators described earlier.

Some southbound flows were also observed during the summer peak times, as shown in Figure C21. The Southern Generators' cases lead to different outcomes relative to the base and Re-orientation cases, but whether this effect was positive or negative depended on the contracting case.

By contrast, northbound flows on the Snowy-NSW interconnector during winter peak times were hardly affected by the choice of the Rule change proposal. Similarly, summer and winter peak flows into Victoria on the Snowy-Victoria interconnector were not systematically higher or lower under the Southern Generators' proposal across a range of contracting scenarios.

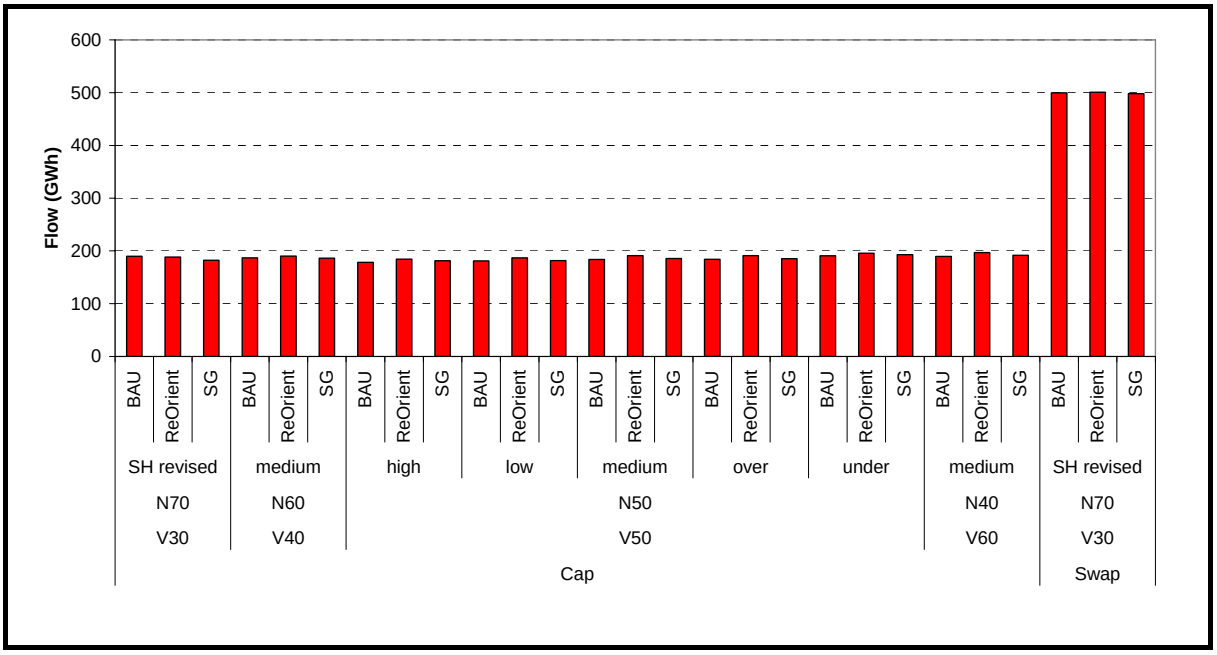

Figure C20: Summer flows at peak times on Snowy-NSW interconnector (total GWh north)

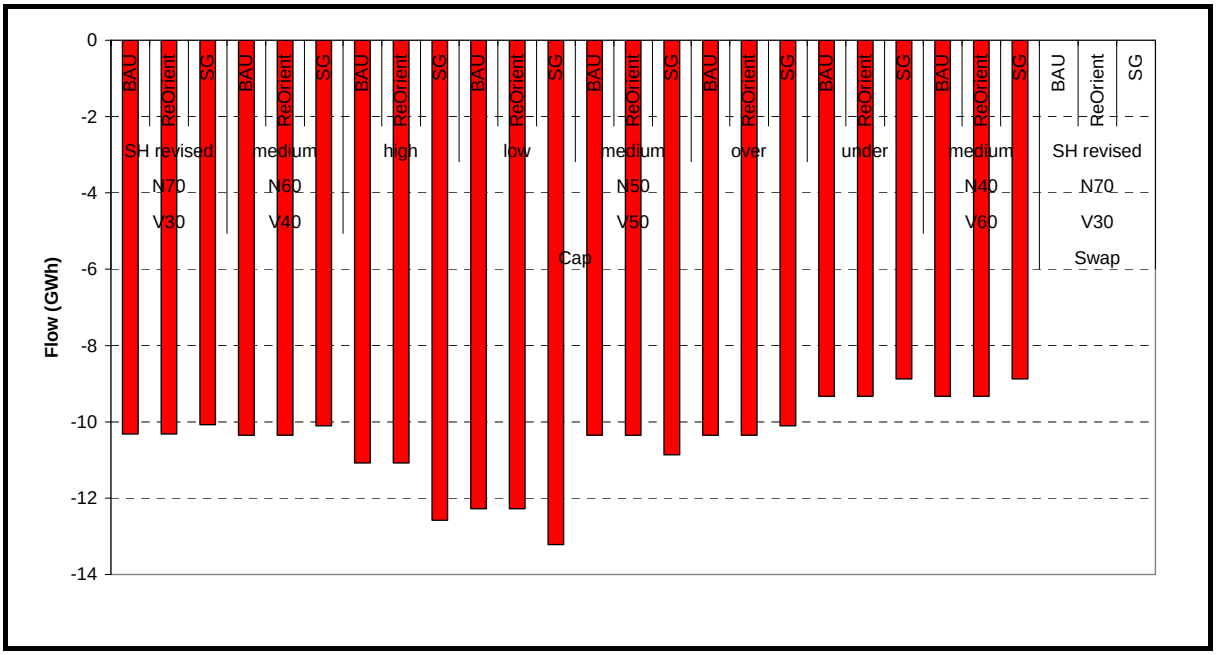

Figure C21: Summer flows at peak times on Snowy-NSW interconnector (total GWh south)

Prices

The analysis shows that across most contracting scenarios and on an annual time-weighted basis, the Southern Generators' and Re-orientation proposals generally led to:

- Lower prices in the NSW and Snowy regions – by between $1 and $5/MWh. In many scenarios, this led to convergence between NSW and Victorian prices, with implications for the risk analysis (discussed in the next section); and

- Little change to prices in other regions – Victorian, South Australian and Queensland prices stayed within about $1/MWh of their base case levels. Victorian prices had a tendency to increase slightly when clamping ceased, whilst Queensland prices moved down and South Australian prices remained almost constant.

The Re-orientation case produced slightly more price reductions than the SG proposal in most scenarios. This effect was $0.07/MWh on average across all cases and regions and never greater than $0.33/MWh. As discussed below in more detail, Snowy Hydro has incentives in the base case to potentially pursue bidding behaviour that leads to higher NSW and Snowy prices. These incentives are not present in either of the proposal cases since Snowy Hydro is no longer rewarded by clamping. As such, we see a potential price fall in NSW and Snowy due to either proposal.

These results are presented in Figure C22 and Table C8 below.

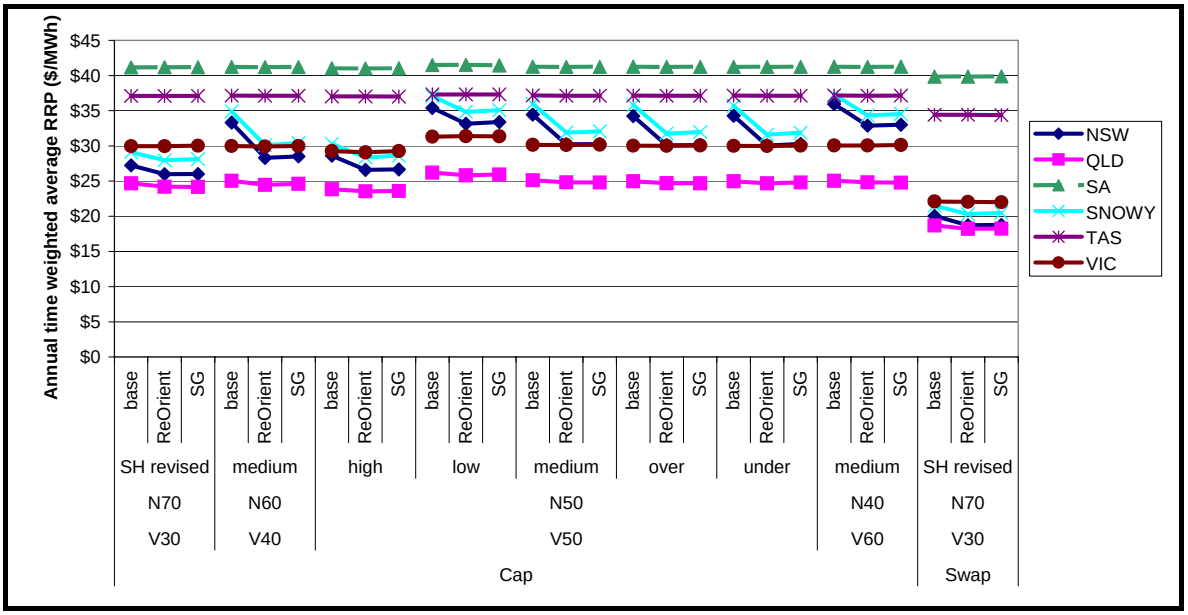

Figure C22: Expected annual (time weighted) price changes ($/MWh)

Table C8: Annual average prices (time weighted) by scenario ($/MWh)

Scenario	Split	Contracting case	Management regime	NSW	QLD	SA	SNOWY	TAS	VIC
Cap	V30/ N70	SH revised	BAU	$27.24	$24.67	$41.17	$29.11	$37.12	$29.97
			ReOrient	$25.99	$24.20	$41.18	$27.97	$37.11	$29.97
			SG	$26.01	$24.17	$41.19	$28.14	$37.11	$30.04
	V40/ N60	medium	BAU	$33.32	$25.05	$41.25	$34.90	$37.16	$30.00
			ReOrient	$28.30	$24.48	$41.22	$30.11	$37.14	$29.93
			SG	$28.51	$24.60	$41.20	$30.44	$37.15	$29.98
	V50/ N50	high	BAU	$28.62	$23.83	$41.05	$30.32	$37.03	$29.26
			ReOrient	$26.59	$23.55	$41.02	$28.36	$37.03	$29.09
			SG	$26.67	$23.60	$41.04	$28.61	$37.01	$29.28
		low	BAU	$35.40	$26.20	$41.51	$37.08	$37.34	$31.33
			ReOrient	$33.15	$25.81	$41.53	$34.83	$37.33	$31.39
			SG	$33.39	$25.95	$41.45	$35.07	$37.32	$31.37
		medium	BAU	$34.45	$25.11	$41.25	$36.01	$37.18	$30.16
			ReOrient	$30.23	$24.84	$41.23	$31.91	$37.14	$30.13
			SG	$30.27	$24.80	$41.24	$32.06	$37.14	$30.20
		over	BAU	$34.23	$24.98	$41.25	$35.80	$37.17	$30.03
			ReOrient	$30.09	$24.71	$41.23	$31.78	$37.14	$30.01
			SG	$30.14	$24.68	$41.24	$31.97	$37.14	$30.07

Scenario	Split	Contracting case	Management regime	NSW	QLD	SA	SNOWY	TAS	VIC
		under	BAU	$34.28	$24.97	$41.25	$35.70	$37.17	$30.02
			ReOrient	$30.07	$24.69	$41.23	$31.61	$37.14	$29.98
			SG	$30.27	$24.79	$41.23	$31.87	$37.14	$30.05
	V60/ N40	medium	BAU	$35.94	$25.05	$41.26	$37.32	$37.18	$30.07
			ReOrient	$32.90	$24.82	$41.25	$34.34	$37.15	$30.07
			SG	$33.02	$24.77	$41.25	$34.54	$37.15	$30.14
Swap	V30/ N70	SH revised	BAU	$20.05	$18.71	$39.87	$21.51	$34.43	$22.09
			ReOrient	$18.71	$18.21	$39.86	$20.31	$34.42	$22.05
			SG	$18.76	$18.24	$39.88	$20.49	$34.39	$22.01

When considering the results by time of year, it is clear that the price reductions identified above from the Southern Generators' proposal and the Re-orientation case occurred primarily during summer peak times (see Figure C23).

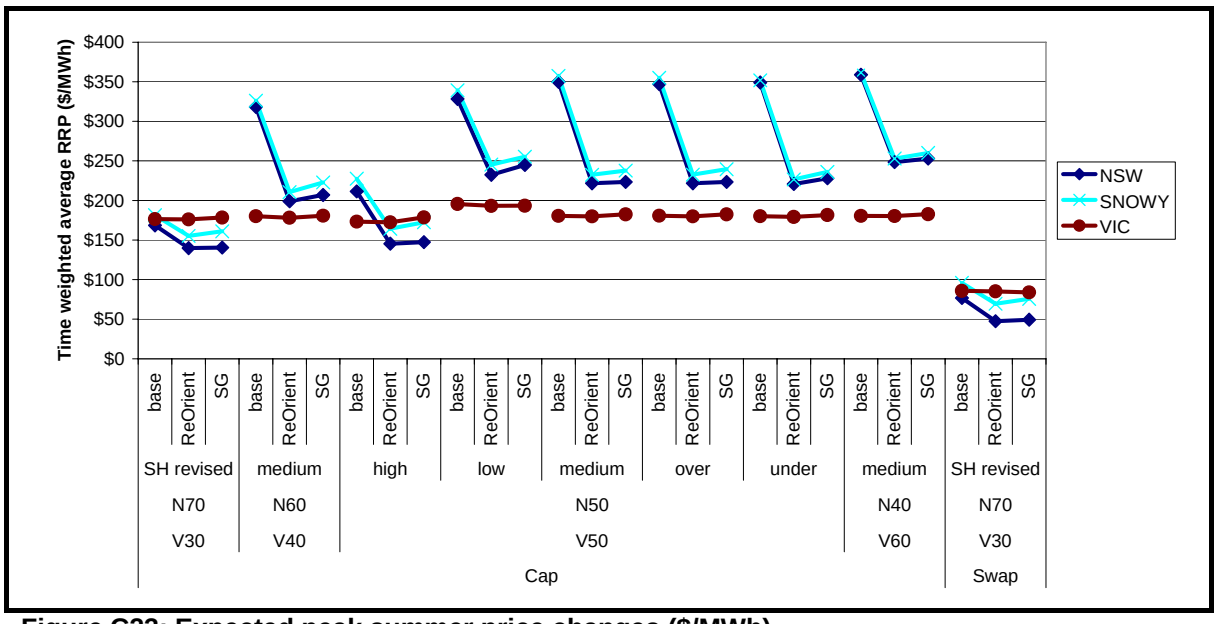

Figure C23: Expected peak summer price changes ($/MWh)

The price outcomes during peak winter times, shown in Figure C24, accounted for some of difference between cases. Again this effect was lessened in the presence of higher contracting levels. The changes at these times were not as great as for the summer periods.

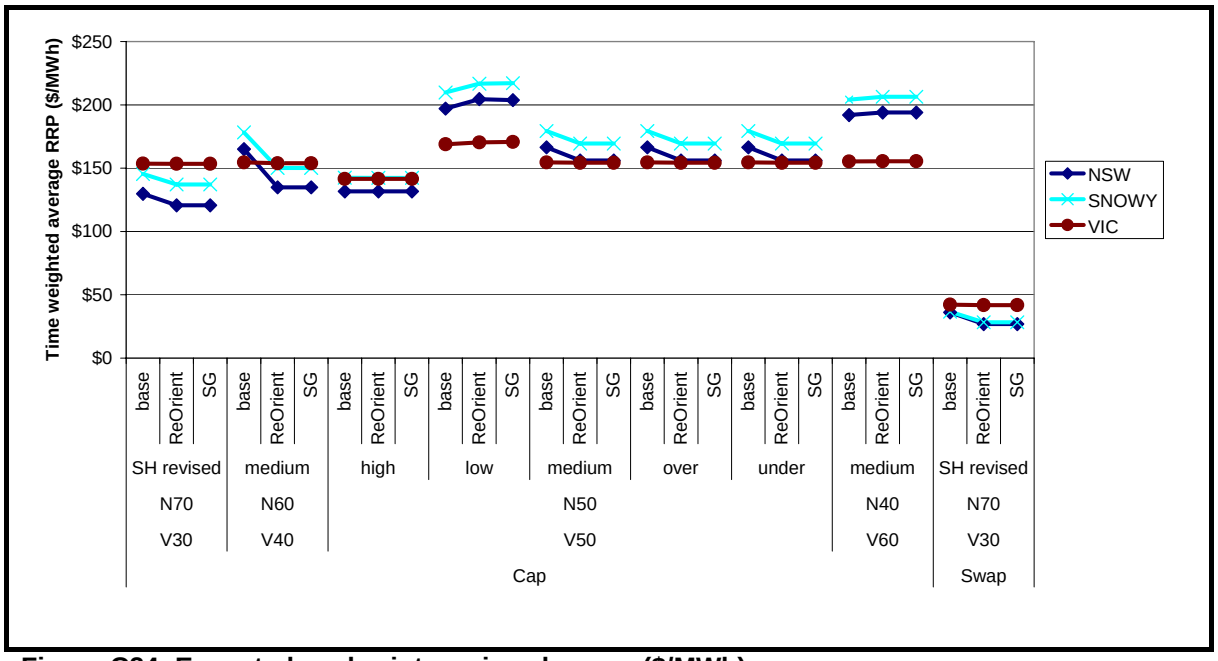

Figure C24: Expected peak winter price changes ($/MWh)

The price outcomes during other parts of the year were virtually unchanged (see Figure C25). Differences were at a maximum of $0.50/MWh in the high contracting case and almost constant elsewhere.

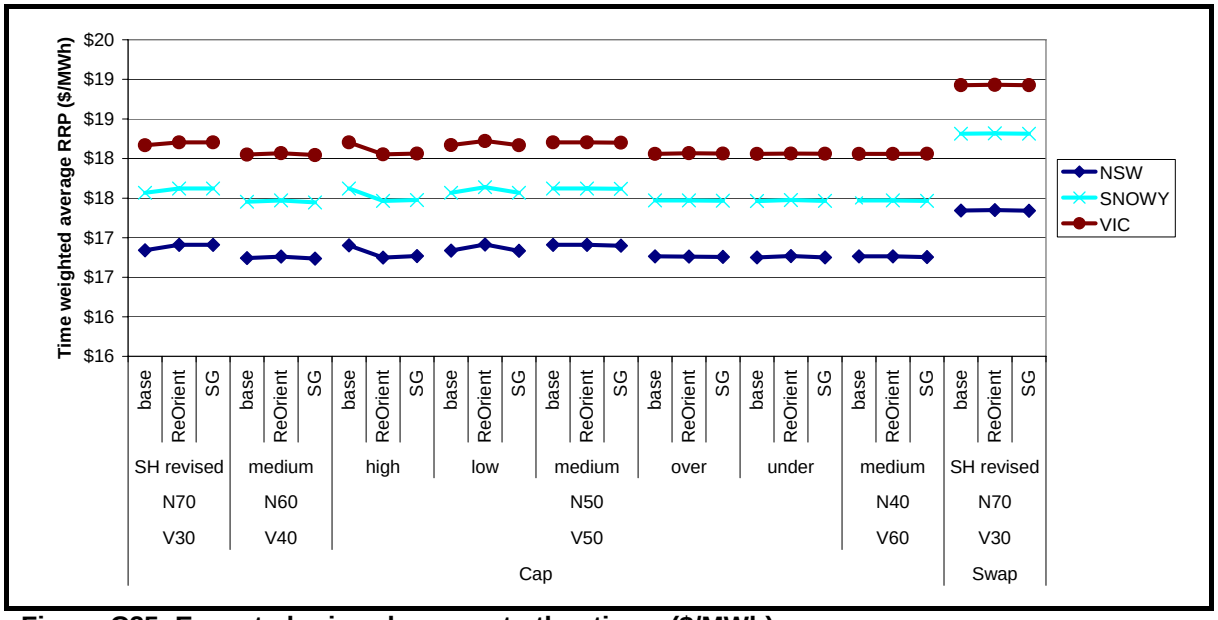

Figure C25: Expected price changes at other times ($/MWh)

Source of the NSW price fall

Across a broad range of assumptions, the modelling consistently showed that the adoption of either the Southern Generators' or Re-orientation proposals could lead to a reduction in NSW and Snowy prices relative to the base case. This is due to changes in the set of potential equilibrium outcomes between the base case and either of the proposal cases. Specifically, the model finds equilibria in the base case, at times of relatively high NSW demand, and relatively low Victorian demand, where:

- Snowy Hydro bids to maximise flows on the Snowy to NSW interconnector; and
- Snowy Hydro withholds additional capacity from Tumut, resulting in lower flows on the Snowy to NSW interconnector and substantially higher NSW and Snowy prices.

For the Rule change proposals, the latter set of equilibria are not present as they are no longer sustainable – due to increased competition at these times from southern generators in the absence of clamping. That is, unclamping the interconnect deepens competition across the NEM.

The historical analysis indicated that at times of clamping Snowy typically bids to minimise headroom on the Snowy to NSW interconnector, the dispatch modelling presented here is consistent with the observed data. The analysis indicates that this type of behaviour may continue to be sustainable in the absence of any changes to the Rules governing clamping. However, the analysis also shows that, in the presence of clamping (i.e. the base case) there are other profitable bidding strategies that Snowy could pursue in addition to the ones that they typically adopt. These other strategies lead to outcomes with even higher NSW prices than their current strategies. The modelling found that these other strategies are not sustainable under either of the Rule change proposals, and hence the analysis indicates a possible relative price decrease in NSW and Snowy.

This effect can be understood more clearly by a more detailed analysis of an example demand point. The following example will consider the base, SG and Reorient cases for the Swap, SH revised, V30/N70 contracting cases, where Snowy is assumed to hold swap contracts equal to 80% of capacity, 70% of which are struck at the NSW node. This case was chosen as it has the highest level of Snowy Hydro contract cover of the scenarios modelled.

The following example uses the results for demand point 26, which has the following characteristics:

- Summer peak point with highest NSW demand;
- 3.5 hours long;
- NSW demand of 12,932 MW; and,
- Victorian demand of 7,213 MW.

Three equilibria were found in the base case - A, B and C - equilibria C involved clamping on the Victoria to Snowy interconnector. Equilibria A and B were also present in each of the SG and Reorientation cases.

Table C9 shows the Nash equilibria strategies for demand point 26. In this case equilibria A and B are present under all three possible Rules. For equilibrium A, Snowy Hydro offers all of its capacity into the market and both Macquarie Generation (MacGen) and Delta Electricity (Delta) withdraw some capacity. Similar results are seen for equilibrium B, where Snowy Hydro withdraws the smallest possible increment of capacity (12.5% of Murray). The response of MacGen and Delta is for MacGen to withdraw more capacity and Delta withdraws less such that the two generators offer less combined capacity. These two results are broadly consistent with Snowy Hydro's claims regarding its bidding behaviour.

In the base case, an extra equilibria is also found - equilibria C. Here, Snowy Hydro withdraws significantly more capacity – 50% of Tumut and 25% of Murray is withdrawn from the market. MacGen and Delta also offer less capacity for this equilibria, illustrating *SPARK's* ability to capture the strategic interaction of players in the market.

The results suggest that, by removing clamping, either of the proposals remove Snowy Hydro's incentives to pursue the bidding strategy represented in equilibria C.

Table C9: Equilibria strategies in the Swap, SH revised cases

Scenario	Strategic Group	Equilibria A	Equilibria B	Equilibria C (clamping)
		Capacity offered into the market		
base	Delta	75%	90%	75%
	MacGen	80%	70%	70%
	Murray	100%	87.5%	75%
	Tumut	100%	100%	50%
ReOrient	Delta	75%	90%	No comparable equilibria
	MacGen	80%	70%	
	Murray	100%	87.5%	
	Tumut	100%	100%	
SG	Delta	75%	90%	No comparable equilibria
	MacGen	80%	70%	
	Murray	100%	87.5%	
	Tumut	100%	100%	

The bids listed above result in different flows and levels of headroom on the Snowy to NSW interconnector. Table C10 shows that, for equilibria A and B, northward flows on the interconnector are relatively high. For equilibria A, northward flows are binding at the export limit. For equilibria B and C, only limited headroom on the interconnector is observed, approximately 120 MW. These outcomes are consistent with Snowy Hydro's claims.

Table C10: Equilibria flows in the Swap, SH revised cases

Scenario	Equilibria A	Equilibria B	Equilibria C (clamping)
	Flows/export limits on Snowy to NSW interconnector (MW)		
base	2,830 / 2,830	2,700 / 2,824	2,303 / 2,409
Reorient	2,830 / 2,830	2,700 / 2,824	No comparable equilibria
SG	2,830 / 2,830	2,700 / 2,824	

The price effects of the above bids and flows are shown in Table C11. Equilibria A and B lead to prices where peaking capacity is setting the price at approximately $150/MWh. For equilibria C, where the capacity that Snowy and the combined capacity of MacGen and Delta offered into the market is reduced, a price of $2500/MWh is produced (effectively a VoLL price, as described earlier in this report).

Table C11: Equilibria prices in the Swap, SH revised cases

Scenario	Equilibria A	Equilibria B	Equilibria C (clamping)
	NSW prices ($/MWh)		
BAU	$155.89	$149.80	$2,500.00
Reorient	$155.89	$149.80	No comparable equilibria
SG	$155.89	$149.80	

Price volatility

Another important finding of the modelling was that the Southern Generators' proposal appeared to narrow the distribution of price outcomes compared to the base case. Of course this has (positive) implications for risk management in the NEM, and particularly for interstate trading.

This effect on the distribution of prices is shown in Figure C26 for the medium, V50/N50 cases where the base price distributions are shown for NSW, Snowy and Victoria as dashed lines. It is clear that the removal of clamping, via either the Southern Generators' or Re-orientation proposal, had two effects on the NSW and Snowy price distributions:

- a leftward shift corresponding to a reduction in level; and,
- a tightening of the distribution representing a reduction in volatility.

This reduction in volatility will have consequences for the risk analysis performed in the next section.

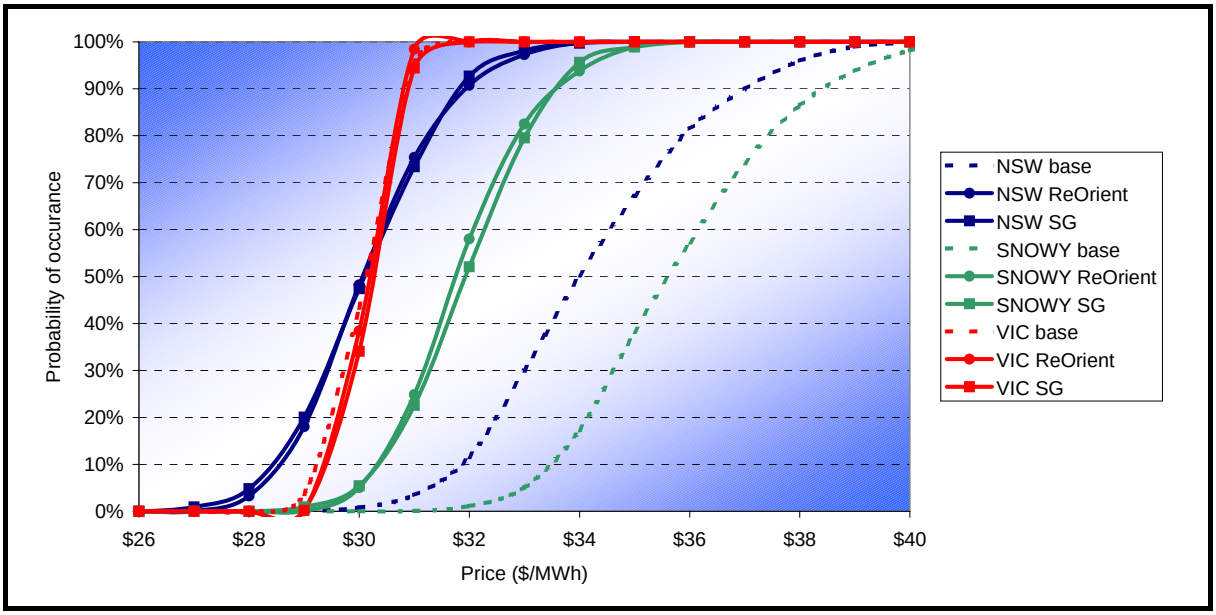

Figure C26: Distribution of average annual prices, medium V50/N50 cases ($/MWh)

Conclusions

Overall, the dispatch and price modelling suggest that either the Southern Generators' or Reorientation proposals could lead to small dispatch efficiency gain compared to the base case in which clamping occurs.

The reduction in production cost under both alternatives is due to a shifting of production patterns throughout the year. More specifically, Snowy Hydro withdraws less capacity under either Rule change proposal at peak times (summer and winter) which means that relatively expensive generation is not run as much at these times. These peak cost savings are offset by some extent by Snowy Hydro operating less at other times of the year and thermal generation operating more. However, the cost of the generators operating more at these non-peak times is less than the cost of the peak thermal generators that are displaced at the peak times. This means that there are net costs savings.

Both the proposals affected the average price results. Average annual prices in the NSW and Snowy regions were approximately $1 to $5/MWh lower under the Southern Generators' proposal and the Re-orientation case compared to the base

case. This impact largely occurred during summer peak times. Prices during the winter peak showed a similar trend to the summer peak, but the magnitude of the effect was smaller, while the remainder of the year was only marginally affected by either option. In many scenarios, NSW prices converged with Victorian prices, with implications for the risk analysis (see next section). While price reductions are not equivalent to overall efficiency gains, to the extent customers respond to lower retail prices by expanding consumption in the longer term, an overall market benefit may be created.

The modelling shows that across a broad range of scenarios the removal of clamping, whether via the Southern Generators' or Reorientation proposal, consistently leads to potential small reductions in production costs and possible decreases in NSW and Snowy prices. This result is driven by changes in incentives for Snowy, and other market players', during times when clamping would be imposed in the base case.

C5 Risk modelling

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

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 Southern Generators' proposal and the re-orientation counterfactual.

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 C27).

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.

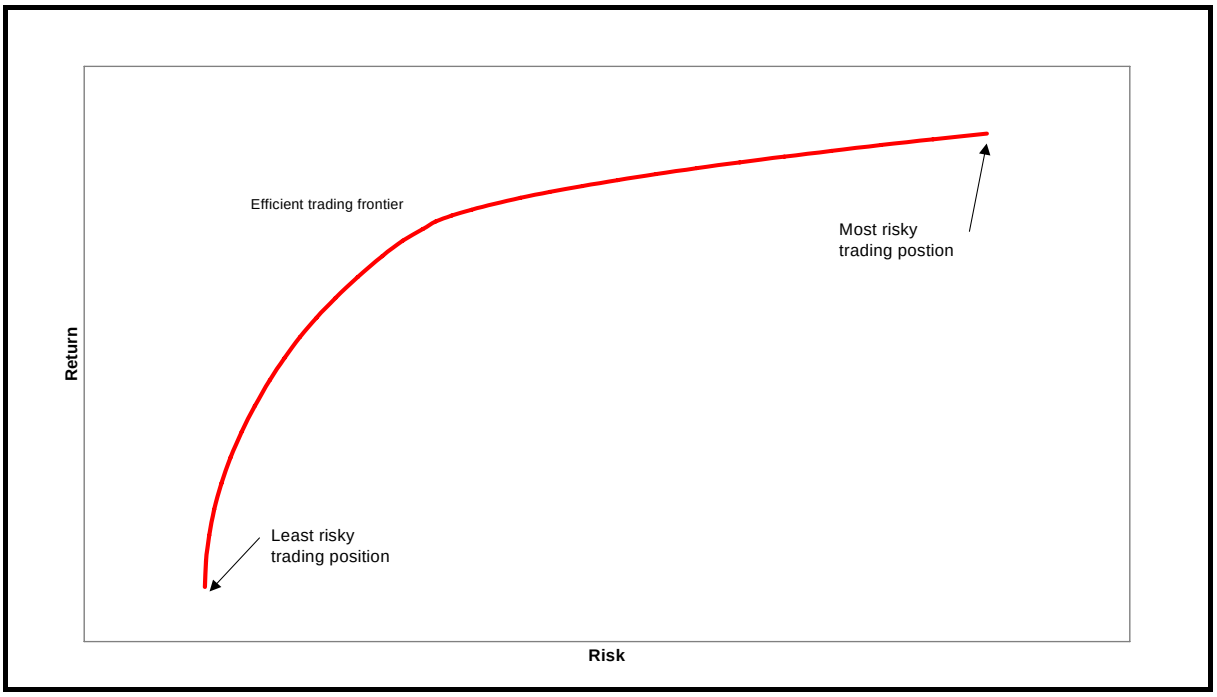

Figure C27: A generalised efficient frontier for hedging energy trading risks

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 Southern Generators' Rule change proposal, to be compared to both the base case and the re-orientation counterfactual.

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 generator hedging at both the Victorian and NSW nodes concurrently.

The Southern Generators' Rule change proposal directly affects settlement residues on the Victoria-Snowy and Snowy-NSW interconnectors. The above scenarios cover the range of likely risk-management applications using combinations of these residues.

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

The precise effect on risk will depend on where participants choose to locate on the efficient frontier – that is their risk preferences. Given we are primarily concerned with the relative effects of the alternative proposals, for simplicity the results here are presented for the most conservative risk position on the efficient frontier (that is, the bottom left point of the efficient frontier). The results represent the optimal volume that would be hedged inter-regionally in order to minimise portfolio risk.

Assumptions

The risk modelling was based on the spot prices and IRSRs produced by the dispatch modelling for the base case, Southern Generators' proposal and the re-orientation counterfactual described above.

For each of the spot price series and associated IRSRs, we compared the efficient frontiers for each of the following hypothetical generators seeking to hedge inter-regionally using Victoria-Snowy, Snowy-Victoria, Snowy-NSW, and NSW-Snowy IRSRs:

- A 100 MW Victorian generator seeking to enter contracts in NSW and able to purchase a mix of Victoria-Snowy and Snowy-NSW IRSR units;
- A 100 MW NSW generator seeking to enter contracts in Victoria and able to purchase a mix of NSW-Snowy and Snowy-Victoria IRSR units; and
- A 100 MW Snowy generator seeking to enter contracts in Victoria and NSW and able to purchase a mix of Snowy-Victoria and Snowy-NSW IRSR units

For the purposes of comparison, the generation and loads were assumed to be flat in each case. IRSR units were assumed to be available to the generator at break-even cost (i.e. the cost of the unit was equal to the expected return of the residues[7]).

Results

The *STRIKE* analysis found that the Southern Generators' proposal and the Re-orientation proposal produced, on average:

- Increases in the Victorian generator's willingness to enter contracts in NSW (See Figure C28);
- Minor reductions in the NSW generator's willingness to enter contracts in Victoria (See Figure C29);
- Minor reductions in the Snowy generator's willingness to enter contracts in NSW (See Figure C30); and
- Increases in the Snowy generator's willingness to enter contracts in Victoria (See Figure C31).

7. 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.

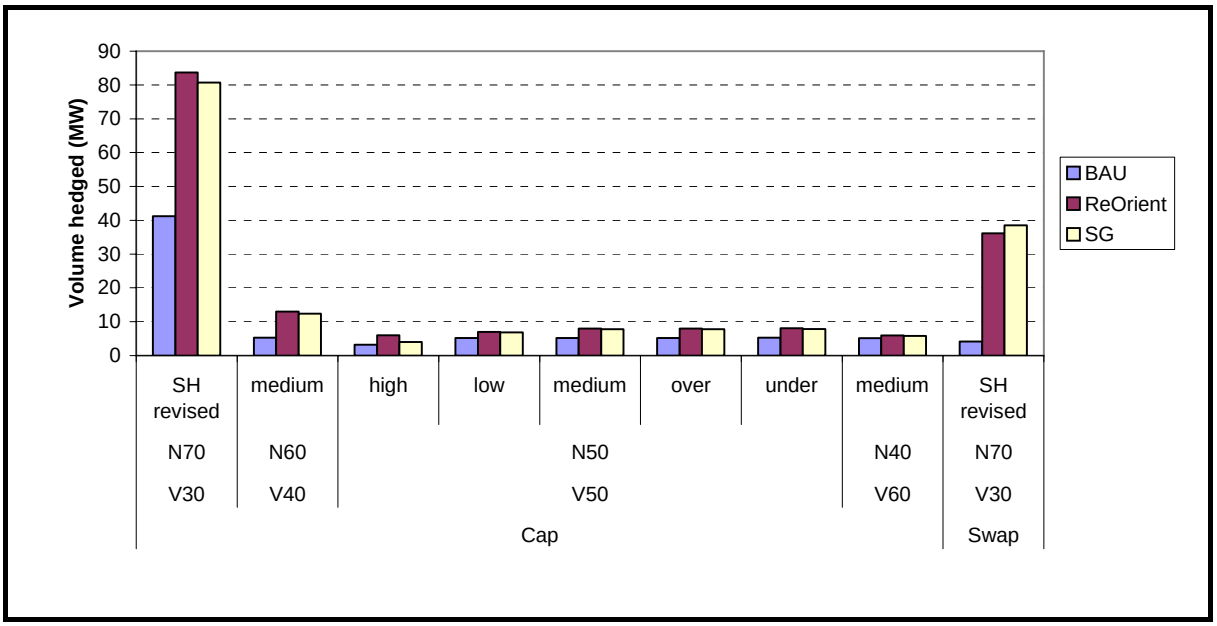

Figure C28: Victorian generator's optimal contracting in NSW

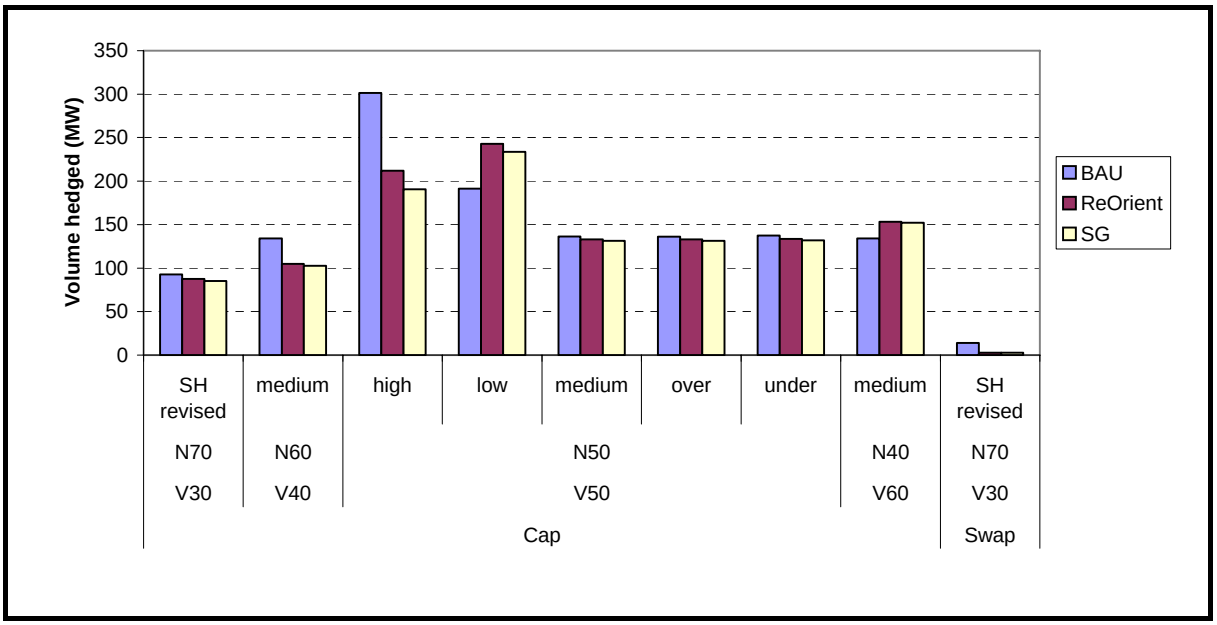

Figure C29: NSW generator's optimal contracting in Victoria

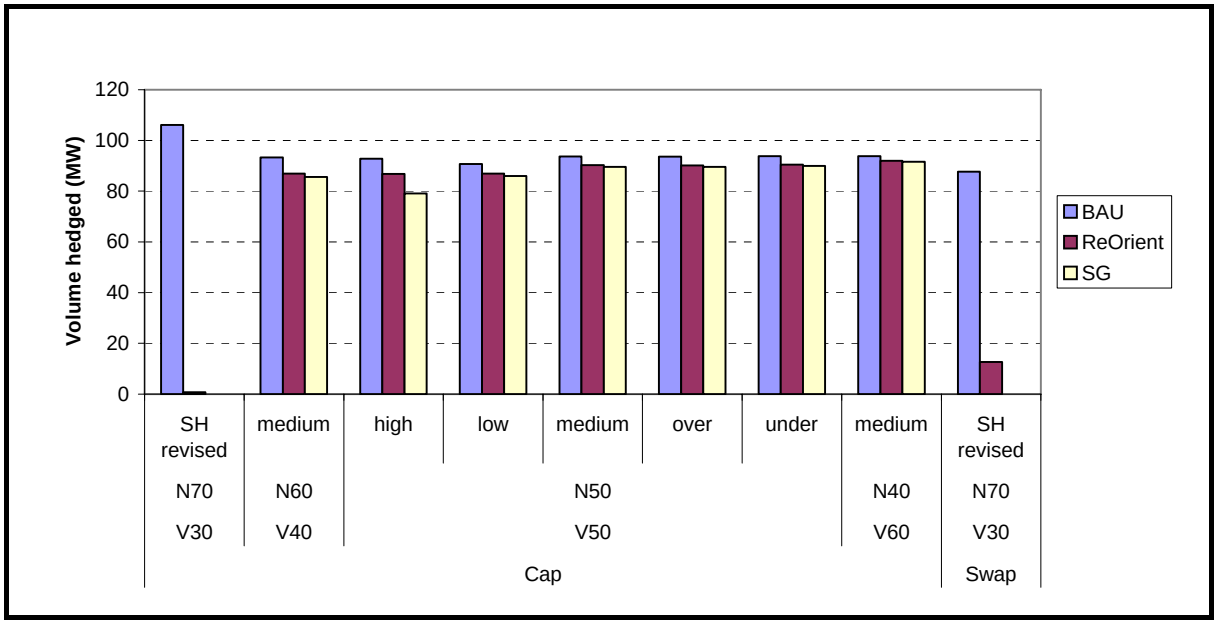

Figure C30: Snowy generator's optimal contracting in NSW

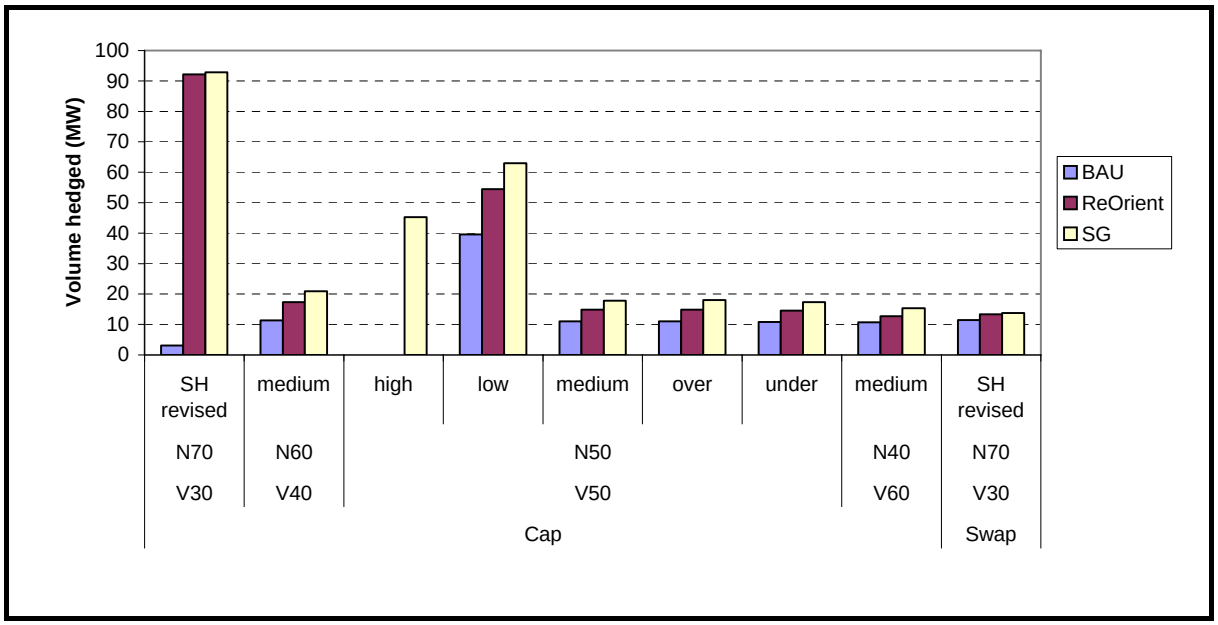

Figure C31: Snowy generator's optimal contracting in Victoria

The figures show that for some cases it is optimal for the generator to hedge more than its 100 MW of physical capacity inter-regionally. While this may at first appear to be counter-intuitive, it is driven by the fact that the generator region price is more volatile than the inter-regional price. This means that each MW of generation requires more than 1MW of inter-regional hedge cover to minimise the risk of the portfolio.

Conclusions

The results of the risk analysis suggest that the Southern Generators' proposal would increase the willingness of Victorian (and possibly South Australian) generators to enter contracts referenced to the NSW regional reference node. This is due to both the greater firmness of the Victoria-Snowy IRSR units - due to the elimination of clamping - and lower expected price differences (and volatility) between the Victorian and NSW regions (see price analysis above). However, the willingness of NSW generators to enter into contracts at the Victorian regional reference node might be slightly reduced, perhaps due to the use of NSW-Snowy IRSRs to fund occasional deficits on the Snowy-Victoria interconnector. Meanwhile, the willingness of a generator located within the Snowy region to enter contracts inter-regionally is slightly increased for contracts referenced to the Victorian regional reference node and slightly reduced for contracts referenced to the NSW regional reference node.

Appendix D – Reliability of supply in Victoria

D1 Introduction

This Appendix examines and assesses the reliability of supply issues raised in a supplementary submission from Snowy Hydro received on 28 August 2006.

D2 Background

On Monday 28th August 2006, the AEMC received a letter from Snowy Hydro (published on the AEMC website), in which Snowy Hydro made a number of assertions relating to the reliability implications of the Southern Generators' proposal. Snowy Hydro contended that the implementation of the Southern Generators' proposal instead of its own Re-orientation proposal (or maintenance of the status quo arrangements) could create risks for Victorian supply reliability over the summer of 2006-07. [1]

Snowy Hydro subsequently gave a presentation to the Commission on Tuesday 5 September 2006 in which it explained the basis for the assertions contained in its letter of 28 August 2006. A modified version of this presentation is available on the AEMC website.

At the request of the Commission, NEMMCO considered some of the issues arising from Snowy Hydro's letter and presentation and responded by way of a letter dated 5 September 2006, which was also published on the AEMC website. NEMMCO also requested clarification from Snowy Hydro of their contentions on a number of matters, and Snowy Hydro responded to those matters, providing a copy of its response to the Commission on 6 September 2006 (that correspondence is also published on the AEMC website). NEMMCO subsequently confirmed to the Commission that the contents of the second Snowy Hydro letter did not alter the views expressed in its letter of 5 September 2006.

D3 Snowy Hydro's assertions

This section discusses the key assertions in Snowy Hydro's initial letter[2] and presentation[3] to the Commission.

D3.1 Snowy Hydro letter

Snowy Hydro's letter stated that the current hydrological inflow conditions in the Snowy Mountains area are extremely dry and are approaching 1 in 100 year cumulative dry conditions for the present winter season. Under a "nodal" priced

1 Reserve shortfalls in Victoria may also affect South Australia.
2 Letter from Mr Roger Whitby, Executive Officer, Trading, Snowy Hydro Limited, to Dr John Tamblyn, Chairman, AEMC, 28 August 2006.
3 Snowy Hydro Limited, AEMC Presentation, Southern Generators' proposal, 5 September 2006.

Murray generation market arrangement (i.e. the Southern Generators' proposal[4]), Snowy Hydro stated that it would adopt a water management strategy of maintaining medium to low Geehi Reservoir storage levels in order to avoid the risk of summer storm inflows and reservoir spillage/forced generation. Snowy Hydro indicated that this strategy would be adopted for commercial reasons, not to meet technical requirements of water management or electricity generation.

Snowy Hydro noted that under average or normal dam storage level conditions any risk that medium to low Geehi Reservoir storage levels impose on Victorian supply reliability would be mitigated by:

- Storage in Lake Eucumbene, which can be piped through tunnels to Geehi for use in the Murray power stations;
- Pumping of water from Lake Jindabyne to Geehi; and
- NEMMCO's ability to direct Snowy Hydro's operations, subject to compensation.

However, due to critically low winter inflows and extremely low Eucumbene reservoir levels, Snowy Hydro stated that NEMMCO intervention may not be possible or effective.

Snowy Hydro also asserted that under its Re-orientation Rule change proposal, there would be no risk to Victorian reliability because its commercial and water management strategy would involve maintaining medium to high storage levels at Geehi.

D3.2 Snowy Hydro presentation

Snowy Hydro supported its assertion of low current inflow conditions by comparing July and August 2006 inflows to Lake Eucumbene with the historical averages for these months. For example, while the average August inflow is 345 GL, actual inflow this August was only 87 GL. However, according to Snowy Hydro, low levels at Eucumbene (currently <20%) do not presently show up in medium-term PASA and would be unlikely to do so unless and until levels fell further (to about 10-15%).

During periods of higher Eucumbene storage levels (eg as prevailed 2 years ago), Snowy Hydro noted that it is possible to divert enough water from Eucumbene and Jindabyne to allow for a continuous output (ie 24 hours a day) of about 500 MW from the Murray power stations. However, at current levels of Eucumbene storage, it is only possible to divert enough water from Eucumbene and Jindabyne[5] to allow for a maximum of 350 MW of continuous output from Murray and this may fall to 300 MW if and when Eucumbene storage levels fall further.

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4 Under the Status Quo, Murray generation also receives a "nodal" price as it is physically located at the Snowy regional reference node. However, under the Status Quo, NEMMCO currently intervenes by "clamping" flows on the Victoria to Snowy interconnector in response to negative settlement residue accumulation.

5 Some water can be pumped from Lake Jindabyne to the Geehi Reservoir, but the principal source of water from the Snowy Mountains Scheme is water transfers from Lake Eucumbene. The Geehi Reservoir also receives natural inflows from surrounding mountain streams.

At the same time, Snowy Hydro explained that under the Southern Generators' proposal, Snowy Hydro would choose (based on its preferred commercial strategy rather than technical imperatives) to maintain a lower level of storage at its Geehi storage reservoir than if either the status quo arrangements were maintained or Snowy Hydro's proposed re-orientation option were adopted. Specifically, Snowy Hydro claimed that:

- Under the Southern Generators' proposal, Geehi target storage would be 30-50% of active storage capacity (the total Geehi active storage capacity is about 13 GL in total); and

- Under the status quo or the Snowy Hydro Re-orientation proposal, Geehi target storage would be 60-80% of active storage capacity.

Snowy Hydro's rationale for the change in strategy was based on the risk of summer storms eventuating and rapidly filling Geehi storage from natural inflows. Snowy Hydro stated that maximum Murray operation of 1500 MW utilises approximately 240 cubic meters of water per second (about 0.864 GL per hour).[6]

According to Snowy Hydro's presentation, summer storms in the Geehi region can lead to natural inflows into Geehi Reservoir of between 3.9 GL per day (0.164 GL per hour) at the 10% probability of exceedence (POE) level and 8 GL per day (0.333 GL per hour) at the <1% POE level.[7] Snowy Hydro also confirmed that during severe summer storms, inflows can reach up to 440 cubic meters per second (about 1.58 GL per hour). This means that net Geehi storage levels could rise by up to 200 cubic meters per second with Murray generating at its maximum level and by even more if Murray were generating less than 1500 MW. The possible duration of any storm of this magnitude would be unknown at the time it occurs. As environmental regulations do not permit snowy Hydro to 'spill' water from the Geehi reservoir, Geehi cannot be allowed to overfill under any circumstances.

Under these conditions, Snowy Hydro may be forced to generate at certain levels in order to eventually avoid spillage. Ensuring that such forced generation would be physically dispatched could be effected through 'fixed load bids' and would not itself create difficulties for Snowy Hydro. However, Snowy Hydro contended that under the Southern Generators' proposal, the *price* Snowy Hydro would receive for its Murray generation when forced to operate in this manner would be relatively unattractive and could even be negative (that is, Snowy Hydro would be required to *pay* to generate).

Finally, Snowy Hydro claimed that because of its strategic decision to maintain low to medium levels at Geehi and low levels at Eucumbene, it may not be able to comply with a potential NEMMCO direction to either increase Murray generation or increase diversions from Eucumbene/Jindabyne. Snowy Hydro also submitted that for a NEMMCO direction to be effective, NEMMCO must know with some advance

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6 See Snowy Hydro Limited, Engineering Features of the Snowy Mountains Scheme, Fourth Edition, 2003, pp.123 and 133. An inference that can be drawn from this is that Murray can produce electricity at approximately 0.576 GL per GWh.

7 See Snowy Hydro Limited, AEMC Presentation, Southern Generators' proposal, 5 September 2006, slide entitled "Geehi summer inflow risks".

warning that there is a reliability issue that can be dealt with through a direction. This may not be the case if a high demand situation in Victoria or low Geehi storage emerges quickly.

D4 Commission's considerations

The Commission considered Snowy Hydro's written submissions and presentation and has reached the view that, on balance, the Southern Generators' proposal would not materially increase the risk of supply shortfalls in Victoria over the summer of 2006/07. This section presents the analysis undertaken by the Commission in support of that view. Some preliminary observations are made on the analytical approach before examining:

- the risk of summer storms in the Snowy area and their implications for Geehi storage levels, based on assumptions proposed or data provided by Snowy Hydro;

- the implications of low Geehi storage levels and diminished diversion rates from Eucumbene and Jindabyne for potential levels of Murray generation, based on assumptions proposed or data provided by Snowy Hydro; and

- the implications for supply reliability of relaxing some of the assumptions proposed by Snowy Hydro.

The Commission also took account of NEMMCO's statements, outlined below, on the reliability implications of some of Snowy Hydro's assertions.

D4.1 Preliminary observations

Snowy Hydro conceded that the reliability risks for Victoria to which it referred would arise as a direct result of the commercial strategy it claimed it would adopt in response to a Commission decision to approve the Southern Generators' proposal. That is, the risk (or the increased risk) referred to would not be caused by dry conditions as such. However, even if Snowy Hydro did not engage in the low Geehi storage level strategy described above, the current levels of Eucumbene could (if Snowy Hydro's assertions about lower diversion levels are correct) result in lower potential continuous Murray generation than would otherwise be the case.

As noted above, the Commission's analysis proceeds largely on the basis of the assumptions proposed by Snowy Hydro in its presentation. In particular, it takes as given Snowy Hydro's assertions that its commercial strategy in response to the adoption of the Southern Generators' proposal would be to reduce storage levels at Geehi, although it tests whether the magnitude of this reduction is consistent with the way Snowy Hydro currently sets Geehi storage levels. It should be noted that the Commission did not receive any documentary evidence (created independently of the current Rule change consultation process) that Snowy Hydro would adopt this strategy in response to the implementation of the Southern Generators' proposal.

The discussion also proceeds, unless otherwise specified, on the basis that Snowy Hydro's factual assertions regarding:

- Eucumbene storage levels and the implications of these levels for maximum diversion flows to Geehi from Eucumbene and Jindabyne; and

- Potential Murray output based on Geehi storage and maximum diversions to Geehi,

are accurate.

However, in Section D4.4 below, the Commission also considers the likely implications of relaxing some of Snowy Hydro's assertions and assumptions.

In the Commission's view, this approach ensures that the analysis on which it has based its conclusions is conservatively biased in favour of maintaining supply reliability.

D4.2 Risk of summer storms and resulting implications

Storm data

The Commission contacted the Bureau of Meteorology (Bureau) seeking data on the risk of summer storms in the Geehi region and whether these storms were related to preceding or coincident hot weather patterns in South Australia, Victoria or NSW.[8] The Bureau's response was published on the AEMC website. [9]

The Bureau provided selected rainfall data for recording stations in the Geehi region (Corryong and Khancoban). However, the Bureau made clear that it had not been able to determine whether these stations were "representative of the range of variability of summer rainfall in the [Geehi reservoir] region".[10] In light of the Bureau's informed reservations concerning whether the data provided was "representative" of storm-related inflows into the Geehi Reservoir, the Commission has decided to not place particular weight on this data.

However, as noted above, Snowy Hydro's presentation provided some relevant information on summer inflows to Geehi. The presentation shows the 10% POE level of summer inflows as about 3.9 GL per day and the 1% POE level as about 8 GL per day. Further, Snowy Hydro confirmed that severe summer storms could lead to Geehi inflows of 1.58 GL per hour (38 GL per day). This suggests that even on the greatest inflow per summer day (i.e., the 1% POE summer inflow level), such concentrated inflows would typically not prevail for more than a few hours.

Price received for Snowy Hydro generation if forced to generate

The Commission began by undertaking its own qualitative analysis of the potential spot revenue implications for Snowy Hydro of the different negative settlement residue management options – Southern Generators' proposal, re-orientation and

8 Letter from Mr Tendai Gregan, Senior Advisor, AEMC, to Mr Tony Baldwin, Marketing Manager, Special Services Unit, Bureau of Meteorology, dated 5 September 2006.

9 Letter from Dr Geoff Love, Director of Meteorology, Bureau of Meteorology, to Dr John Tamblyn, Chairman, AEMC, dated 7 September 2006 (BoM letter).

10 BoM letter, Attachment, p.1

status quo (with clamping). The Commission's analysis on this issue is presented below.

In the context of describing the likely price levels under each option, 'high' refers to the price that, subject to constraints on the Victoria-Snowy or Snowy-NSW interconnectors, should be equivalent to (or higher than) the loss-adjusted Victorian or NSW regional reference price, whichever is higher. 'Low' refers to a price below a 'high' price.

Under the status quo arrangements:

- At times of **northward flows**, Snowy Hydro would receive:
    - the loss-adjusted (high) NSW price on its Murray generation, if the forced generation at Murray led to a constraint between Murray and Tumut that resulted in NEMMCO clamping of the Victoria-Snowy interconnector and the Murray-Tumut constraint subsequently unbound so that the Snowy RRN price (ie the Murray nodal price) aligned with the NSW price; or
    - the (low and possibly negative[11]) Snowy RRN price on its Murray generation, if the forced generation at Murray caused the Murray-Tumut constraint to bind and either NEMMCO had not yet implemented clamping or clamping was imposed and the Murray-Tumut constraint remained binding; and
    - the Tumut price for all its Tumut generation, under the CSP/CSC trial.
- At times of **southward flows**, Snowy Hydro would receive:
    - the (high) Dederang nodal price (typically the loss-adjusted Victorian RRN price) on its Murray generation, if the Murray-Tumut constraint bound; or
    - the (high) Snowy RRN price on its Murray generation, if the Murray-Tumut constraint did not bind; and
    - the Tumut price for all but 550 MW of its Tumut generation under the CSP/CSC trial – the remaining 550 MW would receive the same price Murray received.

Under the Snowy Hydro Re-orientation proposal:

- At times of **northward flows**, Snowy Hydro would receive:
    - the (high) Snowy RRN price for its Murray generation, if the forced generation at Murray did not result in the binding of the Murray-Tumut constraint; or

11 The Snowy RRN price could only be negative if the NSW price were very high. This is because a high NSW price would increase the sub-optimality of Murray generation "crowding out" generation from the southern regions of the NEM.

- the (lower but still positive) Dederang price for its Murray generation, if the forced generation at Murray did result in the binding of the Murray-Tumut constraint; and

- the Tumut price for all its Tumut generation, under the CSP/CSC trial.

- At times of **southward flows**, Snowy Hydro would receive:

  - the (high) Snowy RRN price on its Murray generation, if the Murray-Tumut constraint did not bind; or

  - the (high) Dederang nodal price on its Murray generation, if the Murray-Tumut constraint did bind; and

  - the Tumut price for all but 550 MW of its Tumut generation under the CSP/CSC trial – the remaining 550 MW would receive the same price Murray received.

Under the Southern Generators' proposal:

- At times of **northward flows**, Snowy Hydro would receive:

  - The (high) Snowy RRN price on its Murray generation, if the forced generation at Murray did not result in the binding of the Murray-Tumut constraint; or

  - The (low and potentially negative) Snowy RRN price on its Murray generation, if the forced generation at Murray did result in the binding of the Murray-Tumut constraint; and

  - the Tumut price for all its Tumut generation, under the CSP/CSC trial.

- At times of **southward flows**, Snowy Hydro would receive either:

  - The (high) Snowy RRN price on its Murray generation, if the Murray-Tumut constraint was not binding; or

  - The (very high) Snowy RRN price (ie above the Victorian RRN price) on its Murray generation, if the Murray-Tumut constraint did bind; and

  - the Tumut price for all but 550 MW of its Tumut generation under the CSP/CSC trial – the remaining 550 MW would receive the same price Murray received.

This analysis is instructive because it demonstrates that even under the status quo arrangements or re-orientation, Snowy Hydro may experience periods of low or negative prices at certain times when forced to generate, due to delays or imperfections in NEMMCO intervention through clamping or re-orientation. Further, such delays (and accompanying low or negative prices) would increase in

duration if the threshold trigger for NEMMCO intervention were raised from the current $6,000 over a continuous series of dispatch intervals to $100,000.[12]

Snowy Hydro behaviour in response to risk of low/negative prices

Starting from the assumption that Snowy Hydro would be willing to operate Murray at 1500 MW during and after summer storms under the status quo arrangements or re-orientation and Geehi begins at 70% active storage capacity, Geehi would never reach 100% active storage capacity based on natural inflows in summer of 3.9 GL per day (the 10% POE inflow level). Even at 8 GL per day (the 1% POE inflow level), Geehi would never be filled. It is only under conditions of the most severe storms and highest natural inflows (1.58 GL per hour) that Geehi would reach capacity and then only after 5.4 hours. As noted above, such inflows would be extremely rare based on the data provided by Snowy Hydro.

If, under the Southern Generators' proposal, Snowy Hydro were only willing to operate Murray at 250 MW during and after summer storms (to avoid the risk of constraining the lines between Murray and Tumut to avoid low or negative prices at Murray),[13] it would take the following periods for Geehi to reach full capacity:

- Based on the 10% POE natural inflow level of 3.9 GL/day inflows, if Geehi began at 30% active storage capacity, it would take 451 hours for Geehi to reach 100% active storage capacity;

- Based on the 10% POE natural inflow level of 3.9 GL/day inflows, if Geehi began at 70% active storage capacity, it would take 193 hours for Geehi to reach 100% active storage capacity;

- Based on the 1% POE natural inflow level of 8 GL/day inflows, if Geehi began at 30% active storage capacity, it would take 48 hours for Geehi to reach 100% active storage capacity;

- Based on the 1% POE natural inflow level of 8 GL/day inflows, if Geehi began at 70% active storage capacity, it would take over 20 hours for Geehi to reach 100% active storage capacity.

Therefore, assuming no other factors were relevant to Snowy Hydro's choice of Geehi storage levels – such as foregone spot market opportunities for Murray generation at high prices or the sale of hedge contracts into Victoria – a choice of 30% Geehi storage level under the Southern Generators' proposal suggests that Snowy Hydro guards against the risk of 2 continuous days of 1% POE natural summer inflows to Geehi or 19 continuous days of 10% POE natural summer inflows.

Alternatively, based on extreme natural inflows during summer of 1.58 GL per hour, if Snowy Hydro operated Murray at 250 MW and was willing to allow up to 5.4

12 See NEMMCO, Review of the Trigger Level for Management of Negative Settlement Residues, Draft, 5 September 2006.

13 It is worth noting that Snowy Hydro could run Murray at more than 250 MW and avoid constraining the Murray-Tumut limit if VIC-Snowy (northward) flows fell below their maximum of 1100 MW (or reversed). It would be highly unlikely for VIC-Snowy flows to be continuously at this level for the number of hours relevant to this point (ie 20-40 hours plus).

hours of these extreme inflows prior to spilling (the same period as implied by a 70% Geehi level with 1500 MW continuous generation), Snowy Hydro should be willing to keep Geehi at 40% storage.

D4.3 Potential duration of continuous Murray operation at 550MW

The southward limit on the Snowy to Victoria directional interconnector can be up to 1900 MW (but only if expensive network control ancillary services (NCAS) are procured).[14] Given potential flows from Tumut and NSW of 1350 MW (which would be expected at times of high demand and risks to supply reliability in Victoria), Murray would be required to generate 550 MW to enable maximum imports into Victoria from the north.

Assuming Murray operated at an output of 550 MW and 300 MWh per hour worth of diversions from Eucumbene and Jindabyne (which is conservative), a 30% storage level at Geehi (about 4 GL) should allow:

- 27.1 hrs (1.13 days) of continuous Murray generation;
- 4.23 days of Murray operation assuming Murray generates for 16 hrs per day;
- Indefinite Murray operation assuming Murray generates for 12 hrs per day.

The final estimate accords with intuition because at 550 MW operation, Murray only uses 250 MWh/hr from Geehi for the half the day (12 hrs) it runs, while for the other half of the day it does not run, Geehi can fill up at a rate of 300MWh/hr. In other words, at 12 hours operation per day, Geehi can fill up faster than it needs to be used to maximise Victorian imports from the northern regions.

Nevertheless, Snowy Hydro suggested in its presentation and subsequent letter to NEMMCO that the risk to supply reliability may not emerge at times where Murray generation is required and Geehi is at 30% storage. Rather, the risk may arise where Murray generation is required *after* several high demand days and Geehi storage levels have been driven down below 30%. In other words, a 30% Geehi *target* storage level may mean that, if the pattern of Murray generation is the same as last summer, at certain times during the forthcoming summer, Geehi is close to empty (i.e. at its Minimum Operating Level (MOL)) and Murray generation is only available at diversion levels. While taken at face value this scenario potentially creates some concerns, the likelihood of such a scenario both occurring and giving rise to reliability problems is considered to be low, as examined in the next section.

14 The NCAS primarily involves enabling the rapid off-loading of aluminium smelter potlines in Victoria. This enables the (higher) 5-minute thermal limits on the Victoria-Snowy interconnector to be used in dispatch. The enabling of the NCAS services increases the Victoria-Snowy import limit by 200MW from 1,700MW to 1,900MW. These NCAS services are only used under lack of reserve level 2 (LOR2) conditions, as defined in clause 4.8.4(r) of the Rules and after NEMMCO has assessed if there is an economic benefit from enabling the NCAS.

D4.4 Implications of relaxing assumptions based on Snowy Hydro assertions

This section considers the implications of relaxing some of the assertions and assumptions taken as given in the previous sections about Snowy Hydro's likely commercial strategy towards the operation of Murray generation.

The potential maximum durations of Murray operation under the Southern Generators' proposal outlined above would be higher if any of a number of Snowy Hydro's proposed assumptions were relaxed. There are three reasons for this.

First, for a number of sound commercial reasons, Snowy Hydro may actually choose a target Geehi active storage level above 30%. A key drawback of maintaining a low level at Geehi is that it may inhibit Snowy Hydro operating Murray at high levels in order to benefit from high Victorian demand and spot prices. Hence, there would be a material and potentially substantial opportunity cost in reducing Geehi storage levels solely to address the risk of extremely rare high intensity summer storms. Alternatively, Snowy Hydro may find it worthwhile to sell caps or hedge contracts at the Victorian regional reference node for peak summer conditions – it would partly lose the ability (and benefits) of doing so if it chose to run a low Geehi level strategy. It is worth noting that a 30% Geehi level suggests Snowy Hydro is concerned about a scenario of 2 consecutive days of 1% POE natural summer inflows into Geehi combined with Victoria-Snowy exports of 1100MW – it is under these conditions that Murray could be forced to generate at potentially low prices under the Southern Generators' proposal. To the extent Victoria-Snowy flows fell below 1100 MW, Murray would be able to generate more than 250 MW (and hence hold a higher storage at Geehi) without triggering a constraint between Murray and Tumut and low prices. By way of contrast, if Snowy Hydro were instead willing to allow for up to 1 day of 1% POE summer inflows into Geehi combined with 1100 MW Victoria-Snowy exports, it could safely maintain a Geehi storage level of 65%.[15] This is not to say that Snowy Hydro would not choose to reduce its Geehi storage levels *at all* in response to the implementation of the Southern Generators' proposal, but that any reduction would involve potential commercial costs as well as benefits.

Second, Murray operation may change under the Southern Generators' proposal either because:

- Snowy Hydro may have different bidding incentives – for example, Snowy Hydro would not be incentivised to bid Murray below its opportunity cost (ie overgenerate at Murray) at times of northward flows to induce NEMMCO clamping in an attempt to drive the Snowy RRN price up towards the NSW price at these times; and

- Snowy Hydro targets lower storage levels at Geehi – if, as Snowy Hydro asserts, it would maintain lower storage levels at Geehi than under the status quo, this would be likely to alter its operation of Murray. Presumably, other things being equal, Snowy Hydro would not run Murray at as high an output

15 Even if Snowy Hydro were concerned about severe summer inflows (1.58 GL per hour), it could maintain Geehi storage at 40% and retain the same 5.4 hour "buffer" before spillage it would have at a 70% storage level and 1500 MW continuous generation.

as often as it would if it maintained higher storage levels at Geehi. This is because at lower levels of storage, the scarcity value of Geehi water (ie Murray opportunity cost) would be higher.

Both of these differences suggest that it would be inappropriate to assume the same level and duration of Murray output as last summer, even given the same demand conditions. Murray would be expected to operate more conservatively, with less risk of being physically unavailable than Snowy Hydro's presentation implies. Therefore, while it is impossible to ensure Murray would always have sufficient water available to generate at 550 MW during peak Victorian demand periods, the scenario outlined in Snowy Hydro's presentation of Murray unavailability based on unchanging generation patterns is likely to be overly pessimistic. In this context, it is worth noting the relatively low level of Murray output on a number of high Victorian demand days from the summer of 2005/06 (see Figures D1 and D2 below).

Figure D1: Victorian record peak demand day, 24 February 2006

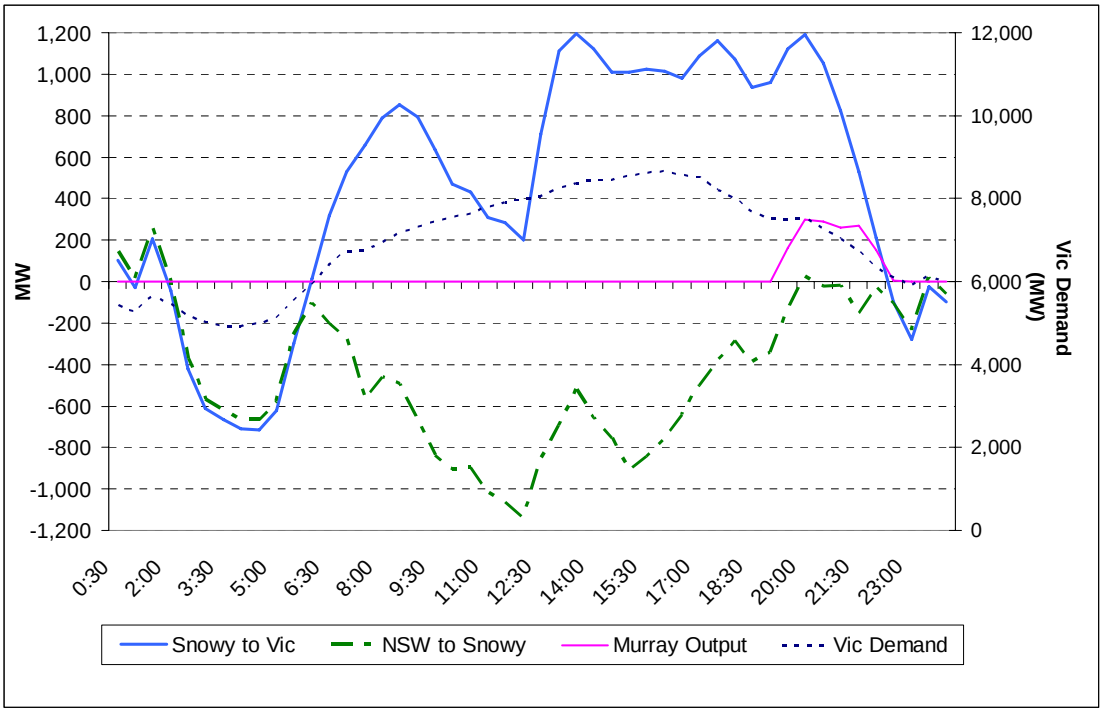
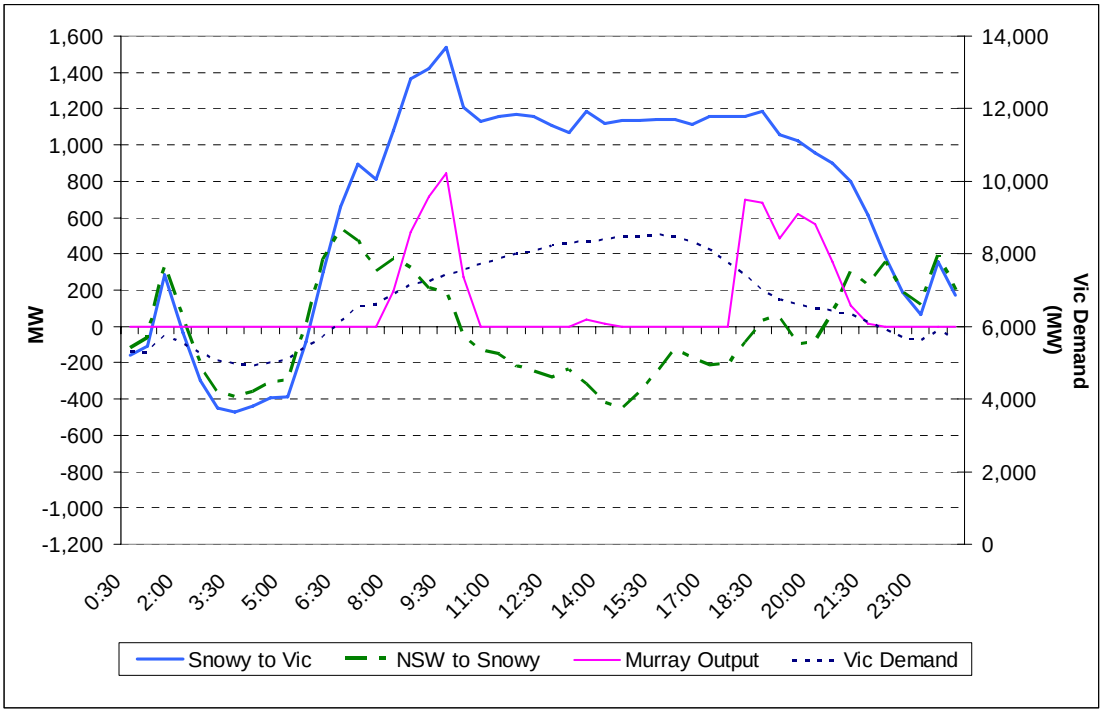


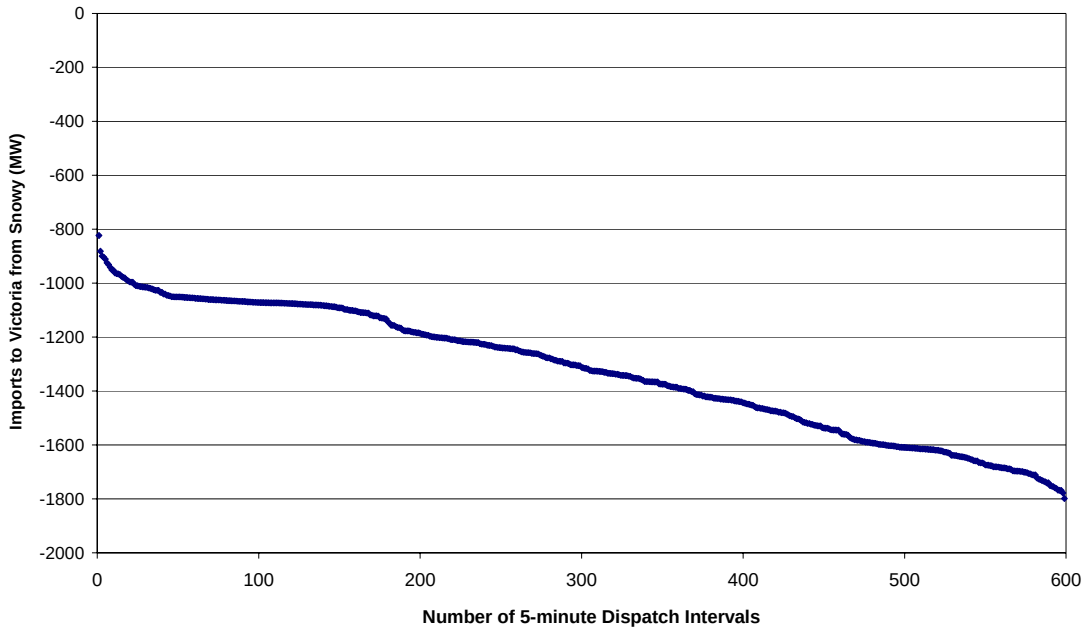
Figure D2: Victorian high peak demand day, with high Snowy prices, 20 January 2006



Third, the importance of Murray generation to Victorian reliability could be reduced if the 1900 MW southward limit on the Snowy to Victoria interconnector were reduced to 1700 MW (which would occur in the absence of NCAS being enabled). Given this lower limit, Murray would only be required to generate 350 MW in order to ensure imports from and through the Snowy region were maximised. This is approximately equal to the energy value of diversions from Eucumbene and Jindabyne.

Another way of depicting this point is to review the historical Snowy to Victoria limits during higher periods of demand in Victoria. The graph below displays historical Snowy to Victoria interconnector limits during 2005/2006, when Victorian demand was above 90% of the Maximum Demand level and the interconnector was operating at its limit. It shows that the Victoria to Snowy interconnector bound for 600 dispatch intervals, when Victorian demand was high enough to exceed the 90% of Maximum threshold. The limit over these dispatch intervals was fairly evenly distributed between 800MW and 1800MW, with a median level of 1314MW and a maximum of 1800MW. This would indicate that, assuming the normal limit of 1300 MW of transfers from Tumut to Snowy is not similarly limited, on many occasions when supply is tight in Victoria, high levels of Murray generation may not be all that necessary to ensure supply reliability into Victoria. In particular, when the Snowy-Victoria interconnector is operating at a limit of 1800 MW, and there is a full transfer of 1300 MW from Tumut to Murray, Murray generation would need to operate at 500 MW (i.e., 33% of Murray's maximum generation capacity) for flows along the Snowy-Victoria interconnector to be at their limit.

Figure D3: Flow duration curve: VIC Import from Snowy – Periods of Constrained Import, High VIC Demand (load > 90% of Maximum Demand Level), System Normal, Financial year 2005-06



Finally, the Commission considered the implications of changes to NEMMCO's threshold for intervention in the event of counter-price flows. This increase, if implemented, would temporarily expose Snowy Hydro to similar (low or negative) prices for Murray generation to those it would receive under the Southern Generators' proposal at times of northward flows and constraints between Murray and Tumut. Therefore, the incremental effect of the Southern Generators' proposal on the price received by (and hence the likely commercial behaviour of) Murray generation may be less than would otherwise be the case. That being said, the Commission has no way of knowing whether or not NEMMCO will ultimately increase this threshold as NEMMCO's consultation has only just commenced.

D5 NEMMCO correspondence and Snowy Hydro response

The Commission sought advice from NEMMCO regarding its view on the likely need for direction intervention as a result of Snowy Hydro advising the Commission that it may run Geehi storage at 25% of active storage capacity rather than 80%. This represents an extreme interpretation of the incremental impact of Snowy Hydro's reaction to the adoption of the Southern Generators' proposal.

NEMMCO stated that there were a number of uncertain factors influencing the level of reserves and the possibility of a NEMMCO direction to establish increased reserves to Murray. These included: availability of supply from NSW and Tumut; the likely extent of any reserve shortfall and the prior notice of the shortfall; Snowy to Victoria interconnector capability; and prior use of Murray and the Geehi storage level at the time.

NEMMCO's letter stated that, in its view, leaving aside its power of direction, even a 25% storage level at Geehi would not result in a significant degradation of reserves for 2006/07. In addition, NEMMCO could, being aware of Snowy Hydro's intention

to keep low storage levels at Geehi and seeing a reserve shortfall approaching in Victoria and South Australia, request or direct Snowy Hydro to allow higher storage levels to accumulate at Geehi (ie require Murray to reduce generation levels in the short term). In addition, NEMMCO could request or, if necessary, direct other Participants to reschedule plant outages and/or increase energy reserves. NEMMCO also noted that even in the event of a sudden reduction in reserves (due to plant failure or industrial action), (increased) load shedding due to low Geehi levels would be a low likelihood event. In these circumstances, "depending on the supply of from Tumut and NSW, the requirement from Murray could be as low as 600 MW (out of a capacity of 1500 MW) to fully utilise the Snowy to Victoria interconnector (at 1900 MW from Snowy to Victoria and a limit of about 1300 MW from Tumut to Murray)."[16] Therefore, contrary to Snowy Hydro's assertions, NEMMCO believed that its ability to direct would assist in the maintenance of reliability:

> "Thus with the opportunity to direct if necessary to meet a foreseeable reserve shortfall NEMMCO does not see any significant deterioration in reliability to Victoria and South Australia."[17]

In response to Snowy Hydro's original 28 August 2006 letter to the Commission, NEMMCO e-mailed Snowy Hydro on 31 August 2006, with questions clarifying Snowy Hydro's assertions regarding Energy Reserves and NEMMCO's Power of Direction.[18] Snowy Hydro responded to NEMMCO's e-mail with a letter dated 6 September 2006 (the Commission also received a copy of that correspondence, which is also available on the AEMC website).[19]

Snowy Hydro's response emphasised the implications of low Eucumbene storage levels for diversion potential to Geehi and Murray generation and reiterated that Snowy Hydro did not believe that a direction from NEMMCO would be effective in managing reliability shortfalls in certain circumstances (i.e. a sequence of multiple hot days in Victoria/South Australia; sudden forced outages or coincident high demand in Victoria/South Australia and NSW over consecutive days). This, Snowy Hydro stated, was because they anticipated a "reliability problem would be observed with little warning and in unexpected circumstances", i.e. NEMMCO would be unable to issue a Direction with sufficient notice to prevent the reliability problem.

NEMMCO confirmed to the Commission that Snowy Hydro's response to its questions did not alter NEMMCO's views as presented in its letter to the Commission of 5 September 2006.

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16 Letter from Mr Brian Spalding, Chief Operating Officer, NEMMCO, to Dr John Tamblyn, Chairman, AEMC, 5 September 2006, p.2.

17 Ibid

18 Email from Mr Brian Spalding, Chief Operating Officer, NEMMCO, to Mr Roger Whitby, Executive Officer, Trading, Snowy Hydro Limited, 31 August 2006 (available on the AEMC website).

19 Letter from Mr Roger Whitby, Executive Officer, Trading, Snowy Hydro Limited, to Mr Brian Spalding, Chief Operating Officer, NEMMCO, dated 6 September 2006.

D6 Commission's assessment

The Commission believes that there is a need for caution in making decisions about proposals for changes to the Rules based upon statements by Market Participants about their future intentions in respect of changes to their commercial strategies where those Market Participants have a significant interest in the outcome of the Commission's deliberations. Predictions by Market Participants about how they may respond in the future to regulatory change are likely to be subject to uncertainty and qualification given the complex and dynamic commercial environment most Market Participants operate within. Where a Market Participant is seeking to influence the deliberations of the Commission in its own commercial interests there is a risk that any statement of intentions may be exaggerated.

Given these risks and the fact that statements of commercial intention may be difficult to independently verify, the integrity of the Rule making process may be undermined unless the Commission exercises caution. In the present case, it is not entirely clear that Snowy Hydro will face a single and unambiguous imperative to materially reduce the water level of Geehi dam in the event the Commission adopts the proposal of the Southern Generators. If Snowy Hydro were to materially reduce the water level of Geehi dam, it would potentially materially reduce the available output of Murray in periods in which the Victorian price may well be very high. The Commission would expect a prudent generator to manage its affairs so that it could either take advantage of high prices in Victoria or sell contracts into Victoria.

The Commission's assessment has been informed by advice from NEMMCO in its 5 September 2006 letter to the Commission. As power system controller, NEMMCO's expert opinion was that it "does not consider it likely that there would be a significant degradation in reserves for 2006/07 as a result of the operation of Geehi at about 25% capacity".[20]

Having considered Snowy Hydro's correspondence and presentation, advice from NEMMCO, stakeholder comments, and its own analysis, the Commission has concluded on balance that adoption of the Southern Generators' proposal would not materially increase the risk of supply shortfalls in Victoria over the summer of 2006-2007.

The Commission's view is supported even it if is accepted that Snowy Hydro would implement its proposed commercial strategy if the Southern Generators' proposal were adopted. Relaxation of some of Snowy Hydro's assumptions and assertions regarding its commercial incentives and strategy strengthen the likelihood that adoption of the Southern Generators' proposal would have a minimal effect on expected reliability.

Therefore, the Commission has proceeded with its Final Rule Determination on the Southern Generators' proposal and its Draft Rule Determination on the Snowy Hydro Re-orientation proposal on the basis that the NEM supply reliability

20 Letter from Mr Brian Spalding, Chief Operating Officer, NEMMCO, to Dr John Tamblyn, Chairman, AEMC, 5 September 2006, p.3

implications of the Southern Generators' proposal are not substantially different to those of the Snowy Hydro Re-orientation proposal and the status quo arrangements.

Appendix E – Consistency with Snowy CSP/CSC Trial

E1 Introduction

Both the Southern Generators and Snowy Hydro Re-orientation proposals seek to improve the efficiency of dispatch and effective management of inter-regional trading risk using IRSRs, in the context of the current trial of CSP/CSC in the Snowy region.[1] Both proposals are based on the Tumut CSP/CSC trial continuing to operate in the period leading up to the expiry of the Part 8 Chapter 8A derogation, and they both propose to expire with the expiry of the trial.

As such, it is instructive to assess both proposals in the context of the Tumut CSP/CSC trial, and the way in which they modify the existing trial.

Before doing so, it is important to understand that the Tumut CSP/CSC trial, as currently implemented, is not a full implementation of CSP/CSC arrangements envisaged by the developers of the CSP/CSC concept, CRA. This was noted by NEMMCO in its 6 January 2005 submission to NECA regarding the implementation of the current Snowy CSP/CSC trial.[2] CRA clearly intended that a complete implementation of the CSP/CSC mechanism for a given constraint would include payments to or from all the generators/interconnectors on the "left hand side" (LHS) of the constraint.[3] This is because all LHS terms influence the degree to which the constraint binds and all can be altered by the NEM dispatch engine to manage the binding constraint so the physical limit (or "right hand side", RHS) is not exceeded.

To see this more clearly, note that a Murray-Tumut constraint has the general form:

$$\alpha_1 * F_{SN \to NSW} - \alpha_2 * F_{VIC \to SN} - \alpha_3 * Q_{LT} - \alpha_4 * Q_{UT} \leq RHS$$

Where: $F_{SN \to NSW}$ is the flow on the Snowy-NSW interconnector, $F_{VIC \to SN}$ is the flow on the VIC-Snowy interconnector, Q_{LT} is the output of Lower Tumut power station, Q_{UT} is the output of Upper Tumut power station, and RHS is the physical network limit (the constraint "right hand side").[4]

Since VIC-Snowy interconnector terms are on the left hand side of the Murray-Tumut constraint, it follows that an implementation of the CSP/CSC mechanism as

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1 The Snowy congestion management trial — i.e. the "Tumut CSP/CSC trial" or "Snowy CSP/CSC trial" — seeks to test the use of Congestion Support Prices (CSPs) and Congestion Support Contracts (CSCs) in managing network congestion. For a non-technical description of the CSPs and CSCs and the Snowy CSP/CSC trial, see Sections 5.4.1 and 5.4.3 of AEMC "Congestion Management Issues Paper", AEMC, Sydney, March 2006 (available at http://www.aemc.gov.au)

2 NEMMCO, "Despatching the market: constraint support pricing and contracting trial", NEMMCO submission to NECA, 6 January 2005, pp.3-5.

3 CRA "Constraint Support Pricing: Implementation of Snowy Proposal", Report submitted to NEMMCO, CRA, Melbourne, March 2005. (available on the Congestion Management Review page of the Commission's website, http://www.aemc.gov.au)

4 For further details on Murray-Tumut constraints, see Box B1 in Part 3 Appendix B.

originally envisaged would include a payment to or from the IRSR fund for the VIC-Snowy interconnector.

Although not specifically allocated in the derogation, the Commission understands the current partial implementation of CSP/CSC arrangements in the Snowy region completely leaves out the VIC-Snowy interconnector — that is, it is left out of both the CSP adjustments and the CSC mechanism. The Commission understands that this has the same implicit effect as including the VIC-Snowy interconnector in both the CSP and CSC mechanisms, but with a CSC equal to its dispatched flow.[5]

Having this understanding of the partial implementation of the CSP/CSC concept in the current Snowy CSP/CSC trial enables the effects of the Southern Generators' and Snowy Hydro Re-orientation proposals on the trial to be assessed.

E2 Southern Generators proposal

In the current NEM regional structure the Murray node is the RRN for the Snowy region, so Murray generation is settled at its local nodal price. This settlement is not changed by Southern Generators' proposal, so that both Murray generation and a portion of Tumut (as defined by the CSC for Tumut) generation are settled at their respective nodal prices. This observation is consistent with the assertions made by Snowy Hydro that the Southern Generators' proposal is essentially a nodal approach to settlement in the Snowy region. [6] However, this nodal approach to settlement of Murray and Tumut generation is inherent in the current implementation of the Snowy CSP/CSC trial, and has not been introduced by the Southern Generators' proposal. Under the existing CSP/CSC pricing arrangements, when the Murray-Tumut constraint binds, the location-specific prices at nodes around the loop (absent the exercise of market power) can provide economically efficient price signals to generation plant at different nodes to adjust their output in ways that allow the congestion to be managed at the least cost to the market.[7] The Southern Generators' proposal could be viewed as preserving and extending the trial by including the southern interconnector, without further changing the settlement arrangements for generation plant at either Murray or Tumut.

On this basis the Southern Generators' proposal would be equivalent to including the VIC-Snowy interconnector in the current CSP/CSC trial, but with a dynamic, non-zero CSC that is just sufficient to eliminate any negative residue on the VIC-Snowy IRSR fund when the Murray-Tumut constraint binds, and making matching adjustments to other implicit CSC allocations so as to make the arrangement self-funding within each trading interval.[8],[9] Therefore it appears to be the case that the Southern Generators' proposal amounts to a form of "completion" of the CSP/CSC trial.

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5 See p. 21, CRA "Constraint Support Pricing: Implementation of Snowy Proposal", Report submitted to NEMMCO, CRA, Melbourne, March 2005.

6 Snowy Hydro, s.95 submission on Southern Generators' proposal.

7 For further discussion, see Section A1.1 of Part 3 Appendix A.

8 That is, it is broadly equivalent in accounting, and hence hedging terms. As with any dynamic hedge allocation based on real-time performance, the economic incentives will be different from those pertaining if the same allocation had been fixed *ex ante*.

9 See third dot point of p. 21, CRA "Constraint Support Pricing: Implementation of Snowy Proposal", Report submitted to NEMMCO, CRA, Melbourne, March 2005.

If there were more than one constraint binding, the Southern Generators' proposal may not always be similarly related to a fuller implementation of the CSP/CSC mechanism. For example, if the Murray-Tumut constraint was binding at the same time as a binding constraint on Victorian exports to Snowy, the full CSP/CSC mechanism might lead to a larger transfer to the VIC-Snowy IRSRs than would the Southern Generators' proposal (which only offsets the IRSRs by enough to make them equal to zero).

However, the Commission considers that the Southern Generators' proposal is broadly consistent with the CSP/CSC concept, and represents a more complete implementation of it in the case of the Snowy constraint, than was implemented at the outset of the trial.

In the Commission's view, implementation of the Southern Generators' proposal over the remaining, limited, duration of the Snowy CSP/CSC trial is consistent with good regulatory practice and the longer term development of the NEM because:

- The proposal directly addresses a distortion in the market and minimises impact of the intervention in the dispatch process by NEMMCO to manage the accumulation of negative residues. However, the proposal involves an intervention in the settlements process;

- It appears to allow a more complete implementation of the CSP/CSC trial, and thereby better inform the Commission's future assessment of Snowy CSP/CSC trial and the potential use of CSPs/CSCs as a means of managing congestion within the comprehensive "Congestion Management Regime" that the Commission is developing; and

- The proposal standardises the exercise of bureaucratic discretion by NEMMCO in deciding when and by how much it will intervene in the dispatch process.

E3 Snowy Hydro Re-orientation Proposal

Athough the Snowy Hydro Re-orientation proposal offers the potential for similar improvements to the Southern Generators' proposal, with respect to the current partial implementation of CSP/CSC in the Snowy CSP/CSC trial, it is less consistent with "full implementation" of the CSP/CSC concept in the Snowy region and likely to be more akin to a permanent change in the Snowy region boundary.

Implementation of re-orientation, when combined with the operation of the Tumut CSP/CSC trial, means that *all* generation in the Snowy region is settled at a price that differs from the current regional reference node price (Murray). Re-orientation involves shifting the Snowy RRN from Murray to Dederang whenever negative settlement residues would otherwise have occurred on the Victoria-Snowy interconnector. In effect, reorientation provides all generators in the Snowy region with an implicit right to sell as much output as they like at the Victorian price. That is, reorientation is equivalent to granting Murray generation a CSC for access to the Victorian price, with a volume equal to Murray generation's output. Since the volume of the CSC varies with Murray output, Murray generation has a strong incentive (as described in section A5.1.2 of Part 3 Appendix A) to increase the

amount of its generation that is dispatched, in order to increase its allocation of valuable CSCs. This incentive potentially reduces economic efficiency, relative to the Southern Generators' proposal, because the price now paid to Murray generation—the Dederang price— less accurately reflects the economic value of an incremental change in generation output physically located at Murray. The Dederang price will either be above (in the case of northward flows) or below (in the case of southward flows) the economic value created by an marginal change in generation output physically connected to the Murray node.

Under re-orientation, the price received by Tumut generation will also be changed, to the extent it has access to the Dederang price via its fixed 550MW CSC (in the case of southward flows).

The combined effects of these changed price signals for Murray and Tumut generation have the potential to increase the total cost to the market of rebalancing power injections around the constrained loop, so as to manage the congestion, relative to the case where the locational prices accurately reflect the economic value that changes in output at locations around the loop have in either contributing to or relieving congestion.

If existing inter-regional price differences between Snowy and Victoria are primarily caused by the constraints that trigger the application of re-orientation, the limited duration of the Snowy Hydro Re-orientation proposal may, in effect, not be very different to permanently shifting the Snowy RRN.

At times of re-orientation, Murray generation is effectively settled at the Victorian price, whilst Tumut generation is effectively settled at the NSW price under the CSP/CSC trial.[10] Consequently, the combined effect of re-orientation together with the Tumut CSP/CSC trial is the de-facto abolition of the Snowy region during times when the Murray-Tumut constraint is binding (or forecast to bind) and causing negative residues to accumulate (or being forecast to accumulate) on the Vic-Snowy interconnector. This temporary abolition of the Snowy region under the Snowy Hydro Re-orientation proposal and the CSP/CSC trial is something Snowy Hydro are seeking to make a permanent feature of the market in a separate Rule change proposal, which is currently under consideration by the Commission.[11]

The Commission considers that implementation of the Snowy Hydro Re-orientation proposal in the time period before the Snowy CSP/CSC trial is less consistent with good regulatory practice because although the proposal directly addresses a distortion in the market and reduces the impact of NEMMCO's intervention to manage the accumulation of negative residues, it replaces one form of intervention in the dispatch process with another.

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10 Under the Tumut CSP/CSC trial, Tumut generation effectively receives the NSW region price (adjusted by losses and absent any binding transmission constraints between Tumut and the NSW reference node), rather than the Snowy regional reference price (Murray node), on all its output when flow is northwards and on all but 550MW (i.e. its CSC) of its output when flow is southwards. The Tumut generation volume relating to its CSC receives the Snowy RRP.

11 Snowy Hydro, "Rule Change Proposal for the Snowy Region: Revision of Transmission Connection Nodes", Snowy Hydro, Sydney, letter to AEMC 11 November 2005. (available on AEMC website)

The Commission also considers that the Snowy Hydro Re-orientation proposal appears to be more consistent with a permanent change in the Snowy region boundary, than an adjustment to the temporary and short-lived Snowy CSP/CSC trial.

The Commission is in the process of considering the merits of long-term changes to the Snowy region boundary, and has before it two proposals, neither of which can be implemented in the period before summer 2006-07.[12] In its evaluation of the two proposals for long term changes to the Snowy region boundary, the Commission will have regard to the MCE's view that congestion in the NEM is best handled in a staged manner, involving steps of managing congestion through pricing, investments, and—as a last resort—region boundary change.

As indicated in its 6 June 2006 "Congestion Management Program — Statement of Approach"[13], the Commission will also have regard to: legacy issues arising from the existing definition of the Snowy region; the potential for investment to alleviate congestion in the Snowy region; and the operation of the Snowy CSP/CSC trial as a means of managing congestion.

The Commission's decision to not accept this temporary Snowy Hydro Re-orientation proposal does not in any way imply the Commission's possible views on longer-term boundary changes in the Snowy region.

12 Macquarie Generation has put forward an alternative proposal for changing the Snowy region boundary, see Macquarie Generation, "Rule Change Proposal to establish NEM regions in Northern Victoria and Southwest NSW", letter to AEMC, received on 10 February 2006 (available on AEMC website)

13 AEMC "Congestion Management Program—Statement of Approach", AEMC, Sydney, 6 June 2006 (available on AEMC website, http://www.aemc.gov.au)

Appendix F – Rule as made

See attached "Rule as made".

AEMC

National Electricity Amendment (Management of negative settlement residues in the Snowy Region) Rule 2006 No.14

under the National Electricity Law as applied by:

(a) the National Electricity (South Australia) Act 1996; and
(b) the Electricity (National Scheme) Act 1997 of the Australian Capital Territory; and
(c) the National Electricity (New South Wales) Act 1997 of New South Wales; and
(d) the Electricity - National Scheme (Queensland) Act 1997 of Queensland; and
(e) the Electricity - National Scheme (Tasmania) Act 1999 of Tasmania; and
(f) the National Electricity (Victoria) Act 2005 of Victoria; and
(g) the Australian Energy Market Act 2004 of the Commonwealth.

The Australian Energy Market Commission makes the following Rule under the National Electricity Law.

John Tamblyn
Chairman
Australian Energy Market Commission

National Electricity Amendment (Management of negative settlement residues in the Snowy Region) Rule 2006 No.14

1. Title of Rule

This Rule is the *National Electricity Amendment (Management of negative settlement residues in the Snowy Region) Rule 2006 No.14*.

2. Commencement

This Rule commences operation on 1 November 2006.

3. Amendment of the National Electricity Rules

The National Electricity Rules are amended as set out in Schedule 1.

Schedule 1 Amendment of National Electricity Rules

(Clause 3)

[1] Chapter 8A, Part 8 Network Constraint Formulation

In Chapter 8A, after Part 8 paragraph (c) insert:

(c1) Paragraph (c) does not apply to the use of a *network constraint* referred to in the 'Murray/Tumut constraint list' developed pursuant to paragraph (f).

[2] Chapter 8A, Part 8

In Chapter 8A, omit Part 8 subparagraph (n)(2), and insert:

(2) *Trading amounts* determined as follows:

$$TA_1 = \text{Min}\ (\ EVA_N,\ IRSR_{Sn\text{-}NSW}\ )$$

$$TA_7 = -1 \times \text{Min}\ (\ 0,\ IRSR_{Vic\text{-}Sn}\ )$$

$$TA_2 = -1 \times TA_1 - TA_7$$

Where:

TA_1 is a *trading amount* for Snowy Hydro Limited;

$IRSR_{Sn-NSW}$ is the inter-regional settlement residue allocated to flows **from the Snowy *region* to the NSW *region*** for the relevant *trading interval*;

$IRSR_{Vic-Sn}$ is the inter-regional settlement residue allocated to flows **from the Victorian *region* to the Snowy *region*** for the relevant *trading interval*;

TA_2 is a *trading amount* for the inter-regional settlement residue allocated to flows **from the Snowy *region* to the NSW *region***; and

TA_7 is a *trading amount* for the inter-regional settlement residue allocated to flows **from the Victorian *region* to the Snowy *region*.**

[3] Chapter 8A, Part 8

Omit Part 8 subparagraph (o)(4) and substitute:

(4) A *settlements residue trading amount* determined as follows:

$TA_8 = -1 \times \text{Min}(0, IRSR_{Sn\text{-}Vic})$

where:

TA_8 is a *trading amount* for the inter-regional settlement residue allocated to flows **from the Snowy *region* to the Victorian *region***; and

$IRSR_{Sn-Vic}$ is the inter-regional settlement residue allocated to flows **from the Snowy *region* to the Victorian *region*** for the relevant *trading interval.*

(5) A *settlements residue trading amount* determined as follows:

$TA_6 = (-1 \times TA_3) - TA_4 - TA_5 - TA_8$

where:

TA_6 is a *trading amount* for the inter-regional settlement residue allocated to flows **from the NSW *region* to the Snowy *region***; and

$IRSR_{Sn-Vic}$ is the inter-regional settlement residue allocated to flows **from the Snowy *region* to the Victorian *region*** for the relevant *trading interval.*