2. New Baseload Generation

Key Findings

- With a risk-averse approach, New South Wales needs to be in a position where new baseload generation can be operational by 2013-14 if necessary, in order to avoid potential energy shortfalls.

- Forecast growth in electricity use implies a need to provide around 91,000 GWh of electrical energy in New South Wales in 2013-14. This is around 10,500 GWh above current annual consumption – equivalent to the yearly output of the Mt Piper power station.

- Part of this gap will be filled by energy efficiency, new renewable energy generation and increased output from existing generators.

- New South Wales currently imports around ten per cent of its energy needs but growing energy consumption in other States may reduce the amount of energy available over interconnectors.

- Development applications need to be submitted in 2007 to maintain the options for new base generation to be operational by 2013-14.

2.1 Introduction

Electrical energy consumption in New South Wales has grown by about 1,700 GWh per year for around the past 30 years. TransGrid forecast a slightly slower average growth rate of around 1,600GWh per year over the next ten years in part due to the impact of energy efficiency measures.

New South Wales has had access to surplus generation capacity (including electricity imports from interstate) for the last 15 years. This has been more than sufficient to meet the growth in energy consumption. However, this surplus has reduced significantly as energy consumption has continued to grow.

One of the Inquiry's terms of reference is to review and advise the Government on the need for and timing of new baseload generation to maintain both security of supply and competitively priced electricity in New South Wales.
Simply put, new generation is needed when the consumption of energy is greater than the existing supply of energy. However, actually determining when baseload should be built is more complex, requiring consideration of both whether there is enough electrical energy available, and how best to meet electrical energy needs in a commercially efficient manner which ensures reasonable prices for all consumers, households and businesses.

The Inquiry has focused on understanding the earliest timeframe in which new investment may be required. This does not mean that the Inquiry needs to or should determine the exact year that new investment is required. But the Inquiry does need to understand the parameters that point to the need for early investment.

There is an asymmetry of risk with regard to the timing of new investment and, as such, the Inquiry has taken a risk-averse approach. The additional financing costs associated with completing a new generator one or two years earlier than it is needed are far smaller than the cost to the people of New South Wales and to market participants of not having adequate generation.

A risk-averse approach means being prepared sooner rather than later - being ready so that new generation can be brought online whenever there is a possibility of energy consumption exceeding energy supply. Being prepared maintains flexibility. It does not prevent postponing the construction of a new power station if the time horizon for additional baseload investment moves outwards. Much of the timeframe in preparing for new baseload consists of planning and design. This can be put on hold if the need for new baseload is not confirmed.

The Inquiry agrees with the numerous submissions which noted that the NEM is efficient in providing price signals to investors on the need and timing for investment in new generation. Views expressed in the submissions included:

‘...it is the market, free from impediments, that is best placed to deliver the most efficient and timely investment in all forms of new generation, including baseload.’

‘...retailers are generally confident that the National Electricity Market (NEM) can deliver investment of the right type to the right locations in a timely fashion.’

‘...The NEM has established a track record of delivering capacity on a timely basis to meet supply requirements thus far, and to date (excluding the impacts of industrial action) there have been no system security issues that have resulted from a lack of supply in the NEM or across individual regions.’

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1 Energy Supply Association of Australia submission, p5
2 Energy Retailers Association of Australia submission, p1
3 Babcock and Brown Power, submission p2
The Inquiry agrees that the NEM is well designed to ensure adequate investment, and appreciates that the governments of all NEM jurisdictions have put in place a number of mechanisms, such as through the Reliability Panel of the Australian Energy Market Commission (AEMC) and through NEMMCO’s forward looking reserve forecasting to ensure that adequate generation is available.

Having said this, Governments, as well as market participants, take an interest in the appropriate timing for new generation. The Inquiry notes that the NSW Government’s role is to ensure that, as far as possible, there are no unnecessary impediments to timely investment.

2.2 Methodology

What is the Inquiry’s approach to understanding the need for and timing of new baseload generation?

Since significant modelling and analysis of energy consumption and supply forecasts already exists, the Inquiry did not have to undertake further modelling work.

With a focus on baseload energy, the Inquiry has primarily considered NSW total energy needs over time, rather than the maximum demand for electricity at a single point of time (i.e. baseload energy requirements rather than peak demand).

The objective of the NEM is to ensure the most commercially efficient combination of plant types is used to meet reliability standards. If less efficient options are brought forward, this results in relatively higher electricity costs, which works against the Government’s objective to maintain competitively priced electricity.

Baseload and intermediate generators are the most cost-effective generation for providing significant quantities of energy to consumers. By contrast, peak generators are the cheapest to build, but the least efficient and most expensive to run, and are therefore not well suited to providing bulk energy. As shown in Appendix 2.3, peak generators run only at times of peak demand, and contribute very little energy. A need for energy therefore drives a need for baseload and intermediate plant.
Energy consumption forecasts are projections of the amount of electrical energy required to meet consumer needs, usually over the period of one year. Energy consumption forecasts are measured in gigawatt hours (GWh). Forecasts are typically used to estimate the amount of electrical energy that will need to be supplied over a period of time, from all sources including power stations in New South Wales and interconnectors which import electricity into New South Wales from other regions of the NEM, such as Queensland (see section 2.5).

To identify the range of dates within which NSW electrical energy needs might exceed available supply, the Inquiry examined forecasts of the amount of electrical energy that will be consumed in New South Wales and compared this to the amount of electrical energy that can be produced in New South Wales by existing power stations, plus the amount of electrical energy that could be imported into New South Wales via interconnectors.

The energy consumption forecasts used by the Inquiry are taken from TransGrid analysis. As the NSW jurisdictional planning body, TransGrid is responsible for providing forecasting information annually to NEMMCO. This is the same information that was considered by the Inquiry.

Details on the methodology used by TransGrid to calculate energy consumption and the Inquiry’s approach to estimating energy supplies are discussed in sections 2.4 and 2.5 respectively. TransGrid’s energy consumption and maximum demand forecasts are used by NEMMCO in the preparation of its annual Statement of Opportunities (SOO), which considers the supply-demand balance with a focus on peak demand in the NEM rather than baseload.

The Inquiry did not need to differentiate between intermediate or baseload plant. As discussed in Chapter 3, depending on the carbon price the same technology Combined Cycle Gas Turbines (CCGT) may be used for intermediate and baseload generation.

Whilst peak demand is not the focus of the Inquiry, maximum demand and peak generation are discussed in more detail in Appendix 2.1 and 2.2.

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The mix of existing NSW plant types is discussed in Appendix 2.3 and Figure 2.3.1 shows how peak generation, such as Open Cycle Gas Turbines (OCGT) or hydro generation, contribute significantly to peak capacity (MW) at times of very high loads, but only a small amount of energy (GWh) to NSW annual energy consumption.

**The electricity market is dynamic**

One limitation that affects all analysis is the dynamic nature of the electricity market. No sooner is the analysis complete, than market conditions evolve and the results start to become outdated. All analysis represents a snapshot in time. It is simply a matter of recognising this limitation, working with the most up to date evidence available, and factoring this limitation (and any others) into the analysis.

While the methodology used by the Inquiry is appropriate to advise government on the range of times within which new baseload generation may be required, such an approach would be limited for a potential investor.

Any investment and risk decisions will ultimately lie with the market participant investing in new generation. Therefore, those investing large amounts of capital in new power stations will, as a matter of course, undertake extensive modelling of their own. The investment decision will have a number of elements to it, including, but not limited to, the investor’s detailed analysis of evolving market conditions and their particular business strategies.

Individual investors will determine which type of power station to invest in (baseload, intermediate or peak generation), the precise timing of the investment, and the location of the power station within the NEM.

As in any market, there are a number of variables that can affect the energy balance, which may in turn affect the need for and timing of new baseload generation. These variables are discussed in more detail in section 2.7.

### 2.3 Energy Consumption Forecasts

The amount of electrical energy that households and businesses consume is the most important factor determining the requirement for new baseload generation.

New South Wales currently uses more electrical energy (79,030 GWh in 2005-06) than any other State. However, on a per capita basis, NSW’s energy consumption is only slightly higher than Victoria and South Australia (both have greater gas penetration, for example, for heating and cooking), slightly lower than Queensland and much lower than Tasmania. Energy consumption is growing much more quickly in Queensland than in New South Wales (see section 2.5).
Each year, TransGrid prepares an Annual Planning Report, setting out forecast energy consumption and maximum demand in New South Wales over a 10-year horizon, identifying future constraints in the network and providing options for their removal. The latest forecasts were released in June 2007.\(^5\)

Recognising the uncertainties inherent in forecasting, TransGrid prepares three energy consumption forecasts based on low, medium and high growth scenarios. TransGrid takes into account a number of factors when preparing the forecasts, including historical trends, economic data, and known large industrial loads.

TransGrid uses historical energy data obtained from a number of sources, including NEMMCO, TransGrid’s internal systems, Distribution Network Service Providers and the Energy Supply Association of Australia.

TransGrid uses economic information provided by the National Institute of Economic and Industry Research (NIEIR) on behalf of NEMMCO.\(^6\) The NIEIR forecasts Gross State Product to increase by an average of 2.8 per cent per year over the forecast period. Population forecasts are also sourced from NIEIR and the NSW population is forecast to grow by 0.9 per cent per year to 2010-11. Large industrial loads account for around 17 per cent of NSW energy consumption.\(^7\)

TransGrid forecasts that total energy consumption in New South Wales will grow at about 1,600 GWh per annum over the next 10 years under their medium growth scenario.\(^8\) This rate of increase is lower than the 1,700 GWh per annum historical average growth and reflects reduced energy consumption, at least in part from energy efficiency measures. TransGrid has not explicitly identified the contribution of energy efficiency measures to reducing growth in energy consumption. Instead, it has implicitly factored in the continuation of the reduced rate of energy growth apparent since around 2001. The difference between the long term energy trend and the TransGrid forecast of total energy required is shown by the difference between the green and red lines in Figure 2.1.

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\(^5\)TransGrid, Annual Planning Report, 2007

\(^6\)Figure 3.2 and Table 4.1, The Economic Outlook for NEM States to 2016/17; The own price elasticity of demand for electricity in NEM regions; Impact of greenhouse policies on the electricity sector supplies and demands, and Factors affecting the electricity demand in the NEM. All reports prepared by the National Institute of Economic and Industry Research for the National Electricity Market Management Company, June 2007.

\(^7\)On an energy sent out basis.

\(^8\)As generated at power stations TransGrid Annual Planning Report, 2007, see Table A3.1 and Table 4.5.
The trend-line shows the level of energy consumption which would be expected to occur if the historical growth trend is projected forward.

The Inquiry considers that the difference between the energy consumption forecast and the historical growth trend projected forward includes the impact of energy efficiency programs. This suggests that energy efficiency measures will continue to slow the rate of energy consumption growth compared with historical trends.

As shown in Figure 2.1, TransGrid is forecasting total energy consumption in 2016-17 to be some 2,000 GWh lower than it would have been if energy consumption had continued to increase at the pre-2001 rates. However, it is not possible to identify the precise contribution made by energy efficiency to these reduced energy needs.

The actual data for TransGrid’s medium growth energy forecasts is provided in Table 2.1.
## Table 2.1: NSW Energy Forecast (Medium Growth Scenario)

<table>
<thead>
<tr>
<th>Financial year</th>
<th>Scheduled Energy (GWh)</th>
<th>Non-scheduled Energy (GWh)</th>
<th>Total Energy (GWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991-92 actual</td>
<td>52,828</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1992-93 actual</td>
<td>54,551</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1993-94 actual</td>
<td>56,531</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1994-95 actual</td>
<td>58,091</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995-96 actual</td>
<td>59,885</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996-97 actual</td>
<td>61,260</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1997-98 actual</td>
<td>63,894</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1998-99 actual</td>
<td>65,420</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1999-00 actual</td>
<td>67,569</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000-01 actual</td>
<td>69,353</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001-02 actual</td>
<td>70,289</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002-03 actual</td>
<td>71,687</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003-04 actual</td>
<td>73,783</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004-05 actual</td>
<td>74,584</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005-06 actual</td>
<td>76,979</td>
<td>2,051</td>
<td>79,030</td>
</tr>
<tr>
<td>2006-07 estimated</td>
<td>78,400</td>
<td>2,049</td>
<td>80,449</td>
</tr>
<tr>
<td>2007-08 projection</td>
<td>79,730</td>
<td>2,300</td>
<td>82,030</td>
</tr>
<tr>
<td>2008-09 projection</td>
<td>80,810</td>
<td>2,390</td>
<td>83,200</td>
</tr>
<tr>
<td>2009-10 projection</td>
<td>81,920</td>
<td>2,470</td>
<td>84,390</td>
</tr>
<tr>
<td>2010-11 projection</td>
<td>82,880</td>
<td>2,890</td>
<td>85,770</td>
</tr>
<tr>
<td>2011-12 projection</td>
<td>84,200</td>
<td>3,520</td>
<td>87,720</td>
</tr>
<tr>
<td>2012-13 projection</td>
<td>85,770</td>
<td>3,630</td>
<td>89,400</td>
</tr>
<tr>
<td>2013-14 projection</td>
<td>87,290</td>
<td>3,710</td>
<td>91,000</td>
</tr>
<tr>
<td>2014-15 projection</td>
<td>88,890</td>
<td>3,810</td>
<td>92,700</td>
</tr>
<tr>
<td>2015-16 projection</td>
<td>90,720</td>
<td>3,890</td>
<td>94,610</td>
</tr>
<tr>
<td>2016-17 projection</td>
<td>92,450</td>
<td>4,000</td>
<td>96,450</td>
</tr>
</tbody>
</table>

**1991-92 to 2006-07 average annual growth**

<table>
<thead>
<tr>
<th>Year</th>
<th>Growth (GWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991-92 to 2006-07</td>
<td>1,700GWh</td>
</tr>
<tr>
<td>2007-08 to 2016-17</td>
<td>1,400GWh</td>
</tr>
</tbody>
</table>

Source: TransGrid, Annual Planning Report, 2007, p81 & Table 4.5.

The scheduled and non-scheduled energy columns of Table 2.1 are discussed in more detail in section 2.4.
Overall, the Inquiry considers that TransGrid’s forecasts are both transparent and reasonable given the available quantifiable data. However, the forecasts do not include any additional major energy intensive industrial load that may develop in New South Wales. Therefore, TransGrid’s forecasts could be exceeded if unanticipated additional loads come online.

2.4 Energy Supply Forecasts within New South Wales

This section of the report examines the current energy supply available to New South Wales. It also includes forecasts of how much energy could be supplied by existing New South Wales generators and via interconnectors to meet future NSW electricity needs.

What electrical energy is generated within New South Wales?

Energy needs can be satisfied by energy supplied from scheduled and/or non-scheduled power stations. ‘Scheduled’ and ‘non-scheduled’ are terms used to describe how power stations operate within the NEM. Scheduled energy is the portion of energy supplied to New South Wales that is dispatched by NEMMCO as part of the operation of the NEM. In New South Wales, scheduled power stations are generally larger generators, including the major coal-fired units.

Non-scheduled energy is that portion of energy supplied to New South Wales that is usually connected to distribution networks or ‘embedded’ within consumer premises. This generation supplies a much lesser amount of energy to New South Wales. Renewable energy from wind is included in this. The use of non-scheduled energy displaces the need to take scheduled energy from the grid.

Reflecting the different sources of energy supply, TransGrid forecasts scheduled energy and non-scheduled energy (see Table 2.1). This indicates which sources of energy supply will satisfy energy consumption. The scheduled energy is the one which determines the amount of baseload energy supply.

Scheduled generation - capability of existing New South Wales plant

Scheduled electricity supplies are sourced from a range of power stations with different capabilities and constraints. In New South Wales, scheduled generation is mainly from coal-fired generators.

It was important for the Inquiry to understand the full capability of scheduled electricity sources – both maximum power output and maximum annual energy – in order to identify the likelihood of shortfalls in the future NSW energy balance.
Table 2.2 provides a forecast of the maximum energy supply from each NSW generator and indicative projections of the maximum energy supply capability based on capacity factors provided by Connell Wagner (Appendix C of Expert Report 1) for the major NSW power stations.

The capacity factor is the amount of energy delivered by a generator, divided by the amount of energy that would have been delivered had the generator run continuously at its maximum (nameplate) output, expressed as a percentage. The “Maximum Technical Capacity Factor” and “Expected maximum energy capability” columns in Table 2.2 refer to the maximum capacity factors and energy outputs achievable due to technical limitations. They do not take into account commercial or competitive considerations.

Table 2.2 does not provide energy supply forecasts from renewables and embedded generation within New South Wales which is discussed below.

### Table 2.2: Existing or Committed Generation in NSW

<table>
<thead>
<tr>
<th>Generator</th>
<th>Ownership</th>
<th>Year Commissioned</th>
<th>Fuel</th>
<th>Nameplate Rating (MW)</th>
<th>Expected maximum energy capability (GWh/annum) (i)</th>
<th>Maximum Technical Capacity Factor (%) (i)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Munmorah Delta Electricity</td>
<td>Macquarie Generation</td>
<td>1968-69</td>
<td>Coal</td>
<td>700</td>
<td>0(ii)</td>
<td>0</td>
</tr>
<tr>
<td>Liddell</td>
<td>Macquarie Generation</td>
<td>1971-73</td>
<td>Coal</td>
<td>2,000</td>
<td>13,000</td>
<td>74</td>
</tr>
<tr>
<td>Wallerawang Delta Electricity</td>
<td>1976-80</td>
<td>Coal</td>
<td>1,000</td>
<td>6,500</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Vales Point Delta Electricity</td>
<td>1978-79</td>
<td>Coal</td>
<td>1,320</td>
<td>8,700</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Eraring Eraring Energy</td>
<td>Macquarie Generation</td>
<td>1982-84</td>
<td>Coal</td>
<td>2,640</td>
<td>20,800</td>
<td>90</td>
</tr>
<tr>
<td>Bayswater Macquarie Generation</td>
<td>1985-86</td>
<td>Coal</td>
<td>2,640</td>
<td>20,800</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Mt. Piper Delta Electricity</td>
<td>1992-93</td>
<td>Coal</td>
<td>1,320</td>
<td>10,400</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Redbank Babcock &amp; Brown</td>
<td>1999</td>
<td>Coal</td>
<td>150</td>
<td>1,000</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td>Bendeela Eraring Energy</td>
<td>1977</td>
<td>Hydro</td>
<td>80</td>
<td>Negligible</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Kangaroo Valley Eraring Energy</td>
<td>1977</td>
<td>Hydro</td>
<td>160</td>
<td>Negligible</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Smithfield Marubeni</td>
<td>1995</td>
<td>Gas</td>
<td>160</td>
<td>1,000</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>Tallawarra TRUenergy</td>
<td>2008</td>
<td>Gas</td>
<td>440</td>
<td>2,300</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Colongra Delta Electricity</td>
<td>2009-10</td>
<td>Gas</td>
<td>660</td>
<td>300</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Uranquinty NewGen</td>
<td>2009-10</td>
<td>Gas</td>
<td>600</td>
<td>300</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>85,100</strong>(iii)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(i) Maximum capacities - output and annual energy capability - on nameplate rating as supplied by submissions to the Inquiry and reviewed by Connell Wagner. These capabilities do not take into account any plant limitations that have recently been experienced following drought conditions in eastern Australia.

(ii) Delta Electricity note in their submission that it would be necessary to significantly refurbish Munmorah power station to extend its life beyond 2012. Munmorah’s output has therefore not been included in this table.

(iii) The expected maximum energy supply capability of existing and committed power stations within NSW is at most 85,100GWh/annum. This is on the assumption that the maximum capacity could be sourced co-incidentally from each power station.
Some submissions to the Inquiry suggested that coal-fired generators in New South Wales could supply more energy by running at capacity factors similar to coal-fired generators in Victoria or Queensland. AGL said that, ‘If existing coal-fired generators in New South Wales operated at capacity factors comparable to coal-fired generators in Victoria and Queensland (around 80 per cent) an additional 15,000 GWh of energy per annum would be available’.9

Connell Wagner has reported that the capacity factor, and hence the annual energy output of some coal-fired power stations in New South Wales, is constrained by technical limitations (see Appendix C of Expert Report 1).

For example, the high ash content coal and the high gas velocity design of boilers at some power stations in New South Wales lead to high boiler erosion rates especially when plants are operating at or near full output. This constrains the technically achievable maximum capacity factor of some plant. Running these plants at high capacity for long periods would lead to reliability degradation as boiler tubes wear, and/or a need for more regular and major boiler maintenance.

The three newer large plants in New South Wales (Bayswater, Mt. Piper and Eraring) have much lower gas velocities, and hence can run at higher capacity factors. There are also fuel differences between New South Wales coal-fired generators, which use black coal, and Victorian coal-fired generators which use brown coal. Due to the nature of the fuel, Victorian brown coal generators have very low gas velocities and therefore do not suffer significant erosion issues.

Delta Electricity has advised the Inquiry that, in its present condition, the Munmorah power station (600MW) cannot fulfil a normal baseload role. Delta indicated in its submission that there is ‘Necessary refurbishment to extend the life of Munmorah Power Station beyond 2012’. A refurbishment of Munmorah ‘increases the capacity of each unit by 50MW but essentially represents a 700MW increase to baseload capacity beyond 2012’.10

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9 AGL submission, p 4
10 Delta Electricity submission, p 47.
As refurbishment represents a substantial investment in itself, the Inquiry considers that it is an investment option for meeting baseload energy requirements, and its output has not been included in Table 2.2.

Based on Table 2.2, generating plant in New South Wales is capable of delivering up to approximately 85,000 GWh of energy per annum. However, this assumes that all generators are running to their maximum technical capacity factor limits, and that they do this year after year.

The Inquiry acknowledges that there is a significant down-side risk. Due to refurbishment plans generation may not be fully available every year. Also, most of these plants have never previously achieved the high annual capacity factors used in Table 2.2 and issues may emerge as they are run harder.

Connell Wagner states that “The capacity achieved depends on many factors including technical, environmental, their performance in the National Electricity Market and the aging of the stations. Consequently the outcome from year to year will vary and it is unlikely the maximum capacity factors for all stations could be achieved in any year”.11

The Inquiry therefore considers that the maximum output available from existing NSW plant is less than 85,000 GWh, assuming no significant contribution from the existing Munmorah units.

**Non-scheduled energy**

Non-scheduled energy is usually connected to distribution networks or ‘embedded’ in consumer power systems, and includes most renewable energy. Compared to scheduled energy supplies, non-scheduled energy supplies are small, around 2,000 GWh in 2005-06.

Another major factor responsible for the lower growth forecasts in scheduled energy is TransGrid’s allowance for stronger contributions from non-scheduled generation in New South Wales. TransGrid estimates that by 2016-17, non-scheduled energy will supply around 4,000 GWh per year within New South Wales.

The majority of this generation is expected to be from renewable sources connected to distribution networks. This estimate is prepared by NIEIR for NEMMCO, and includes the impact of newly introduced renewable energy targets in New South Wales, Victoria and South Australia.12

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11 Expert Report 1, section 8.6.
This increase in renewable energy supplies is largely due to the Commonwealth Mandatory Renewable Energy Target (MRET) scheme and the NSW Government’s decision to introduce a 15 per cent Renewable Energy Target. NIEIR forecasts indicate this target will result in an average increase in supply from NSW renewable sources (primarily wind and biomass) of more than 150GWh each year.  

Another 50 GWh per year annual increase is forecast to come from gas generation embedded in distribution or customer networks. The impact of this forecast renewable and embedded generation on energy requirements is significant, and is shown by the difference between the green and black lines in Figure 2.2.

**Figure 2.2: Forecast increase in the contribution of non-scheduled electricity generators in NSW, 1991-92 to 2016-17**

Source Data: TransGrid

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The Inquiry notes that renewable energy targets in Victoria, South Australia and New South Wales are in their infancy. Whilst NIEIR has taken account of these renewable energy targets in their forecasts for non-scheduled energy supplies, there is still a degree of uncertainty over where the generation required to meet the targets will be placed. NIEIR note that there are a number of uncertainties in their forecasts and that “…extreme care should be exercised when using these figures.”\textsuperscript{14} Approvals for some wind farms have also been problematic.\textsuperscript{15}

Some submissions to the Inquiry have suggested that additional capacity from non-scheduled generation (i.e. renewables) may be available in New South Wales\textsuperscript{16}. However, as noted above, it will be some time before a clear picture emerges on the extent of the additional energy supplies that will be located in New South Wales.

Having said this, the Inquiry notes that renewable energy supplies will play an increasingly important role in the generation mix in New South Wales.

2.5 Electrical Energy Available from Imports to New South Wales

As shown in Figure 2.3, New South Wales is connected to the Queensland, Snowy and Victorian regions by 330 kV interconnectors. New South Wales currently imports significant amounts of energy from the Queensland and Snowy regions.\textsuperscript{17}

Inter-regional transmission has provided efficiency and reliability benefits to New South Wales over many years.

The New South Wales and Victorian power systems have been interconnected via the Snowy region for almost 50 years and the Queensland-NSW Interconnector (QNI) was completed in 2000-01. Interconnections provide an important part of all the NEM States’ energy and peak demand balance.

\begin{footnotes}
\item[15] For example, in April 2006 the Federal Government rejected a Wind Power’s wind farm development at Bald Hills in South Gippsland, reportedly because of the risk it posed to the Orange-Bellied Parrot. In August 2007, AGL abandoned its planned Gippsland Wind Farm. According to The Australian, about 1500 objections has been lodged against the project.
\item[16] For example, EPURON’s supplementary submission of 17th August suggested that NSW renewables had potential for “production of 9,500 - 13,000 GWh/an of diversified, dependable power”.
\item[17] On 30 August 2007 the Australian Energy Market Commission determined the Snowy Region would be abolished from 1 July 2008. This is not a physical change to the amount of generation or the transmission network and so does not impact on the Inquiry’s conclusions.
\end{footnotes}
In 2006-07, inter-regional supplies contributed about 9,000 GWh to New South Wales’, which is over 10 per cent of New South Wales' energy needs.

Each interconnector has a maximum limit to the amount of energy it can supply. The amount of energy available to New South Wales also depends on the energy consumption in the other regions of the NEM and relative costs of supplying energy to each region. If energy is more expensive in New South Wales, then energy is likely to be supplied from Queensland to New South Wales. The converse is also true.

Energy will from time to time flow from the region with higher average generation costs to the region with lower average generation costs but on average energy will flow towards the region with higher generating costs.

The process of determining the least cost option for supplying energy across the NEM to meet growing energy consumption in the different NEM regions is complex. The Inquiry has considered some high level scenarios as to how growing energy consumption in different NEM regions and the relative costs of generation will influence energy supplies between the NEM regions.

Market participants and proponents of new generation need to make an assessment of the levels of energy supply to New South Wales from adjoining NEM regions and model that as part of their investment strategies. The potential for interstate transmission augmentation is further discussed in Appendix 2.4.
Energy growth in other NEM regions

Additional growth in energy consumption in Queensland may result in less energy being available to New South Wales. Similarly, energy consumption growth in Victoria may result in additional energy transfers south from Snowy, leaving less energy available to New South Wales.
The Inquiry has not undertaken detailed modelling of the likely impact of growth in energy consumption in other NEM regions on the interconnector energy supplies to New South Wales.

However, forecasts recently developed by the State appointed Jurisdictional Planning Bodies (JPB) and published by NEMMCO in July 2007 expect scheduled annual energy consumption to grow over the next 10 years (2006-07 to 2016-17) by 22,000 GWh (3.5 per cent per annum) in Queensland and 8,000 GWh (0.8 per cent per annum) in Victoria/South Australia/Tasmania.\(^\text{18}\) This compares\(^\text{19}\) with scheduled energy consumption growth in New South Wales of 14,000 GWh (1.7 per cent per annum). Scheduled energy growth in the Victoria/South Australia/Tasmania regions is low in part due to the high contribution assumed from non-scheduled generation driven by renewable energy targets. An additional 6,000GWh of non-scheduled generation is expected in Victoria by 2016-17 compared to 2,000GWh in New South Wales,\(^\text{20}\) reflecting the better quality of wind resources in Victoria.

**Future energy supplies from Queensland**

The high forecast growth of energy consumption in Queensland is expected to rapidly absorb any under-utilised energy supply capacity in that region. Last year, the Queensland-NSW Interconnector (QNI) transferred almost 6,000 GWh of “net energy” to New South Wales – that is, the difference between energy supplied south and energy supplied north. An energy transfer of that magnitude may be very close to the practical maximum capacity factor limit of QNI.

The new Kogan Creek power station is likely to be capable of providing around 6,000 GWh of Queensland’s forecast increase of 22,000 GWh by 2016-17. As with New South Wales there may be some potential to further increase the capacity factors of existing generators. But it is likely that some of the energy required by Queensland could come from energy that would otherwise flow to New South Wales.


\(^{19}\) 14,000GWh and 1.7 per cent refer to scheduled energy growth. For total energy growth, the figures are 16,000GWh and 1.8 per cent.

\(^{20}\) Tables C2 and B2, _Projections of Non-scheduled and exempted generation in the NEM_, A report for the National Electricity Market Management Company, prepared by the National Institute of Economic and Industry Research (2007)
Investing in additional generation in Queensland to support New South Wales’ energy needs is not necessarily optimal. Energy generated for New South Wales in Queensland is subject to significant additional transmission losses. Furthermore, Queensland generation is at greater risk of being “constrained off” due to interconnector capacity limits, meaning that Queensland generators face the risk of not being able to fully deliver their power to New South Wales at times of high NSW electricity prices.

For these reasons, new Queensland baseload generation (beyond that required for Queensland’s own needs) is only likely to occur if Queensland generation has significant cost advantages over New South Wales.

As discussed in Chapter 3, new scheduled baseload generation is likely to be either coal-fired or gas-fired, and generating costs will be driven largely by the cost of these two fuels.

The Inquiry considers that there is a high degree of uncertainty around any fuel cost differentials between New South Wales and Queensland. For example, ACIL Tasman forecast the gas price in Central New South Wales to be nearly 30 per cent higher than the gas prices in South East Queensland, and that gas availability restricts New South Wales to a total of three combined cycle gas units in the next ten years.

Conversely, as noted in Chapter 3 and in submissions, whilst Queensland currently has cheaper gas, there is significant upside potential for coal seam methane gas reserves in New South Wales in the medium term. If these were developed, the relative price differential between Queensland and New South Wales could change dramatically over the next few years. Limitations on future New South Wales gas availability also appear to be falling away.

Similarly, ACIL Tasman have forecast Queensland coal prices to be around 15 per cent cheaper than NSW coal, whilst submissions to the Inquiry have suggested a lower cost for NSW coal.

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22 Ibid, Table 58
23 Ibid, Table 15
24 Macquarie Generation submission, p19
If fuel prices were similar in Queensland and New South Wales, more generation development would take place in New South Wales and less development would take place in Queensland, as there would be no benefits to new Queensland generators that would outweigh the cost of transmitting electricity long distances to New South Wales.

For the purpose of this analysis, the Inquiry has taken the view that in the long term, net electrical energy imports from Queensland are likely to be no higher than about 6,000 GWh, and could be markedly reduced over the next ten years.

**Future energy supplies from Snowy Hydro**

Annual consumption of scheduled energy in Tasmania, South Australia and Victoria is expected to grow by around 8,000 GWh over the next ten years, and those States may draw more energy from Snowy than they have previously. Snowy Hydro supplies energy to Victoria and New South Wales. In the NEM, Victoria is linked to Tasmania and South Australia. The energy consumption in one region can therefore affect available energy supplies in another region.

Energy generated by Snowy Hydro averages about 4,800 GWh per annum assuming no withholding of water for drought recovery25.

New South Wales has historically consumed most of the net energy supplied by the Snowy Hydro Scheme. However, increasing energy consumption in Victoria, South Australia and Tasmania may mean that significantly more of Snowy Hydro’s energy is supplied to Victoria.

Whilst ACIL Tasman is forecasting gas prices in Victoria that are currently lower than gas prices in New South Wales, development in coal seam gas and access to abundant black coal may make high energy output baseload plant cheaper to operate in New South Wales than in Victoria, South Australia or Tasmania. This may mean that it is cheaper to meet the additional energy needs of the States south of Snowy Hydro by increasing the energy flows from Snowy Hydro to the south, and by reducing the energy flows to the north.

Unlike Queensland generation, Snowy generation is equally remote from both northern and southern loads, so there are limited loss factor differences in supplying net energy in a particular direction.

If additional energy was required to the south of Snowy Hydro, then the energy available to New South Wales could drop over time from around 3,000 GWh per annum to zero or even negative.

25 NEMMCO 2006 Statement of Opportunities, page 4-11
2.6 Timing of New Baseload Generation

The Inquiry has considered all submissions on the timing of new baseload. There is significant variation in the analysis of when new generation is required. A number of submissions and NEMMCO’s 2006 market simulation suggested new intermediate or baseload plant will be required around 2013.

Some other submissions, and previous modelling carried out by NSW Government agencies considered that new intermediate or baseload generation would be required at a later time, for example, around 2016-17. The differences in anticipated timing are largely due to different assumptions about energy efficiency measures, embedded and renewable generation, maximum existing NSW generator capacity factors, inter-regional flows driven by differences in regional fuel costs and fuel and operating costs of existing NSW plant.

Both Origin Energy and TRUenergy recognised the importance of these assumptions.

‘Origin’s modelling suggests baseload discussions revolve around three key dates:

- Assuming full interconnection and availability of supply from other states, baseload is not required until about 2017
- Assuming interconnection cannot be fully relied upon, baseload is not required until about 2015 (it also becomes economic for generators to build baseload around this time)
- Demand for swap contracts to meet average demand, is projected to exceed supply from 2014 in NSW.’

‘In summary, we believe base load investment could be required from as early as 2012, however there is significant uncertainty in the forecast, and credible cases can be made out to 2015/16’.

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26 NEMMCO submission, p3 also stated that ‘It should be noted that whilst the 2006 NEMMCO modelling suggest a commercial opportunity at this time, this is not the same as the timing of an energy shortfall’.


29 Origin Energy submission p2.

30 TRUenergy submission p7.
Notwithstanding the different views on this matter, the Inquiry finds that it is likely that new generation will be required in New South Wales within the period 2013 to 2017. It could possibly be slightly earlier for generators initially operating as intermediate plant, but notes that the actual timing will be dependent on both market and project specific considerations.

TransGrid’s low, medium and high scenarios for scheduled energy consumption forecasts are set out in Table 2.3 below.

**Table 2.3: NSW Scheduled Energy Consumption, by Growth Scenario**

<table>
<thead>
<tr>
<th>Year</th>
<th>2007-08 GWh</th>
<th>2008-09 GWh</th>
<th>2009-10 GWh</th>
<th>2010-11 GWh</th>
<th>2011-12 GWh</th>
<th>2012-13 GWh</th>
<th>2013-14 GWh</th>
<th>2014-15 GWh</th>
<th>2015-16 GWh</th>
<th>2016-17 GWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>79,420</td>
<td>80,040</td>
<td>80,560</td>
<td>81,110</td>
<td>81,820</td>
<td>82,590</td>
<td>83,140</td>
<td>83,880</td>
<td>84,720</td>
<td>85,560</td>
</tr>
<tr>
<td>Medium</td>
<td>79,730</td>
<td>80,810</td>
<td>81,920</td>
<td>82,880</td>
<td>84,200</td>
<td>85,770</td>
<td>87,290</td>
<td>88,890</td>
<td>90,720</td>
<td>92,450</td>
</tr>
<tr>
<td>High</td>
<td>80,130</td>
<td>81,870</td>
<td>83,970</td>
<td>85,770</td>
<td>87,880</td>
<td>90,390</td>
<td>92,830</td>
<td>95,370</td>
<td>98,220</td>
<td>101,050</td>
</tr>
</tbody>
</table>

Source: TransGrid

As outlined, the range of annual scheduled energy available to New South Wales could be as follows:

- NSW existing generation less than 85,000GWh
- From Queensland: 0 to 6,000GWh
- From Snowy/Victoria: 0 to 3,000GWh.

As set out in Chapter 3, different technologies have different lead times for commissioning. Coal-fired generation can be delivered is 2013, whilst the earliest date that gas-fired CCGT generation could be available is 2010-211. Based on the above consumption forecasts and available energy, there are plausible scenarios where high energy plant would be required by these times.

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31 The medium growth scenario is published on page 81 of the TransGrid’s Annual Planning Report. High and low scenarios were provided directly to the Inquiry by TransGrid.

32 See Table 2.4

33 Page 3 of Eraring Energy’s submission suggests a possible 2012 commissioning. Page 46 of Delta Energy’s submission suggests 2013-14. The Inquiry has adopted the more conservative timing estimate. Timing is discussed further in Chapter 3.

34 For example, Delta’s Bamarang proposal already has planning approval (Delta submission, p47) and could in theory be built in two to three years. Proposals without planning approval will take longer.
For instance, the medium energy consumption in 2013-14 is 87,290GWh, which means that over 2,000GWh needs to come from other regions even if all plants run at full capacity. If the high forecast of 92,830GWh is realised, then at least 7,830GWh needs to be imported.

The Inquiry recommends that all baseload options remain available. In order to ensure that a coal-fired option remains open, market participants need to submit development applications before the end of 2007. It is relatively simple to curtail the progress of these projects at any time prior to entering construction contracts should they not be required, or be required at a later date.

If necessary, additional energy needs prior to 2013-14 can be met with gas-fired plant and/or a refurbishment of Munmorah power station. New South Wales already has sites with development approval for additional combined cycle gas generators and construction would take two to three years. Additional development applications will be required in the next one to two years if combined cycle gas proves to be the best form of generation for providing the bulk electrical energy needs of New South Wales.

The process for addressing energy supply shortfalls and the environmental planning and assessment processes are discussed in more detail in Appendices 2.6 and 2.7.

## 2.7 Key Variables

### What variables affect the timing of new baseload generation?

As previously mentioned, there are a number of variables which affect the energy balance in New South Wales. These variables will influence the need for new baseload generation. This section summarises the key variables (interconnection, capacity factors, renewable power stations, large industrial projects and energy efficiency) which have been identified as having a significant influence on the need for new baseload generation.

**Supply – interconnection**

The extent to which New South Wales can import energy supply from other NEM regions via interconnectors is influenced by the factors discussed in section 2.5.

**Supply – capacity factors**

The capacity factors of existing NSW plant is discussed in section 2.4.
Impact of drought

Water is an important component of electricity production, as it can be used as a source for hydro generation or as part of the production process (cooling for coal-fired and CCGT generators). The Inquiry notes that drought can also influence capacity factors.

As discussed in Appendix 2.5, in the first half of 2007, upward pressure on wholesale electricity prices followed generator capacity and energy restrictions in the NEM as a result of the drought and maintenance outages. For instance, the drought has caused the Snowy Hydro Scheme to shift some electricity production to its more expensive gas-fired plants in Victoria. There have also been generation reductions at South-East Queensland power stations following water scarcity.

Ensuring that any continuation of the drought does not impact on the security and reliability of NSW power supplies is a high priority. The Inquiry notes that the NSW generators have already undertaken measures to secure water supplies for power stations, including building a new recycled water treatment plant at the Vales Point power station to replace fresh water. The Inquiry also notes that the NSW Government has also announced that it will establish a 40 billion litre strategic water reserve to protect NSW power generation.

Water storage levels at dams that supply the major NSW inland power stations (Bayswater, Liddell, Mt Piper and Wallerawang) received inflows following the wet weather in June and early July. The Inquiry notes that NEMMCO released an updated version of its drought report, in which it is indicated that the extent to which the drought is affecting the generating capacity of power stations is easing.35

Factors such as drought add to the asymmetry of risk when considering the need for and timing of new baseload generation.

Renewable energy

The NSW Government’s commitment to renewable energy has already been factored into the forecasts. However, there is uncertainty around the likely siting of renewable generation.

Due to the wide-ranging opinions about the extent to which renewable sources of energy are able to supply baseload generation needs, the Inquiry considers that this also adds to the asymmetry of risk when considering the need for and timing of new baseload generation.

Energy efficiency

Current energy efficiency efforts are already implicitly factored into the TransGrid forecast. Demand-side abatement under the NSW Greenhouse Gas Reduction Abatement Scheme (GGAS), the Building Sustainability Index (BASIX), energy efficiency standards, the Climate Change Fund and greenhouse gas emission reduction targets will all play a key role in reducing the consumption of energy.

There is debate about the extent that energy efficiency measures are able to defer the need for new baseload energy. This issue is discussed in more detail in Chapter 4. There may be new methods to reduce energy consumption in the future. The Inquiry notes that effective new energy efficiency and demand management could affect the timing of the new supply – but that it does not obviate the need to be prepared now.

Large industrial projects

Any large new energy intensive industrial project in NSW could be expected to bring forward the timing of new baseload energy supplies, as it would significantly contribute to the future consumption of electricity. Such projects are often not incorporated in forecasts for energy consumption, unless publicly announced.

The Australian Bureau of Agriculture and Resource Economics (ABARE) notes that the growth in energy intensive industries (e.g. aluminium, alumina and iron/steel) is expected to continue, but it does not list any new large energy intensive industrial projects for New South Wales. 36

The Inquiry notes again that the potential for such a development adds to the asymmetry of risk when considering the need for and timing of new baseload generation.