NEMMCO

National Electricity Market
Management Company Limited
ABN 94 072 010 327

Impact of intra-regional constraints on pricing

Review of the results of the paper "How significant is the mis-pricing impact of congestion in the NEM ?" by Dr. Darryl Biggar

9 March 2007

Executive summary

This study was conducted in response to AEMC's request to review the report produced by Dr. Darryl Biggar titled "How significant is the mis-pricing impact of congestion in the NEM ?". In this context, mis-pricing relates to differences between regional and local prices. The study confirmed the finding that there is an increasing trend towards mis-pricing from 2003/04 onwards for the NSW, QLD and SA regions. Victorian region showed decreasing a trend.

There are some generic causes which may have contributed to the increased mis-pricing throughout the NEM. Increase in system demand and increase in generator offers contributed to the increase in congestion in network constrained subregions. The progressive conversion of option 8 (interconnector terms only on the Left Hand Side) constraints to a fully co-optimised formulation from July 2005 onwards would also have contributed to the increase in incidence of mis-pricing. However there are also some specific causes which contributed to mis-pricing trends in different regions.

These are some of the reasons identified as contributing to mis-pricing. This is not a complete list and does not represent the order of importance. NEMMCO acknowledges that there may be other contributing reasons.

- Increase in load in some areas
- Network outages including those to manage system augmentations
- Change in generation output
- Generators switching their output to different networks
- Use of higher short-term ratings for transformers and lines
- Commissioning transmission assets
- Impact of drought on some hydro generators
- Change in constraint formulation
- Directions and Network Support Agreements to manage system conditions
- Change in voltage and transient stability limits due to generator, load and network changes
- Increase in generation from wind-farms

Most of these reasons are specific to the region and the situation at the time. It is difficult to predict if these causes will continue in future. Therefore it is not possible to comment on the future direction of the mis-pricing trends identified in Dr. Biggar's paper.

Introduction

The AEMC made a request to NEMMCO on 13 December 2006 to review the results published in the paper titled "How significant is the mis-pricing impact of congestion in the NEM ?' by Dr. Darryl Biggar.

NEMMCO agreed to extend the analysis to cover a larger study period and perform a review to identify the causes behind any trends in mis-pricing.

The term mis-pricing is used in the above paper to describe the incidence of a difference between regional reference and local (sometimes referred to as nodal) prices. Mis-pricing occurs when a dispatched quantity of a generator is directly subjected to a binding constraint. The local price may be higher or lower than the reference price.

Scope

The main aim of this study was to check whether the mis-pricing trends identified in Dr Biggar's paper is consistent for a larger dataset. The study also refined the set of constraints to match the unmitigated impact of network congestion, as discussed in the next subsection.

This study did not attempt to quantify the amount of mis-pricing. It did not differentiate between small scale mis-pricing (eg $0.05/MWh) and large scale mis-pricing (eg $10000.00/MWh). It also did not differentiate between small volume of mis-pricing (eg applied to a small generator) and large volume (eg applied to a large station with 4 generators with 700 MW capacity). NEMMCO acknowledge this kind of analysis is required to estimate the materiality of any mis-pricing, however it was considered out of scope of this study.

Assumptions

In this study NEMMCO used a methodology to identify mis-pricing. This methodology was subjected to several assumptions.

As discussed in the original paper mis-pricing occurs when a generator is directly controlled by a binding constraint. Therefore this study initially looked at the binding constraints with generator terms during the study period to identify mis-pricing. After that any constraints not relevant to congestion were removed from study dataset. NEMMCO assumed the following constraint types are not relevant to congestion:

- FCAS constraints: These are constraints which are imposed to manage FCAS dispatch.

- Identified Network Support Agreement (NSA) constraints: These are the constraints applied to represent known NSAs between TNSPs and generators. Any mis-pricing due to these constraints is assumed to be managed by the agreement between the parties.
- Identified constraints to manage connection point equipment outages: These are the constraints applied to set the output of a generator to zero to manage any outage of the connection equipment. In some situations these constraints are used instead of generators making their units unavailable. It was assumed that these situations were managed by agreements between parties. Any mis-pricing in these situations had no financial impact since there was no output from the generators
- Identified non-conformance constraints: These are the constraints to manage generator non-conformance.
- Any internal NEMDE constraints: There are many internal NEMDE constraints which manage FCAS limits, ramp-rates and other issues. These relate to scheduled unit characteristics and are considered to be not relevant to network congestion.

Note: The dataset used for the study includes some of the constraints discussed above where the identified purpose of the constraint was not established. The regional analysis section of this report shows results of detailed analysis of the top 5 binding constraints, which include some of the non-conformance constraints etc.

Results and Analysis

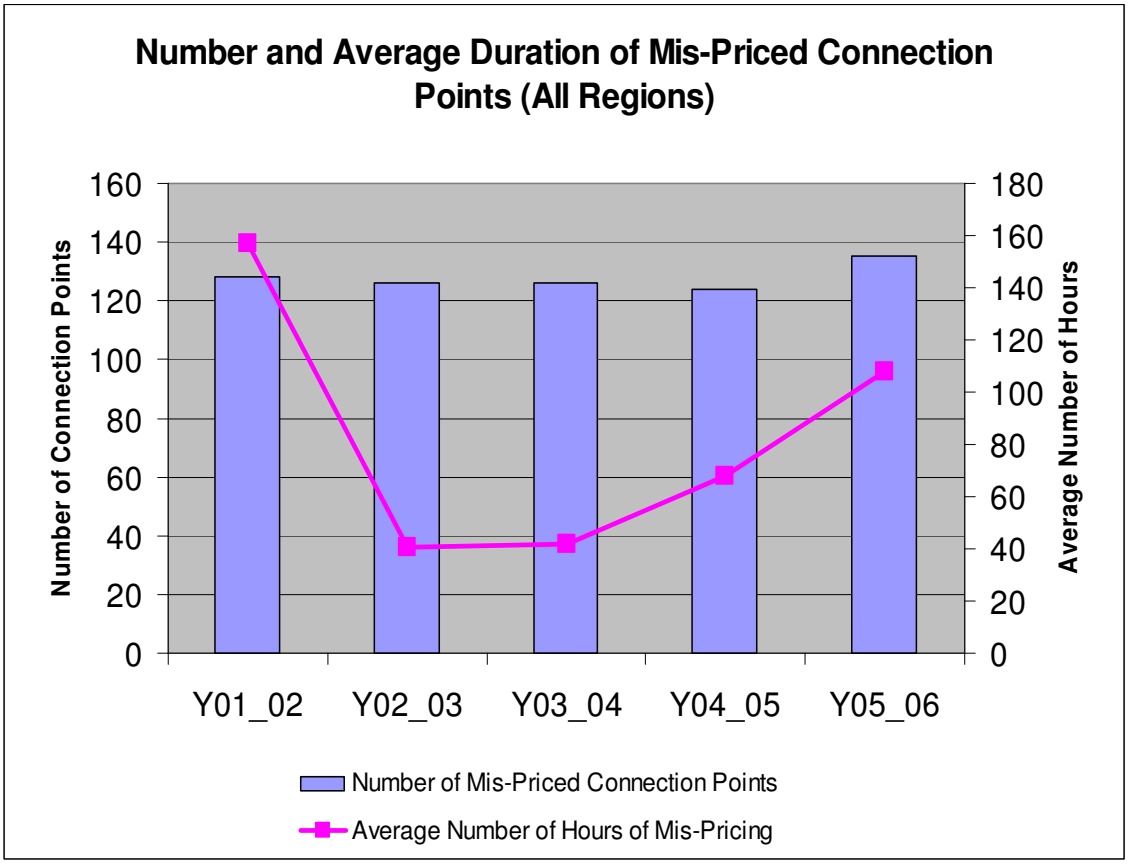

Figure 1

Figure 1 shows that there is very little variation in the number of mis-priced nodes during the study period. There is a variation in the average time duration of mis-pricing. There is a sharp reduction in the average duration from 2001/02 to 2002/03 and gradual increase after that.

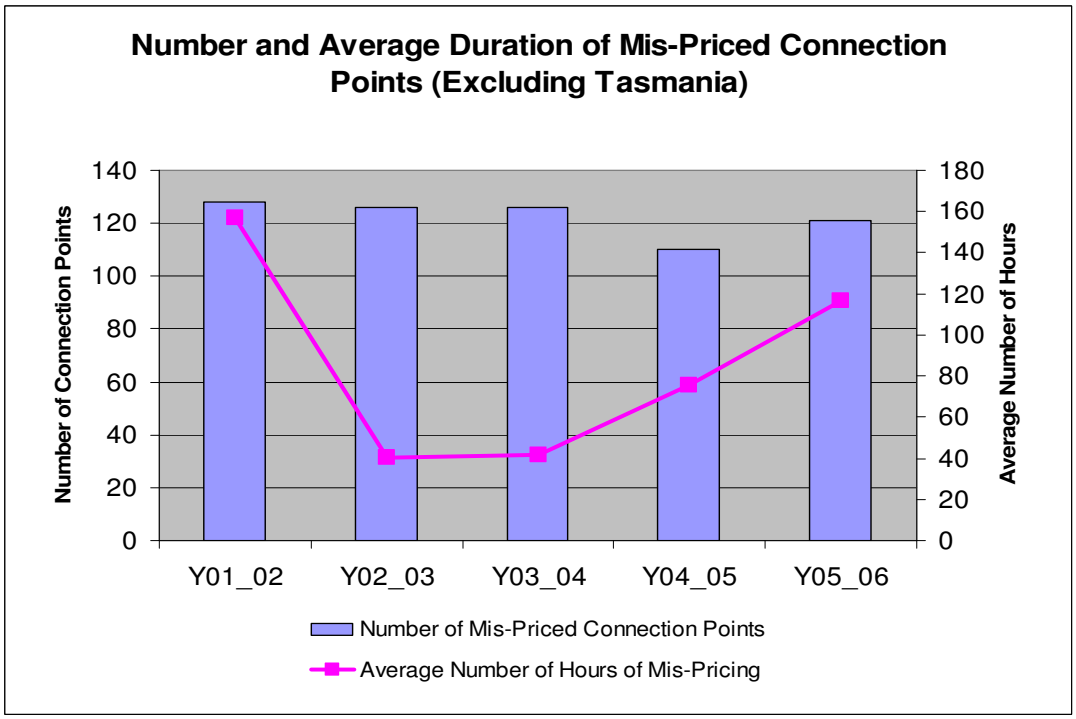

Figure 2

Figure 2 shows the results excluding Tasmania. There is a small reduction in the number of mis-priced nodes in last two years.

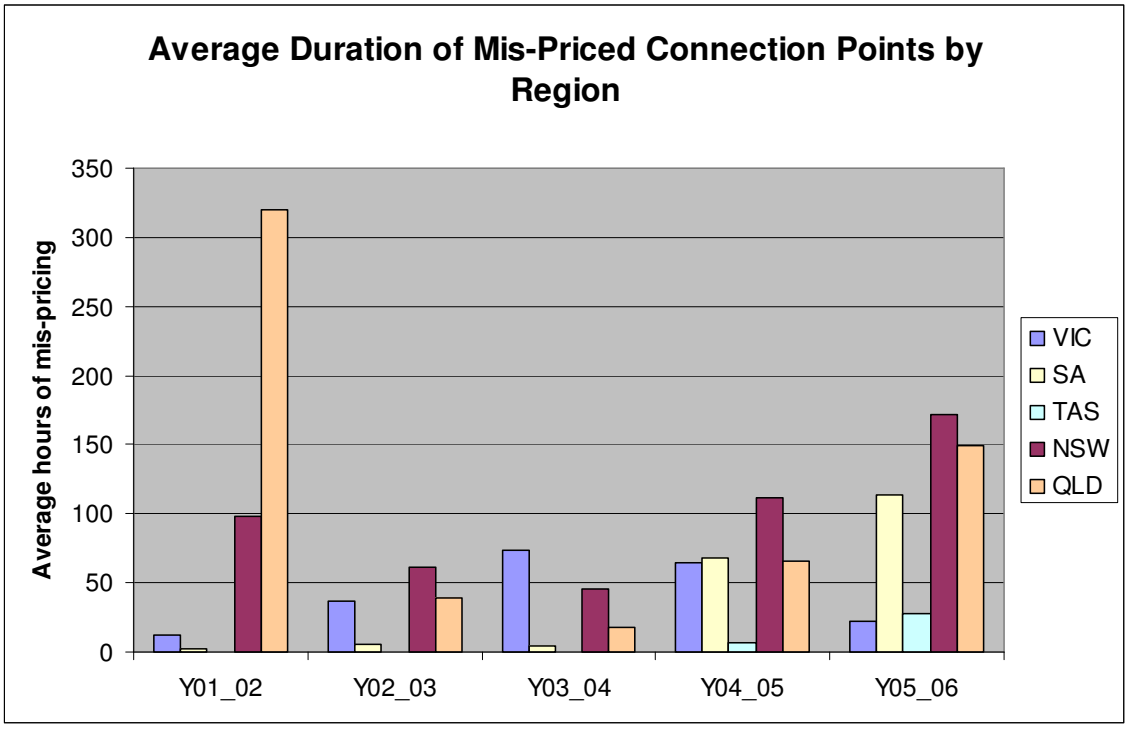

Figure 3

Figure 3 gives the breakdown of average mis-priced duration by region. Region by region analysis is given in next subsections.

Regional analysis

Victoria

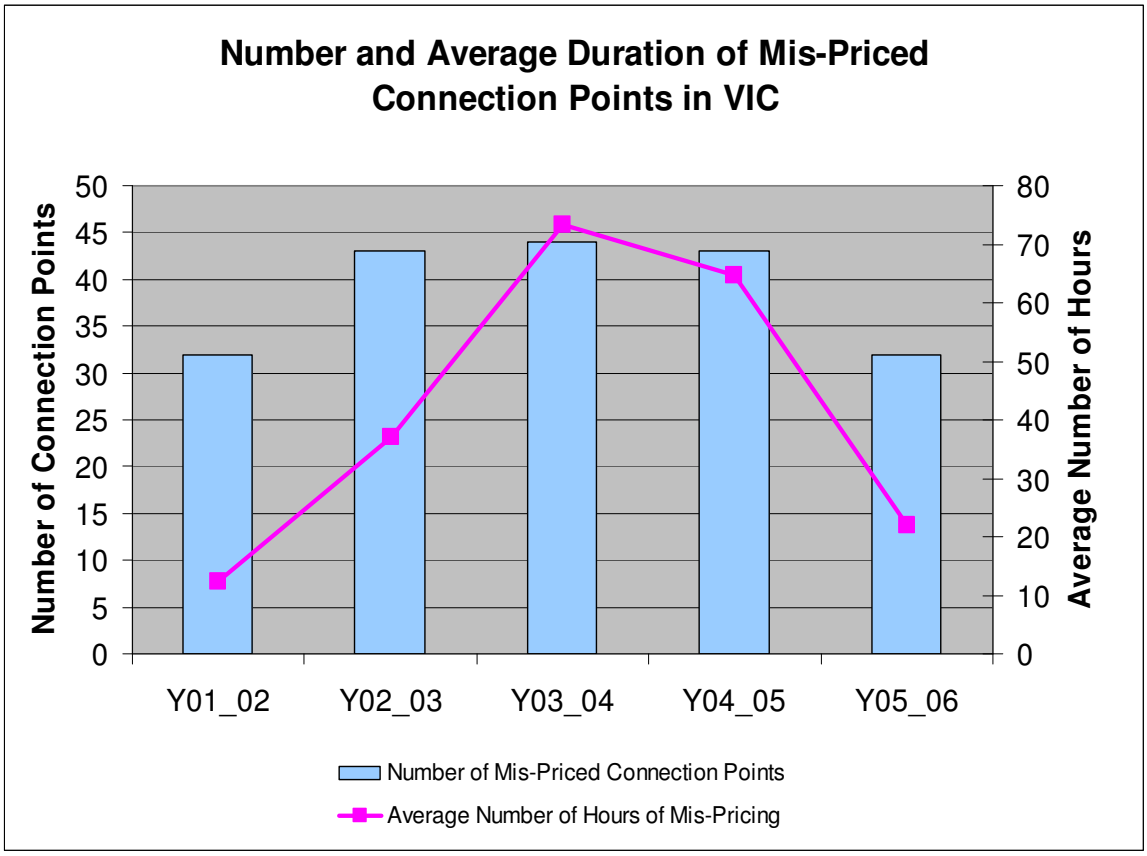

Figure 4

In Victoria the amount of mis-pricing peaked around 2003/04 year as shown in Figure 4. There is a sharp reduction in the number of mis-priced nodes and average duration.

The predominant binding constraints resulting in mis-pricing were those that manage flow across the Hazelwood Terminal Station (HWTS) 500/220 kV transformers. Between 2001/02 and 2003/04 the number of binding dispatch intervals for the V>V1NIL and V>V2NIL constraint equations, which manage flow across the HWTS No. 2, 3 and 4 transformers, increased from 178 to 1974 before reducing to 1206 in 2004/05 and 168 in 2005/06. There are a number of reasons for this variation including:

⇒ Increased output from Hazelwood power station generators 1,2,6,7 and 8 in 2002/03 and 2003/04 compared with 2001/02. Output decreased in 2004/05 and again in 2005/06. Higher outputs from these units result in increased flow across the transformers.

⇒ Yallourn W unit 1 supplied more power to the 500 kV network in 2004/05 compared with 2001/02 to 2003/04 where the power supplied remained reasonably constant. Yallourn W unit 1 supply to the 500 kV network fell again in 2005/06. Yallourn W unit 1 supply into the 500 kV network results in increased flow across the transformers.

⇒ A 638 MVA short-term rating was made available for the HWTS transformers in July 2004. Before this time a 600 MVA rating was used.

The V>V_NIL_4 constraint bound for 1100 dispatch intervals in 2005/06 but did not bind in any of the years before then. This constraint ensures the output of HWPS units 3, 4 and 5 does not exceed the 600 MVA continuous rating of the HWTS No. 1 transformer. It has only been required since the commissioning of the fourth 500 kV line between the Latrobe Valley and Melbourne metropolitan area in August 2005. Following the commissioning of this line the Hazelwood power station buses were reconfigured such that these three units are now connected to the power system radially through the No. 1 transformer. The constraint only binds when output from the units exceeds the registered capacity of the transformer.

VENCorp is planning to complete work at Hazelwood power station by December 2008 which will result in an improved bus arrangement and alleviate the HWTS transformer loading issues.

There are increasing instances of binding for constraints associated with transfer from Snowy to Victoria in 2005/06 due to higher power transfers into Victoria. It is likely that this increase is due, at least in part, to the impact of the drought on Victorian hydro generation.

The following table provides a summary of binding dispatch intervals resulting in mis-pricing based on the analysis of the top 5 constraint equations binding each financial year. The N-2 column refers to constraints binding due to the loss of more than one transmission line being declared credible.

Year	System Normal	Non conformance	NSA/Direction	N-2	Outage	Disconnected from network
01/02	205	383	0	0	172	0
02/03	953	600	0	0	0	0
03/04	1974	129	0	0	138	0
04/05	1329	0	0	0	103	0
05/06	1318	0	0	0	227	0

Table 1

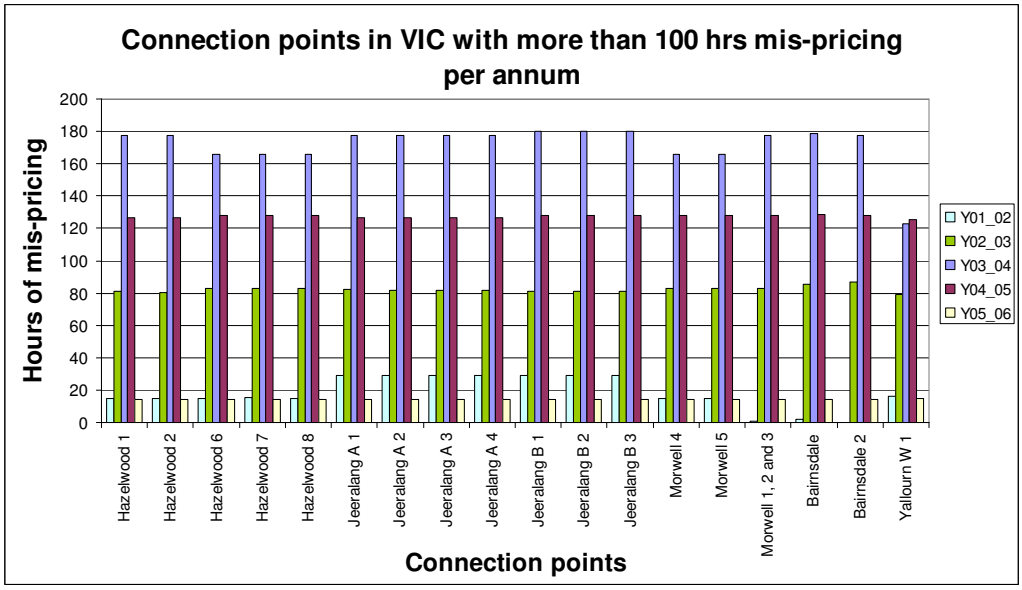

Figure 5

Figure 5 shows connection points in Victoria where the total duration of mis-pricing is more than 100 hours in at least one year in the study period.

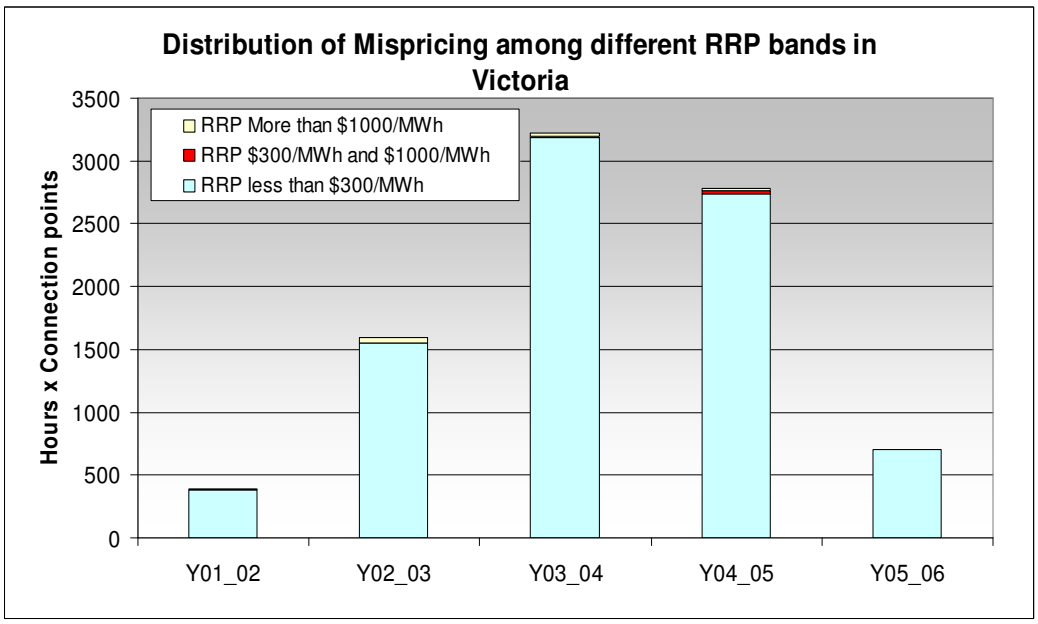

Figure 6

Figure 6 shows the mis-pricing distribution on regional reference price. Most of the mis-pricing is when the regional reference price is less than $300/MWh.

New South Wales

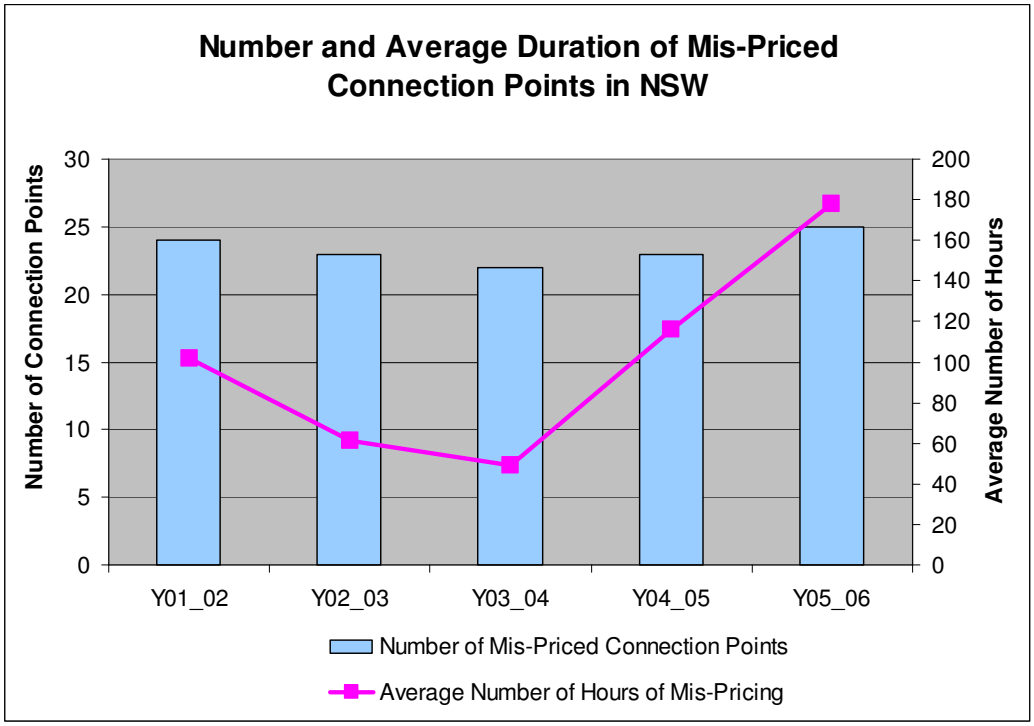

Figure 7

In NSW the amount of mis-pricing bottomed around 2003/04 year. There is a trend to increase the number of nodes and average duration of mis-pricing.

The binding dispatch intervals in the 2001/02 period were dominated by constraints managing the flow on the Vales Pt - Munmorah (23) line during system normal and outage conditions. There is some binding on this line during outages in 02/03 and 03/04 as well, but no binding from then on. Other than transmission outages one of the main influences on the binding of this constraint is the output from Munmorah power station which varied as follows (average output over year):

01/02	02/03	03/04	04/05	05/06
8 MW	58 MW	33 MW	106 MW	174 MW

Table 2

The higher the output from Munmorah the less power would flow across the 23 line and the less likely it would be to bind. The 23 line sustained emergency rating also increased in late 2004 from 1370 MVA to 1429 MVA which would have contributed to a reduction in binding instances.

Between 2003/04 and 2005/06 constraints managing flow on the 82 line (and to a lesser extent the 81 line) dominated. The majority of binding dispatch intervals occurred during network outages. The main drivers in this case were increasing flow on QNI towards NSW and increasing output from Bayswater and Liddell power

stations which resulted in higher flows on these lines. The changes in flow and generator outputs are tabled below:

	2001/02	2002/03	2003/04	2004/05	2005/06
QNI	-177	-266	-438	-510	-619
Bayswater	2036	1907	2012	2050	2010
Liddell	900	877	1055	1160	1192

Table 3

Load growth in the Newcastle area also contributes to higher flows on the 81 and 82 lines.

The rating of the 82 line was increased by 170 MVA in December 2006 which acts to reduce binding instances in future. However, the commissioning of Kogan Creek power station in early to mid 2007 is likely to increase power flows south from Queensland and it is expected that the binding of constraints managing flows on the 81 and 82 lines will continue in coming years. TransGrid is planning to develop 500 kV transmission between Bayswater and Mt Piper in 2008/09 which should transfer power away from these lines and consequently reduce the incidence of constraints binding in the longer term.

The following table provides a summary of binding dispatch intervals resulting in mis-pricing based on the analysis of the top 5 constraint equations binding each financial year. The N-2 column refers to constraints binding due to the loss of more than one transmission line being declared credible.

Year	System Normal	Non conformance	NSA/Direction	N-2	Outage	Disconnected from network
01/02	544	139	0	0	516	0
02/03	172	241	0	0	372	0
03/04	36	128	0	0	502	0
04/05	500	0	0	0	1131	0
05/06	860	0	0	0	1334	0

Table 4

Constraint equation N>N-NIL_1U bound for 500 dispatch intervals in 2004/05. This constraint manages flow on the Mt Piper 330 – 132 kV (94Y) line for loss of the Mt Piper – Wallerawang (71) line. The rating of the 94Y line was increased by more than 190 MVA in mid 2005 and this equation has not bound since.

Of the top 5 constraint equations binding in 2005/06, four are fully co-optimised. Prior to July 2005 (i.e. the general introduction of the fully co-optimised formulation), a number of these equations were modeled using an option 3 constraint pair (one equation with only interconnector terms on the LHS, and the other equation with only generator terms on the LHS). It is likely that the inter-regional component of this constraint pair bound on its own during this period and this would tend to reduce the number of mis-priced binding periods.

For example the "Q>N-81__1T" and "N>N-81__1T" option 3 constraint pair was formulated to managed flow on the 82 line during outage of the 81 line (Nil trip).

This constraint pair bound for 1056 (inter-regional) plus 713 (intra-regional) dispatch intervals in 2004/05. This option 3 constraint pair was replaced on 14/07/07 by the current Option4 N>>N-81_1T equation which bound for 1168 dispatch intervals in 2005/06. Thus, the increase in mis-pricing in this case is due at least in part to the change in constraint formulation.

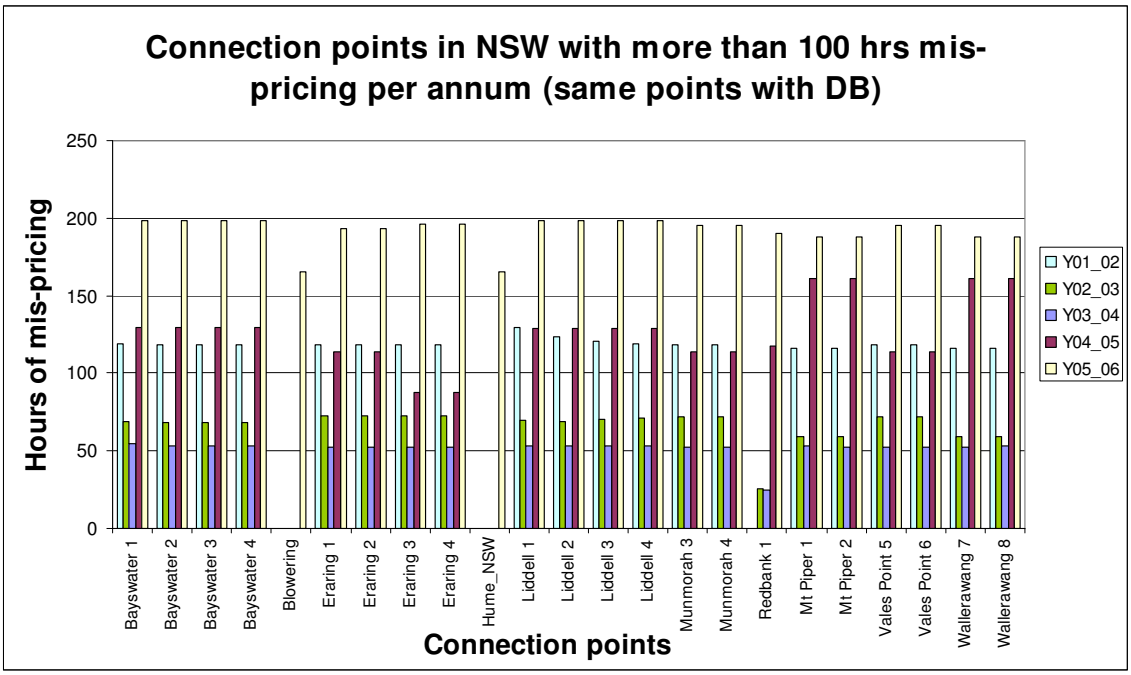

Figure 8

Figure 8 shows connection points in NSW where the total duration of mis-pricing is more than 100 hours in at least one year in the study period.

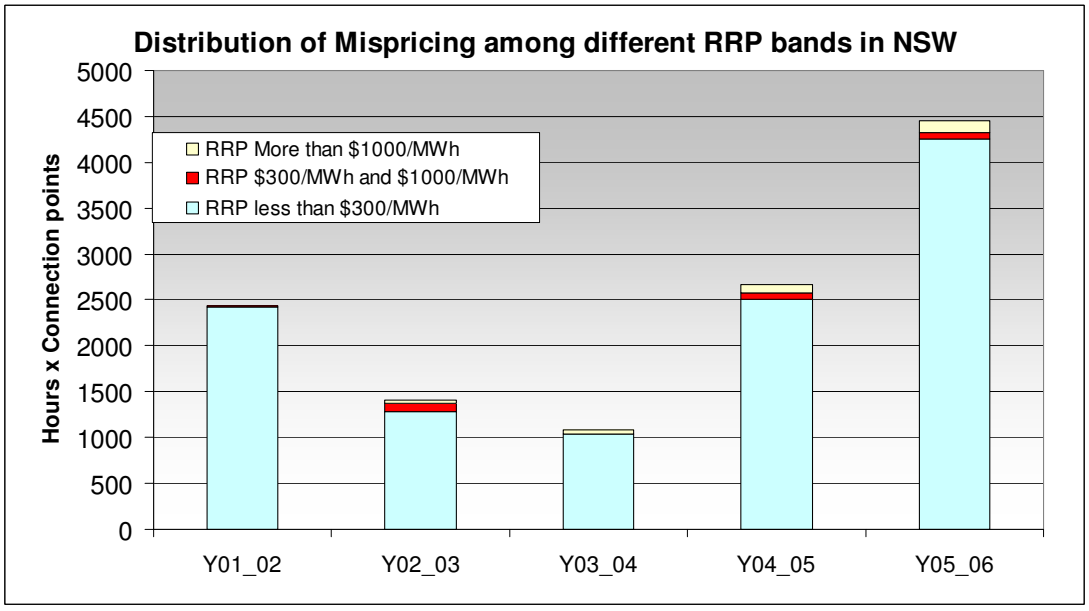

Figure 9

Figure 9 shows the mis-pricing distribution for regional reference price bands. Most of the mis-pricing is when the regional reference price is less than $300/MWh. The amount of mis-pricing at higher RRP bands increased after 2004/05.

Queensland

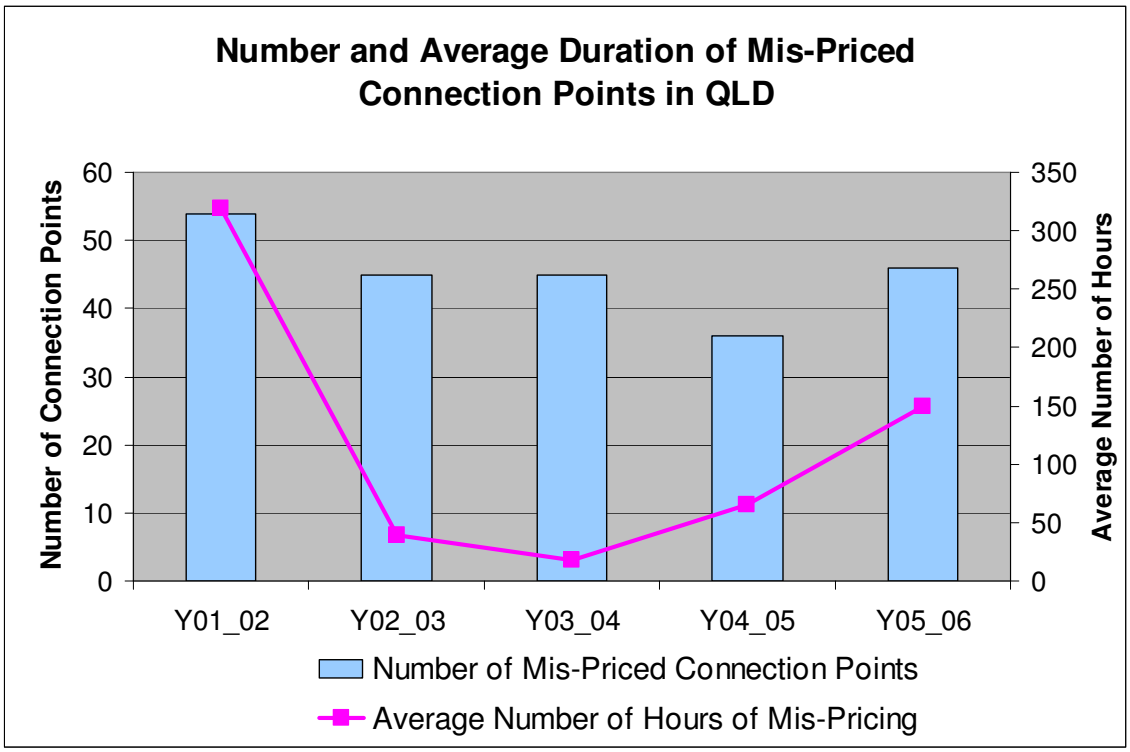

Figure 10

In Queensland the amount of mis-pricing bottomed around 2003/04 year. There is a moderate increase in the average duration after that.

The majority of binding constraints in Queensland between 2001/02 and 2005/06 were associated with managing flows from central to north Queensland and from central to south Queensland.

In 2001/02 most of the binding instances were due to generating units being constrained on under NSA or direction to manage the central to north Queensland flow or the Ross limit in the far north. In January 2002 an improved constraint formulation was implemented to provide a more efficient way to manage the loading of gas turbines in north Queensland under network support agreements. This significantly reduced the number of quick constraints(constraints prefixed with the hash # symbol in the constraint identifier) binding in ensuing years. A large number of binding instances were also associated with managing voltage and stability limits for flows between central, north and far north Queensland. The limit for flows from central to north Queensland was increased from 780 MW to 800 MW in late 2001. An 1800 MW limit on flows from central to south Queensland bound for 1030 dispatch intervals during the financial year.

In 2002/03 there were still a number of binding instances due to gas turbines in north Queensland being constrained on for network support agreements or by direction for system security. However, the number was approximately a quarter that observed in 2001/02. In February 2003 the limit for flows from central to north Queensland was

changed from an 800 MW static limit to a dynamic limit ranging from 925 MW to 985 MW and the instances of binding for flows from central to north Queensland consequently reduced.

In 2003/04 the overall number of binding constraints was significantly less than observed in the previous two years. This trend changed in 2004/05 with a significant increase in binding dispatch intervals. As with previous years the majority of mis-pricing instances were associated with managing flows between central, north and far north Queensland.

In 2005/06 the majority of binding dispatch intervals was associated with flows from central to south Queensland during system normal and network outage conditions. There were less than 100 dispatch intervals associated with the binding of constraints used to constrain on generation under network support agreements or by direction to manage flows between central and north Queensland.

The following table provides a summary of binding dispatch intervals resulting in mis-pricing based on the analysis of the top 5 constraint equations binding each financial year. The N-2 column refers to constraints binding due to the loss of more than one transmission line being declared credible.

Year	System Normal	Non conformance	NSA/Direction	N-2	Outage	Disconnected from network
01/02	8670	0	10242	0	0	0
02/03	192	0	2613	0	0	0
03/04	110	0	187	0	272	163
04/05	1097	0	853	0	0	1559
05/06	1002	0	0	283	1649	0

Table 5

There were several major augmentation projects in North Queensland over the period of investigation which enabled limits between central and north Queensland to be increased including the establishment of Strathmore and Woree substations, and installation of SVCs at Ross and Woree. These projects would have contributed to the reduction in network support agreement and direction constraints.

There was also an extended period when the Nebo SVC was out of service for repair between February 2003 and October 2003. This would have reduced the central to north Queensland limit thereby increasing the likelihood that network support agreement or direction constraints would have been required during this period.

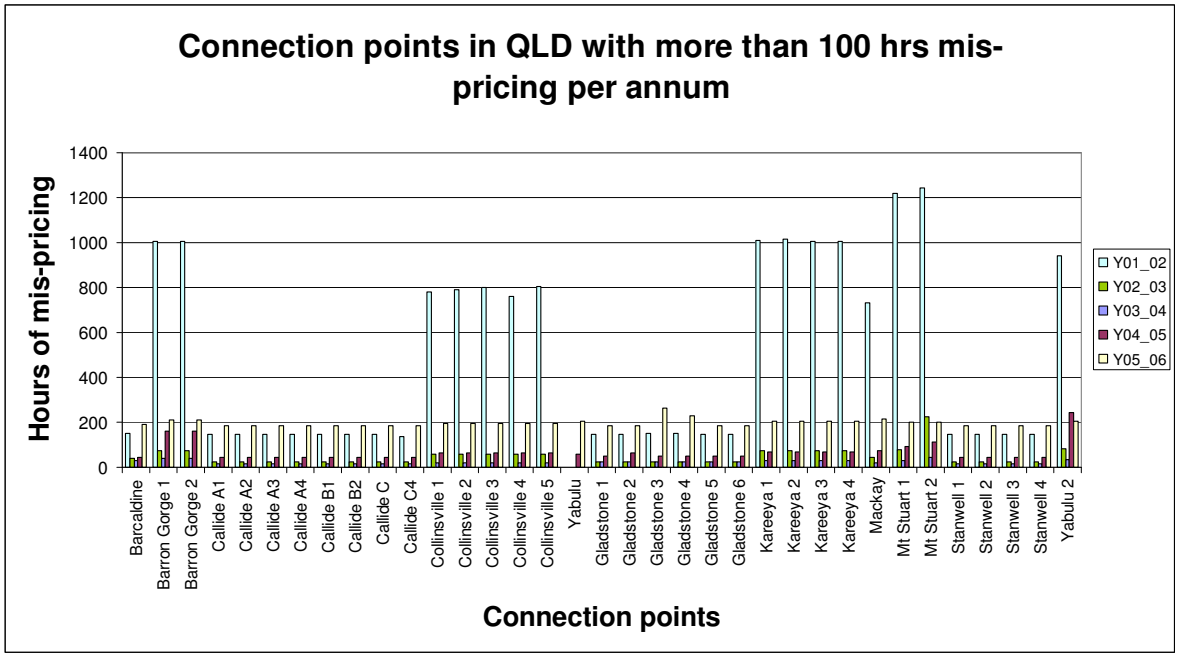

Figure 11

Figure 11 shows connection points in Queensland where the total duration of mis-pricing is more than 100 hours in at least one year in the study period.

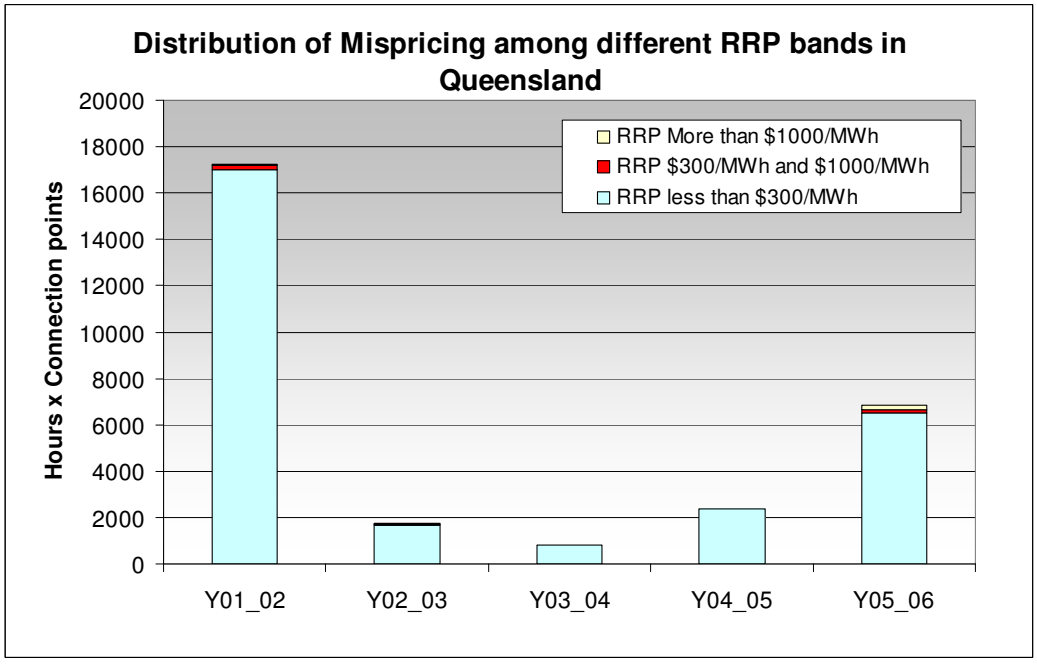

Figure 12

Figure 12 shows the mis-pricing distribution on regional reference price. Most of the mis-pricing is when the regional reference price is less than $300/MWh.

South Australia

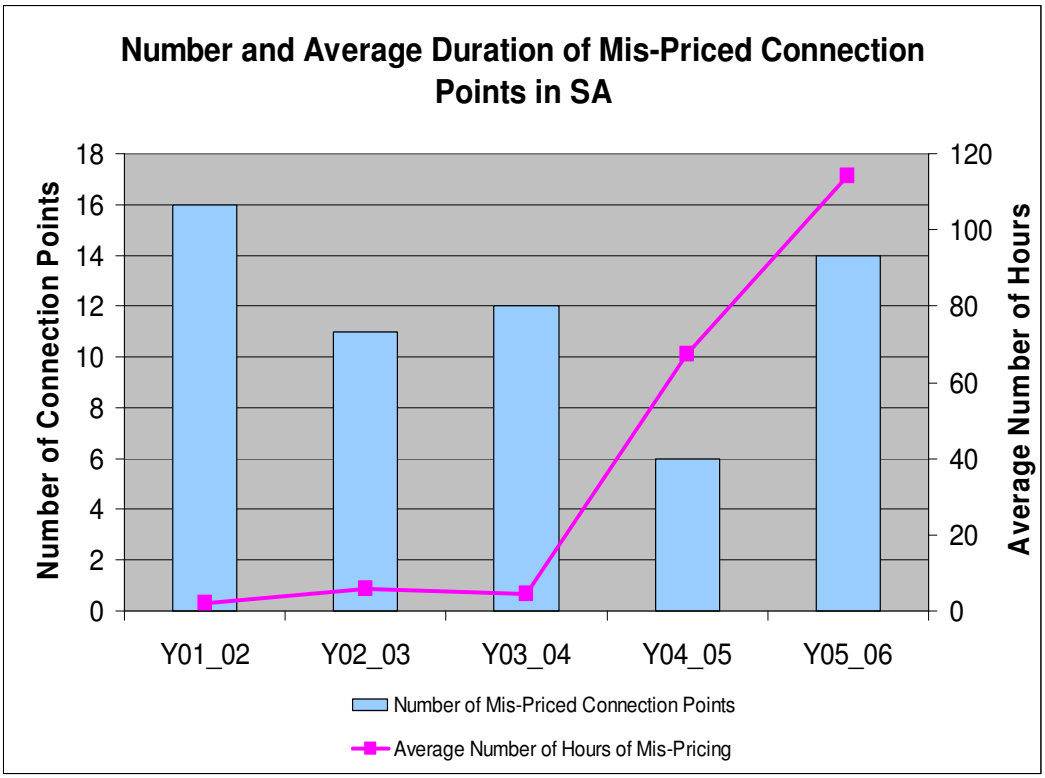

Figure 13

There were less incidences of mis-pricing in the initial years because many of the SA constraints were formulated as option 8 constraints (interconnector terms only on the LHS).

The increase in mis-pricing in 2004/05 was due primarily to a significant increase in NSA/Direction constraints binding on the Snuggery and Port Lincoln units to manage line loading. The number of instances of Snuggery generation being constrained on dropped considerably in 2005/06, due to the adoption of a higher 15-min rating on the Keith – Snuggery line in December 2004 and reduction in line flows due to increasing generation from the Lake Bonney and Canunda wind farms. Constraining on Port Lincoln through NSA/Direction also reduced in 2005/06, probably due to output from the Cathedral Rocks wind farm, which commenced generation in June 2005.

SA constraint equations were progressively converted to fully co-optimised formulations (generator and interconnector terms on the left hand side) commencing July 2005. Combined with this work ElectraNet SA also updated a number of limit equations to include the impact of the Lake Bonney and Canunda wind farms. The revised formulations and increased output from the wind farms resulted in the system normal transient stability equation producing a much lower limit than had previously been the case. The V::S_NIL constraint equation consequently bound for 4700 dispatch intervals in 2005/06. A number of other equations that had been converted to fully co-optimised formulations continued to bind for a similar number of dispatch intervals as in previous years. However, because of the conversion to fully co-

optimised formulations these binding dispatch intervals began to contribute to the incidences of mis-pricing resulting in the significant increase in 2005/06 compared to 2004/05.

The following table provides a summary of binding dispatch intervals resulting in mis-pricing based on the analysis of the top 5 constraint equations binding each financial year. The N-2 column refers to constraints binding due to the loss of more than one transmission line or the loss of Pelican Point PS being declared credible. Most of the N-2 binding instances are due to the latter condition.

Year	System Normal	Non conformance	NSA/Direction	N-2	Outage	Disconnected from network
01/02	0	183	0	0	0	72
02/03	0	0	131	464	0	0
03/04	0	0	94	169	183	141
04/05	0	0	2194	0	0	1409
05/06	5511	0	0	0	1804	0

Table 6

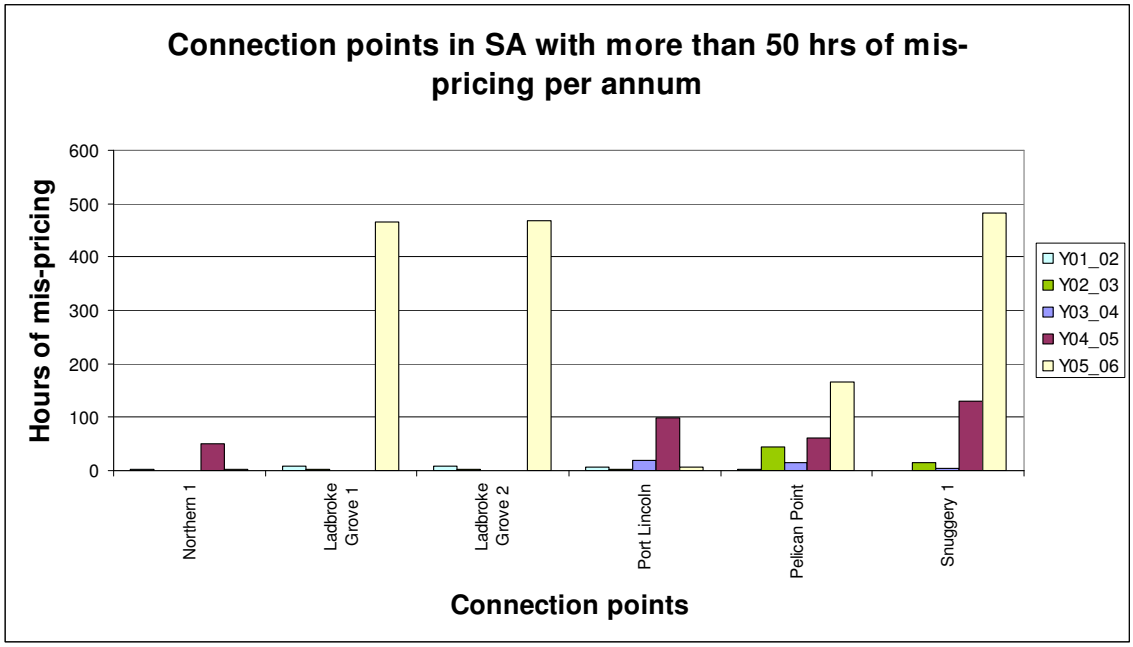

Figure 14

Figure 14 shows connection points in SA where the total duration of mis-pricing is more than 50 hours in at least one year in the study period.

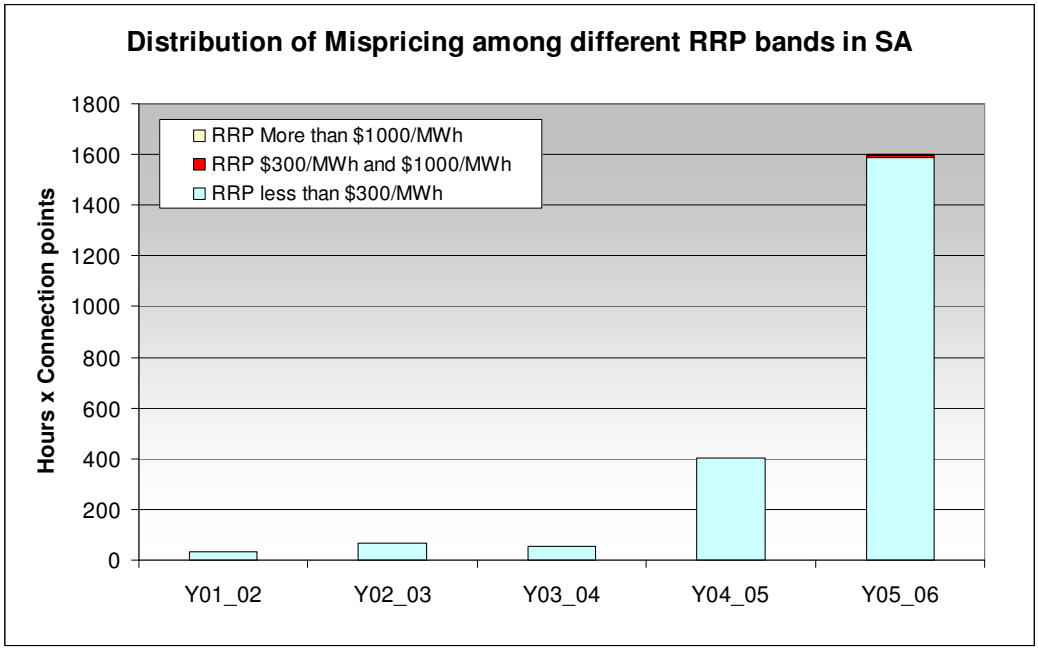

Figure 15

Figure 15 shows the mis-pricing distribution on regional reference price. Most of the mis-pricing is when the regional reference price is less than $300/MWh.

Snowy

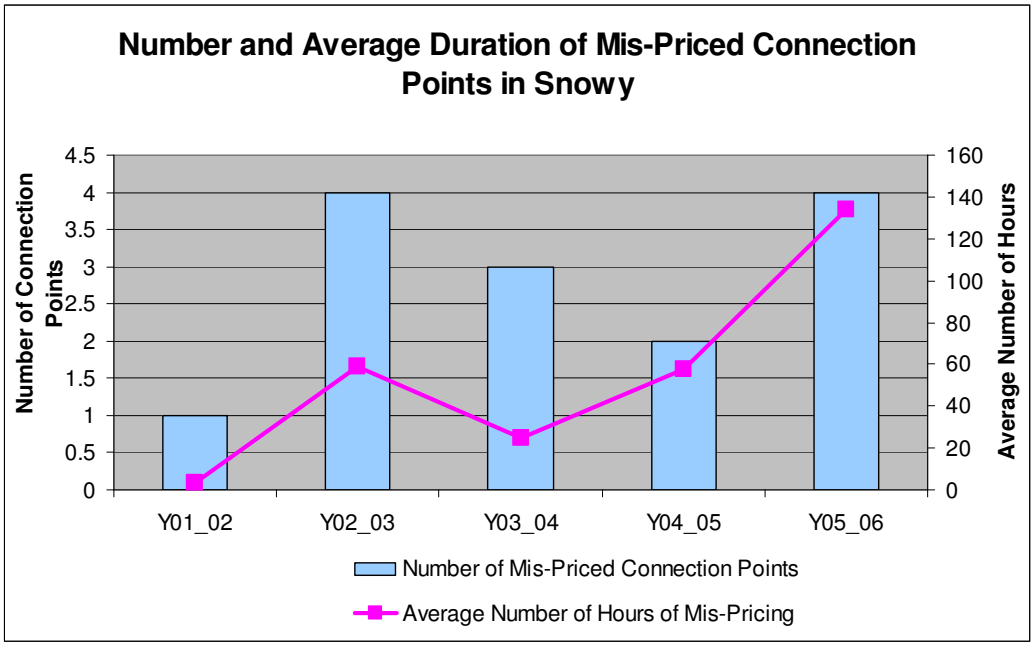

Figure 16

In Snowy region the amount of mis-pricing increased moderately from 2003/04.

There were only a few mis-pricing instances in the Snowy region in 2001/02. In June 2002 the Snowy transmission assets were transferred to TransGrid. In November 2002 the 15 minute ratings for the Murray – Tumut lines were withdrawn resulting in a reduction in rating of up to 160 MVA. It is likely that this reduction contributed to the increase in binding dispatch intervals observed in 2002/03.

The constraint equations managing the Murray – Tumut line flows were formulated as option 1 types (generator terms only on the left hand side). Because these line flows are also strongly influenced by the Victoria – Snowy and Snowy – NSW interconnector flows this formulation did not provide sufficient control to maintain adequate system security. On-line staff was therefore required to invoke discretionary constraints to reduce Murray and/or Tumut power station outputs below that indicated by the constraint equations.

The lower ratings remained in place until July 2003 when 15 minute ratings were restored. However, the requirement to place discretionary constraints on the Murray and Tumut generators to maintain security continued until November 2003 when all of the Snowy constraint equations were converted to fully co-optimised formulations.

The number of binding dispatch intervals remained relatively static between 2003/04 and 2004/05.

The CSP/CSC trial commenced in October 2005. Although there is an increase in mis-pricing in the 2005/06 period the market settlement impact was mitigated by the CSP/CSC financial arrangements.

The following table provides a summary of binding dispatch intervals resulting in mis-pricing based on the analysis of the top 5 constraint equations binding each financial year. The N-2 column refers to constraints binding due to the loss of more than one transmission line being declared credible.

Year	System Normal	Non conformance	NSA/Direction	N-2	Outage	Disconnected from network
01/02	0	0	0	0	41	0
02/03	2043	0	0	0	0	0
03/04	586	0	0	0	0	0
04/05	646	0	0	0	0	0
05/06	1912	0	0	0	0	0

Table 7

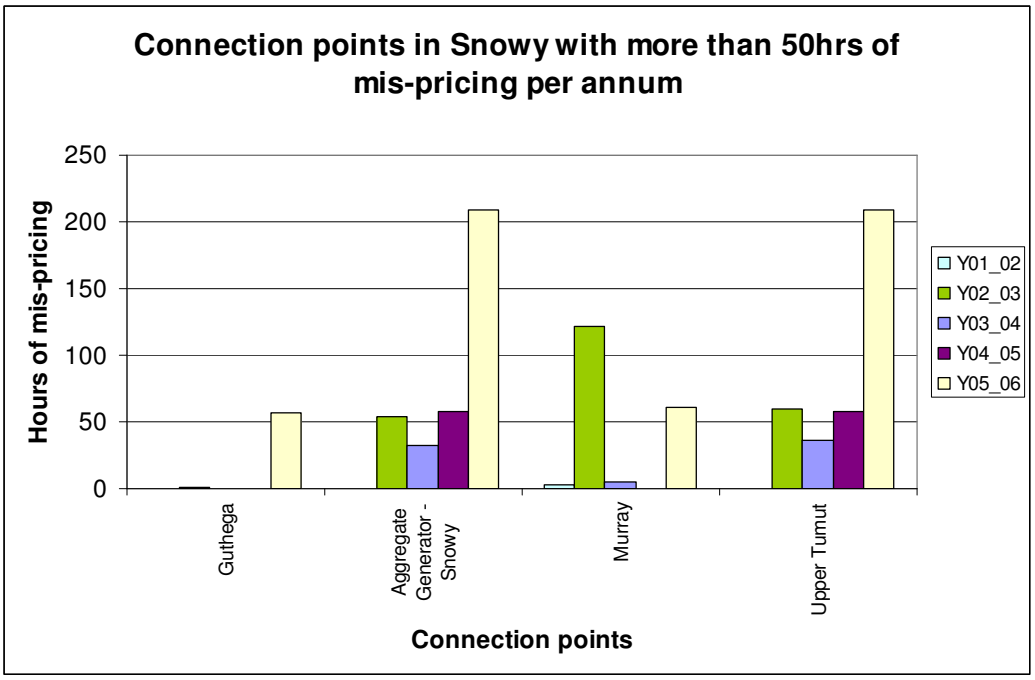

Figure 17

Figure 17 shows connection points in Snowy where the total duration of mis-pricing is more than 50 hours in at least one year in the study period.

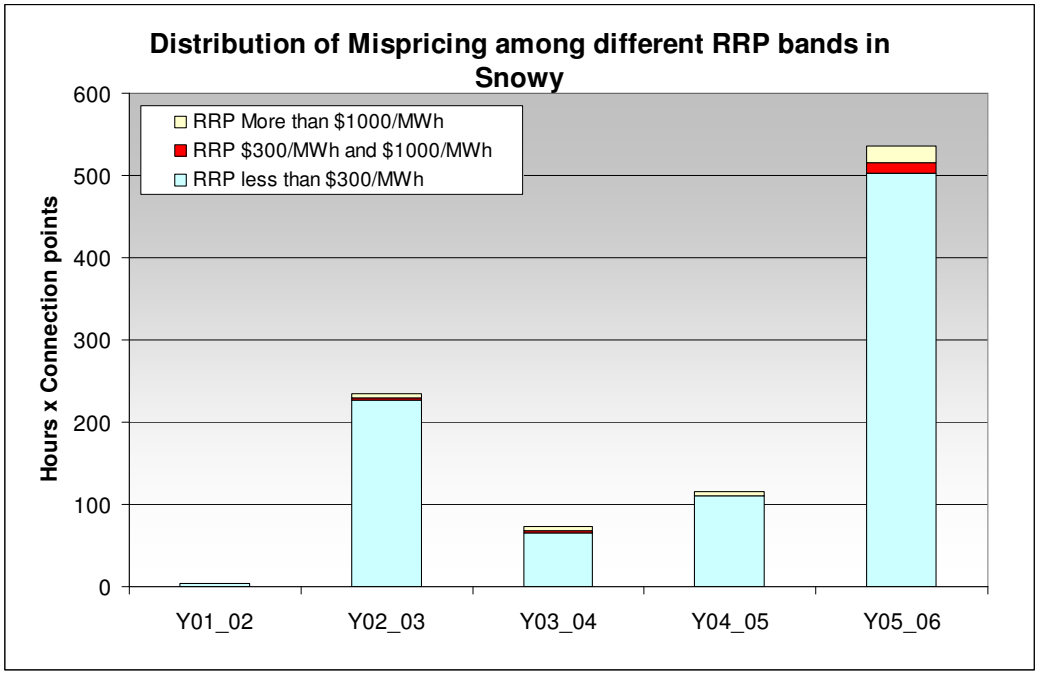

Figure 18

Figure 18 shows the mis-pricing distribution on regional reference price. Most of the mis-pricing is when the regional reference price is less than $300/MWh.

Tasmania

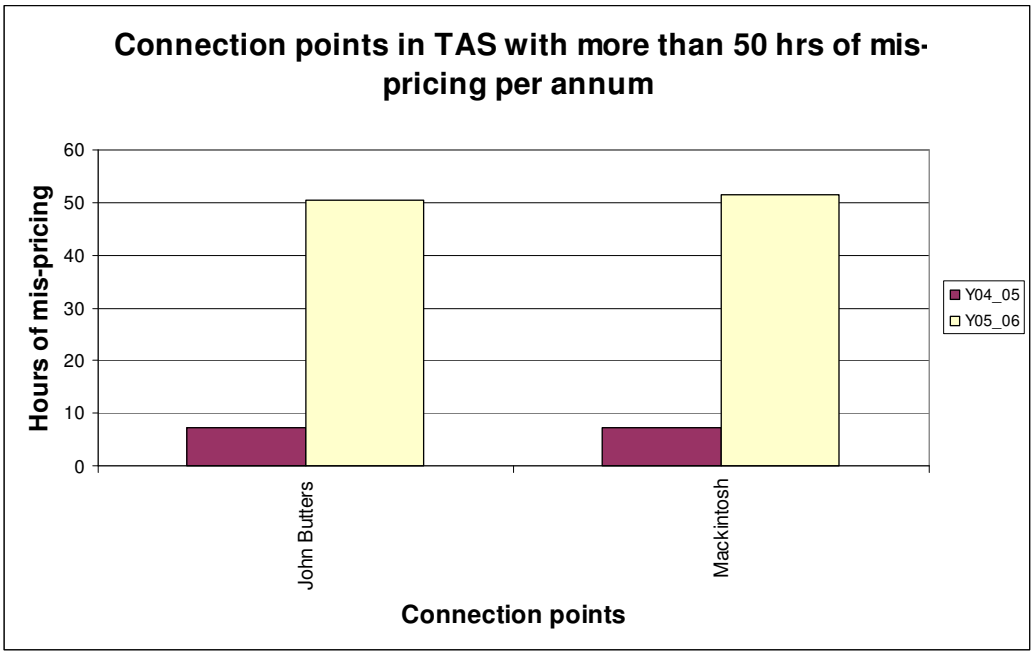

Figure 19

Figure 19 shows connection points in Tasmania where the total duration of mis-pricing is more than 50 hours in at least one year in the study period.

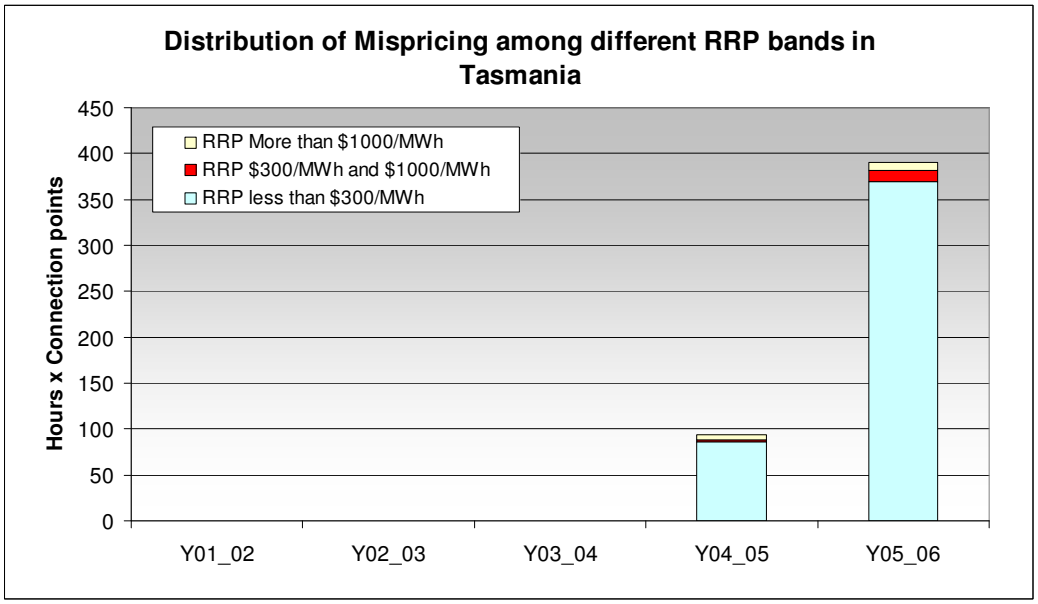

Figure 20

Figure 20 shows the mis-pricing distribution on regional reference price. Most of the mis-pricing is when the regional reference price is less than $300/MWh.

It is not possible to infer trends from the instances of mis-pricing associated with Tasmania because:

⇒ Tasmania did not join the NEM until May 2005;

⇒ Basslink did not commence transferring power until November 2005; and

⇒ Basslink did not enter commercial operation until late April 2006.

The following table provides a summary of binding dispatch intervals resulting in mis-pricing based on the analysis of the top 5 constraint equations binding each financial year. The N-2 column refers to constraints binding due to the loss of more than one transmission line being declared credible.

Year	System Normal	Non conformance	NSA/Direction	N-2	Outage	Disconnected from network
04/05	451	0	0	0	147	0
05/06	487	0	22	0	203	129

Table 8

Impact of planned transmission outages

A limited sample study for 2005/06 showed that majority of the mis-pricing was due to binding constraints applied to manage transmission outages, as distinct from those applying with system normal conditions. The amount of mis-pricing is not directly related to the number of constraints binding since the number of constrained generators per constraint is not fixed. More detailed analysis is required to identify details of such impact.

Possible extension of this analysis

The results published in this report are from an initial review to analyse Dr Biggar's findings. This analysis can be extended to find other trends on constraining on/off generators. They include:

- **Analysis on the materiality of mis-pricing**: This is to quantify mis-pricing as the difference in the prices or the financial amount by applying it to the amount of constrained generation. This type of study will be based on several assumptions of price capping and the marginal impact on constraints. It would have to assume no change in the participant behaviour.
- **Analysis of the impact of planned transmission outages on mis-pricing**: This is to identify the mis-pricing directly due to transmission outages.
- **Analysis of the distribution of positive and negative mis-pricing**: The analysis is to identify and quantify the instances of constrained on and constrained off generation.

Conclusions

This study confirmed the finding that there is an increasing trend of mis-pricing from 2003/04 for the regions NSW, QLD and SA. The Victorian region showed a decreasing trend.

There are some generic causes which may have contributed to the increased mis-pricing throughout the NEM. An increase in system demand would have contributed to an increase in congestion. The progressive conversion of option 8 (interconnector terms only on the LHS) constraints to a fully co-optimised formulation from July 2005 onwards would also have contributed to the increase in incidence of mis-pricing, while providing better control of the power system.

A region by region analysis of mis-pricing was able to identify region-specific issues which contributed to trends in mis-pricing as summarised below.

Victoria:

- Changes in generation output especially in Hazelwood Power Station
- Generators switching output from the 220kV network to the 500 kV network (Yallourn W unit 1)
- The use of higher short-term rating for Hazelwood Transmission Station transformers from July 2004
- Commissioning of the fourth 500kV transmission line between Latrobe Valley and Melbourne metropolitan area in August 2005
- The impact of drought on Victorian hydro generators

New South Wales

- Multi-day network outages for work to provide long term capacity improvements
- Increase in flow through QNI interconnector from Queensland
- Increase in output from Bayswater and Liddell power stations
- Increase in load in Newcastle area
- Change in constraint formulation to apply single constraint with both generator and interconnector terms instead of a constraint pair for generators and interconnectors separately

Queensland:

- Directions and NSA to manage system conditions in 2001/02
- Increase in voltage stability limit flows from central to north Queensland in late 2001
- Application of dynamic voltage stability limit flows from central to north Queensland in February 2003
- System outages

South Australia:

- The change in constraint formulation from interconnector only constraints to fully co-optimised constraints

- The adoption of higher 15 minute rating for the Keith-Snuggery line in December 2004
- An increase in generation from Lake Bonney and Canunda wind-farms
- A reduction in the Victoria to South Australia transient stability limit. (The increase in wind-farm outputs is one of the probable causes)

Snowy

- The removal of 15 minute rating for Murray-Tumut lines in early 2002 reduced the line limit. This rating was restored in mid 2002.
- The use of discretionary constraints to manage Murray and Tumut generation before fully-cooptimised constraints were adopted.

As discussed above most of these reasons are specific to the region and the situation at the time. They are incremental and once-only in character, rather than continuous and on-going for more than one or two years. Therefore it is not possible to comment on whether the apparent mis-pricing trends identified in the Dr. Biggar's paper will continue in the future.

Appendix 1: Base data for distribution of mis-pricing among regional reference price bands

Region	Regional reference price bands	Connection points x Hours				
		Y01_02	Y02_03	Y03_04	Y04_05	Y05_06
NSW1	RRP < $300/MWh	2419.58	1285.08	1031.94	2501.83	4257.87
	$300/MWh ≤RRP≤ $1000/MWh	13.57	85.73	9.3	72.84	63
	RRP > $1000/MWh	3.4	36.32	38.5	91.38	131.81
QLD1	RRP < $300/MWh	16984.29	1660.86	789.41	2363.42	6497.49
	$300/MWh ≤RRP≤ $1000/MWh	201.96	30.26	3.6	3.22	146.74
	RRP > $1000/MWh	75.48	86.88	17.91	3.39	212.38
SA1	RRP < $300/MWh	34.16	65.57	52.59	404.42	1588.15
	$300/MWh ≤RRP≤ $1000/MWh	0	0	0.59	0.16	7.68
	RRP > $1000/MWh	0.08	0.25	0.33	0.24	3.24
SNOWY1	RRP < $300/MWh	3.42	226.34	65.16	110.34	502.26
	$300/MWh ≤RRP≤ $1000/MWh	0	3.58	2.51	0	13.18
	RRP > $1000/MWh	0	5.26	6.01	4.66	20.84
TAS1	RRP < $300/MWh	0	0	0	86.5	369.99
	$300/MWh ≤RRP≤ $1000/MWh	0	0	0	1.75	11.23
	RRP > $1000/MWh	0	0	0	5.35	9.4
VIC1	RRP < $300/MWh	377.34	1549.25	3185.86	2737.31	697.98
	$300/MWh ≤RRP≤ $1000/MWh	1.83	5.21	12.17	23.94	2
	RRP > $1000/MWh	12.81	38.44	28.39	22.5	0.83