1. Overview

1.1 The Inquiry

What are the Terms of Reference?

The NSW Premier, the Honourable Morris Iemma, MP established an Inquiry into Electricity Supply in NSW (the Inquiry) in May 2007 to advise the Government on the actions it needs to take for a timely investment in new baseload generation.¹

The Inquiry's terms of reference are to:

1. Review the need and timing for new baseload generation that maintains both security of supply and competitively priced electricity.

2. Examine the baseload options available to efficiently meet any emerging generation needs.

3. Review the timing and feasibility of technologies and/or measures available both nationally and internationally that reduce greenhouse gas emissions.

4. Determine the conditions needed to ensure investment in any emerging generation, consistent with maintaining the State’s AAA credit rating.

How important is a reliable electricity supply to NSW?

Providing reliable and competitively-priced electricity to the people of New South Wales is an essential service. It allows our businesses to compete domestically and overseas, and support’s the quality of life that is enjoyed by across the State.

Maintaining high standards of reliability for both electricity and gas is a key priority for the NSW Government. A reliable electricity supply must be considered from the perspective of both electricity generation, and the transmission and distribution network that delivers electricity to homes and businesses. Network reliability is very high in New South Wales and the Government is pursuing the even more ambitious reliability targets as set out in its the State Plan².

¹ See Appendix 1.1.
Over the next four years, NSW transmission and distribution businesses will invest over $10 billion in expanding and upgrading the State’s electricity network in Appendix 1.2 gives a snapshot and overview of the NSW electricity sector, including its different components, and further discusses network reliability.

Generation reliability means that New South Wales needs to generate or import enough electricity to meet customer needs at all times, including times of peak demand. The State’s everyday energy needs should be met in a way that gives its customers value for money. Until the beginning of this decade, New South Wales had the capacity to generate much more electricity than it needed. This followed the building of several large generators in the 1980s and early 1990s, and improved plant performance during the 1990s.

In 1998, the National Electricity Market (NEM) began operating as a wholesale market for the supply of electricity to retailers and end-users in New South Wales, Victoria, Queensland, South Australia and the Australian Capital Territory. Transmission interconnectors allowed electricity to be sent across jurisdictions. The NEM allows low cost power in those States with spare capacity to flow to States that need more capacity. Ongoing improvements in the NEM’s operation, upgrades to existing generators and development of generators designed to run at times of peak demand, have also helped ensure reliability of supply.

**Why is there a need for this Inquiry?**

The NSW Government has a crucial role in reviewing whether electricity supply will continue to be adequate for the state’s current and projected energy needs. This includes assessing whether current supply options will continue to meet energy needs in an economically efficient way. The Government also ensures that policy settings enable the market to come forward with new investment appropriate to emerging needs.

In looking at baseload options, the Inquiry particularly focussed on policy settings that would enable the investment decisions needed to maintain an ongoing secure electricity supply.

**Demand catching up with supply**

The State’s energy consumption has grown consistently over the last 30 years. Energy demand is expected to continue to grow over the next ten years but at a lower rate, due in part to energy efficiency measures. As no baseload generation plant has been built in New South Wales in the last 15 years, the energy consumed in New South Wales is catching up with supply. Chapter 2 discusses these trends in detail.

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3 Tasmania joined the National Electricity Market in 2005.
The advent of new technology with improved characteristics including higher efficiency, lower carbon dioxide (CO₂) emissions and lower water usage, is important in reviewing the need and timing of new investment in generation. This is particularly the case given growing public awareness of the energy sector’s contribution to greenhouse gas emissions and expectations that the sector will play a key role in reducing future emissions.

The Inquiry was also asked to advise the Government on whether new investment is needed, and if so, when, and what the options for new generation were.

Public and industry interest in a reliable electricity supply has been heightened by the effect of the drought. The water shortage has reduced the output of some hydro and coal-fired generators (which respectively use water to turn turbines, and for cooling), and has placed upward pressure on wholesale electricity prices.4

**Environmental and finance issues**

The Inquiry’s terms of reference reflect the Government’s commitment to the environment. In the State Plan, the Government has committed to a 60 per cent reduction in greenhouse gas emissions by 2050 and a return to year 2000 greenhouse gas emissions levels by 2025 (Priority E3). In addition, 15 per cent of electricity consumed in New South Wales is to be from renewable sources by 2020 (Priority E2). Climate change and environment protection policy will therefore have a major bearing on future generation investment options.

Similarly, the NSW Government’s commitment to responsible financial management and the maintaining the State’s AAA credit rating (Priority P1) will also have a major bearing on future generation investment options.

**How did the Inquiry approach its task?**

**Invitation for written submissions**

The Inquiry has encouraged broad public participation and used an evidence-based approach for its terms of reference. It invited the public and other stakeholders, through newspaper advertisements and its website, to make written submissions.

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The Inquiry received 74 written submissions. These came from a range of stakeholders, including members of the public, businesses that use and supply electricity, peak industry groups, unions, environmental groups, community welfare organisations, and Members of Parliament. Professor Anthony Owen also met with many stakeholders to further discuss their views and concerns.

Appendix 1.4 lists the stakeholder submissions and meetings and Appendix 1.3 gives a summary of submissions. The Inquiry is grateful to participants for their extensive and detailed submissions and their involvement in discussions.

**Specific research commissioned**

The Inquiry also gathered and reviewed other information relevant to its terms of reference. This included publicly available research papers and analyses of electricity supply and demand, discussed throughout this report.

The Inquiry commissioned extra work to supplement existing information in these four key areas:

- Potential baseload generation technologies likely to be available as the next tranche of baseload capacity needed in New South Wales (advice provided by Connell Wagner).
- Potential carbon emission reduction technologies, such as carbon capture and storage (advice provided by Connell Wagner, with assistance from Dr Lila Gurba and peer review from Dr Kelly Thambimuthu).
- Ongoing availability and cost of gas supplies for baseload generation in New South Wales (advice provided by Wood Mackenzie).
- Conditions required for private sector investment in new generation in New South Wales and the options available to bring about those conditions for investment (advice provided by Morgan Stanley).


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6 Dr Lila Gurba, Adjunct Senior Research Fellow, School of Biological, Environmental and Earth Sciences, University of NSW.

7 Dr Kelly Thambimuthu, Chief Executive of the Centre for Low Emission Technology.
1.2 Characteristics of Electricity Generation

What types of generation exist?

Baseload, intermediate and peaking plant

As electricity cannot be stored, it must be generated in the same instant it is consumed. Since demand for electricity varies during the day and across seasons, electrical systems need a mix of plant types that have different characteristics. This allows the system to respond reliably to these variations.

Baseload generation refers broadly to generators that operate at a steady output regardless of total demand for electricity. These plants tend to operate at all times throughout the year, except for when repair or scheduled maintenance work is done. By contrast, peaking generators operate only at times of high demand, such as cold winter evenings and hot summer afternoons when households are using heaters or air-conditioners.

Baseload plants are typically large in capacity, and provide most of the energy supply. They are also slow to fire up and cool down. Baseload generators typically have high capital costs and relatively low operating costs, which means they are well-suited to supplying electricity on a continuous basis. Baseload generation provides for the bulk of Australia’s electricity needs. In New South Wales, baseload generators are predominantly coal-fired.

Peaking generators can start up at short notice, operate over a wide range of output and respond rapidly to short-term peaks in demand. In New South Wales, hydro generators have mainly filled the peaking role. However, further potential for hydro peaking plants is very limited. Open cycle gas turbines are now used for peaking duty.

Gas-fired peaking generators typically have lower capital cost (relative to other types of generation) but are expensive to run. Peaking hydro plants are constrained from operating for long periods of time or at a high sustained output by the limited availability of water.

Recurring variations in demand above steady baseload are best met by intermediate plant. Such plants have lower capital cost but higher fuel costs than baseload.
Scheduled generation

Baseload, intermediate and peaking plants provide ‘scheduled’ generation to the NEM by offering their output to the wholesale market at particular prices or bids. These bids are ranked in ascending price order. The market operator, the National Electricity Market Management Company (NEMMCO), schedules each plant to come into production to meet demand, starting with the plant offering to supply electricity at the lowest price.

Appendix 1.5 illustrates how the relative costs of baseload intermediate and peaking generation affects their optimal levels of utilisation.

Non-scheduled generation

With some generation technologies, operators cannot control when energy will be produced, or how much will be generated at any given time. Such generators are typically dependent on external conditions, and include wind, most solar and run-of-river hydro schemes.

Electricity produced by such generators is called ‘non-scheduled generation’, and while in operation, displaces the need for scheduled supply whether it be peaking, intermediate or baseload. Non-scheduled generation only operates when external conditions allow, for example, wind generation depends on the availability minute-to-minute of sufficient wind. As such, non-scheduled generation cannot on its own maintain the security of supply of electricity.

Non-scheduled generation from renewable sources is expected to make an increasing contribution to the NSW generation mix over coming decades. Chapter 2 discusses this in detail.

The changing concept of baseload

Competitive wholesale electricity market participants are guided by their own commercial considerations when assessing which type of plant is best suited to run at a particular time. The commercial environment is changeable, and this is reflected in the way different generators are dispatched.

Emerging technologies and policy settings on carbon emissions will affect the relative operating costs of different types of generation. Over time, technologies other than those that have traditionally been associated with baseload generation may also be able to deliver 24-hour-a-day electricity competitively. Chapter 3 discusses this in detail.
What characterises NSW baseload?

Current baseload power stations in New South Wales are based upon black coal-fired water cooled technology. These power stations were deployed between 1968 and 1993. They burn relatively high ash coal of non-export quality which is delivered by rail, conveyor or truck (mainly on dedicated haul roads). Their generating units require approximately 12 to 20 hours to start up from cold. They are unable to operate below about 30 per cent of their maximum output for sustained periods of time.

Baseload capacity in Queensland is similar to New South Wales, except that Queensland’s newer plants have technology which uses less coal per unit of electricity generated. The plants have similar operational flexibility to the NSW plants.

Baseload capacity in Victoria is mainly based upon brown coal-fired technology typically built in the 1970s and 1980s. These units are less flexible than either NSW or Queensland baseload units, and require around 15 to 24 hours to start up from cold, with very limited ability to follow changes in overall power required on the system. They are generally unable to operate below about 80 per cent of maximum output for sustained periods of time. Brown coal-fired generators have lower thermal efficiencies and much higher CO₂ emissions per unit of output than black coal-fired generators.

1.3 Key Findings and Recommendations

This section summarises the key findings made in the course of the Inquiry and sets out the Report’s recommendations.

**New South Wales needs to prepare for baseload supply by 2013-14**

- 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.

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8 Coal-fired generators can be either water cooled or air cooled. See Chapter 3 for more detail on the different generation technologies.
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.

**To be ready for 2013-14 baseload supply needs, preparation should start now**

Based on recent power station developments in Australia, it can typically take up to six years to reach the stage of letting a contract for a new power station. This can be broken down as follows:

- feasibility, site selection and site purchase (up to two years)
- environmental assessment, and development and planning approval (up to two years)
- detailed design and lettings of construction contracts - which can be undertaken in parallel with development and planning approval - (one to two years)
- construction of a coal-fired power station can take up to four years inclusive of pre-commissioning works
- construction time for gas-fired powers stations can be around two years (plus pre-investment works).

**Coal or gas will meet most of the new baseload generation needs**

- Most of NSW extra baseload energy needs are likely to be met by coal-fired and/or gas-fired generation as other technologies can only contribute on a relatively small scale or will not mature until 2020 at the earliest.
- New renewable energy generation sources, mainly wind and biomass, are expected to supply 1,375GWh in 2013-14 and about 1,600GWh by 2016-17 (equivalent to replacing the current energy supplied by the Munmorah coal-fired power station).
- Technologies with minimal carbon emissions, such as Solar Thermal, and Geothermal Hot Rock could offer much as baseload generation in the future, but not for stations that are to be operational within the next ten years.
Nuclear is not an option due to the NSW Government’s policy position. In addition, establishing a nuclear energy regulatory framework and planning, building and commissioning a nuclear power plant in Australia is expected to take at least 10 to 20 years.

**Ultra-supercritical pulverised fuel coal generation is the only coal-fired technology that can efficiently meet emerging generation needs**

Three types of coal-fired generation technologies were identified by Connell Wagner:
- Ultra-supercritical Pulverised Fuel coal generation
- Integrated Gasification Combined Cycle (IGCC) coal generation
- Ultra Clean Coal (UCC) generation

As IGCC and UCC technologies are still at the demonstration stage, only Ultra-supercritical pulverised fuel coal generation will be capable of being operational by 2013-14.

Ultra-supercritical pulverised fuel coal-fired generation has a carbon intensity lower than current plant and will displace less efficient and more carbon intensive coal-fired generation in the merit order of dispatch, thereby reducing the average carbon intensity in the NEM.

New South Wales has ample resources of coal to supply new baseload coal-fired generation, with estimated recoverable reserves of around 10 billion tonnes. In 2004-05, the NSW coal industry produced 156 million tonnes of raw coal. Existing NSW power stations consume around 30 million tonnes of coal per annum.

**Combined Cycle Gas Turbines may be able to meet emerging generation needs**

Combined cycle gas turbines (CCGTs) are capable of running efficiently at high capacity factors. They are cheaper to build than coal-fired generators, but have higher fuel costs, and it is this that reduces their attractiveness for baseload power.

CCGT technology is amongst the most attractive for new intermediate plant.

Though not as firm as coal supply, adequate domestic gas is likely to be available for electricity generation until at least 2020 and possibly well beyond.
As a number of pipeline projects are already progressed in their planning, there is adequate lead time for the projects to be completed by around 2013-14.

Investment in new baseload generation in New South Wales needs greater regulatory certainty about an emissions trading policy

New investment in electricity generation will occur within a carbon-constrained environment. All States and Territories have committed to long-term emission reduction targets. The Commonwealth Government has promised to establish a long-term emission reduction target in 2008.

To achieve the long-term target, significant change in the way we generate and use electricity may be required across the National Electricity Market.

Australia inevitably will have a national emissions trading scheme, commencing no later than 2012. This will allow the market to determine the carbon price within the overall abatement targets.

Uncertainty over the key design elements of a national emissions trading scheme is delaying necessary investment in new generation, including low emission technologies development.

The Commonwealth Government should give regulatory certainty by bringing forward the timetable for establishing an emissions trading scheme. At a minimum it should resolve and announce the following key parameters:

- the national greenhouse gas reduction target and short term caps and associated penalties
- the basis for allocating emissions permits.

Emissions trading rules will influence the technology choice for new baseload generation

Combined Cycle Gas Turbines have less than half the carbon emissions of new coal-fired power stations, and will benefit relative to coal from an emissions trading scheme. With a high enough carbon price, combined cycle gas turbines could potentially provide lower cost baseload than coal-fired generation.
Renewable and low-emission target schemes, such as the NSW Renewable Energy Target will help to accelerate the use of technologies needed to meet long-term emission reduction goals, before and in the early years of an emissions trading scheme.

Carbon Capture and Storage (CCS) is being actively researched but is unlikely to be developed at utility scale for incorporation in baseload plants until beyond 2020.

Any new coal-fired generation should provide for retrofitting of Post Combustion Capture (PCC) to facilitate future CCS.

Manufacturers are able to make generators PCC-ready by allowing space in their designs for carbon capture plants that will be required if PCC is to be retrofitted.

The indicative costs provided by Alstom in their submission to the Inquiry suggest Ultra-supercritical pulverised fuel technology with PCC will have approximately the same capital cost and better technical performance (availability) than Integrated Gasification Combined Cycle with carbon capture.

CCS technology is estimated to require up to 30 per cent of the energy generated to be used in the power station and carbon capture process plant. This compares with typically 5 per cent for a power station without CCS.

**Energy efficiency measures will play a significant role in reducing electricity consumption**

Energy efficiency can and should play a significant role in helping to achieve the NSW Government’s energy and climate change policy objectives.

Enhanced energy efficiency can contribute to reducing electricity consumption. It is unlikely to offset the need for new investment in baseload generation in New South Wales in the short to medium term.

The NSW Government should continue to explore options to enhance the role of energy efficiency and consider extra measures to tackle ongoing barriers to the uptake of cost-effective investment in energy efficiency.

The Government should evaluate the case for replacing the Demand Side Abatement (DSA) Rule with an energy efficiency target and trading scheme in the switch from the existing NSW Greenhouse Gas Reduction Scheme to a national emissions trading scheme. This will help keep incentives for energy efficiency in place.
The National Electricity Market is working efficiently and effectively

- The energy market reforms of the 1990s have established a national and competitive energy market governed by a tested regulatory framework. The success of these reforms means the Government no longer needs to own electricity businesses to ensure security of supply.

- The National Electricity Market (NEM) provides a market that is efficient and protects consumers regarding price, quality, reliability and security of electricity supply.

- Government ownership of electricity businesses operating in the competitive sectors of the industry neither increases nor decreases the State’s ability to ensure that price, social and environmental outcomes are achieved from the electricity industry.

The impact on the State could be up to $15 billion to ensure security of supply, compliance with regulatory requirements and commercial competitiveness

- Should the NSW Government choose to continue to own most of the State’s electricity industry, the State will almost certainly have to both fund the next tranche of baseload generation in New South Wales and invest further in the State-owned energy corporations. There is no sustainable half-way house. If the Government continues to own businesses operating in the competitive energy market, it needs to accept that these businesses will have to pursue business strategies and investments across the NEM that will allow them to be successful.

- Investment in baseload capacity is but one example of the type of investments that Government would need to fund. The cost of new investment in generation capacity in New South Wales over the next 10 to 15 years is expected to be in the vicinity of $7 billion to $8 billion.

- The Government-owned retail businesses will struggle to remain viable without significant additional capital to allow them to adopt a more vertically and horizontally integrated business model. The potential cost of doing so is in the range of $2 billion to $3 billion over the same period.
Further, the Inquiry believes Government may be exposed to investing in the order of $3 billion to $4 billion over the next 15 years to retro-fit some existing power stations with carbon reduction technologies.

While these investments may earn a return, the NSW Government would need to accept that it has less choice over how its limited capital is allocated to meet State Plan objectives and be prepared to make adjustments elsewhere in its capital program and State Budget to account for the increased business risk that such investment entails.

Alternatively, divesting the retail and generation interests to the private sector would mitigate the need for public funding of the investment in these businesses and would realise proceeds otherwise unavailable to the Government.

The combined impact of both the divestment of generation and retail and the avoidance of new generation investment means that total State net debt would be up to $26 billion lower in 2020 compared to a ‘retain and invest’ scenario. This would significantly improve the State’s fiscal position and the Government’s ability to meet its State Plan objectives.

The State’s business profile and credit rating will benefit from the removal of ‘high risk’ generation and retail assets from its balance sheet.

In summary, the Inquiry considers private sector investment will meet the State’s emerging generation needs while allowing the Government to achieve its energy and environmental policy goals, maintain the State’s credit rating and improve its ability to deliver State Plan objectives.

The Private Sector will invest in baseload generation in New South Wales if a number of conditions are met

- The private sector has demonstrated it will invest in new generation in the NEM under the right conditions (including access to a stable revenue stream, to generation development sites and to fuel sources).
- The private sector can manage the commercial risks in developing a power station but has less capacity to handle policy and regulatory risks. Submissions to the Inquiry highlighted carbon uncertainty and Government ownership as impediments to investment.
To secure on-going generation investment in New South Wales that is adequate, economic and timely, the NSW Government should transfer its retail and generation interests to the private sector.

In transferring these interests, the Government will maximise the range of competing potential investors, quarantine risk to the State’s fiscal position and AAA credit rating, and realise proceeds not otherwise available and likely to be eroded over time.

This does not involve selling the ‘poles and wires’ of the State’s electricity transmission and distribution networks.

The Commonwealth Government should bring forward the timetable for establishing a national emissions trading scheme.

The Inquiry therefore recommends that the NSW Government:


2. Divest the State of the generation businesses of Macquarie Generation, Delta Electricity and Eraring Energy.

3. In the event that the Government does not wish to sell generation, then it should implement an appropriately structured long-term leasing of current generation assets. The State would retain ownership of the assets, with operational and commercial control by the private sector.

4. Actively monitor the progress of reforms to NSW planning, development approval and environmental licensing process to ensure that proposals for new generation capacity, and associated fuel supplies, are considered expeditiously, and in a cost-effective and predictable manner, without compromising the quality of environmental assessment.

5. Support the planned review of the effectiveness of retail competition by the Australian Energy Market Commission in 2010, and consider the removal of regulated retail price caps at that time, should the review find effective competition in the NSW retail market.
6. Encourage the Commonwealth Government to bring forward the timetable for establishing a national emissions trading scheme. At a minimum the Commonwealth should resolve and announce:

- the national greenhouse gas reduction target and short term caps and associated penalties
- the basis for allocating emissions permits.

7. Develop and implement clear and timely transitional rules for existing State-based greenhouse gas and emission schemes to the national emissions trading scheme (in the event of its introduction).

8. Encourage and support energy efficiency initiatives where possible.