

# The parlous investment environment for Australian electricity generation and transmission

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## Introduction

The 1990s delivered a decade of structural change, with astonishing rapidity, to electricity sectors around the world. Australia's electricity restructuring has been hailed by the International Energy Agency (IEA) as a role model against which other countries should benchmark their own progress. A core feature of this restructuring has been to place far greater reliance on the market to determine pricing and investment outcomes. This article explores the prospects for market provision of sufficient investment to provide the generation and transmission capacity needed to meet forecast electricity demand.

## Today's electricity sector

The Australian electricity sector which existed in the early 1990s is unrecognisable today. Mimicking the changes initiated by the England-Wales sector and subsequently adopted by other international electricity sectors, the functions of generation and retail are exposed to competition and the natural monopoly functions of transmission and distribution are regulated to support competition. Electricity companies have generally become single function operations although, like elsewhere internationally, there is increasing re-integration of generation and retail activities. The vast majority of electricity generated and consumed in Australia is traded through the mandatory wholesale National Electricity Market (NEM) which commenced in late 1998.<sup>1</sup>

Thirty-four government electricity companies existed in 1990. By December 2007, the NEM had 126 registered participants compared to 77 when the market commenced some nine years earlier (NEMMCO, 1999, 2007b). However, the sector is dominated by government-owned companies de-integrated from former State government monopolies.

Across the NEM, private ownership currently accounts for around 30% of generation and transmission capacities respectively, 52% of services to distribution customers and more than 60% of services to retail customers (Chester, 2007). Offshore transnationals dominate private ownership just like other electricity sectors around the world and ownership changes are an ongoing feature.<sup>2</sup>

Retail competition has been progressively introduced, regulation has been increasingly transferred from State governments to Federal authorities and, like the UK and European Union, the regulation of electricity and gas is being merged.

Two features of today's Australian electricity sector, however, make it stand apart from its international counterparts. It is the only electricity sector to introduce and

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maintain a mandatory wholesale market.<sup>3</sup> Secondly, there has been no change to the key policy instruments used to transform the sector such as de-integration, privatisation, the creation of a mandatory wholesale market, retail competition, and regulation of transmission and distribution.

### **The current state of generation capacity**

Since 1990-91, when electricity restructuring was first mooted in Australia, total electricity consumption has increased by more than 50% and is forecast to grow by more than 60% from 2006 to 2030. A similar increase in generation capacity is needed to meet this expected growth (ESAA, 2003, 2007; Syed, Wilson et al, 2007).

Different types of electricity demand are growing at different rates. Peak demand, defined as periods of very high or very low temperatures resulting in the use of air-conditioning or heating, is growing at a much faster rate than average demand, the level of demand which occurs most of the time.<sup>4</sup> For example, 10% of the State of New South Wales' (NSW) generating capacity is being used for only 1% (or 87 hours) of total demand each year (NSW Government, 2004: 10). Consequently, the additional generation capacity needed to meet forecast demand needs to comprise both base-load and peaking plant capacity.

The NEM's operator, the National Electricity Market Management Company (NEMMCO), each year releases 10-year projections of the adequacy of generation plants and transmission networks to meet projected demand. The most recent projections, assuming a scenario of extreme temperature conditions, indicate a high probability of electricity supply interruptions for the State of Queensland by the summer of 2009-10, and a similar situation the following summer in Victoria and South Australia followed by NSW in 2013-14 if there is no additional generation capacity to that already committed (NEMMCO, 2007a).<sup>5</sup>

Installed generation capacity across Australia is nearly 45,000 MW - of which 91% was within the NEM - and IPPs provided a further 5,170MW of capacity (ESAA, 2007). The three eastern states of NSW, Queensland and Victoria collectively account for 85% of the NEM's capacity.

Installed capacity within the NEM has increased by 14% (5,113MW) since the mandatory wholesale market's commencement in 1998, but 98% of this increase occurred during 1998-2002. Moreover, nearly two-thirds of this increase was in Queensland with a further 22% in South Australia. Peaking plants dominated the increase, with additional base-load capacity essentially being minor augmentation to existing plants (ESAA, 2003; IEA, 2003). Coal provides about 80% of the fuel used to generate Australian electricity although gas-fuelled generation has dominated additions to capacity in recent years.

Table 1 shows intended and actual new NEM generation capacity for each year from 2000 to 2006. It is immediately apparent that only a small proportion of that proposed has reached construction stage. The lead times between construction and commissioning are also readily apparent.

The vast majority of generation capacity currently under construction is expected to be commissioned by 2008-09. At least 60% of this addition will be peaking capacity fuelled by gas and renewables. The remainder is base-load Queensland capacity fuelled by coal.

**Table 1 : Intended and actual new NEM generation capacity, 2000 to 2006 (MW) <sup>6</sup>**

Year of estimate	Intended new generation capacity			Actual increase in capacity
	Proposed	Planned	Under Construction	
2000	3,620	3,041	2,638	321
2001	6,086	455	1,708	1,083
2002	3,646	3,111	110	2,481
2003	5,368	2,210	127	-177
2004	11,382	3,062	1,450	105
2005	12,187	2,239	1,575	170
2006	13,620	4,479	1,937	28

Source: ESAA (various years)

### Wholesale prices as an investment signal?

The level of wholesale prices - particularly, its volatility or spikes - is claimed to signal the need for investment in additional generation capacity (COAG Energy Market Review, 2002; NEMMCO, 2005; NSW Government, 2004; Quiggin, 2003). However, the IEA (2003) claims that investment in base-load generation capacity is being driven by long-term fundamentals rather than short-term wholesale market prices although these do provide sufficient incentive for peaking capacity investment.<sup>7</sup>

Average annual NEM prices (Table 2), with the exception of NSW, have generally shown a downward trend in each region until 2006-07. Similar trends are evident in average monthly NEM prices although a different pattern of volatility is apparent.

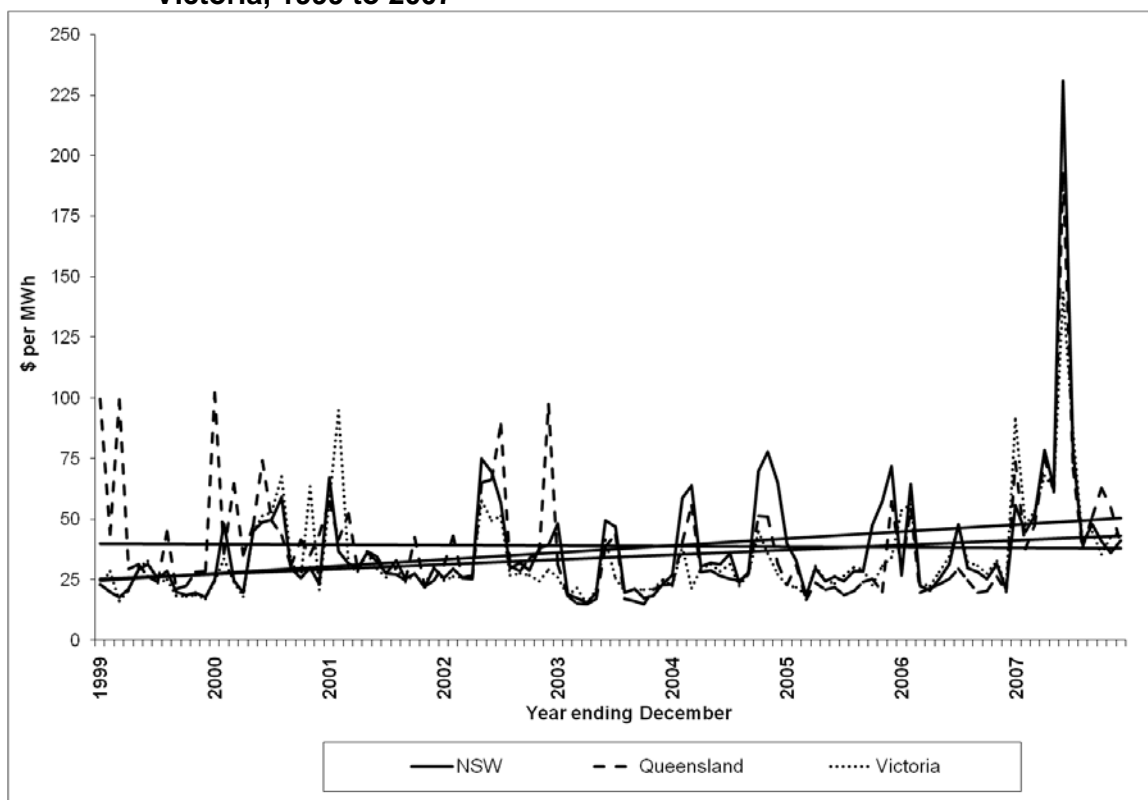
**Table 2 : Average annual NEM prices, 1998-99 to 2006-07 <sup>8</sup>**

Year ending June	\$ per MWh				
	NSW	Queensland	South Australia	Snowy Mountains	Victoria
1999 <sup>9</sup>	33.13	51.65	156.02	32.34	36.33
2000	28.27	44.11	59.27	27.96	26.35
2001	37.69	41.33	56.39	37.06	44.57
2002	34.76	35.34	31.61	31.59	30.97
2003	32.91	37.79	30.11	29.83	27.56
2004	32.37	28.18	34.86	30.80	25.38
2005	39.33	28.96	36.07	34.05	27.62
2006	37.24	28.12	37.76	31.09	32.47
2007	58.72	52.14	51.61	55.19	54.80

Source: NEMMCO (2008).

Figure 1 shows the average monthly NEM prices for NSW, Queensland and Victoria. There is clearly much more volatility than that shown by the annual averages suggesting further volatility underlying these figures given the 'smoothing' which occurs with monthly averages.<sup>10</sup>

**Figure 1 : Average monthly prices for the NEM regions of NSW, Queensland and Victoria, 1999 to 2007**



Source: NEMMCO (2008)

Price volatility within the NEM has been widely acknowledged (ABARE, 2002a; Australian Government, 2004; NSW Treasury, 2001; Productivity Commission, 2005b). The most critical aspect of this volatility is not so much its occurrence but the extent of the price spike and its duration. The Australian Government's white paper, *Securing Australia's Energy Future*, stated that NEM price spikes in 2002, while "lasting for only 3.2% of the annual duration of the market accounted for 36% of total spot market costs" (2004: 70).

Price spikes have regularly occurred at levels well below maximum demand. From the commencement of the NEM in December 1998 until 31 December 2007, there were nearly 159,000 half-hour trading intervals. During this period, there were around 7,300 trading intervals (4.6%) when the wholesale price was greater than A\$200 per MWh, but barely a quarter of these occasions have been at demand levels of 90% or more of maximum annual demand and on only *one* occasion when the maximum wholesale price paid in a given year was at the maximum annual demand level (NEMMCO, 2008). Demand has certainly not been the driver of NEM price volatility.

The number of generators in the NEM has increased considerably although a small number of companies dominate capacity in each region. Three private owners currently hold ownership interests in more than 55% of Victorian capacity and two of these owners dominate South Australian generation capacity. Government ownership accounts for at least two-thirds of total NEM generation capacity.<sup>11</sup>

It has been claimed that the generation sub-sector is able to push the NEM's prices to a level inconsistent with a competitive market by withholding capacity, either physical (for example, offline for maintenance) or economic, whereby a block of capacity is bid at a higher price band (ABARE, 2002; Booth, 2003). The cause of significant price spikes cannot be attributed to shortages of supply due to transmission congestion or capacity offline for scheduled maintenance (Booth, 2004; COAG Energy Market Review, 2002). The NEM's regulatory regime does however permit re-bidding. The significant extent to which re-bidding moves the volume of generation capacity to a higher price band (at least 50%), and the high proportion of re-bids made within one and a half hours of dispatch (40%), signals the considerable market power held by a few generation companies (Chester, 2006).

Furthermore, the majority of re-bids do not reflect the marginal cost of bringing extra capacity into production – assumed by the market's design – but a higher price to yield a more advantageous financial outcome for the generation company concerned. The long-run marginal cost (LRMCs) for new generation entrants have been estimated at A\$38.37–\$53.72 per MWh for gas plants and A\$31.06–\$35.33 per MWh for coal plants (ACIL Tasman, 2005). Annual and monthly NEM prices have predominantly averaged around the lower end of the range for gas plants. Yet, over the period 1999 to 2005, generators were able to sustain revenue – in each year except 2004 - above these estimated LRMCs even after assuming an additional average cost of A\$5MWh for hedging (Bardak Ventures, 2005).<sup>12</sup> Such a 'revenue achievement' occurred with wholesale price spikes at levels well below maximum demand. These generators were able to make substantial financial gains by exercising their market power, without breaching the bidding rules of the NEM's regulatory regime. These same generation companies have also provided substantial dividend and tax equivalent payments to their government owners each year (Chester, 2007).

Bidding practices by the NSW government-owned generator Macquarie Generation also contributed to the significant June 2007 price spikes (Figure 1). The Australian Energy Regulator (AER) found that these spikes were caused by an unprecedented congruence of record demand levels during a period of capacity shortage. Prolonged drought conditions restricted water for both cooling (Queensland) and generation (Tasmania and the Snowy region) while flooding and scheduled offline maintenance reduced NSW capacity, and transmission constraints also contributed. Macquarie Generation took advantage of these circumstances and repriced capacity into higher price bands all of which coincided with severe price spikes but did not breach the NEM's regulatory regime (AER, 2007b).

Overall, investment in generation capacity and its relationship to wholesale prices can be summarised as follows:

- The increase in NEM generating capacity to date has been concentrated in two States and dominated by peaking capacity. Only marginal additions to base-load capacity have occurred through augmentation of existing plant;
- Those States to benefit from a peaking capacity increase - South Australia and Queensland - did experience comparatively higher levels of wholesale prices in the early years of the NEM. This correlation, however, has not been sustained. The long-term upward trend in NSW prices has not stimulated private investment even in peaking capacity;
- The trend in wholesale prices is not stimulating investment in base-load capacity notwithstanding the volatility that has occurred;
- Demand has not driven wholesale price volatility; and

- NEM generation capacity is dominated by a handful of companies, the majority of which are government-owned. These companies have exercised their market power, within the NEM's bidding rules, causing wholesale prices to spike and deliver significant financial gains.

### **The storm clouds of climate change**

Divergent Federal and State government greenhouse gas abatement schemes have been criticised as unsustainable policy and a serious impediment to generation investment (ESAA, 2004; Port Jackson Partners Limited, 2005; Productivity Commission, 2005a).<sup>13</sup>

Climate change and greenhouse gas emissions have become major community concerns with an intensified political debate throughout 2007. The IEA has cited Australia as facing a unique challenge because emission intensity is very high at 1.5% of global greenhouse gas and 43% above the IEA average (IEA, 2005). Electricity generation produces around 38% of Australia's greenhouse gas emissions, coal being primarily responsible. Coal will, however, remain electricity generation's dominant fuel source for many decades given past investment in coal-fired capacity, its suitability for base-load generation, and its low cost relative to other fuels.

The previous Federal Government announced its intention to establish an emissions trading system but no targets were defined. The newly elected Federal government took immediate steps in December 2007 to ratify the Kyoto protocol and has a number of climate change policy commitments including the development of renewable energy, clean coal technology and a national emissions trading scheme. However, the Prime Minister has categorically ruled out the setting of targets to cut greenhouse gas emissions prior to the late 2008 completion of the Garnaut Climate Change Review.<sup>14</sup>

Consequently, critical considerations for new investment in electricity generation are the potential for adverse environmental impacts and the additional costs that may be incurred to meet government emission trading or other forms of abatement schemes.<sup>15</sup> Policy uncertainty, as well as the time needed to develop new commercially viable technologies, makes generation investment planning tenuous at best and adds some support to the IEA claims of base-load capacity investment being driven by long-term fundamentals rather than wholesale price movements.

### **The current state of transmission interconnections**

Regulated interconnectors - ones which have passed the regulatory test, are deemed to add value to the NEM and receive annual revenue determined by regulation regardless of usage - operate between all adjacent regions of the NEM. One interconnector, Basslink, is unregulated and generates revenue from spot price differentials between NEM regions.<sup>16</sup>

The transmission interconnections between NEM regions are shown in Table 2. Only two major interconnections have been built since 1991 - the Queensland-NSW Interconnector (QNI) in 2001 and Basslink, between Tasmania and Victoria, in 2006. Directlink and Murraylink only provided minor additions to capacity. The QNI and the two long-standing Snowy interconnectors provide the greatest transfer capacity within the NEM.

A key NEM objective is to export electricity to a region when demand cannot be met by local generators or when the price of electricity in an adjoining region is lower than local supply. For such trade to occur, high-voltage transmission lines with adequate import–export capacity need to be in place. For NSW and Victoria, import capacity is a little more than a third of their respective generation capacity whereas South Australia and Tasmania have an import capacity of around 19%, and Queensland has 4%.

**Table 2 : Transmission interconnector capacity**

Interconnector	Region	Maximum transfer capacity (MW)
QNI	Queensland to New South Wales	1080
	New South Wales to Queensland	300
Directlink	Queensland to New South Wales	180
	New South Wales to Queensland	80
SNO-NSW	Snowy Mountains to New South Wales	3000
SNO-VIC	Snowy Mountains to Victoria	1900
VIC-SA	Victoria to South Australia	460
	South Australia to Victoria	330
Murraylink	Victoria to South Australia	220
	South Australia to Victoria	150
Basslink	Tasmania to Victoria	600
	Victoria to Tasmania	480

Source: AER (2007b)

NEMMCO's scheduling of generators is thus heavily dependent on the physical transfer capacity of available interconnectors. When the technical limit of capacity is reached, local generators must be dispatched to meet outstanding local demand. This means that higher spot prices occur than would be the case without capacity constraints.<sup>17</sup> Transmission constraints contributed to the severe spike in June 2007 NEM prices.

NEMMCO has reported for some years that augmentation is required between Victoria to the Snowy Mountains, Snowy Mountains to Victoria, and Queensland and NSW (both directions) (NEMMCO, 2007a).

As a result of existing interconnector capacities, the NEM operates essentially as six regional markets, with generators and retailers largely trading intra-regionally. Reasons posited for little augmentation include: the absence of national network planning; a lengthy and uncertain approval process for new investments (for example, a proposal to connect SA and Victoria first arose in 1998, took three years for approval but is still to commence due to litigation); flaws in the current regulatory benefits test used to assess augmentation proposals; complex NEM rules and procedures; and agreements to allow unregulated transmission interconnectors which have a strong interest in maintaining NEM regional price differentials (Booth, 2003; COAG Energy Market Review, 2002; Port Jackson Partners Limited, 2005).

The AER has been given responsibility for national transmission planning as well as regulation of transmission pricing and augmentation proposals. The regulatory benefits test has been reviewed and adjusted. There is no evidence, however, of any support for an approach which combines market incentives for small transmission augmentation and incentive regulation for large augmentation projects, an approach

regarded by others as possibly the most realistic way to effectively stimulate the expansion of electricity transmission (Hogan, 2003; Rosellón, 2003). In the meantime, proposals for new investment are not materialising.

### **What are the prospects for investment in sufficient capacity to meet projected electricity demand?**

The Australian Energy Regulator recently claimed that the “NEM has generated sufficient investment capacity to keep pace with rising demand ... and to provide a ‘safety margin’ of capacity to maintain the reliability of the power system” (AER, 2007a: 73). The foregoing discussion has signalled a number of reasons which may well prevent this situation from continuing.

Australian electricity demand is growing rapidly, especially peak demand when extreme temperatures occur. Generation capacity has increased although predominantly in Queensland peaking plants. Timely investment in new base-load generation capacity to meet forecast demand and reliability standards is not being stimulated by long-term NEM prices but the sector now relies on price signals to determine new investment. The movement in wholesale prices is not signalling, as widely believed, generation capacity constraints although these are being projected by the market operator. The volatility in wholesale electricity prices is being driven not by demand but a handful of generators exercising market power, and transmission constraints.

Coal is currently the most cost-effective fuel for base-load capacity but one of the highest contributors to greenhouse gas. The dearth of investment in new base-load capacity is being compounded by the prospect of significant capital costs to meet prospective policies requiring reductions in greenhouse gas emissions.

The Australian Energy Regulator (2007a) posited that mixed ownership within the sector has led to an ‘uneasiness’ about investment which privatisation of electricity assets still in public ownership may overcome. A more recent report to the NSW Government contended that public ownership inhibited private sector generation investment which will occur “when wholesale prices and market-related conditions point to a decision based upon commercial criteria” (Owen, 2007: vii). If this is the case, no new private sector investment will occur until all generation assets are privatised. Little other than marginal augmentation to base-load capacity has occurred since the privatisation of Victorian and South Australian generation assets. The impending sale of NSW generation will mean that 60% of NEM capacity will be privately owned. Is this a sufficient level of private ownership to allay the alleged uneasiness before private investment commences? Or will the remaining 40% - held in government ownership across Queensland, the Snowy Mountains region and Tasmania – need to be also privatised for there to be a sufficient investment stimulus? The NSW sale will take at least 18 months to achieve assuming current community opposition dissipates sufficiently. Further potential privatisations would extend the timeframe considerably. In the meantime, demand grows and capacity tightens.

But what of the level of wholesale prices, potential climate change policies and transmission capacity? Will new private owners of progressively privatised generation assets exercise market power as owners before them have done and manipulate wholesale price outcomes to earn sufficient returns to repay debt used to purchase generation assets, meet LRMCs and provide healthy financial payouts to their shareholders? Without changes to the NEM bidding rules, it is difficult to see why such opportunities would be overlooked notwithstanding that new entrants will remain



dissuaded. As for climate change policies, it will take some years for these to be formulated and fully implemented. In the meantime, demand grows and capacity tightens.

Privatisation of NSW, or any other, generation assets will not be sufficient in itself to stimulate timely capacity investment in order to meet forecast demand. Clearer definition of climate change policies and their application will provide greater certainty about potential costs. But until these costs are known and the extent to which government may assist implementation, private investors will not commit to new capacity. Moreover that commitment will be muted without sufficient augmentation to transmission capacity to ameliorate the current constraints on import-export.

On the basis of current policy settings, the time horizon for investment in sufficient generation and transmission capacity to meet forecast demand over the next 10 years is bleak and the security of Australia's electricity supply is under threat.

## Footnotes

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<sup>1</sup> The land area of Australia is roughly comparable to the US although more than 85% of the population is concentrated along the eastern seaboard and in the south-east. The NEM covers the southern and eastern States and Territories (Queensland, NSW, ACT, Victoria, Tasmania and South Australia). The geographic remoteness of the population centres of Western Australia and the Northern Territory make the cost of transmission interconnection to a national grid prohibitive.

<sup>2</sup> Privatisation of former government electricity companies has occurred but not to the extent often claimed. The NSW Government's November 2007 announcement of its intention to sell its generation and retail assets will result in around 60% of NEM generation capacity being privately owned.

<sup>3</sup> Spain's centralised market is only part mandatory.

<sup>4</sup> In NSW, summer peak demand increased by 3.8% per annum from 1999 to 2004 while average demand grew annually by 2.8%. The forecast growth in peak power demand in Victoria is 3% per annum until 2020 compared to total growth in demand of 2% each year.

<sup>5</sup> These projections are based on the generating and transmission capacity to maintain the agreed standard of supply reliability within each NEM region. The system is deemed reliable if, over the long-term, at least 99.998% of consumer energy demand can be met.

<sup>6</sup> Proposed refers to proposals that have not been fully evaluated or received all necessary approvals to become a more definite prospect of proceeding. Planned is equivalent to a definite commitment although still subject to final decisions before construction is commenced. Not all of the proposals in this latter group will be found to be sufficiently viable to proceed to full planning.

<sup>7</sup> The more capital-intensive base-load generation (for example, coal) is costly and hence, it is claimed that investment will be stimulated by a long-term trend in higher prices. Less capital-intensive plants (for example, gas) are easier to start up, although more expensive to operate, and thus highly suitable to supply short peak periods of demand. Investment in these peaking plants will also require a sustained trend in higher prices but, being of a lower capital cost, the payback period is considerably shorter.

<sup>8</sup> Tasmania is not included because data is only available from mid 2005.

<sup>9</sup> Seven months only from December 1998 to June 1999.

<sup>10</sup> Average monthly figures for each NEM region are derived from over 1,400 prices given the 48 half-hour trading intervals per day and, for the majority of the year, at least 30 trading days per month. A more complex picture of volatility is shown by average daily and half-hourly spot prices (see Chester, 2006).

<sup>11</sup> In 1995 there were nine government-owned generation companies, two privately owned and four integrated government companies. By the end of 2006, this group of companies had grown

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to 24 (nine government, thirteen private and one integrated). In addition, a number of private generators had commenced operating.

<sup>12</sup> During 2002-05, only NSW and Queensland (government-owned) generators exceeded the new entry LRMCs. Victorian generators were broadly equivalent and those in South Australia below.

<sup>13</sup> For example, the Federal government's Mandatory Renewable Energy Target scheme has been criticised for being biased towards wind power which is far more costly than conventional energy but is only available when there is wind. Hence, conventional energy is required as a back-up which adds considerably to capital costs. The NSW Greenhouse Abatement Scheme has been found to lead to minimal cuts in emissions but with considerable costs to electricity consumers.

<sup>14</sup> This review was commissioned in April by the Federal Labor Party, when in opposition, and all State and Territory Governments. A final report is due in September 2008.

<sup>15</sup> In 2005, the Victorian government reached agreement with International Power, majority owner of Hazelwood Power (1600MW), for a reduction in emissions of 34 million tonnes during the next 25 years in return for access to 43 million tonnes of brown coal. Currently the generator emits 17 million tonnes per annum of greenhouse gases and will need to spend A\$400 million to meet the agreed target.

<sup>16</sup> Two interconnectors, Murraylink and Directlink, were built as unregulated interconnectors but subsequently met the regulatory test in 2003 and 2006 respectively.

<sup>17</sup> It is claimed that NEM regional price differentials, due to transmission capacity constraints, have added from A\$1.6 to 2.6 billion to the cost of wholesale electricity each year since 1999 (Port Jackson Partners Limited, 2005). The cost of transmission network congestion has been estimated at: A\$36 million in 2003-04, A\$45 million in 2004-05, A\$66 million in 2005-06 and A\$107 million in 2006-07 (AER, 2007c).

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