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Key Issues in Energy

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by Daniel Montoya and Nathan Wales

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Key Issues in Energy

by

Daniel Montoya

&

Nathan Wales

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ABBREVIATIONS AND ACRONYMS

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
AC	Air Cooled
ACCC	Australian Competition & Consumer Commission
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AERA	Australian Energy Resource Assessment
ARENA	Australian Renewable Energy Agency
ASPO	The Australian Association for the Study of Peak Oil and Gas
ATSE	Australian Academy of Technological Sciences and Engineering
BREE	Bureau of Resources and Energy Economics
Capex	Capital Expenditure
CCGT	Combined Cycle Gas Turbine
CCS	Carbon Capture and Storage
CEC	Clean Energy Council
CO_2-e	Carbon Dioxide Equivalent Gases
COAG	Council of Australian Governments
CPI	Consumer Price Index
CRET	Commonwealth Renewable Energy Target
CSG	Coal Seam Gas
Cth	Commonwealth
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DTIRIS	Department of Trade and Investment, Regional Infrastructure and Services (NSW)
EBITDA	Earnings Before Interest, Tax, Depreciation and Amortisation
EDR	Economic Demonstrated Resources
EPHC	Environment Protection and Heritage Council
EUAA	Energy Users Association of Australia

GGas	Greenhouse Gas Reduction Scheme
GHG	Greenhouse Gas
GJ	Gigajoule (1 billion joules)
Gt	Gigatonne (1 billion tonnes)
GW	Gigawatt (1 billion watts)
GWh	Gigawatt hour (1 billion watt-hours)
HHV	Higher Heating Value
IGCC	Integrated Gasification Combined Cycle
IPART	Independent Pricing and Regulatory Tribunal
LEP	Local Environmental Plan
LRC	Low Reserve Condition
LRET	Large-scale Renewable Energy Target
MJ	Megajoule (1 million joules)
MRET	Mandatory Renewable Energy Target
MRL	Minimum Reserve Level
MRRT	Minerals Resource Rent Tax
Mt	Megatonne (1 million tonnes)
Mtpa	Megatonne Per Annum (1 million tonnes per annum)
MW	Megawatt (1 million watts)
MWh	Megawatt hour (1 million watt-hours)
NCC	National Competition Council
NCIG	Newcastle Coal Infrastructure Group
NECF	National Energy Customer Framework
NEL	National Electricity Law
NEM	National Electricity Market
NERL	National Energy Retail Law
NGL	National Gas Law
NHMRC	National Health and Medical Research Council
NTNDP	National Transmission Network Development Plan

OCGT	Open Cycle Gas Turbine
OECD	Organisation for Economic Cooperation and Development
Opex	Operating Expenditure
ORER	Office of the Renewable Energy Regulator
PEP	Petroleum Exploration Permit
PJ	Petajoule (10^{15} joules)
$PM_{2.5}$	Particulate Matter <2.5 μm
PM_{10}	Particulate Matter <10 μm
PV	Solar Photovoltaic
PWCS	Port Waratah Coal Services
REC	Renewable Energy Certificate
RET	Renewable Energy Target
SC	Super-Critical
SCER	Standing Council on Energy and Resources
SEPP	State Environmental Planning Policy
SRES	Small-scale Renewable Energy Scheme
SRMC	Short-Run Marginal Cost
STTM	Short Term Trading Market
tCO_2-e	Tonnes of Carbon Dioxide Equivalent Gases
TJ	Terajoule (1 trillion joules)
USC	Ultra Super-Critical
VTPA	Voluntary Transitional Pricing Arrangements
WAPC	Weighted Average Price Cap
WC	Water Cooled

FOREWORD

The purpose of this briefing book on Key Issues in Energy is to provide Members of the New South Wales Parliament with an up to date and accessible overview of this important, complex and many sided subject. Issues relevant to energy, including its production, consumption and pricing, are significant at every level of politics, economics and environmental science in New South Wales and beyond. Energy related issues impact on people of all walks of life and in a variety of contexts, from cost of living and employment concerns to debates about sustainability and the like.

With a focus on New South Wales, this briefing book covers a wide range of topics, setting out key data on renewable and non-renewable energy resources in its early pages and expanding on these themes in later sections of the publication. The importance of coal to the New South Wales economy is discussed, as are the environmental concerns arising from our traditional reliance on fossil-fuel power generation. Likewise, the potential of wind-powered generation is considered, in which context certain health related concerns are canvassed. In all cases, the intention is to set out the facts, figures and issues clearly and even-handedly, without arguing the case for or against any particular solution to future energy needs. The closing sections of the publication set out the relevant trends and projections relating to gas and electricity pricing, issues which are likely to be the subject of intense future debate. All care has been taken to source the data presented from the best available research. The information included in the briefing book is current as at December 2011 and includes the findings of the Commonwealth Government's Draft Energy White Paper, released on 13 December 2011.

While every effort has been made to present the data in an accessible form, certain aspects of the discussion are to some degree unavoidably technical in nature. Likewise, the complexities of the intergovernmental regulatory frameworks operating in many of these areas must be addressed to an extent on their own difficult terms. To assist the reader to navigate the plethora of research and regulations, hyperlinks are provided to key documents in all the subject areas, along with an extensive bibliography.

It is also the case that, while the topics covered in this publication are wide-ranging, it does not purport to be comprehensive in scope. Some key issues in energy are identified but for various reasons are not discussed in detail. These include the topical subjects of coal seam gas (CSG), carbon pricing, and climate change, all of which are the subject of ongoing debate and inquiry. For example, there is currently a NSW Legislative Council inquiry into the environmental, health, economic and social impacts of CSG activities. It should also be noted that, with the focus on New South Wales, the discussion of the national and international dimensions to the energy debate is not exhaustive. These are among the relevant topics that may be addressed in future Research Service publications.

This Key Issues on Energy Paper is available in hard copy to Members, as well as in electronic format on the Parliament's website and on the Internet.

Gareth Griffith

Manager, Research Service

21 December 2011

INTRODUCTION

The supply of reliable and affordable energy is vitally important for most aspects of our daily lives and for the functioning of the national economy. NSW meets a large part of its energy needs through local production but it is a net importer of gas, electricity and liquid fuels. NSW exports substantial quantities of coal to other countries, and this makes an important contribution to the State's export revenues.

As shown below, energy resources and markets in Australia exist as a complex array of linkages. Beginning with the accessing of primary energy sources, as identified on the diagram's left, energy resources eventually make their way to either the export market, for transformation into secondary energy resources such as electricity and heat, and/or final consumption by residential and commercial users. Energy supply chains reflect domestic and international energy export, production and consumption trends.

Reliance on fossil fuels (coal, oil and gas) since the mid-19th century as the dominant global energy source has resulted in rapid growth in the emission of greenhouse gases (GHGs), such as carbon dioxide. It is now widely accepted in the scientific community that the global rise in GHG emissions is contributing to climate change, which could have serious adverse consequences. A major challenge therefore is to integrate renewable forms of energy into the energy sector.

In recent years, State and Federal Government energy policies and legislation have sought to encourage the adoption of renewable forms of energy whilst maintaining reliable, secure energy supplies and responding to increased domestic and international demand. Australia's energy production is predicted to more than double by 2035, primarily due to strong export demand. Over the same period, domestic primary energy consumption is expected to rise by 30% and electricity generation by 42%.

OUTLINE OF PAPER

This paper starts with an overview of some of the major energy developments in recent years.

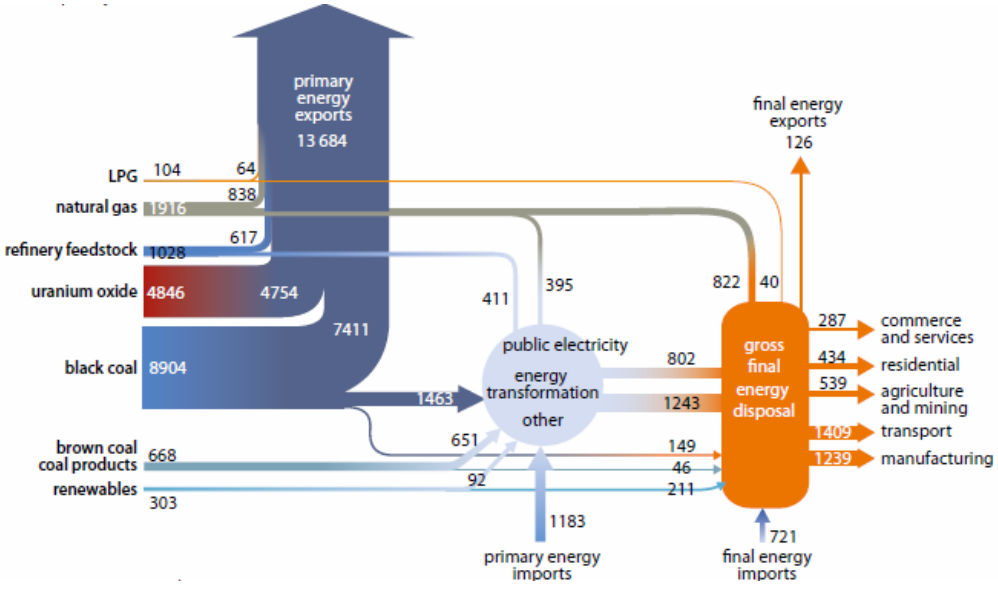
Next, there are three background chapters containing statistics and general information on NSW energy resources, production and consumption. This information is contextualised by reference to energy trends across Australia.

The following two chapters explore different aspects of two of NSW's most significant energy resources, coal and gas and their use in the generation of the State's electricity. Coal and gas are set to play significant roles in NSW's energy future, as exemplified by large forecast investment in the sector. However, this is likely to involve significant environmental issues.

The third section of the paper addresses renewable energy sources such as solar, wind and bioenergy. Recent State and Federal policy and legislative developments are summarised, and issues and challenges identified.

The paper ends with overviews of two closely connected energy markets - electricity and gas. Current regulatory frameworks, recent and ongoing reforms, and retail price trends and developments are discussed.

The flow of energy in Australia in 2008-09 (petajoules)



RECENT DEVELOPMENTS

Energy policy and legislation relevant to NSW is developed by the NSW and Federal Governments. The Council of Australian Governments (COAG) also plays a key role. One of the most significant recent national developments was the release in December 2011 of the Federal Government's Draft Energy White Paper. The Paper sets out a comprehensive strategic policy framework to guide the development of Australia's energy sector.

PRIMARY ENERGY

Recent primary energy developments have the potential to extensively alter the future energy landscape. First, the coal seam gas (CSG) industry has undergone rapid expansion in the past decade, much of it in Queensland. While an estimated 2,983 petajoules (PJ) of commercially recoverable CSG are located in NSW, total CSG reserves in NSW may be as high as 155,000 PJ. To put this in context, NSW consumed 1,623 PJ of energy in 2009.

In November 2011, the Senate Rural Affairs and Transport Reference Committee released its interim report into the impact of CSG mining on the Murray Darling Basin. The Committee effectively recommended a moratorium on CSG development approvals, pending new research into the potential impacts on surface and ground water in the Murray Darling Basin. In December 2011, the O'Farrell Government extended its moratorium on CSG 'fraccing' until April 2012, pending the completion of an independent review process. In addition, in December 2011 the COAG Standing Council on Energy and Resources announced agreement on the development of a national harmonised regulatory framework for the CSG industry, to be released for consultation in September 2012. There is also an ongoing NSW Legislative Council inquiry into the environmental, health, economic and social impacts of CSG activities.

The second primary energy development relates to the passing through the House of Representatives in November 2011 of the Federal Government's Minerals Resource Rent Tax Bill 2011. Under this proposed tax, any profit made by mining companies above 6% of their capital investment would be taxed at 40%, and all royalties presently paid to the States would be rebated.

A third primary energy development is that, in December 2011, Labor's national conference voted to overturn the ban on selling uranium to India. Following this development, the NSW Premier, Barry O'Farrell, announced that in early 2012 Cabinet would consider overturning the ban on exploration for uranium in NSW.

CLEAN ENERGY

Climate change is the dominant environmental subject of our times. There is now bipartisan national support for an unconditional national GHG emissions target of 5% below 2000 levels by 2020, as well as a continuing bipartisan commitment to a Renewable Energy Target of 20% by 2020. The NSW Government is also committed to a Renewable Energy Target of 20% by 2020. In December 2011, the Federal Government's Clean Energy Future Legislative Package received Royal Assent. Central to the package is a price on carbon, set to commence on 1 July 2012 at $23 per tonne. According to the Federal Government, the carbon tax, in essence a 'pollution tax' on sources which emit carbon dioxide, is the most effective and least costly mechanism to reduce carbon output. The precise implications for NSW, economic and environmental, remain to be determined.

ENERGY MARKET REFORMS

Three recent energy market developments are particularly noteworthy. One concerns the Australian Energy Market Commission, which is currently reviewing the regulatory framework for electricity and gas network companies. This review was requested because rising network costs make up a large proportion of recent substantial electricity and gas price increases. Another major development is that, on 24 November 2011, the O'Farrell Government announced that it would sell the State's electricity generators in 2012 whilst retaining the transmission and distribution networks in public ownership. Finally, there is an ongoing Legislative Assembly inquiry into the economics of energy generation.

The Federal Government's Draft Energy White Paper identifies a set of "critical" energy market reform issues:

- Privatising government-owned energy assets;
- Fully deregulating retail energy prices where effective competition exists;
- Implementing an improved energy productivity (demand side) framework to efficiently reduce peak-demand growth and provide an enhanced set of options for consumers to better manage their energy use and costs;
- Completing the transition to truly national energy markets;
- Further gas market monitoring to better inform government decision-making; and
- Reviewing current non-complementary policy interventions from all levels of government which are adding unnecessary costs to energy bills.

NSW ENERGY RESOURCES - PART ONE

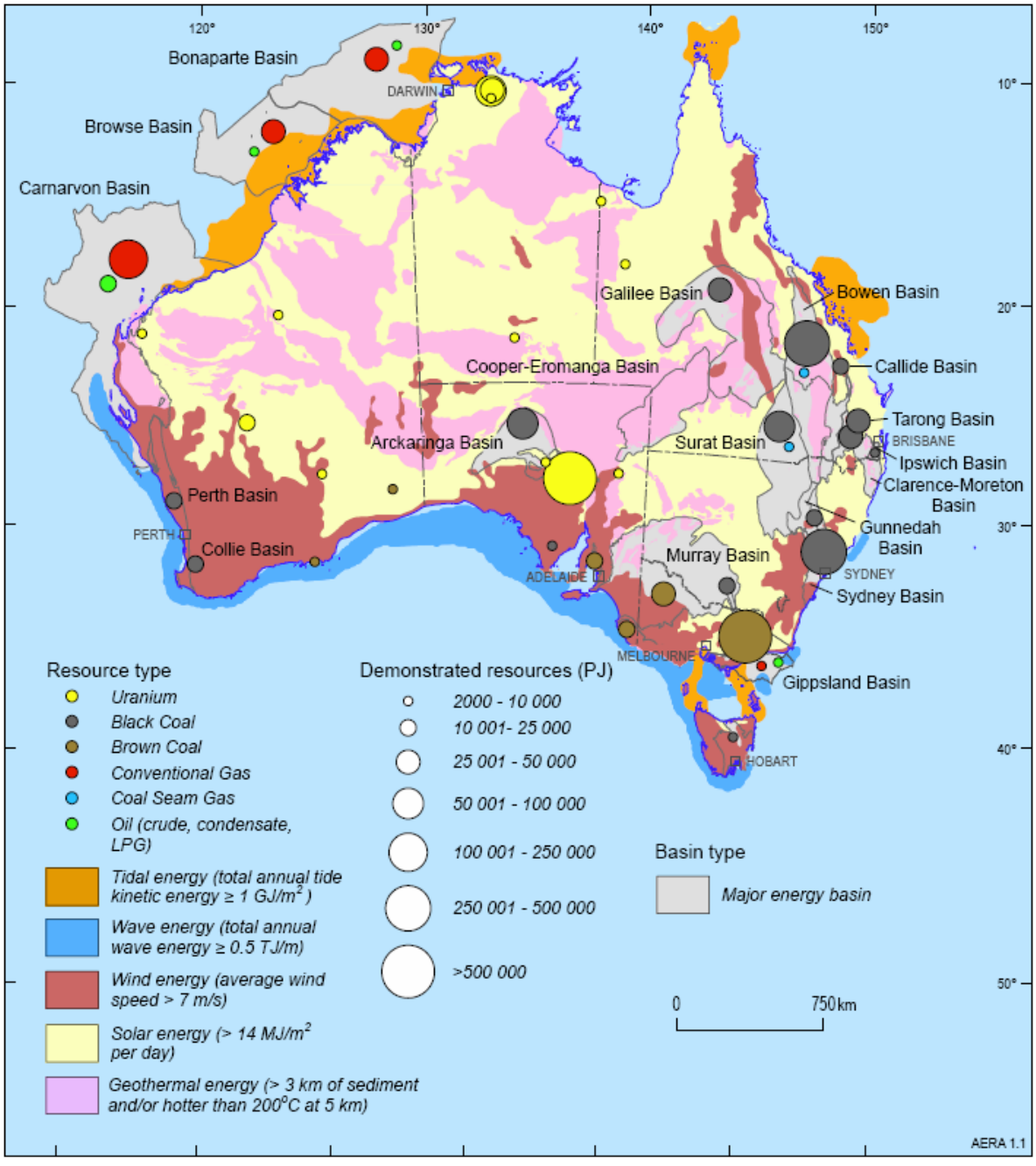
Australia has abundant and diverse energy resources. Its three largest non-renewable energy resources are coal, uranium and gas. NSW has significant coal reserves, relatively small gas reserves and an unknown quantity of uranium.

40% of Australia's "economic demonstrated resources" of black coal are found in NSW. In contrast, 5.3% of Australia's economic demonstrated resources of coal seam gas (CSG) and less than 0.01% of Australia's economic demonstrated resources of natural gas are in NSW.

NSW non-renewable energy resources

Resource	Economic Demonstrated Resources (PJ)	
	NSW	Australia
Black coal	390,519	987,064
Conventional gas	12	122,100
Coal seam gas	2,983	16,590
Condensate	0	12,560
Crude oil	0	6,950
LPG	0	4,614
Oil shale	0	Valuation in progress
Uranium	0	651,280
Thorium	Unknown	Unknown

Australia's major energy resources, excluding hydro and bioenergy

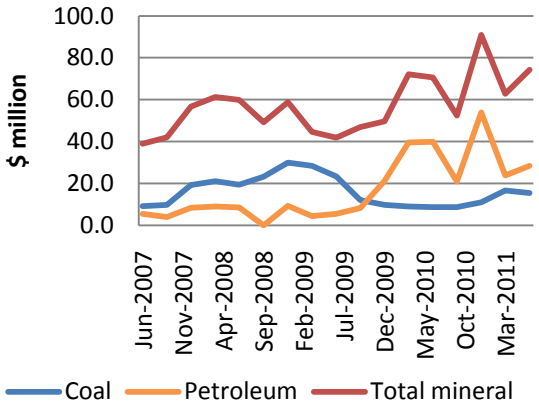


COAL

Coal is NSW's largest fossil fuel energy source. 375,084 Petajoules (PJ) of economic demonstrated resources of black coal are found in NSW. This is equivalent to 16.64 Gigatonnes. The majority of this coal is found in three geological formations: the Sydney Basin; the Gunnedah Basin; and the Murray Basin. Consequently, the majority of NSW black coal exploration and mining licences are found within these Basins.

Based on ABS figures, coal exploration expenditure decreased from a high of $29.9 million in the December 2008 quarter to $8.7 million in the September 2010 quarter. However, since the September 2010 quarter, coal exploration expenditure has been trending upwards.

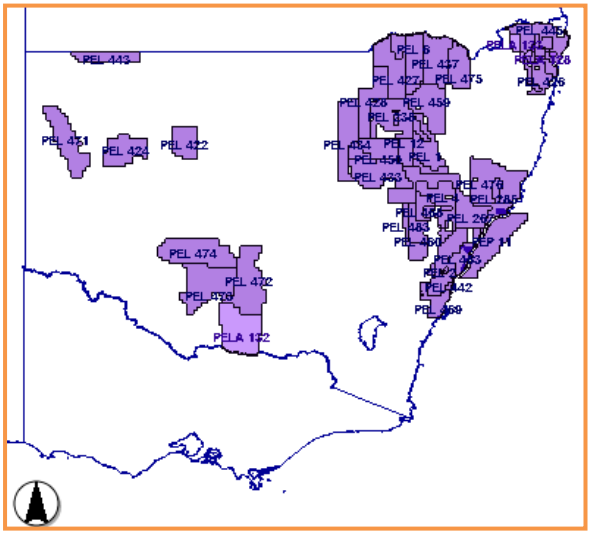
Mineral exploration expenditure in NSW



PETROLEUM

"Petroleum" resources include oil and conventional gas, along with unconventional petroleum resources such as coal seam gas (CSG) and shale oil.

Petroleum titles and applications in NSW



NSW remains significantly under-explored for petroleum compared to neighbouring States. The exploration that has occurred established that some of the sedimentary basins in NSW have all the elements of petroleum systems suitable for the generation of oil and gas. Petroleum exploration expenditure has significantly increased since the September 2009 quarter, during which $8.2 million was spent. Expenditure peaked in the December 2010 quarter at $54 million, and dropped to $28.4 million in the June 2011 quarter. CSG exploration comprises most of the increased expenditure.

Exploratory wells have found oil, shale oil and gas in NSW. However, only gas is currently being produced. In December 2010, the first offshore petroleum exploratory well was drilled near Newcastle. While no gas was found, the company which holds Petroleum Exploration Permit 11 (PEP 11) is optimistic of finding gas. The PEP 11 area stretches from Newcastle to half way between Sydney and Wollongong and contains an estimated 16,695 PJ of gas.

COAL SEAM GAS

As a form of petroleum, CSG exploration takes place under petroleum titles. 2,983 PJ of 'proven and probable' CSG are located in NSW. This figure represents the best estimate of commercially recoverable CSG. However, total CSG reserves in NSW may be as high as 155,000 PJ.

Coal seam gas reserves in NSW (PJ)

Gas basin	Proved & Probable (2P)	Proved, Probable & Possible (3P)
Clarence-Moreton	461	1,655
Gloucester	721	895
Gunnedah	1,636	149,740
Sydney	165	(included with Gunnedah)
Total	2,983	152,290

URANIUM AND THORIUM

Uranium exploration is banned in NSW under the *Uranium Mining and Nuclear Facilities (Prohibitions) Act 1986*, a position that will be reviewed by Cabinet in early 2012. According to Geoscience Australia, no known deposits of uranium exist in NSW. However, uranium is likely to be present in NSW given geological regions known to contain uranium extend from other States into NSW.

Thorium is currently under consideration worldwide as a potential fuel for nuclear reactors. While very little exploration for thorium has taken place in Australia, two likely sources in NSW exist at Ginkgo and Dubbo.

NSW ENERGY RESOURCES - PART TWO

Australia has significant renewable energy potential including wind, solar, bioenergy, geothermal, hydro and ocean (including tidal and wave). In contrast to non-renewable energy resources, it is difficult to quantify the amount of renewable energy that is available.

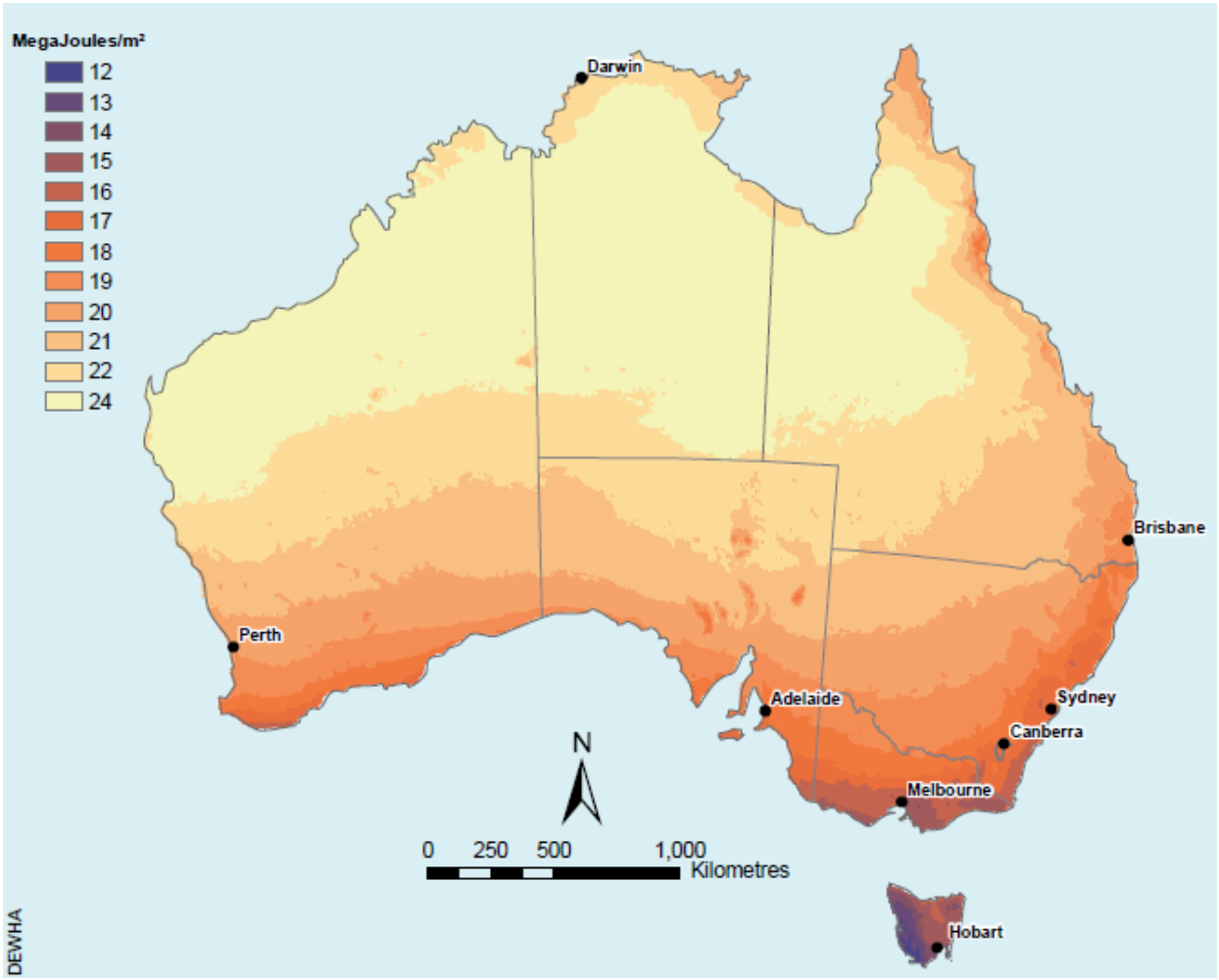
Factors such as investment and research and development into renewables provide insight into its potential, as does the evolving policy environment, supporting infrastructure and future projections.

SOLAR

Australia has the highest average solar radiation of any continent in the world. Solar power is Australia's most abundant energy resource. Annual average solar exposure exceeds 15MJ/m^2 per day throughout NSW and increases to 21MJ/m^2 per day in the north-west of the State. Solar insolation greater than 18MJ/m2 per day is considered high.

The feasibility of solar energy is not only restricted by the amount of the resource, but also infrastructure, grid capacity for storage, and the number of sunshine hours.

Solar potential in Australia



WIND

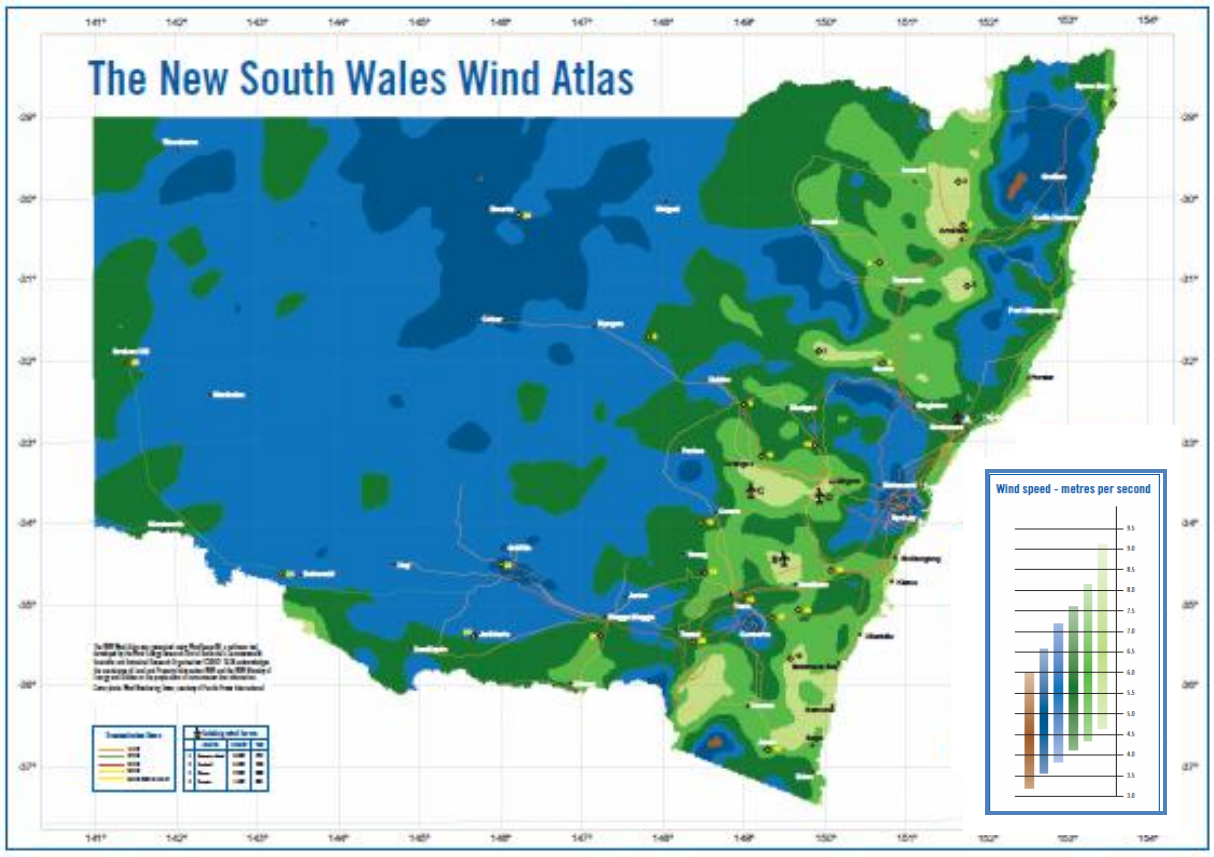
Available wind resource varies depending on factors including seasonality and wind speed. Wind speed generally increases with height and is affected by local topography.

The potential for wind power to contribute to the future supply of energy requires better estimates of wind speed over the long-term. For example, planning for a proposed wind farm development, the Kyoto Energy Park, near Scone, is based on approximately 10 years long-term wind resources monitoring.

A 2011 article published in the Journal of Climate found that average wind speeds have increased across Australia. According to the author, this should generate greater investment interest.

The NSW Wind Atlas shows average wind speeds across the State and existing infrastructure such as the location of existing wind farms and transmission lines.

Wind resources in NSW

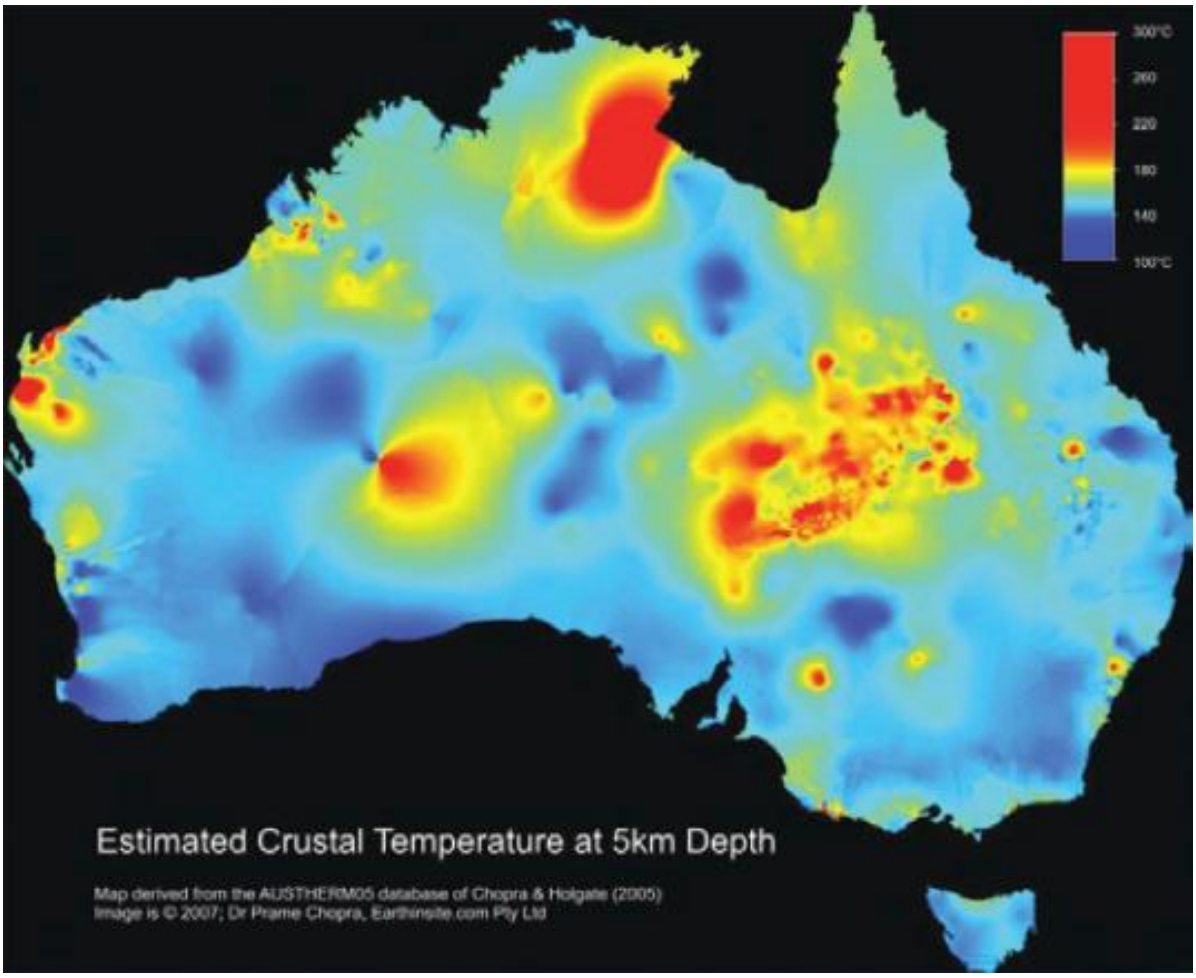


GEOTHERMAL

A 2009 report by the Australian Academy of Science suggests that the potential for geothermal energy in Australia in general is enormous. However, the potential is uneven across the continent, and significantly less in NSW than other areas. One issue is that the amount available may not correspond to the quantity that can be accessed. As shown in the map below, the geothermal resource in NSW is limited largely to the Hunter region.

Thermal mapping suggests that the energy contained in the upper 5 kilometres of Australia's crust is 1.9 x 1025 Joules, which is the equivalent of about 2.6 million years energy supply at 2004–05 consumption levels. Of course, not all of this energy will be accessible for extraction. Nevertheless, if a low estimate of 1% was taken geothermal sources could provide 26,000 years of energy supply.

Potential geothermal energy resources in NSW



BIOENERGY

Any fuel that is derived from biomass can be used to produce bioenergy. Biomass resources include wood-related waste, residues from forests and agricultural production such as sugarcane. They also include organic waste by-products from industry, domesticated animals, human activities such as landfill and sewage gas, and urban biomass.

The potential of bioenergy as an energy source is significant. Globally, 220 billion 'dry' tonnes of biomass are produced every year, which as an energy source represents some ten times the world's total current energy use. However, quantification of the available bioenergy resource is difficult given the range and variability in supply of bioenergy sources.

The potential long-term bioenergy contribution to electricity generation in Australia

Resource	Potential (GWh)
Agricultural-related wastes	50,556
Sugarcane	7,800
Wood-related wastes	5,060
Urban biomass	4,320
Landfill gas	3,420
Sewage gas	929
Energy crops	534
Total	72,629

The NSW Government has identified large potential resources for bioenergy in NSW, across agriculture, forestry and wastes. It is estimated that over 1,500 MW of bioenergy could be produced per annum.

OCEAN

Ocean energy primarily comes from wave and tide motion and occurs with a relatively high degree of predictability. Global ocean energy (including tidal and wave) could produce over 5,000 times the world's current use of electrical energy, according to a report by the Australian Academy of Science. The report argues that Australia is well placed to be a large utiliser of wave and tidal energy, with up to 5% of our needs potentially coming from wave energy within 20 years and possibly up to 25% by 2060:

> Wave energy densities in southern Australia are very high, with potential to offer very high load factors. Such potential could be readily harnessed by heavy industries (e.g. aluminium smelting) as manufacturing production can be managed to align with predictable peak generation periods.

However, examination of the total annual tidal kinetic energy for NSW suggests there is limited potential for tidal energy in NSW compared to elsewhere in Australia. The low amount of tidal energy adjacent to NSW reflects the low volume of waters along the continental shelf, and the current speed of those waters, which are smaller in NSW coastal waters compared to elsewhere in Australia.

Total annual tidal kinetic energy in Australia

State/Territory	Total energy (TJ)
Northern Territory	311.63
Queensland	454.19
New South Wales	1.21
Victoria and Tasmania	151.41
South Australia	27.15
Western Australia	1,496.33
National total	2,441.92

HYDROELECTRICITY

While hydroelectricity is currently Australia's major source of renewable electricity, the potential for hydro energy is constrained in the long term by water availability. According to the Australian Energy Resource Assessment, future growth in Australia's hydroelectricity generation will be underpinned by the development of small scale hydroelectricity facilities and efficiency gains from the refurbishment of large scale hydro plants. The share of hydro in total national electricity generation is projected to fall from 5.5% in 2007-08 to around 3.5% in 2029–30.

NSW ENERGY PRODUCTION

Australia is the world's ninth largest energy producer. The main fuels produced in Australia are coal, uranium and natural gas. NSW has large coal reserves, potentially significant coal seam gas reserves, and unknown uranium reserves.

Primary energy is energy embodied in natural resources such as coal, uranium, water and sunlight. Secondary energy includes electricity and heat generated from primary energy sources.

PRIMARY ENERGY PRODUCTION

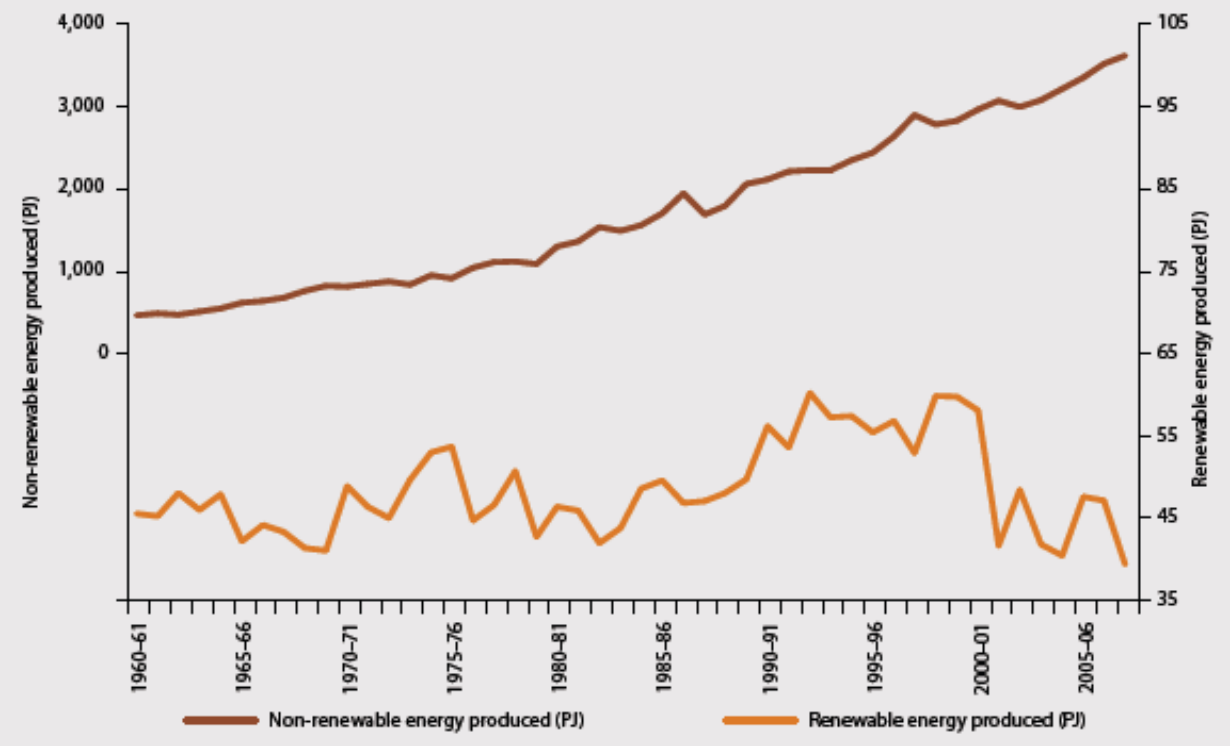
NSW primary energy production in 2007-08 was equal to 3,629 Petajoules (PJ). The main energy source was coal (over 98%). Less than 2% of primary energy production was from renewable sources, including wood (0.6%), hydroelectricity (0.3%) and bagasse (0.2%). Natural gas comprised 0.4% of the total. Small amounts of gas are produced from the Coonarah Gas Field and the Camden Gas Project, which has been producing gas since 2001.

RENEWABLES AND NON-RENEWABLES

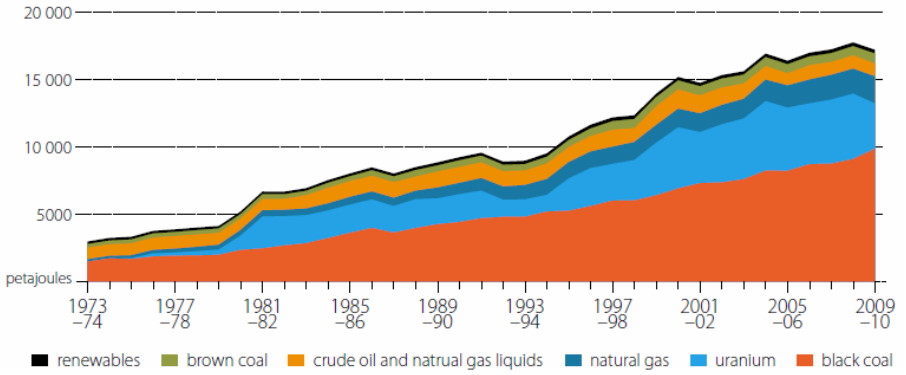
From 1960–61 to 2007–08, the production of non-renewable fuels in NSW has continually shown an upward trend, increasing from 438 PJ to 3,590 PJ. Renewable energy production in NSW decreased after 2000 to levels similar to those recorded in the early 1960s. This was due to a decrease in the use of wood and reduced supply from hydroelectric schemes because of drought.

By comparison, Australia's energy production was approximately 17,800 PJ in 2008-09 and 17,282 PJ in 2009-10. The main energy sources produced nationally, on an energy content basis, were coal (61%), uranium (19.5%) and crude oil and gas (17.5%). Renewable energy accounts for nearly 2% of total production. Renewable energy production nationally was equal to 290 PJ in 2007–08. This was equivalent to 5% of Australia's total primary energy consumption of 5,572 PJ and represented 16% of capacity of all electricity generation projects in Australia.

Primary energy production in NSW and the ACT between 1960-61 and 2007-08



Primary energy production (PJ) in Australia by type between 1973 and 2010

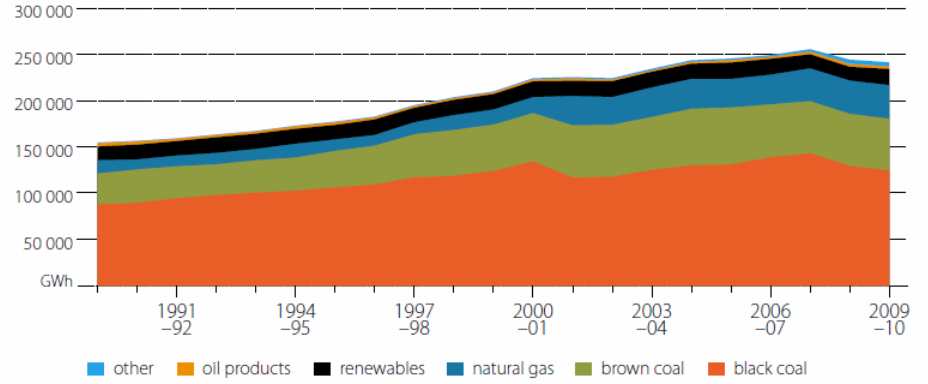


ELECTRICITY GENERATION

Total electricity generation in Australia was approximately 925 PJ in 2007–08. Coal accounts for about three-quarters of Australia's electricity generation, followed by gas (16%). Renewable energy sources account for an estimated 7% of electricity generation. Electricity generation, by fuel, is shown below.

Total electricity generation in NSW was approximately 287 PJ in 2008–09. 7.2% of electricity generated in 2008–09 was from renewable fuel, up from 6.4% in 2004–05. Black coal contributed to approximately 89% of total electricity generated in NSW in 2008–09.

Electricity production (GWh) in Australia by type between 1991 and 2010



Capacity of fossil-fuel power generation (MW) in NSW/ACT, and Australia, at June 2009

Fuel Type	MW capacity of fossil-fuel power generation		% change NSW/ACT since 2004
	NSW/ACT	Australia	
Black coal	11730	22072	1
Pump storage (hydro)	240	740	0
Natural gas	1235	8023	672
Oil products	50	614	0
Total	15540	50814.5	27

Capacity of renewable generation (MW) in NSW/ACT, and Australia, at December 2009

Fuel Type	MW capacity of renewable generation		% change NSW/ACT since 2004
	NSW/ACT	Australia	
Hydro	2466.1	7070.4	-25
Bagasse	75.5	444.1	387
Biomass	4.4	45.6	-9
Black liquor	20	76.5	0
Geothermal	0	0.1	-
Landfill gas	60	168	108
Sewage gas	7.9	39	126
Solar	4.5	8	85
Wave	0.5	0.5	0
Wind	187.4	1714.1	1025
Total	2826.1	9566.7	-17

Note: the capacity of renewable generation for hydro decreased significantly in 2009 compared to 2004 due to drought

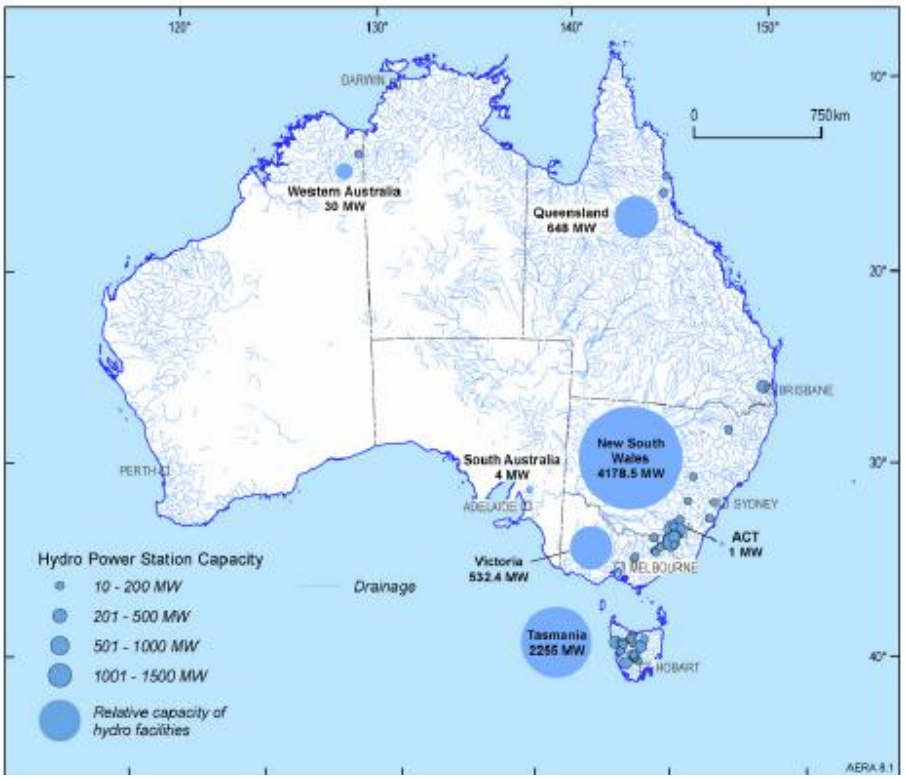
The capacity of renewable electricity generation in NSW in 2009 was a significant portion of the total renewable capacity in Australia. Hydro power far exceeds the capacity of all other renewable fuel types, comprising 87% of the total renewable generation for NSW and the ACT. In 2007–08, 21% of total national hydroelectricity generation occurred in NSW. NSW has a significant share of the total operating hydroelectric power stations with a capacity greater than 10 Megawatts.

Between 2002–2003 and 2008–2009 the value of electricity generated in NSW increased by more than 20%. This coincided with a 9% increase in the Gigawatt hours (GWh) of electricity generated.

Gigawatt hours, and value, of electricity generation in NSW between 2002-03 and 2008-09

Year	Gigawatt hours	Value ($A million)
2002-03	71,627	2,655
2003-04	78,656	2,697
2007-08	78,289	3,487
2008-09	78,700	3,368

Major Australian operating hydro electric facilities with capacity of greater than 10 MW



Major existing power stations in NSW, November 2011

Fuel Type	Number of power stations	Total MW capacity
Black coal	8	11,985
Gas*	6	2,008
Oil	-	-
Wind	3	218
Hydro	6	4,056
Ocean	-	-
Biomass**	2	60
Solar	-	-
Geothermal	-	-
Total	25	18,327

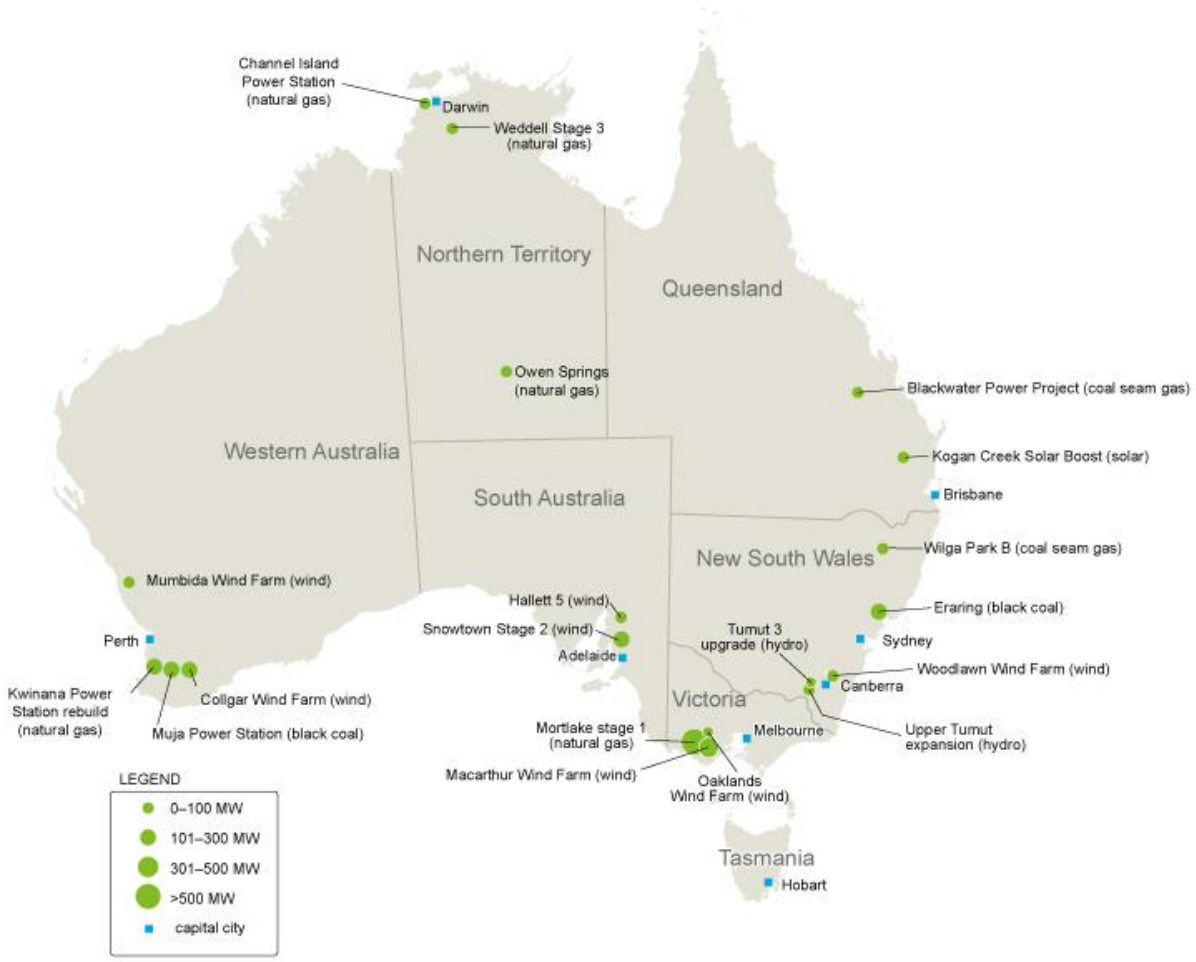
*Includes coal seam gas and gas cogen.
**Includes Bagasse

Proposed and advanced electricity generation projects in NSW, November 2011

Fuel Type	Number of projects		Total MW capacity*
	Advanced	Proposed	
Black coal	2	4	1,726
Gas	7	42	17,705
Oil	-	1	150
Wind	7	92	17,689
Hydro	2	1	127
Ocean	-	3	786
Biomass	-	2	260
Solar	1	12	1,224
Geothermal	-	4	117
Undetermined	-	2	4,000
Total	19	163	43,784

*Represents minimum capacity

Advanced electricity generation projects in Australia, at October 2011



EMPLOYMENT

The energy production industry in NSW experienced a sharp increase in employment between 2005 and 2010. In 2010, 19,115 people were employed in coal mining (the main employer in the energy production sector), compared to 11,290 people in 2005. In 2011, 35,600 people were employed in the mining industry generally in NSW, representing 18.1% of national employment in the industry.

Employment in the electricity generation industry can be divided between the renewable and non-renewable sectors. In 2010, the energy industry in NSW directly employed 15,934 people on a full-time basis (excluding energy retailers).

In 2010, the renewable electricity generation industry in NSW directly employed 2,327 people on a full-time basis. This is expected to increase to 13,281 by 2020. In 2010, 8,085 people were employed nationally in the renewable energy industry. These figures include those directly involved with construction, installation, operations and maintenance activities and do not include indirect activities such as retail sales, administration and management.

Total employees by energy company in NSW (including contractors, excluding retailers)

Company	Employees	Contractors
TransGrid	1,017	287
Eraring Energy	429	Approx 500
Macquarie Generation	627	n/a
Delta Electricity	719	3,097
Ausgrid	5,780	n/a
Essential Energy	4,474	n/a
Endeavour Energy	2,888	n/a
Total	15,934	3,884

NSW ENERGY CONSUMPTION

Total energy consumption is expected to decrease in Australia over the next decade. The Commonwealth and State renewable energy targets will likely lead to an increase in energy prices and a dampening effect on energy demand and therefore consumption. Despite this, the gas sector in Australia is projected to increase in the next two decades, contributing to one-third of primary energy consumption by 2029-30.

According to the most recent data, primary energy consumption in NSW increased between 2003 and 2009. In 2009-10, electricity consumption in Australia declined, compared to the previous two years. Similarly, electricity consumption in NSW declined in 2011, compared to the previous two years.

NSW is the largest energy market in Australia and is a net importer of electricity and gas. 7% of all electricity consumed in NSW in 2008-09 was imported, while 96% of all gas consumed in NSW in 2007-08 was imported.

PRIMARY ENERGY CONSUMPTION

In Australia, primary energy consumption was 5,772 PJ in 2007–08. Non-renewables accounted for approximately 95% of total primary energy consumption. Coal accounted for 40%, followed by oil (34%) and gas (22%). Renewable energy accounted for 5% of primary energy consumption, most of this coming from bioenergy. Wind and solar accounted for 0.3% of primary energy consumption.

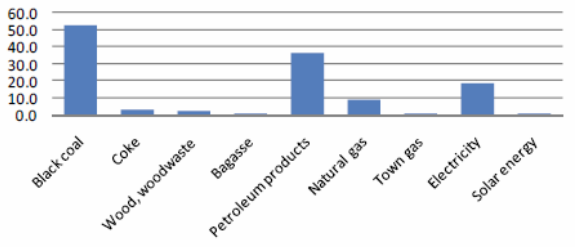
Primary energy consumption in NSW increased from 1,572 PJ in 2003 to 1,623 PJ in 2009, an increase of 3.1%. This was mainly attributable to increases in the consumption of coal and petroleum products.

Energy consumption by fuel, NSW and ACT, 2003-2009 (PJ)

Fuel	2003	2009	% change
Black coal	794	819	3
Coke	62	51	-22
Wood, woodwaste	18	30	40
Bagasse	6	6	0
Petroleum products	540	569	5
Natural gas	147	143	-3
Town gas	4	2.6	-54
Solar energy	0.6	2.5	76
Total	1572	1623	3

Approximately 40% of the energy consumed in NSW in 2009 was sourced from black coal, and 30% from petroleum products.

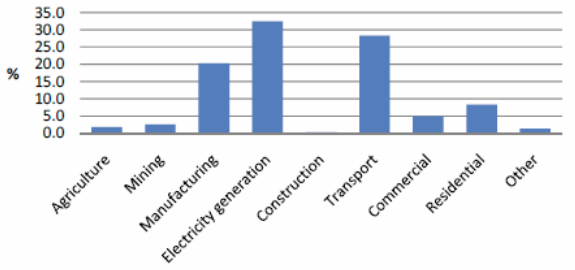
Energy consumption by fuel, NSW and ACT, 2008-09



ENERGY CONSUMPTION BY INDUSTRY

The electricity industry is the largest consumer of energy in NSW and the ACT. This is followed by the transport and manufacturing industries. Together, all three industries consume more than 80% of energy used. Residential use of energy consumes 8% of total energy in NSW and the ACT. Agriculture, mining, construction and commercial industries account for the remaining 12%.

Energy consumption by industry, NSW and ACT, 2009-10



Between 2003 and 2009, there was a marked decline in energy consumed in the manufacturing sector in NSW and the ACT. Energy consumed in the agricultural sector also declined, while all other industries experienced an overall increase between 2003 and 2009.

Energy consumption by industry (PJ), NSW and ACT, 2003-2009

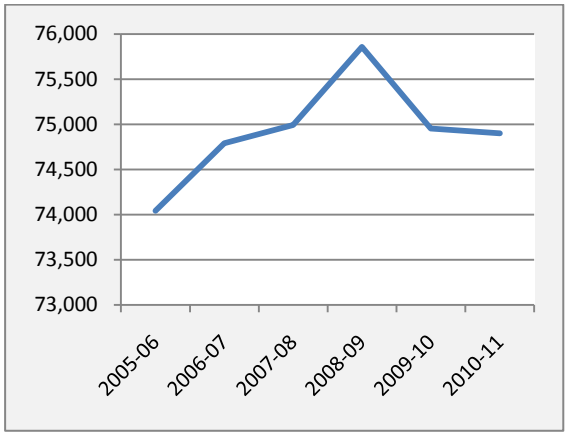
Energy consumption	2003-04	2008-09	% change
Agriculture	28.2	27.4	-3
Mining	36.7	39.5	7
Manufacturing	377.6	317.9	-19
Electricity generation	454.1	506.9	10
Construction	4.1	4.7	13
Transport	402.4	441.9	9
Commercial	71.0	76.4	7
Residential	112.7	129.2	13
Other	22.5	20.3	-11
Total	1,509.2	1,564.2	4

ELECTRICITY CONSUMPTION

The Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) reported a decline in electricity consumption of 5.4% in 2008-09 in Australia, compared to the previous year, and a further 1.2% decline in 2009-10.

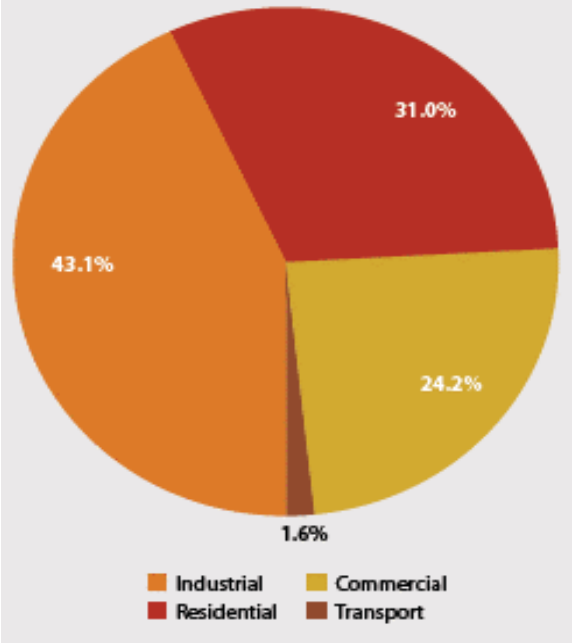
Between 1994-95 and 2006-07 residential electricity consumption in NSW/ACT increased by approximately 11%. Between 2008-09 and 2010-11, however, consumption decreased by more than 1%.

Electricity consumption in NSW, 2005-06 to 2010-11 (GWh)



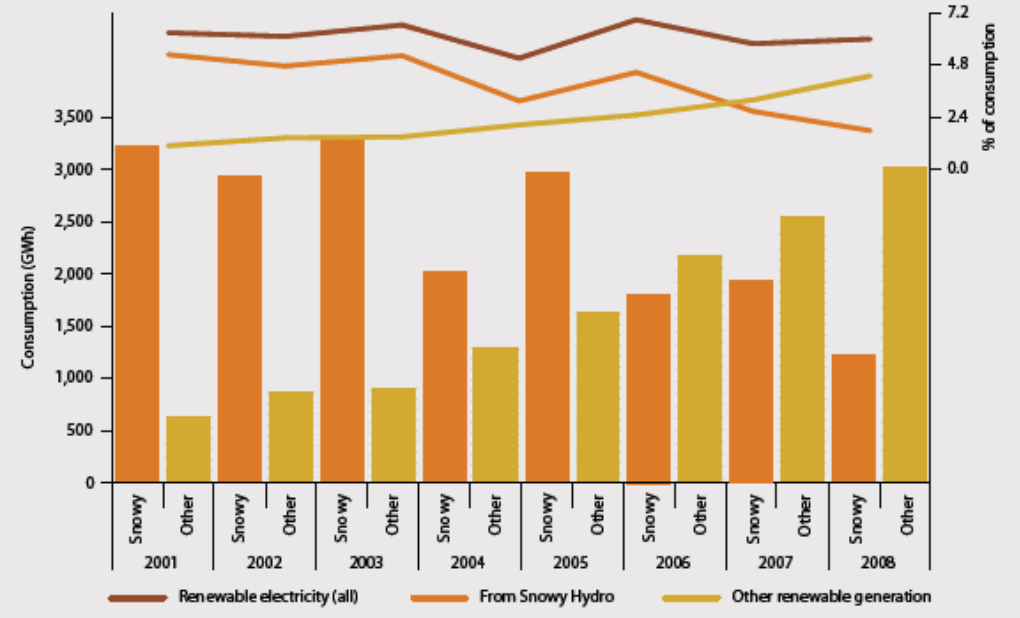
In 2007-08, the industrial sector was the largest consumer of electricity in NSW. This was followed by the residential and commercial sectors, which together are responsible for approximately 55% of the total electricity consumption.

Electricity consumption in NSW and the ACT by sector, 2007–08



Whilst only 0.2% of energy consumed in 2007-08 was produced from solar energy, the consumption of solar energy increased approximately four-fold between 2003-04 and 2008-09.

NSW consumption of electricity from renewable sources



Ausgrid reported a decline in NSW electricity consumption in 2011 compared to the previous two years. This decline, according to Ausgrid, is attributable to a number of factors such as improvements in energy awareness and household energy efficiency measures.

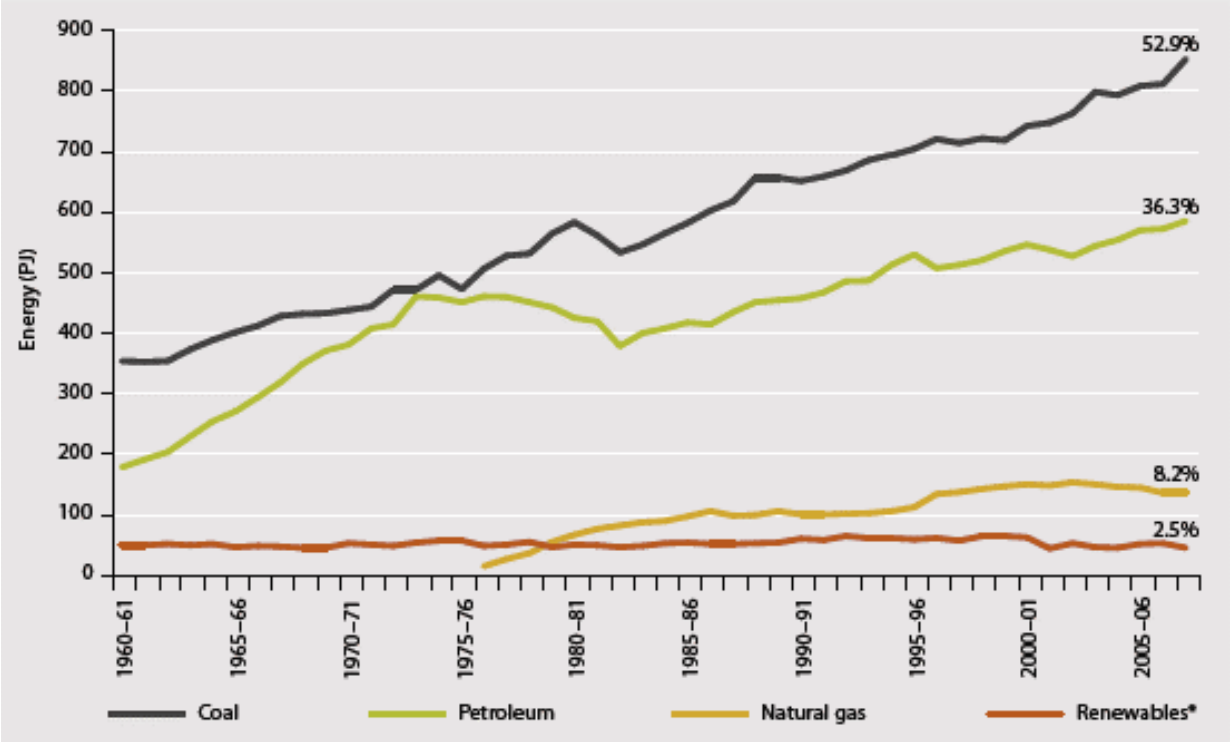
Energy efficiency measures include initiatives such as smart metering, which have the potential to create opportunities for energy users to change energy consumption habits in response to changes in electricity prices. Smart meters measure how much electricity is used at regular time intervals. This means customers are able to pay different rates for electricity based on the time of day it is used. The National Electricity Rules already require the use of such meters for large customers.

ENERGY CONSUMPTION TRENDS

According to the NSW State of the Environment Report 2009, the consumption of energy from non-renewable sources in NSW has shown a long-term upward trend. Coal consumption increased from 350 PJ in 1960–61 to 848 PJ in 2007–08, most of which was used for electricity generation. Petroleum consumption increased by 235% over the same period, and natural gas increased from 0 PJ in 1975–76 to 132 PJ in 2007–08, down slightly from a peak of 148 PJ in 2002–03.

Between 1960-61 and 2005-06 the consumption of renewable sources of energy has not changed significantly. This reflects, in part, the reduced production of hydroelectricity (the result primarily of drought) since 1975.

Primary energy consumption by fuel in NSW and the ACT, 1960–61 to 2007–08



ENERGY CONSUMPTION FORECASTS

The ratio of Australia's energy consumption to energy production (non-uranium) is projected to fall from 44% in 2008-09 to 33% in 2029-30, and to 26% in 2034-35. The surplus energy produced will contribute to Australia's energy exports.

The share of coal in total primary energy consumption is projected to fall from 40% to 23% by 2029-30 and 21% by 2034-35. Conversely, the share of gas is projected to increase from approximately one quarter to one-third of primary energy consumption for the same period.

Electricity demand projections for 2011–12 onwards are lower than those calculated in 2010 by an average of 4,071 GWh. These differences are due to changes in key assumptions, including higher forecast electricity prices resulting from higher distribution and transmission prices, and adjustments to the expected impact of carbon pricing. While average electricity demand is projected to increase by 1.6% per annum until 2020-21, peak demand is projected to increase by 2.0%.

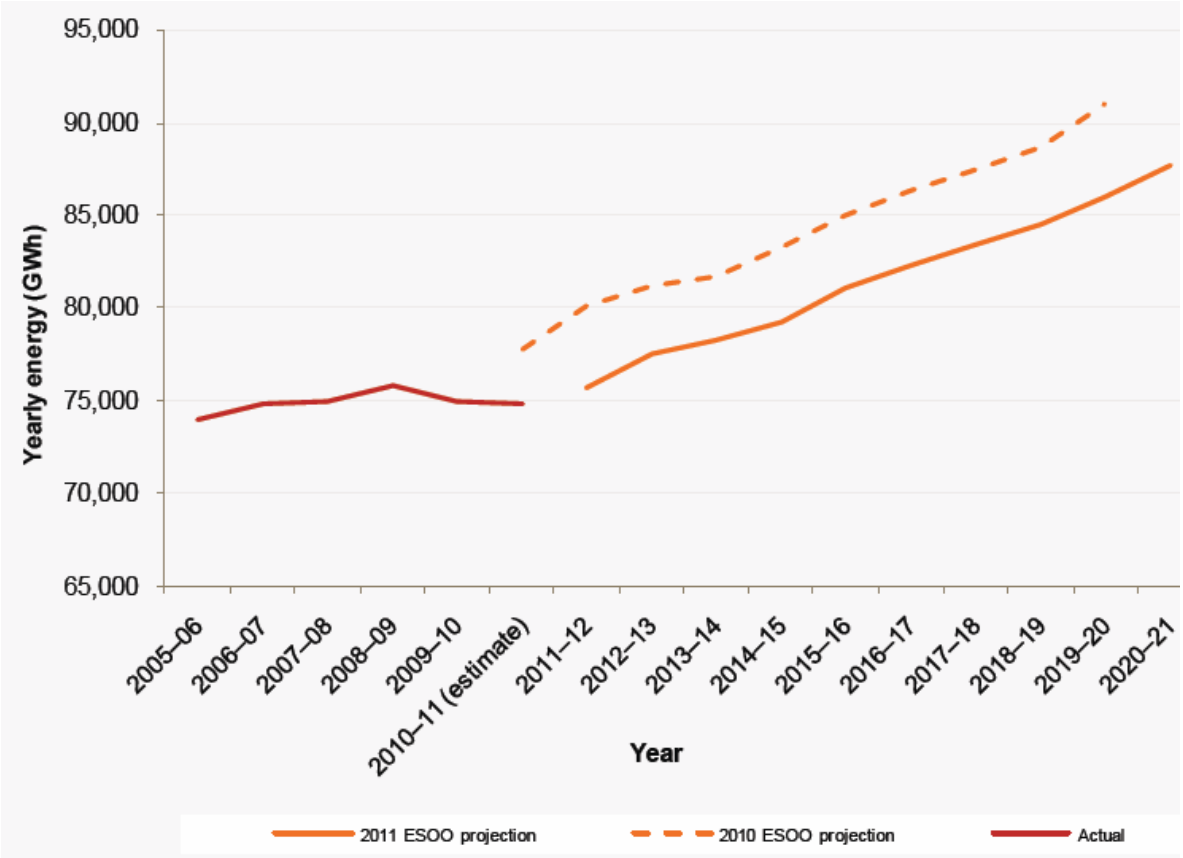
PEAK OIL

The Australian Association for the Study of Peak Oil and Gas (ASPO) and the Biofuels Association of Australia describe Peak Oil as the time when the rate of global oil production reaches its maximum and starts its downtrend. Forecasts vary from between 2011 to beyond 2015.

Peak Oil has become an emerging issue given that oil production in Australia has been declining since 2000. Concurrently, oil consumption in Australia is increasing at a rate of 2% a year and imports of oil continue to increase. 80% of the fuel currently used for transport is imported, either directly or as crude oil, and refined in Australia.

There are socioeconomic issues surrounding Peak Oil. For example, people in regional areas may be more vulnerable to fluctuations in oil prices due to the greater dependence on private motor vehicles. Researchers from the Urban Research Program, Griffith University, argue that there is wide spatial variability in the vulnerability of Australia's urban populations to rising fuel costs, and that these may compound existing social divisions.

Comparison of New South Wales medium growth energy projections (GWh)



COAL

Coal is NSW's largest mineral industry. According to Geoscience Australia, 40% of Australia's Economic Demonstrated Resources (EDR) of black coal is found in NSW, equivalent to 16.64 Gigatonnes (Gt). In addition, NSW has substantial Sub-Economic Demonstrated Resources (Sub-EDR) and inferred black coal resources.

NSW coal resources (PJ)

Basin	EDR	Sub-EDR	Inferred
Clarence Morton	40,888	1,132	-
Gloucester	1,277	-	-
Gunnedah	10,518	146	461,300
Oaklands	22,334	-	-
Sydney	315,502	67,664	286,600
Total	390,519	68,942	747,900

PRODUCTION

In 2009-10, 30 underground and 33 open cut coal mines were in operation in NSW. Together, these mines produced over 145 million tonnes of black coal worth approximately $14.74 billion. This represents a significant decrease in value from 2008-09 when, due to record global prices, coal produced in NSW was worth $20.17 billion.

Production statistics: 2005-2010

	2004-05	2009-10	% change
Number of mines	55	63	15
Underground	28	30	7
Open cut	27	33	22
Saleable coal production ('000 tonnes)	122,063	145,376	19
Underground	43,186	50,772	18
Open cut	78,877	94,604	20
Value ($m)	7,463	14,174	90

Two types of black coal exist, both of which are mined in NSW: thermal; and metallurgical. Thermal (steaming) coal is used mainly for electricity generation. Metallurgical (coking) coal is suitable for use in the production of iron and steel. It is relatively scarce and hence attracts a higher price than thermal coals. In 2009-10, metallurgical coal made up roughly 24% of all coal mined in NSW.

EMPLOYMENT

As of June 2010, 19,115 people were employed in NSW coal mines. The majority of these people were employed in the Hunter and Gunnedah coalfields.

Employment in NSW coal mines: 2005-2010

Coalfields	2005	2010	% change
Gunnedah and Hunter	6,306	11,153	77
Newcastle and Gloucester	1,642	2,511	53
Western	1,331	2,371	78
Southern	2,011	3,080	53
Total	11,290	19,115	69

Research suggests that indirect employment from mining can be calculated using a ratio of 1:4. Based on that calculation, coal mining in NSW indirectly employs 76,460 people.

ROYALTIES

The Mining Regulation 2010 sets three different base rates for Ad Valorem royalties payable on coal:

(1) 8.2% of the value of coal recovered by open cut mining;
(2) 7.2% of the value of coal recovered by underground mining; and
(3) 6.2% of the value of coal recovered by deep underground mining.

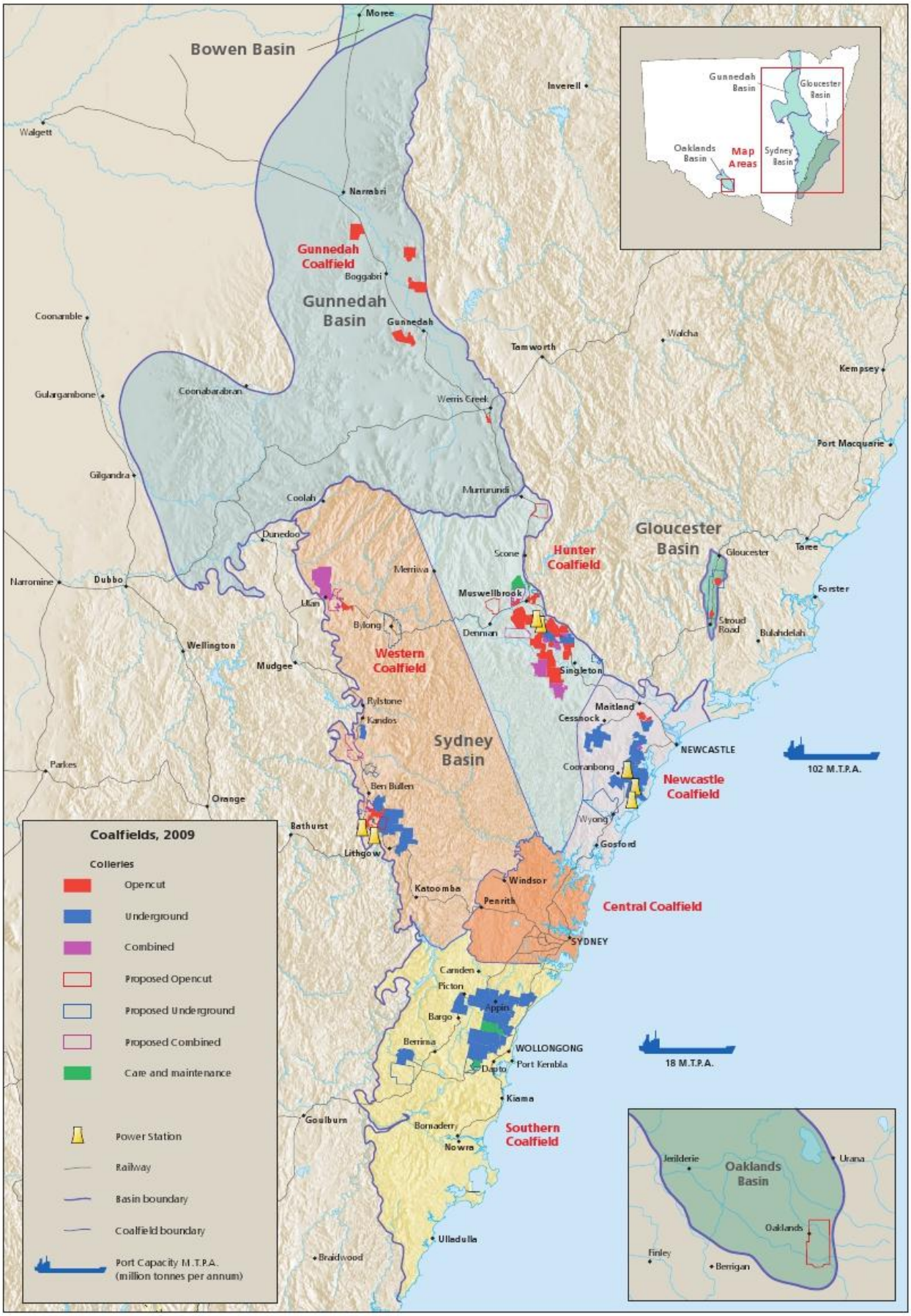
In 2010-11, the NSW Government collected approximately $1,178 million in royalties from coal mining. Royalties in 2010-11 were $528 million lower than expected due to the higher than expected value of the Australian dollar, supply chain issues in Newcastle and reduced Japanese demand.

Mining royalties in NSW: 2009-2013

Year	Coal ($m)	All minerals ($m)
2008-09	1,226	1,280
2009-10	915	985
2010-11 (estimate)	1,178	1,240
2011-12 (forecast)	-	1,768
2012-13 (forecast)	-	2,128

Projected increased royalties in the coming years are due to three factors: higher export volumes; higher prices; and a proposed increase in coal royalties. The proposed increase in royalties, announced in September 2011, is intended to compensate for the effect of the Commonwealth Government's carbon tax. The Minerals Resource Rent Tax Bill 2011, under which the Commonwealth Government will refund to mining companies any State royalties in place prior to 1 July 2011, has passed the House of Representatives. The NSW Premier has said that the Federal Treasurer recently threatened to withdraw infrastructure funding should the NSW Government raise royalties.

Coal in NSW


Bowen Basin
Moree
Inverell
Walgett
Narrabri
Gunnedah Coalfield
Boggabri
Gunnedah Basin
Gunnedah
Coonamble
Tamworth
Walcha
Kempsey
Gulargambone
Coonabarabran
Werris Creek
Port Macquarie
Gilgandra
Coolah
Murrurundi
Dunedoo
Scone
Hunter Coalfield
Gloucester Basin
Gloucester
Taree
Merriwa
Narromine
Dubbo
Muswellbrook
Forster
Ulan
Bylong
Denman
Stroud Road
Bulahdelah
Wellington
Western Coalfield
Mudgee
Singleton
Rylstone
Kandos
Maitland
Cessnock
Sydney Basin
NEWCASTLE
Parkes
Cooranbong
102 M.T.P.A.
Ben Bullen
Newcastle Coalfield
Orange
Wyong
Bathurst
Gosford
Lithgow
Windsor
Katoomba
Penrith
Central Coalfield
SYDNEY
Camden
Picton
Appin
Bargo
Berrima
WOLLONGONG
Port Kembla
Dapto
18 M.T.P.A.
Kiama
Goulburn
Bomaderry
Southern Coalfield
Nowra
Ulladulla
Braidwood
Gunnedah Basin
Gloucester Basin
Oaklands Basin
Map Areas
Sydney Basin
Jerilderie
Urana
Oaklands Basin
Oaklands
Finley
Berrigan
Coalfields, 2009
Collieries
Opencut
Underground
Combined
Proposed Opencut
Proposed Underground
Proposed Combined
Care and maintenance
Power Station
Railway
Basin boundary
Coalfield boundary
Port Capacity M.T.P.A. (million tonnes per annum)

EXPORTS

In 2009-10, coal exports were worth $11.22 billion, down from the record high of $17.12 billion in 2008-09. Metallurgical coal made up 20% of the total amount sold, thermal coal making up the remainder. Over 50% of NSW's coal exports were sold to Japan in 2009-10. Other major export destinations include the Republic of Korea, India, Chinese Taipei and China.

DOMESTIC USE

Power stations and steel works are the largest domestic consumers of coal (85% and 11.3% respectively). In 2009-10, power stations consumed 28.66 Megatonnes of coal and the steel industry consumed 4.45 Megatonnes. In 2010-11, black coal fuelled 89.2% of the electricity generated in NSW.

COAL DEVELOPMENT PROJECTS

The coal supply chain has several stages: mining; processing; transport; and end-use. Transport infrastructure is a key component of the supply chain. Coal is transported by road, rail and conveyor. Rail is the most effective means of long-distance transport, especially for export coal.

Coal is exported from two NSW ports, Newcastle and Port Kembla. Newcastle is the world's largest coal export port, with three coal terminals capable of collectively exporting 143 million tonnes per annum (Mtpa). In May 2010, the first stage of the newest terminal was completed by the Newcastle Coal Infrastructure Group (NCIG). The first stage has an export capacity of 30 Mtpa. Construction of the second stage is underway, and will increase capacity by 23 Mtpa upon completion in 2013. Expansion underway at the Kooragang Coal Terminal will increase its capacity by 32 Mtpa to 120 Mtpa by late 2012.

NSW coal export facilities

Port Loader & Facility	Current Annual Capacity (Mtpa)	Proposed Annual Capacity (Mtpa)
Newcastle		
Carrington Coal Terminal	25	25
Kooragang Coal Terminal	88	120
NCIG Terminal	30	53
Kooragang Island T4	0	100
Total	143	298
Port Kembla		
Port Kembla Coal Terminal	18	18
Grand total	161	316

Port Waratah Coal Services (PWCS), which currently operates the Carrington and Kooragang coal terminals, is planning the development of a fourth coal terminal. This is being conducted under the Hunter Coal Export Framework, as brokered by the NSW Government. The Framework represents the Hunter Valley coal industry's agreement for a long-term solution for providing access to, and expansion of, the coal loading terminals. It was approved by the Australian Competition and Consumer Commission on 9 December 2009, commenced on 1 January 2010 and was granted until 31 December 2024. The fourth coal terminal, if it receives planning approval, will expand the coal export capacity of Newcastle Port by up to 100 Mtpa.

As of October 2011, there were a total of 10 coal infrastructure projects under various stages of planning, approval or construction. These projects are expected to employ at least 1,400 people in the construction stage.

Coal development projects in NSW

	Number	Capital expenditure ($ million)	Jobs
Mining projects			
Under construction	9	4,104	1,715
Less advanced	24	5,757	2,976
Total	33	9,861	4,691
Infrastructure projects			
Under construction	6	3,240	-
Less advanced	4	5,414	-
Total	10	8,654	-
Grand Total	43	18,515	4,691

As of October 2011, nine coal mine projects were under construction. Together, these projects are expected to produce at least 38.9 Mtpa once operational. An additional 24 coal mine projects are at various stages of planning and government approval. Data on capital expenditure and job creation is only available for half of these projects. Where available, the data indicates total capital expenditure of $5,757 million and the creation of 2,976 operational jobs. In total, these projects are expected to produce up to 122.9 Mtpa once operational.

ENVIRONMENTAL ISSUES

Environmental impacts of coal mining may include: water pollution; fractured aquifers; biodiversity and habitat loss; and air pollution. Air pollution has been of significant concern in recent years. In December 2010, the first monitoring stations in the Upper Hunter air quality monitoring network commenced operation, with the remainder to be established by the end of 2011.

The National Pollutant Inventory tracks annual emissions of 93 toxic substances by source. Coal mining is a significant source of the following air pollutants: nitrogen oxides, sulphur dioxide,

particulate matter <10 µm (PM_{10}), particulate matter <2.5 µm ($PM_{2.5}$), arsenic, lead and mercury. The amount released from coal mines of each of these pollutants has increased since 2005-06, except for mercury and sulphur dioxide.

Air pollutants from coal mining in NSW

Pollutant	09-10 (kg)	Change since 05-06 (%)	% of NSW total	NSW rank
Arsenic	590	40.5	0.67	2
Lead	2,200	22.2	0.73	2
Mercury	24	-11.1	0.25	6
Nitrogen oxides	25,000,000	78.6	3.25	2
$PM_{2.5}$	2,300,000	15 (since 07-08)	8.21	1
PM_{10}	59,000,000	3.5	11.1	1
Sulfur dioxide	280,000	-56.9	0.02	11

In NSW, coal mining is the largest source of PM_{10} and $PM_{2.5}$. According to the World Health Organization, health impacts from PM_{10} and $PM_{2.5}$ include cardiovascular and respiratory diseases, among them lung cancer. In May 2010, NSW Health found that respiratory and cardiovascular diseases and cancer were no more prevalent in the Hunter Valley than the rest of NSW. A NSW Health study released in December 2010 confirmed these findings for respiratory diseases.

A recent NSW Government audit of nine coal mines in NSW found that, while there were a number of non-compliances, none were of considerable environmental significance. However, a study for the NSW Environment Department in 2010 found that PM concentrations in the Hunter Valley exceed the Ambient Air Quality National Environment Protection Measure on a number of occasions per year. If, as planned, additional coal mine projects are developed, it is more than likely that PM concentrations will increase in certain parts of the Hunter Valley.

REGULATORY FRAMEWORK

Coal mining is regulated by five NSW Acts and two Commonwealth Acts. With the repeal of Part 3A of the *Environmental Planning & Assessment Act 1979* (EP&A Act), as of 1 October 2011, coal mines require development assessment approval under the State significant assessment system. This was established by two new statutory instruments: the State Environmental Planning Policy (State and Regional Development) 2011; and the Environmental Planning and Assessment Amendment (Part 3A Repeal) Regulation 2011. Any coal mining project approved under the EP&A Act also requires a mining lease under the *Mining Act 1992* and an environment protection licence under the *Protection of the Environment Operations Act 1997*. Water access and use requires a water access licence under the *Water Management Act 2000* or, in a few cases, a water licence under the *Water Act 1912*.

Coal mines located in the Murray-Darling Basin may be subject to the *Water Act 2007* (Cth). The draft Murray-Darling Basin Plan, established under the Federal Act, specifies that State water resource plans must list mining activities as 'interception activities', monitor their impact on water availability, and identify actions to be taken should a significant cumulative impact on water resources be found. In addition, under section 255A of the Federal Act, an independent expert study is required prior to relevant State licences being granted for subsidence mining operations on floodplains that have underlying groundwater systems forming a part of the Murray-Darling Basin system inflows. Coal mines may also require approval under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) if there is a potential impact upon a matter of National Environmental Significance.

STRATEGIC REGIONAL LAND USE

Despite the current NSW regulatory framework, ongoing concerns about the environmental and social impacts of coal mining remain, including the cumulative impact of mining in places like the Hunter Valley. As a result, the NSW Government is currently developing several transitional and long-term policies in response to land use conflicts between the coal mining and coal seam gas industries and agricultural industries.

Four transitional arrangements were announced in May 2011:

1) a 60-day moratorium on issuing exploration licenses;
2) public consultation before exploration licenses are issued;
3) the requirement for an Agricultural Impact Statement with any new coal, coal seam gas and petroleum extraction project application. Such Impact Statements will only be required prior to the development of a Strategic Regional Land Use Plan; and
4) the introduction of an Aquifer Interference Regulation.

Two long-term policies are under development:

1) Strategic Regional Land Use Plans, to be developed for all parts of the State. The plans are intended to give local communities, industries and other stakeholders greater certainty about how the regions will change over time; and
2) an overarching Coal and Gas Policy that will provide an overview of the current state of the industries and the likely growth over the next 25 years.

COAL AND GAS-FIRED POWER GENERATION

In 2010-11, coal and gas-fired power generators accounted for approximately 89% and 5% respectively of electricity generated in NSW. In 2010-11, the amount of electricity imported from other States increased by 35.8% to account for 14.4% of total consumption.

Electricity production and consumption in NSW: 2009-2011 (GWh)

Fuel	2009-10 GWh (% of total)	2010-11 GWh (% of total)
Black coal	60,925.5 (90.92)	57,187.5 (89.19)
Gas (large-scale)	2,902.8 (4.33)	3,047.3 (4.75)
Hydro	1,503.7 (2.24)	2,120.8 (3.31)
Wind	0 (0)	48.9 (0.08)
Other	1,681 (2.51)	1,711 (2.67)
Total production	**67,013**	**64,115.5**
Consumption	74,955	74,902
Net imports	**7,942**	**10,786.5**

As of September 2011, NSW had eight coal-fired, four major gas-fired and seven small gas-fired power stations with a combined capacity of 13,925MW. Ownership of the major power stations is as follows:

- *Delta Electricity*: Colongra, Mt Piper, Munmorah, Vales Point B and Wallerawang C;
- *Eraring Energy*: Eraring;
- *Macquarie Generation*: Bayswater and Liddell;
- *Marubeni Australia Power Services*: Smithfield Energy Facility;
- *Origin Electricity*: Uranquinty;
- *Redbank Project*: Redbank; and
- *TRUenergy*: Tallawarra.

In December 2010, Origin Electricity purchased the electricity generated by the Eraring power station and TRUenergy purchased the electricity generated by the Mt Piper and Wallerawang C power stations [see Key Issues: The GenTrader Transactions]. On November 24, the O'Farrell Government announced that it would sell all of the State's electricity generators in 2012.

COAL-FIRED POWER GENERATION

Three types of coal-fired power generators operate globally:

- Pulverized Coal, of which there are three types - sub-critical, super-critical (SC) and ultra super-critical (USC);
- Fluidized Bed Combustion, of which there are two types - non-pressurized (FBC) and pressurized (with two sub-types: circulating (CFBC) and bubbling (BFBC)); and
- Integrated Gasification Combined Cycle (IGCC).

All NSW coal-fired power stations use subcritical Pulverized Coal technology except for Redbank which is a CFBC power plant.

GAS-FIRED POWER GENERATION

Two types of large-scale gas-fired power generators operate globally:

- Open Cycle Gas Turbines (OCGT) - used for providing power in peak demand periods; and
- Closed Cycle Gas Turbines (CCGT) - used for base-load generation.

Two of each type currently operate in NSW.

Major NSW coal and gas-fired power stations (2011)

Power station	Plant type	Capacity (MW)	Generation 2010-11 (GWh)	Technical retirement year	Marginal cost ($/MWh generated)	Thermal efficiency (HHV sent out)	Emission intensity (tCO_2-e/MWh)
Black coal							
Bayswater	Subcritical	2,640	13,614.9	2036	13.25	35.9%	0.99
Eraring	Subcritical	2,682	13,071.7	2033	17.50	35.4%	1.00
Liddell	Subcritical	2,000	7,763.5	2027	14.15	33.8%	1.08
Mt Piper	Subcritical	1,400	10,006.3	2043	17.87	37.0%	0.94
Munmorah	Subcritical	600	172.2	2015	20.04	30.8%	1.16
Redbank	CFBC	150	1,108.5	2051	12.51	29.3%	1.21
Vales Point B	Subcritical	1,320	5,909.1	2028	18.09	35.4%	1.00
Wallerawang C	Subcritical	1,000	5,541.3	2028	19.34	33.1%	1.05
Gas							
Colongra	OCGT	667	65.5	2039	90.77	32.0%	0.74
Smithfield Energy Facility	CCGT	160	na	2027	37.22	41.0%	0.58
Tallawarra	CCGT	460	2,724.6	2039	27.58	50.0%	0.47
Uranquinty	OCGT	664	257.2	2039	77.64	32.0%	0.74
Total		13,743	60,234.8				

POWER STATION EFFICIENCY

Power stations operate at different efficiencies, as determined by factors such as: technology; power plant age; fuel quality; environmental conditions; cooling methods; and the load under which the plant operates. Thermal efficiency is a measure of power plant efficiency. The greenhouse gas (GHG) emission intensity of a power station is correlated to its thermal efficiency.

The most efficient NSW coal-fired power station - Mt Piper - operates at 37.0% efficiency. In comparison, the most efficient coal-fired technologies are USC (<46%) and IGCC (<42%). According to the CSIRO, both technologies are approaching efficiency, and hence GHG emission intensity, limits. Therefore, achieving lower GHG emissions from coal-fired power stations will require carbon capture and storage (CCS) technology. The most efficient NSW gas-fired power station - Tallawarra - operates at 50.0% efficiency. In comparison, the most efficient CCGT gas-fired technology has a theoretical efficiency of <53%.

Several options are available for modest improvements in efficiency and GHG emission reductions at existing coal-fired power stations. These include retrofitting with improved plant components such as turbines, co-firing with biomass or natural gas, and integrating solar thermal technology into the power plant, as has been done at Liddell power station.

CARBON CAPTURE AND STORAGE

Carbon capture and storage (CCS) involves the capture of CO_2 at some point in the coal to electricity conversion process and its storage in a geological sink. CO_2 may be captured either pre- or post-combustion. Integrated Gasification Combined Cycle (IGCC) with CCS is an example of pre-combustion capture technology. The most advanced form of post-combustion capture utilises gas/liquid absorption technology. While proven, it has not been demonstrated at large scale, nor has it been fully integrated into power plants at any scale. CO_2 capture results in a significant energy penalty, which may reduce the output of power stations by up to 25%. CCS may therefore significantly increase the cost of electricity generated. There is also uncertainty concerning the availability of suitable geological sinks for CO_2 storage.

NSW Government CCS initiatives include Coal Innovation NSW and its associated Fund, CCS demonstration projects and a NSW storage capacity project. Federal Government CCS initiatives include the Global CCS Institute, the CCS Flagships Program and CCS-specific legislation - the *Offshore Petroleum and Greenhouse Gas Storage Act 2006*.

POWER STATION EMISSIONS

Coal and gas-fired power stations are significant sources of pollutants, including GHG emissions. According to the National Greenhouse Gas Accounts, NSW power stations emitted 62.8Mt of carbon dioxide equivalent gases (CO_2-e) in 2009, 39.1% of NSW's total emissions. NSW power stations are the State's largest sources of GHG emissions. CO_2-e emissions from power stations increased by 42.7% between 1990 and 2009.

In 2009-10, according to the National Pollutant Inventory, coal and gas-fired power stations were the largest source of mercury, oxides of nitrogen and sulphur dioxide, and the 6th largest source of

NSW major power station emissions: CO_2-e, particulate matter <10µm (PM_{10}) and mercury

Power station	CO_2-e (2009) (tonnes)	PM_{10} (2009-10)		Mercury (2009-10)	
		kg	% change in kg/MWh since 2004-05	kg	% change in kg/MWh since 2004-05
Coal					
Bayswater	14.60	210,000	-36.95	54	-53.85
Eraring	13.66	950,000	-17.28	42	-34.05
Liddell	10.42	480,000	27.57	55	32.57
Mt Piper	7.04	210,000	-44.26	29	11.19
Munmorah	1.20	33,000	-16.22	4	638.55
Redbank	1.12	6,000	-65.46	0.22	-93.49
Vales Point B	7.84	110,000	-94.75	36	-35.14
Wallerawang C	5.23	940,000	20.59	20	55.65
Total	61.11	2,939,000	-39.20	240.22	-24.72
Gas					
Colongra	na	1,200	na	0.45	na
Smithfield Energy Facility	0.55	28,000	95.86	0.04	na
Tallawarra	0.85	na	na	na	na
Uranquinty	0.20	13,000	na	na	na
Total	1.60	42,200	-	0.49	-
Grand total	62.71	2,981,200		240.71	
% of NSW total	39.05	0.56	-	2.48	-
NSW rank	1	6	-	1	-

particulate matter <10μm (PM_{10}) in NSW. While total PM_{10} and mercury emissions from coal-fired power stations have decreased between 2004 and 2010 by 39.2% and 24.72% respectively, emissions per MWh generated has risen for some power stations. Emissions vary over time and between power stations due to factors such as fuel quality, age and control technology.

ELECTRICITY GENERATION COSTS

Electricity generation costs can be estimated by calculating the short-run marginal cost (SRMC) - a measure of the variable cost of electricity generation (including fuel costs and variable operating and maintenance costs) on a sent out basis. Of existing NSW coal-fired generators, Redbank provides the cheapest electricity ($12.51/MWh) and Munmorah the most expensive ($20.04/MWh). The two OCGT gas-fired power stations - Colongra and Uranquinty - produce the most expensive electricity ($90.77/MWh and $77.64/MWh respectively).

NEW ENTRANT TECHNOLOGIES

New coal and gas-fired power plant technologies have higher operating efficiencies and lower emission intensities. Energy models generally assume that operating efficiencies will improve over time. For example, water cooled (WC) CCGT plants are expected to increase their efficiency by 8% between 2010 and 2030. Water cooled plants generally have an operating efficiency 2% higher than air cooled plants. However, water costs can add to the cost of electricity generated.

New entrant technologies: costs and efficiencies

Technology (Water cooled)	Marginal cost ($/MWh generated) (Air cooled)	Thermal efficiency (HHV sent out)	Emission intensity (tCO_2-e/ MWh)
CCGT (WC)	40.69	52%	0.45
OCGT	91.19	31%	0.76
Black coal SC (WC)	11.69 (AC)	42%	0.84
Black coal USC (WC)	11.07 (AC)	45%	0.78
IGCC	13.16	41%	0.86
IGCC & CCS	15.43	33%	0.14
Black coal USC & CCS (WC)	12.92 (AC)	33%	0.14

FORECAST ELECTRICITY GENERATION REQUIREMENTS

In NSW, average electricity demand is growing by 1.6% per annum, whereas peak demand is growing at 2.0% per annum. Fluctuating electricity demand is met by two types of power plant: base-load; and peaking plants. In 2010-11 in NSW, peak demand capacity requirements of 3,600MW were required only 5% of the year.

Forecast requirements for new generation capacity are calculated according to projected reserve requirement shortfalls. The Australian Energy Market Operator (AEMO) has modelled the timing of NSW's low reserve condition (LRC) point. LRC points indicate when reserve margins will potentially fall below the minimum reserve level (MRL) - a safety margin of installed capacity calculated by the AEMO.

In its most recent calculation, the AEMO found that NSW will reach its LRC point in 2018-19, at which time reserve generation capacity may fall short by between 190 and 367MW. This is two years later than the AEMO's 2010 calculation. Reasons for this recalculation include: electricity price rises; distributed generation from small scale solar reducing the customer demand load; and impacts of energy efficiency and demand management programs.

The AEMO's National Transmission Network Development Plan 2011 (NTNDP) uses 5 scenarios to calculate forecast capacity requirements. Data released with the NTNDP 2011 consultation paper provides indicative figures for required future capacity requirements. According to these scenarios, NSW may require somewhere between 3,350 to 11,050MW of new generation capacity by 2030. In the most likely scenario (a decentralized world with medium carbon price and high emission reduction, medium economic and population growth, high uptake of demand-side technologies and distribution generation, resulting in increased gas demand), NSW will require an additional 8,000MW generation capacity, 7,000MW of which will need to be base-load gas (i.e. CCGT power plants).

Projected NSW generation requirements by 2030 according to 5 scenarios (MW)

Technology	Likely scenario	Possible range Min	Possible range Max
Base-load coal	0	0	1,500
Base-load gas (CCGT)	7,000	0	7,000
Peak load gas (OCGT)	0	0	6,900
Renewable	1,000	300	4,350
Total	8,000	-	-

PROPOSED POWER STATIONS

According to the Federal Government's Draft Energy White Paper, investment of around $240 billion in new generation capacity across all of Australia could be required by 2030. The Australian Energy Market Commission expects that the importance of privately financed generation capacity will grow, if the trend of

decreasing State Government investment in generation capacity continues.

The choice of when to invest in new generation and what type of plant to construct is affected by factors such as: forecast fuel prices; peak demand trends; the impact of the carbon price; and the impact of an enhanced Renewable Energy Target [see Key Issues - Renewable Energy]. The average period between conception and operation for power stations varies by fuel: 4 to 6 years for CCGT; 3 to 5 years for OCGT; and over 5 years for coal.

Investment in "green-field" coal generation has stalled. The only committed coal-fired power station project in NSW involves the upgrade of the existing Eraring power station. Regarding the choice between base-load CCGT plants and peaking OCGT plants, OCGT plants, while considered a less risky investment, produce more expensive electricity.

Currently, between 2,729-3,089MW of generation capacity has planning approval in NSW. Of this amount, a minimum of 940MW will be base-load capacity and a minimum of 910MW will be peaking capacity. A further 6,700 to 7,700MW of generation capacity awaits planning approval.

NSW major coal and gas-fired electricity generation projects (November 2011)

Project	Plant type	Status	Expected startup	Capacity (MW)	Capex ($m)	Employment (construction/ operation)
Black Coal						
Eraring (expansion)	Subcritical	Committed	2012	240	245	600 (C)
Gas (approved)						
Bamarang Stage 1	OCGT	Approved	na	250-300	na	100 (C) 18 (O)
Bamarang Stage 2	Conversion to CCGT	Approved	na	100-150	130	200-300 (C) 18 (O)
Leafs Gully	OCGT	Approved	Post 2014	360	250	200 (C) 5 (O)
Marulan Gas Turbine Facility Stage 1	OCGT	Approved	2013-14	250-350	280	150 (C) 12 (O)
Marulan Gas Turbine Facility Stage 2	Conversion to CCGT	Approved	2013-14	100-150	235	200 (C) 8 (O)
Port Kembla Steelworks Co-gen plant	Cogeneration	Approved	na	220	750	300 (C) 30 (O)
Richmond Valley	Reciprocating	Approved	na	30	40	50 (C) 10 (O)
Tallawarra Stage 2	OCGT/ CCGT	Approved	2015	500	500	200-400 (C) 3-20 (O)
Wellington	OCGT	Approved	2015	550-660	700	400 (C) 10 (O)
Wilga Park B	Reciprocating	Committed	2012	29	42	30 (C) 2 (O)
Gas (in planning process)						
Bannaby	OCGT	Approval under way	na	600	na	na
Dalton Power Station	OCGT	Approval under way	Post 2014	500 (1,500 ultimately)	250-800 (1,500)	250 (C) 6 (O)
Hanging Rock Stage 1	CCGT	Approval under way	na	300	360	150 (C) 15 (O)
Hanging Rock Stage 2	CCGT	Approval under way	na	300	240	150 (C) 15 (O)
Kerrawary Power Station Project	OCGT	Feasibility study	na	1,000	na	na
To be determined						
Bayswater B	CCGT or USC	Concept approved	na	2000	na	na
Mt Piper Expansion	CCGT or USC	Concept approved	2015-16	2000	2,500-5,000	950 (C) 50 (O)
Munmorah rehabilitation	Coal and/or gas	Approved	na	100	795	150 (C)
Total				9,429-10,789	7,317-11,067	4,480 (C) 231 (O)

RENEWABLE ENERGY

By reducing dependence on fossil fuels, renewable energy generation technologies contribute to a lowering of greenhouse gas emissions from energy generating activities.

Renewable energy currently generated in NSW includes hydroelectricity (88%), biomass (5%), landfill methane (5%), wind (1%) and solar (1%). Currently, approximately 7% of electricity produced in NSW comes from renewable energy sources, with the remaining 93% from fossil fuels. Maps showing existing and proposed renewable energy power plants in NSW can be found here and here.

A key priority of the NSW Government is to achieve 20% renewable energy consumption by 2020. To assist in meeting the 20% renewable target, a Solar and Renewable Energy Action Plan will be established, based on the outcomes of the NSW Solar and Renewable Energy Summit held in July 2011.

A major challenge facing the NSW Government is the integration of additional renewable sources of energy into the existing energy framework for the State. Obstacles to date have included pricing, a lack of policies and markets which support the production of renewables, and higher capital costs associated with the transition to renewables. Other issues faced in the transition to renewable sources of energy include technological constraints and the demand for base-load power. Despite the many issues surrounding renewable energy, the State and Commonwealth Governments have put considerable effort into integrating renewable forms of energy into the energy sector.

The Commonwealth Government recently announced it would establish the Australian Renewable Energy Agency (ARENA) as part of its Clean Energy Future package. The role of ARENA will be to allocate funding to renewable energy and enabling technology projects.

REGULATORY FRAMEWORK

NSW Government planning approval for renewable energy systems occurs within the framework of the *Environmental Planning and Assessment Act 1979*. In addition, State level provisions for renewable energy systems are set out in the *State Environmental Planning Policy (Infrastructure) 2007*. These include photovoltaic systems, solar hot water and air heating systems, small wind turbine systems and wind monitoring towers.

Commonwealth legislation that relates to renewable energy includes the *Renewable Energy (Electricity) Act 2000*. This Act provides for the establishment and administration of the Commonwealth Renewable Energy Target (CRET) scheme to encourage additional electricity generation from renewable energy sources.

NSW RENEWABLE ENERGY POLICIES

The 2005 Greenhouse Plan, initiated by the former NSW Labor Government, focuses on programs aimed at addressing greenhouse gas emissions. One of these initiatives is the GreenPower program, a national accreditation program managed by the NSW Government. GreenPower is a voluntary scheme that complements the mandatory targets on energy retailers to provide significant support for renewable energy generation. It is a requirement that GreenPower be supplied to electricity consumers under the NSW target.

Another initiative, the Greenhouse Gas Reduction Scheme (GGas), is designed to encourage adoption of lowest cost emission reduction technologies, including some renewable generation such as small scale biogas and landfill gas projects. GGas is a mandatory greenhouse gas emissions trading scheme which places responsibility on electricity retailers and large electricity users to reduce emissions associated with the electricity used in NSW.

RENEWABLE ENERGY TARGETS

The Commonwealth Renewable Energy Target (CRET) scheme, which replaced the Commonwealth Mandatory Renewable Energy Target (MRET) scheme, is similar to the NSW RET scheme in that it aims to ensure that 20% of Australia's electricity supply will come from renewable sources by 2020. The CRET scheme operates as two separate parts:

1) Large-scale Renewable Energy Target (LRET), which supports the deployment of renewable energy projects like wind farms, and commercial solar and geothermal power stations; and
2) Small-scale Renewable Energy Scheme (SRES), which provides support through mechanisms such as solar credits for installations of small renewable energy systems, including rooftop solar panels and solar water heaters.

Legislation and regulations through which the LRET and SRES are implemented are listed here.

The Office of the Renewable Energy Regulator (ORER) oversees the implementation of the CRET. A planned future audit of the Commonwealth

CRET scheme, by the Australian National Audit Office, will focus on its implementation, including an assessment of how effectively its implementation has been managed by the ORER.

The NSW Government's "NSW 2021" commits the State to achieving a 20% Renewable Energy Target (NSW RET) by 2020. The design of the NSW RET scheme aims to provide policy certainty for the renewable energy industry.

A key issue in the debate is whether a carbon price is necessary to achieve these renewable energy targets. Some research suggests it is, whereas the Clean Energy Council (CEC) is less categorical, suggesting that a carbon price will at the very least encourage new investment into renewables.

RENEWABLE ENERGY CERTIFICATES

Renewable Energy Certificates (RECs), administered under the Commonwealth *Renewable Energy (Electricity) Act 2000*, are designed to encourage renewable energy generation, and in conjunction with Commonwealth Government solar credits, to assist in meeting the Commonwealth Renewable Energy Target (CRET).

RECs are created by accredited power stations that generate energy from renewable sources. Each certificate corresponds to one megawatt hour (MWh) of renewable energy generated on top of a baseline amount. Like shares, RECs are tradeable on the Australian Stock Exchange.

The trade in REC certificates is designed to provide financial incentive for investment in renewable energy. RECs are typically bought by energy companies to assist in reducing their greenhouse gas emissions. The certificates are created and traded through the REC Registry, which is managed by the Office of the Renewable Energy Regulator.

THE TRANSITION TO RENEWABLES

The cost of renewable forms of power generation is often seen as prohibitive in the transition to renewables. Some studies suggest, however, that the high cost of solar is expected to decrease dramatically by 2020.

The need for base-load power is a key consideration in the transition to renewables. Base-load is the term commonly used to describe the amount of electricity demand required on a continuous basis, i.e. 24 hours a day all year round, to power continuous industrial processes and essential services. Base-load requires reliable supply sources without the risk of output dropping below the base-load level. Whether renewables can provide base-load power generation continues to be much debated.

According to an ABARES report, Australia relies more heavily on coal for base-load electricity generation than the world and OECD averages, where the balance of base-load power generation is largely made up by nuclear and hydro energy. The report suggests that the intermittency of renewables has meant they are largely unsuitable for providing base-load power. Despite this, some renewable energy sources, such as geothermal and hydro energy, are recognised as suitable for base-load electricity generation. In addition, solar thermal technology and ocean energy have the potential to provide base-load electricity generation, as argued by organisations such as Energy Science.

While acknowledging the importance of renewables such as solar and wind as an essential part of the energy generation mix, the focus of the current NSW Government is on gas for base-load generation over the next few decades.

CONSTRAINTS AND FUTURE RESEARCH

Technological constraints, such as those relating to solar energy systems, are gradually being addressed with the introduction of new technologies such as smart meters and inverters, which improve the economic benefit of solar PV. On the other hand, some renewable technologies such as geothermal are in the development rather than deployment stage of technology lifecycle, and as a result there is a high degree of uncertainty as to their potential.

Barriers to integrating renewable energy into the existing energy framework in NSW include uncertainty relating to pricing, production and markets for renewables. According to the NSW Department of Trade and Investment, Regional Infrastructure and Services:

> … developing NSW's abundant renewable resources requires a favourable investment environment and regulatory predictability including; an efficient planning system, an electricity grid that can efficiently connect new renewables, and research facilities that continue to lead the world in developing new technologies.

The need for further research into renewables is acknowledged in the public debate.

SOLAR

Solar electricity is generated by two main technologies: solar photovoltaic (PV) cells; and high temperature solar thermal power systems. In addition, relatively low-grade heat is produced in solar water heaters for domestic use. Solar PV cells convert sunlight directly into low voltage electricity, and include large scale, grid-connected technologies and domestic rooftop solar.

Solar thermal systems are generally large scale and include trough, dish and other reflector technologies such as power towers. Solar thermal systems commonly rely on natural gas as a backup heat source where 24-hour power generation is required.

Issues currently faced by the solar PV industry in NSW include recent changes made to NSW Government renewable energy programs. These include the termination of new applications under the NSW Government's Solar Bonus Scheme.

Another key issue faced by the solar industry in Australia is a lack of grid capacity to store electricity generated from solar technologies. In some areas of Australia electricity generated from new rooftop PV installations can no longer be fed back into the grid, and in other areas the feed-in tariffs have been dropped entirely.

NSW REGULATORY FRAMEWORK

The regulatory framework for solar, including the Solar Bonus Scheme, is set out in the *Electricity Supply Act 1995* and the *Electricity Supply (General) Regulation 2001*. The *Electricity Supply Act 1995* regulates the supply of electricity in the retail market and sets out the functions of persons engaged in the conveyance and supply of electricity.

COMMONWEALTH GOVERNMENT INITIATIVES

The Commonwealth Government's Solar Flagships Program was established in 2009 to provide the foundation for large scale, grid connected, solar power to play a significant role in Australia's electricity supply. The 150 megawatt Moree Solar Farm photovoltaic project was recently selected as one of the key solar projects funded through the program.

An analysis by Bloomberg New Energy Finance suggests that the planned $10 billion Australian Government Clean Energy Finance Corporation, to be established as part of the Federal Governments carbon pricing package, will likely favour large scale solar over other renewable developments such as wind farms.

NSW GOVERNMENT INITIATIVES

A pre-feasibility study for a new solar power precinct in NSW has recently been completed by the NSW Government. While confirming the technical feasibility of a solar precinct, the study also found that compared to non-renewables, such as gas, solar plants of this scale would not become cost competitive for up to 20 years. The study also noted the important role of the Government in making such projects more competitive through financial and other assistance. Projects such as this are expected to assist the NSW Government in meeting its renewable energy targets, and will contribute nationally to reducing greenhouse gas emissions.

SOLAR FEED-IN TARIFFS

Feed-in tariffs are important for the solar industry as they provide an incentive for energy users to adopt renewable sources of power, such as solar. Solar PV, like other renewable energy sources, provides environmental benefits through reduced atmospheric pollution, and social benefits through industry development and job creation.

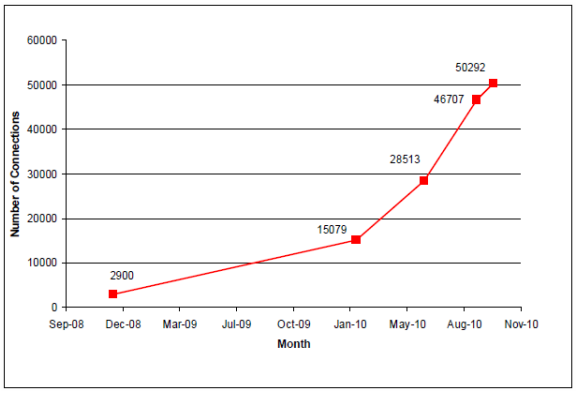
The Solar Bonus Scheme was developed from the work of the NSW Feed-in Tariff Taskforce, established in late 2008, to advise the NSW Government on the design of a feed-in tariff scheme for NSW. The 'Scheme' provides support to people who produce renewable energy through eligible roof-top solar PV systems (or wind turbines) connected to the grid.

Under the *Electricity Supply Act 1995*, the Minister for Energy is required to review the Solar Bonus Scheme either when capacity reaches 50 megawatts (MW) or in 2012, whichever occurs first. The Scheme reached the 50 MW capacity in mid 2010. A review by the NSW Government of feed-in tariffs arrangements, under the NSW Solar Bonus Scheme, indicated that feed-in tariff rates for solar PV systems are generous in NSW. The review also identified the substantial decline in the cost of purchasing solar PV generators since 2009 as another major reason for the rapid uptake of solar PV under the Scheme. System prices more than halved meaning that payback of a 1.5 kilowatt (kW) system now often occurs around two years after purchase, compared to eight years when the Scheme was first announced.

The strong uptake of the NSW Solar Bonus Scheme is reflected in the number of solar PV systems connected in NSW between 2008 and 2010. In late 2008 there were approximately 3,000, and by late 2010 this had increased to more than 50,000. The rapid rise in connections

of solar PV systems was a reflection of the NSW feed-in tariffs, as part of the Solar Bonus Scheme. The Commonwealth Government's Mandatory Renewable Energy Targets likely influenced the uptake rates of solar PV systems in late 2009.

Number of PV systems connected in NSW between 2008 and 2010



Despite recent scaling-back of the Solar Bonus Scheme by the NSW Government, including reducing the rebate and closing the scheme to new applicants, solar industry groups are seeking additional solar rebate subsidies for solar PV systems. A major concern for governments, however, is the possibility that increased subsidies may advantage some at the expense of others. A media release by the NSW Minister for Resources and Energy states:

> Certain groups, including the Australian Solar Energy Society (AuSES) and Solar Energy Industries Association (SEIA) continue to seek Government subsidies and have their hands out for more – with little consideration given to the households that would be hit with higher electricity bills. It is important that any future price must not disadvantage those who least can afford it through higher electricity costs.

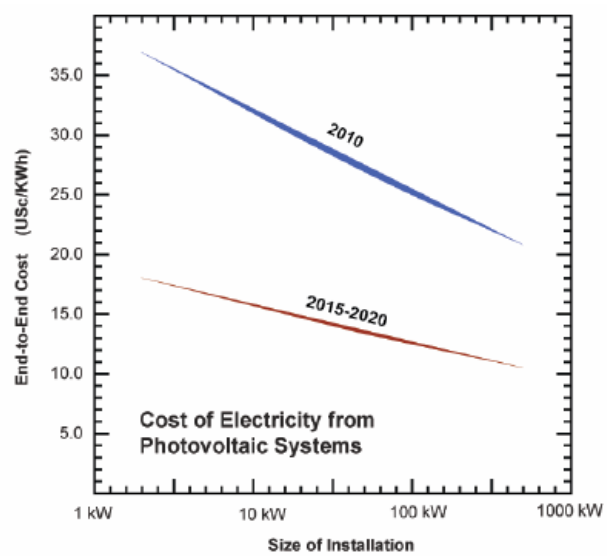
An investigation by the Independent Pricing and Regulatory Tribunal (IPART) into solar feed-in tariffs was recently undertaken, with the intention of establishing a fair and reasonable value for electricity generated by small-scale solar photovoltaic systems. The review also examined any economic gains made by retailers under the Solar Bonus Scheme that could be used to assist with Scheme funding. The investigation recommended a feed-in tariff of 8 to 10 cents per kilowatt hour (c/kWh) to solar PV customers in 2011-12. This approximates to a halving of the current rate of 20c/kWh.

Difficulties with introducing solar feed-in tariffs have been encountered elsewhere in Australia. The solar energy industry in Victoria, for example, has recently experienced a number of setbacks. In 2011, the Victorian Government more than halved its feed-in tariff paid to households and businesses with new solar PV systems from 60c/kWh to 25c/kWh.

SOLAR PRICING

A report by the Australian Academy of Science in December 2009 suggests that advances in the techniques of manufacture are expected to bring the cost of solar PV systems to a point where they become financially viable. The cost of electricity from photovoltaic systems is expected to fall by 50% between 2015 and 2021.

Future cost, including infrastructure and panels, of electricity from photovoltaic systems



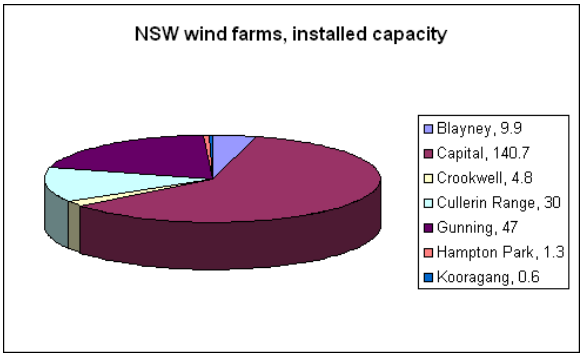
According to the Australian Photovoltaic Association, Australia has defied all expectations and will become one of the first countries in the world to reach grid parity – that is, where the cost of producing energy from rooftop panels over the course of their 25-year lifetime equates to the cost of retail electricity.

WIND

Wind farms figure prominently in renewable electricity projects in Australia, particularly in South Australia, Victoria and to a lesser extent NSW. A report by the Australian Academy of Science suggests that large wind turbines are cheaper than any other renewable energy source, and under the Commonwealth Renewable Energy Target (RET) scheme they compete head-to-head with coal-fired electricity generation at current costs. In addition, the operation of wind turbines produces no greenhouse gas emissions, and emissions involved in the development stage are low compared to electricity generation from other sources.

Recent proposals for wind farm development in NSW include the Kyoto Energy Park, near Scone, and more recent plans for a wind farm at Twofold Bay, Eden. Wind turbines have also been proposed for some suburban shopping centres in the Newcastle area as a means to supply power for lighting and to reduce carbon emissions.

MW capacity of operational NSW wind farms at July 2011



A Clean Energy Council (CEC) snapshot of wind farms in Australia produced in July 2011 provides the following information relating to wind farms in NSW:

- 116 operating turbines;
- Represents 9% of total installed capacity in Australia;
- Represents 10% of all wind turbines in Australia;
- 78,445 equivalent homes powered;
- Creation of 524 jobs (direct and indirect);
- $467 million total capital investment; and
- 556,961 tonnes of carbon pollution avoided.

In NSW there are currently three major existing wind power stations (and four smaller wind power stations), 10 proposed (with development approval) and 16 in the planning stage. A description of each can be found here.

Major existing NSW wind power stations at November 2011

Power Station	Location	Capacity (MW)
Capital Wind Farm	Tarago	141 MW
Cullerin	Upper Lachlan	30 MW
Gunning Wind Farm	Walwa	47 MW
Total		218 MW

Proposed NSW wind power stations at November 2011

Power Station	Location	Capacity (MW)
Boco Rock	Monaro	270 MW
Capital II Wind Farm	Tarago	60-80 MW
Conroy's Gap Wind Farm	Yass	30 MW
Crookwell II	Southern Highlands	92 MW
Glen Innes	Glen Innes	81 MW
Gullen Range	Goulburn	241 MW
Kyoto Energy Park	Upper Hunter	102 MW
Silverton Wind Farm	Broken Hill	1000 MW
Taralga Wind Farm	Taralga	183 MW
Woodlawn Wind Farm	Tarago	48 MW
Total		2,107 MW

NSW REGULATORY FRAMEWORK

New South Wales does not have specific legislation relating to wind farm development. Proposals are instead assessed under a number of environmental planning instruments, including: the *Environmental Planning and Assessment Act 1979*; the Environmental Planning and Assessment Regulation 2000; State Environmental Planning Policies (SEPPs) including the State Environmental Planning Policy (Infrastructure) 2007; and Local Environmental Plans (LEPs).

RENEWABLE ENERGY TARGETS

According to ABARES, government policies, particularly carbon emissions reduction targets and the Commonwealth RET scheme are expected to underpin the future growth of Australia's wind energy industry [see Key Issues: Renewable Energy].

The need for additional wind farms in NSW is one consequence of the Commonwealth Government's 20% RET, and the subject of recent comment by Premier Barry O'Farrell on ABC radio's News 24.

ISSUES AND CHALLENGES

Challenges currently faced by the wind energy industry include the ability of wind energy technology to produce base-load power, finding an economically practical way to store large amounts of highly variable wind power on the grid, the impact of wind farms on surrounding land values, and health concerns by those living in the vicinity of wind farms.

Despite recent reports linking ill-health to wind turbines, according to the National Health and Medical Research Council (NHMRC) and some academics there is currently little scientific evidence to support such claims. The NHMRC further states that any potential impact on humans can be minimised by following existing planning guidelines. However, a Senate inquiry into the Social and Economic Impact of Rural Wind Farms observes:

> Research consistently shows that the noise from wind farms at levels below those required by planning guidelines is annoying to nearby residents and causes sleep disturbance. It would also appear that there is a link between the symptoms of stress and disturbance by wind farm noise.

The inquiry therefore recommended that the Commonwealth Government initiate adequately resourced studies of the possible effects of wind farms on human health, in a process representing the range of interests across industry and the community.

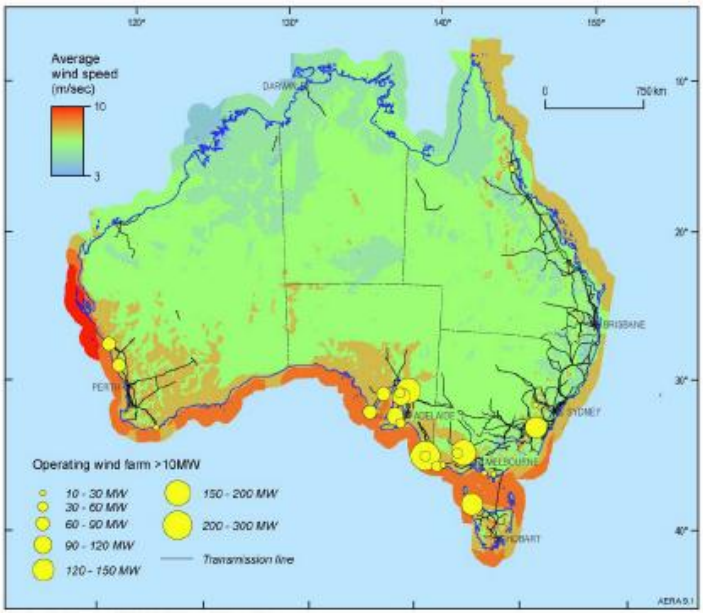
According to the CEC, 80% of the submissions received during the inquiry were supportive of wind farms, with several acknowledging the contribution of wind energy to jobs in regional areas, and to farmer incomes.

The 2010 draft national wind farm development guidelines, released by the Environment Protection and Heritage Council (EPHC), do not include setback (or noise) provisions. The Senate inquiry recommended with regard to the draft guidelines that further consideration be given to the development of policy on separation criteria between residences and wind farm facilities.

In August 2011, the Victorian Government gazetted new planning regulations restricting wind farm development. The changes mean that wind farms cannot be built within two kilometres of a home without the written consent of the owner. The recent amendment has the potential to limit development of further wind farms and will also impact on already approved wind farms if changes are required to plans or permit conditions. According to the CEC, these changes will cost hundreds of regional jobs and lost investment.

On December 23 2011, Draft NSW Planning Guidelines: Wind Farms were released by the NSW Government. In contrast to the new Victorian planning regulations, the NSW Guidelines propose to ban wind turbines within two kilometres of residences unless there is written agreement from relevant landowners *or* unless permitted via a 'gateway' process. The 'gateway' process will involve acquisition by the proponent of a Site Compatibility Certificate. Once a certificate application has been reviewed by the Department of Planning & Infrastructure, along with any public submissions received on the application, the relevant Joint Regional Planning Panel will make a determination as to whether or not to award a Certificate.

Australia's wind resources



BIOENERGY

The Clean Energy Council (CEC) Australian Bioenergy Roadmap defines bioenergy as:

> Renewable energy derived from organic matter otherwise known as biomass. It utilises the solar energy that is stored in biomass by converting it to a different form of energy, such as electricity and thermal energy.

Bioenergy includes biofuels, commonly associated with energy for transport, and biomass, commonly associated with energy used to produce electricity.

The Biofuels Association of Australia describes biomass as biological material from living or recently living organisms such as wood, waste materials, gases and alcohol fuels. Biomass is commonly plant matter that is specifically grown in order to produce electricity or to produce heat. Biofuels are sourced from agricultural-related waste, energy crops, landfill gas, sewage gas, sugarcane, urban biomass, wood-related waste and thermal energy.

The potential contribution of bioenergy in Australia was assessed through a biomass resource appraisal undertaken by the CEC. The appraisal includes descriptions of the various bioenergy resource sectors and focuses on those resources where there is a prospect that the resource can be matched with an appropriate technology to contribute sustainably and economically to the stationary energy supply.

BENEFITS OF BIOENERGY

According to the Australian Bioenergy Roadmap, the benefits of bioenergy over other forms of renewable energy include its:

- Suitability to supply continuous power, and to meet peak demand for power.
- Ability to produce energy from a range of different technologies such as direct combustion and co-firing, pyrolysis and gasification and combined cycle generation.
- Ability to deliver thermal energy in addition to electricity, where the waste heat produced by electricity generation is called cogeneration. The result is increased efficiency through recovery of otherwise wasted thermal energy.

A review in the Australian Farm Journal, May 2011, of bioenergy processes currently being developed from farm commodities, suggests that on-site bioenergy processing is becoming increasingly competitive, driven by the introduction of a carbon tax, increasing energy prices and the cost of waste disposal.

NSW REGULATORY FRAMEWORK

NSW legislation relevant to biofuels includes the *Biofuels Act 2007* and the Biofuels Regulation 2007. The *Biofuels Act 2007* provides for a minimum ethanol and biodiesel content requirement in respect of petrol and diesel fuel sales.

Commonwealth legislation relevant to biofuels includes the *Renewable Energy (Electricity) Act 2000* (Cth) which prescribes eligible renewable energy sources including biomass. In addition, the *Waste Avoidance and Resource Recovery Act 2001* (Cth) is designed to encourage sustainable waste management.

The Clean Energy Council 2010 Bioenergy Industry Report outlines the regulatory framework for biomass and bioenergy. In the case of bioenergy from wood waste, rules under the Commonwealth RET scheme require that native forests are not used specifically as a fuel for bioenergy plants.

ETHANOL AND BIODIESEL

The Biofuels Association of Australia describes two main types of biofuels, bioethanol and biodiesel, as liquid fuels which have been derived from other materials such as waste plant and animal matter. Biofuels are generally blended with petroleum – B5 is diesel containing 5% biodiesel; E10 is petrol containing 10% ethanol.

There are specific targets for ethanol in petrol, as outlined by the NSW Government Office of Biofuels. These targets are based on a 2007 ethanol mandate designed to encourage broader use of ethanol and other biofuels in NSW. According to its website, a state-wide 2% average ethanol content was achieved in September 2008, less than 12 months after the commencement of the mandate, and on 30 June 2011 the Government announced that it would continue the current 4% ethanol mandate until 30 September 2011.

A regulatory review of biofuels, tabled in the NSW Parliament in July 2011, announced that the deferred increase in the ethanol mandate to 6% would proceed on 1 October 2011, and that the increase in the biodiesel mandate to 5% would also go ahead as scheduled on 1 January 2012.

The NSW Government Office of Biofuels website states that from 1 July 2012, all regular grade petrol will be 10% ethanol (E10). In relation to biodiesel, since 1 March 2009, the national Diesel Fuel Quality Standard has permitted up to 5%

biodiesel in all diesel fuel. The *Biofuels Act 2007* now requires suppliers to achieve an average of 2% biodiesel, increasing to 5% in 2012.

BIOMASS FOR ELECTRICITY PRODUCTION

The significant biomass feedstocks from the sugarcane and forestry industries in Australia make it well placed to be a leader in commercialising biofuels.

Comparison of the CEC bioenergy target for electricity generation by 2020 with the potential long-term bioenergy contribution to electricity generation shows significant potential for bioenergy in Australia. The specific contribution of bioenergy to electricity generation in NSW could not be ascertained.

Projected bioenergy target for electricity generation by 2020 in Australia

Fuel Type	Bioenergy Target 2020 (GWh)
Sugarcane	3,165
Wood-related wastes	2,948
Landfill gas	1,880
Sewage gas	901
Agricultural-related waste	791
Urban biomass	721
Energy Crops	218
Total	10,624

The long-term potential to 2050 that was estimated by CEC is 73 terawatt hours per annum, which is about seven times the size of the 2020 target.

The potential long-term bioenergy contribution to electricity generation in Australia

Fuel Type	Long Term Potential (GWh)
Sugarcane	7,800
Wood-related wastes	5,060
Landfill gas	3,420
Sewage gas	929
Agricultural-related waste	50,566
Urban biomass	4,320
Energy Crops	534
Total	72,629

BIOMASS FOR THERMAL ENERGY

There are two current and two proposed bioenergy power stations in NSW, which supply energy to the electricity grid. The four power stations have a combined capacity of 320 MW [see Key Issues: NSW Energy Production].

According to the CEC, the present use of biomass for thermal energy in Australia is not as well studied and quantified as the contribution of biomass to electricity generation.

In the domestic sector, firewood used for space and water heating, is the most significant source of biomass for thermal energy. The Firewood Association of Australia estimates that Australia's annual consumption of firewood is approximately 4,000,000 tonnes. Biomass is also presently used in a wide range of commercial and industrial applications, in particular the cement industry, to provide heating for a variety of purposes.

ISSUES AND CHALLENGES

Policy changes at the Federal level can have an impact on the biofuels sector in NSW. Policies such as the Federal Government's Solar Rebate Scheme are a challenge to the biofuels sector in NSW. For example, the recent sale of two biomass power plants by the NSW Sugar Milling Co-operative and Delta Electricity in 2010 was, according to company executives, mainly a result of the halving of energy credits following the introduction of the Federal Government's Solar Rebate Scheme.

The NSW Greens have expressed concern over the possibility of biofuel inputs being produced from food crops, and the need to prioritise valuable agricultural land for the production of food crops. There are also concerns relating to the use of genetically engineered organisms in the production of biofuel inputs, which potentially provide an unacceptable risk to native and agricultural species, increasing pressure on ecosystems and biodiversity.

The potential contribution of biofuels inputs to greenhouse gas emissions is also an issue. Some reports claim that certain biofuels could contribute to a reduction in greenhouse gas emissions, whereas other peer-reviewed research suggests that biofuels may actually contribute to GHG emissions.

Other issues surrounding bioenergy, including their status as a renewable form of energy, and whether they force up food prices and therefore impact negatively on the poor, have been raised by organisations such as the Food and Agriculture Organisation of the United Nations and the Global Bioenergy Partnership Secretariat.

OTHER RENEWABLES

Aside from solar, wind and bioenergy, other examples of renewable technologies include geothermal, ocean energy, hydroelectricity, co-generation and tri-generation.

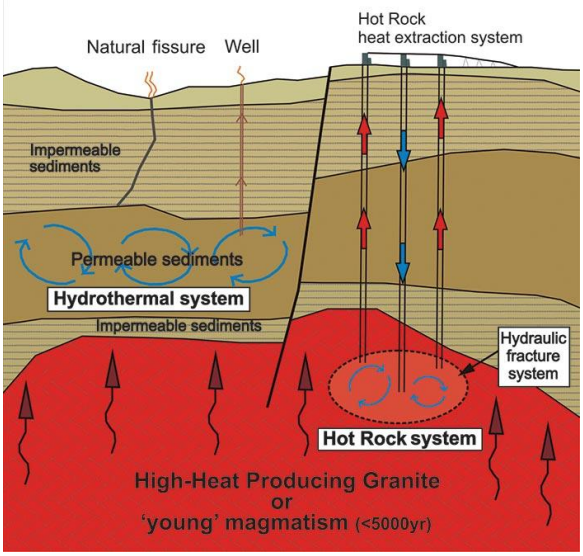
GEOTHERMAL

CSIRO describes geothermal energy as heat extracted from the earth by circulating a fluid through underground reservoirs to bring the heat to the surface. Once on the surface the heat can be used to generate electricity, or as heat in direct use applications.

According to ABARES, geothermal energy is potentially a major resource, which is suitable for base-load electricity generation and direct-use applications.

Geothermal is an emerging technology with a high degree of uncertainty in relation to cost. Geothermal resources are still in the development stage and, according to CSIRO, inherent uncertainty in exploiting geothermal resources exists. According to the Clean Energy Council (CEC), one megawatt hour (MWh) of geothermal-derived electricity avoids approximately one tonne of CO_2, making it a zero-emission source of electricity.

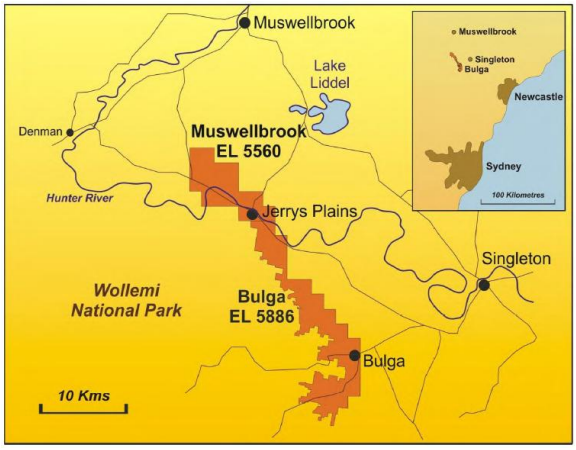
Geological settings of geothermal systems in Australia



The substantial potential of geothermal energy for Australia is highlighted in the Australian Energy Resource Assessment. The assessment points out that just 1% of the geothermal energy resources in Australia, with a minimum temperature of 150°C and a maximum depth of 5 km, could provide 190 million PJ of energy – enough to provide 25,000 times Australia's energy usage.

The most significant geothermal tenement in NSW is located in the Hunter Valley, as identified by the Australian Geothermal Energy Association.

Geothermal tenements in the Hunter Valley



The NSW Government recently funded, to the sum of $10 million, the Geodynamics Limited Hunter Valley Geothermal Power Project. The first of its kind in NSW, this project is expected to feature a 10 MW power station, capable of generating approximately 80 GWh of base load power each year for at least 30 years, with plans for expansion to a 50 MW plant and, potentially, a 200 MW plant in the future.

Current issues faced by the geothermal energy industry include:

- The high capital cost of getting power from known heat sources to the grid;
- Drilling costs;
- Achieving good flow rates;
- Ensuring long term production given high capital costs; and
- The ability to compete with more carbon-intense energy sources.

OCEAN ENERGY

According to the Australian Energy Resource Assessment, ocean energy is an underdeveloped but potentially substantial renewable energy source for the southern and western coasts of Australia. With the majority of the population living near the coastline, oceanic power provides a realistic solution to reducing the high costs of distribution and grid connection that other power sources face. The strong research interest in the field of ocean energy is widely acknowledged, including by the NSW Government.

Recent research into the feasibility of wave power by the CSIRO suggests that wave energy does have the potential to be economically viable in Australia. Although the economic viability of ocean energy in NSW is unclear, the potential is demonstrated by projects such as the Oceanlinx Limited wave powered generation plant at Port Kembla. A one-third scale model of the Oceanlinx floating wave energy technology, deployed for three months in 2010, operated successfully as one of the world's first grid-connected generators of electricity from ocean waves. The full-scale plant is expected to have a capacity of 2.5 MW.

HYDROELECTRICITY

Despite hydroelectricity currently being Australia's major source of renewable electricity, there is limited potential for future further development, according to the Australian Energy Resource Assessment (AERA). The AERA identifies water availability, competition for scarce water resources, and broader environmental factors as key constraints on future growth in Australian hydroelectricity generation.

Profitability of existing hydroelectricity projects in Australia in general remains strong and they will likely benefit further from the introduction of a carbon tax. Hydro Tasmania, for example, recorded a $100 million profit for the 2010-2011 financial year.

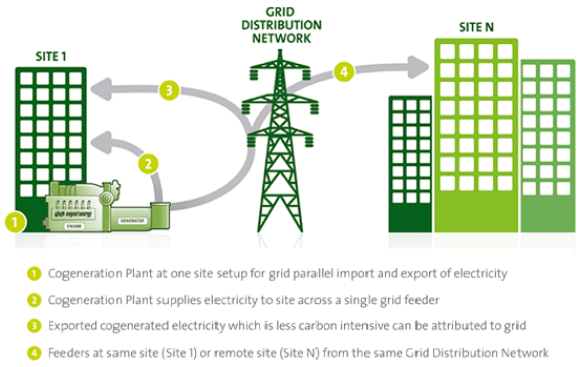
In NSW, there are currently six major hydroelectric power stations with 4,056 MW capacity. There are also a number of smaller hydroelectric power stations, including a hydro-electric plant recently launched at Prospect, NSW, which is expected to generate enough power for 1,500 homes.

COGENERATION AND TRIGENERATION

Cogeneration and Trigeneration can be used in renewable power generating systems aimed at emissions reduction. Cogeneration and Trigeneration systems use a variety of fuels, including gas and renewables, and have the potential to reduce energy use and emissions in industries such as commercial property. The NSW Office of Environment and Heritage describes cogeneration/trigeneration as:

> …the simultaneous generation in one process of thermal energy and electrical and/or mechanical energy. Cogeneration is also referred to as combined heat and power (CHP) and makes productive use of the heat that is normally rejected as waste in conventional generators. Trigeneration is the simultaneous production of electrical and/or mechanical energy, heat and cooling from a single heat source. It can also be referred to as combined heat, cooling and power (CHCP).

Process of cogeneration



There are numerous cogeneration/trigeneration plants in NSW. These are located at a range of sites including commercial buildings, residential units, industrial sites and universities. For example, the Norske Skog paper mill in Albury, NSW, is currently proposing cogeneration utilising biomass and gas. The project is expected to generate 10 megawatts of electricity on site, eight through green generation and two megawatts through gas generation.

In addition, the City of Sydney's Sydney 2030 includes ambitious plans to provide for the energy needs of Sydney CBD buildings by 2030 via a network of cogeneration and trigeneration plants.

The Sydney 2030 plan commits Council to produce 70% of the electricity (330 MW) supply by 2030 from trigeneration, through the conversion of natural and waste gas into electricity, heating and cooling. Trigeneration is also planned for the Prince Alfred Park Pool in Sydney.

KYOTO ENERGY PARK

A case study which combines multiple forms of renewable energy generating systems is the Kyoto Energy Park. Located near Scone NSW, the park is expected to generate more than 100 MW of power. Long-term monitoring at the site has, according to the founding company Pamada, guaranteed the site's suitability for the generation of energy from wind, solar and water under gravity.

ENERGY MARKET REFORMS AND REGULATION

The electricity and gas sectors are comprised of the following elements:

- Gas production (gas);
- Power generation (electricity);
- Transmission networks (gas and electricity);
- Distribution networks (gas and electricity);
- Wholesale markets (gas and electricity); and
- Retail markets (gas and electricity).

Gas is becoming an increasingly important fuel for electricity production, leading to the growing convergence of the Australian gas and electricity markets.

The electricity and gas sectors extend across State borders. The National Electricity Market (NEM), a wholesale electricity market, and the east coast gas market cover Queensland, NSW, the ACT, Victoria, South Australia and Tasmania. Gas and electricity network infrastructure also extends across the same States. Transmission networks transport gas or electricity from their source to distribution hubs, from which distribution networks transport gas or electricity to customers. Both State and Federal Governments are involved in the reform and regulation of energy markets and networks.

ENERGY MARKET REFORMS

In 2004, the Council of Australian Governments (COAG) signed the Australian Energy Market Agreement. Most recently updated in 2011, the Agreement sets out the framework for an open and competitive national energy market. The Agreement established, and in some cases consolidated, the following five reforms:

- Australian Energy Market Legislation
- Ministerial Council on Energy (now known as the COAG Standing Council on Energy and Resources (SCER));
- Australian Energy Market Commission (AEMC);
- Australian Energy Regulator (AER); and
- Australian Energy Market Operator (AEMO).

ENERGY MARKET LEGISLATION

National Electricity Law: In May 1996, the Victorian, South Australian, NSW and ACT energy ministers signed the National Electricity Market Legislation Agreement to establish uniform enabling legislation for the NEM. In June 1996, South Australia passed the lead legislation - the *National Electricity (South Australia) Act 1996*. The National Electricity Law (NEL) is contained in a Schedule attached to this Act. The NEL establishes the governance and enforcement framework and key obligations surrounding the NEM and the regulation of access to electricity networks.

The NEL is in force in NSW, further to the *National Electricity (New South Wales) Act 1997*. The same applies to the National Electricity Regulations, made under the South Australian Act. In addition, the National Electricity Rules are made and amended by the Australian Energy Market Commission (AEMC).

National Gas Law: In 2008, the National Gas Law (NGL) replaced the Gas Pipelines Access Law (including the Gas Code). As with electricity, South Australia passed the lead legislation - the *National Gas (South Australia) Act 2008* - to which the NGL is attached in a Schedule. The NGL was modelled on the NEL and, together with the National Gas Regulations and National Gas Rules, is intended to encourage efficient investment in gas infrastructure, streamline the rule change process and increase transparency in the gas market. In NSW, the statute that applies the NGL to the State is the *National Gas (New South Wales) Act 2008*.

In contrast to the NEL, the NGL provides a role for the National Competition Council, in respect to regulating transmission and distribution networks.

National Energy Retail Law: The National Energy Retail Law (NERL) is a Schedule to the South Australian *National Energy Retail (South Australia) Act 2011*. While the NERL has been enacted, it is not expected to come into force until 1 July 2012.

NSW Electricity Legislation: The *Electricity Supply Act 1995* regulates: retail tariffs and charges; the proportion of connection costs that a distribution network service provider may pass on to new customers; and retail and distribution network supplier licences.

NSW Gas Legislation: The *Gas Supply Act 1996* regulates: gas retail tariffs, fees and charges; and gas supplier and gas reticulator authorisations.

STANDING COUNCIL ON ENERGY AND RESOURCES

In 2001, COAG established the Ministerial Council on Energy. On 1 July 2011, this was replaced by the Standing Council on Energy and Resources (SCER). According to its Terms of Reference, the Council has particular policy responsibilities for:

- Oversight of Australian energy markets;
- Energy security and emergency management of national liquid fuels emergencies;

- The legislative and policy framework for sustainable development of resources; and
- Facilitating the economically competitive development of Australia's resources.

ENERGY MARKET REGULATORY FUNCTIONS

While gas and electricity each have their own legislative regimes, most regulatory functions are implemented by the same administrative bodies. The five key bodies are:

- the Australian Energy Market Operator (AEMO);
- the Australian Energy Market Commission (AEMC);
- the Australian Energy Regulator (AER);
- the National Competition Council (NCC); and
- the Independent Pricing And Regulatory Tribunal (IPART)

Each of these bodies performs several roles in respect to the following four gas and electricity sectors:

- Wholesale markets;
- Transmission networks;
- Distribution networks; and
- Retail markets.

The NSW Department of Trade and Investment, Regional Infrastructure and Services (DTIRIS) has responsibility for electricity and gas network safety.

Energy market and network regulation

Regulatory function	Gas	Electricity
Wholesale market		
Market and system operator	AEMO	AEMO
Rule maker	AEMC	AEMC
Regulator	AER	AEMC/AER
Transmission		
Rule maker	AEMC	AEMC
Access and pricing	AER/NCC	AER
Planner	AEMO	AEMO
Distribution		
Rule maker	AEMC	AEMC
Access and pricing	AER/NCC	AER
Licensing and compliance	IPART	IPART/DTIRIS
Retail market		
Market operator	AEMO	na
Rule maker	AEMC	AEMC
Non-economic regulation	IPART	IPART
Licensing and compliance	IPART	IPART
Regulated tariffs for small customers	IPART	IPART
Safety		
Relevant body	DTIRIS	DTIRIS

AUSTRALIAN ENERGY MARKET OPERATOR

The Australian Energy Market Operator (AEMO) was established by COAG, further to advice from its Ministerial Council on Energy. It is incorporated as a company under the Corporations Act. Government members own 60% and industry members own 40% of the AEMO. It has five core functions:

- Electricity markets operator;
- Gas markets operator;
- National transmission planner;
- Transmission services; and
- Energy market development.

Electricity markets: The AEMO operates the National Electricity Market (NEM) in accordance with the National Electricity Law, Regulations and Rules. The NEM is the wholesale electricity market that operates in Queensland, NSW, the ACT, Victoria, South Australia and Tasmania. Since the commencement of the NEM, electricity consumers have progressively gained the right to choose their own supplier. Consequently, the AEMO now also provides the systems and processes to support competition and choice for all end-users in the retail electricity market.

Gas markets: The AEMO operates the wholesale and retail gas markets. Two wholesale gas markets exist in NSW. The first is the Short Term Trading Market (STTM), which operates as a market-based wholesale gas balancing mechanism established at defined hubs under the National Gas Law. Two hubs are currently in operation in Adelaide and Sydney, and a new hub commenced in Brisbane on 1 December 2011. The second wholesale market is the Declared Wholesale Gas Market. This market operates in Victoria and parts of NSW across the Declared Transmission System.

The AEMO also administers the Gas Bulletin Board. The Bulletin Board was established to improve decision-making and trade in Australian wholesale gas markets by providing readily accessible and up-to-date gas system and market information.

The AEMO facilitates gas retail markets in NSW and the ACT, Queensland, South Australia and Victoria. Retail market services administered by the AEMO include managing the customer transfer for gas delivery points and managing the daily allocation of gas usage to retailers.

National transmission planning: As the National Transmission Planner, the AEMO publishes an annual National Transmission Network Development Plan. In the 2011 plan, the AEMO explored a wide range of scenarios to determine potential electricity transmission

impacts. Each scenario takes a number of drivers into account, including a carbon price, demand growth and increased investment in gas projects and renewable generation technologies.

Energy market development: The AEMO provides a suite of planning documents that present comprehensive information about energy supply, demand and network planning. Key among these are the Electricity Statement of Opportunities, Gas Statement of Opportunities and the Power System Adequacy report.

AUSTRALIAN ENERGY MARKET COMMISSION

In 2004, the Australian Energy Market Commission (AEMC) was established by a South Australian statute: the *Australian Energy Market Commission Act 2004* (SA). The AEMC is the rule maker and developer for the nation's energy markets. Its key responsibilities are:

- Considering rule change proposals that govern energy markets; and
- Conducting energy market reviews for the SCER.

Rule change proposals: National Electricity Rule changes are made by the AEMC according to Division 3 of Part 7 of the National Electricity Law. National Gas Rule changes are made by the AEMC according to Part 3 of Chapter 9 of the National Gas Law. Any person may submit a rule change proposal to the AEMC. Several rule change requests are currently under consideration by the AEMC, two of which concern issues of particular significance: Distribution network planning and expansion framework; and Economic regulation of network service providers [see Key Issues: Electricity Prices].

Energy market reviews: AEMC market reviews of the electricity and gas markets are initiated either by the AEMC or the SCER. Recommendations for changes to national gas and/or electricity rules may be made as a result of a review.

AUSTRALIAN ENERGY REGULATOR

As a consequence of the 2004 Australian Energy Market Agreement, the Federal Government amended its *Trade Practices Act 1974*, now known as the *Competition and Consumer Act 2010*, to establish the Australian Energy Regulator (AER). Currently, the AER regulates gas and electricity wholesale markets, transmission networks and distribution networks. This includes regulating the revenues of transmission and distribution network service providers. Additional regulatory functions will transfer from the States to the AER upon the commencement of the National Energy Customer Framework on 1 July 2012.

NATIONAL COMPETITION COUNCIL

The National Competition Council has four functions under the National Gas Law:

- Classifying pipelines (i.e. as transmission or distribution pipelines);
- Recommending to the relevant Minister whether or not a particular pipeline should be, or remain, subject to access regulation;
- Making decisions as to whether light or full regulation should apply to a pipeline; and
- Making recommendations on exemptions from regulation for new pipeline projects (greenfields pipeline incentives).

INDEPENDENT PRICING AND REGULATORY TRIBUNAL

The NSW Independent Pricing and Regulatory Tribunal (IPART) currently regulates gas and electricity prices for residential and small business customers who have not signed a market contract with a retailer. It also administers gas and electricity supply and distribution licences. Non-economic regulatory functions will be transferred to the AER upon commencement of the National Energy Customer Framework on 1 July 2012.

ONGOING REFORMS

Key to ongoing energy reforms is the National Partnership Agreement to Deliver a Seamless National Economy, under which energy is one of the eight priority areas for competition reform.

ONGOING REFORMS

- Removal of retail price regulation - the AEMC will review the NSW retail energy market in 2012
- Harmonisation of energy market legislation - planned commencement of the National Energy Customer Framework (NECF) by 1 July 2012
- Ensuring adequate energy market investment - AEMO will provide the SCER with a twice-yearly confidential report on energy investment trends
- Efficient demand side participation in energy markets - NSW to complete roll-out of smart meters by December 2017. The AEMC is currently conducting Stage 3 of the Demand Side Participation Review
- National Energy White Paper - Federal Government to complete by 2012
- Distribution reliability standards review - AEMC commenced this review in November 2011.

REMOVAL OF RETAIL PRICE REGULATION

At the request of the Standing Council on Energy and Resources, the AEMC will review the effectiveness of retail competition in the NSW gas and electricity retail markets in 2012. The AEMC has previously reviewed the Victorian (2007), South Australian (2008) and ACT (2010) retail energy markets.

If the AEMC finds effective competition in the gas and electricity retail markets, it must provide advice on ways to phase out retail price regulation. If competition is found to be ineffective, its advice must identify ways to promote the growth of effective competition. Whatever finding results from the AEMC review, it will be for the NSW Government to decide whether to remove or retain retail price regulation.

NATIONAL ENERGY CUSTOMER FRAMEWORK

The National Energy Customer Framework (NECF) is expected to commence on 1 July 2012. The Framework consists of the National Energy Retail Law, Regulations and Rules. As of November 2011, the National Energy Retail Law, as contained in the *National Energy Retail (South Australia) Act 2011* (SA), had been enacted but had not come into operation. Amendments to the National Electricity Law and National Gas Law have also been enacted but are yet to commence, while the Regulations and Rules are in draft form only.

The NECF will be regulated by the AER, whose responsibilities will include:

- Granting retailer authorisations and exemptions;
- Approving retailers' customer hardship policies;
- Compliance and performance monitoring and reporting;
- Administering a price comparator website; and
- Administering a retailer of last resort scheme.

IPART will retain the role of gas and electricity retail price regulator, although this may change after the 2012 AEMC energy retail market review.

DTIRIS is the lead NSW agency for preparing NSW for the transition to the NECF. The NSW Government has decided not to adopt certain elements of the NECF at commencement, although it may adopt them at a later stage. These include:

- Distributor liability - any change in liability arrangements may have an impact on energy network costs;
- Energy efficiency requirements for retailers in a customer hardship policy where required by a local instrument;
- A small compensation claims regime - this regime would have benefits for customers by providing a formal compensation framework for quality of supply incidents such as power surges. However, it may also increase electricity retail prices; and
- Prepayment meters - these meters provide a prepaid electricity service. The NSW Government may adopt these in the future.

The NECF will not entirely displace NSW-specific energy legislation or general consumer protection frameworks. NSW energy laws and policies will continue to supplement key aspects of the NECF through measures such as energy ombudsman schemes and such social policies as: community service obligations; energy rebates; and other government financial assistance for the vulnerable and customers experiencing payment difficulties.

NATIONAL ENERGY WHITE PAPER

In December 2011, the Federal Government released its Draft Energy White Paper. The Paper sets out a comprehensive strategic policy framework to guide Australian energy sector development. Its core objective is to build a secure, resilient and efficient energy system that:

- Provides accessible, reliable and competitively priced energy for all Australians;
- Enhances Australia's domestic and export growth potential; and
- Delivers clean and sustainable energy.

The Paper sets out four priorities:

- Strengthening the resilience of Australia's energy policy framework;
- Reinvigorating the energy market reform agenda (markets and energy productivity);
- Developing Australia's critical energy resources - particularly Australia's gas resources; and
- Accelerating clean energy outcomes.

ENERGY MARKET REFORM SCORE CARD

In 2011, the Energy Users Association of Australia (EUAA) released its second energy market reform score card. The EUAA evaluated Australian energy markets with regard to the benefits provided for energy users in terms of prices, supply reliability and security, and customer focused service. It concluded that, while energy reforms had made little progress since 2010 and had been given a score of 28/100 in 2011, there was reason for optimism with regard to possible improvements in network regulation and prices, and market structure.

NSW ENERGY REFORMS: THE GENTRADER TRANSACTIONS

In 2007, the Owen Inquiry recommended the sale of the State's electricity retail and generation interests to the private sector, and the retention in public hands of the State's electricity transmission and distribution networks. The Inquiry argued that this course of action would "significantly improve the State's fiscal position." Faced with opposition from the Coalition and Greens, the Iemma Government did not proceed with its 2008 Bills to privatise the State's electricity generators and retailers.

Subsequently, the Rees Government adopted what the Tamberlin Inquiry called the "next best option." This was the gentrader model, which involved outsourcing the trading rights of the generators to the private sector. This model was in turn part of an Energy Reform Strategy with four main elements:

- The sale of the retail businesses;
- The sale of development sites;
- Contracting out of Government owned generation (gentrader option); and
- Retention of Government ownership of the network and transmission infrastructure.

In October 2010, the Keneally Government decided that a State entity would own and develop a coal mine at Cobbora. Further, it was planned that this mine would sell coal to the State owned generators at a cost which reflected the estimated cost of production, rather than the price offered through a tender process. This decision increased the retention value of the generators.

The first tranche of the energy reform strategy was completed on 14 December 2010. This included the sale of the retail businesses, two development sites and two of four gentrader contract bundles. On 1 February 2011, the Keneally Government announced that it would not proceed with any further privatisation of the State's energy sector.

THE GENTRADER TRANSACTIONS

Origin Energy bought: the Eraring contract bundle (power generated by the Eraring and Shoalhaven power stations), Integral Energy and Country Energy

TRUenergy bought: the Delta West contract bundle (power generated by the Mt Piper and Wallerawang power stations), the Mt Piper Extension development site, the Marulan development site and EnergyAustralia

TRANSACTIONS RESULTS

The proceeds from the gentrader transactions were $5.3 billion, resulting in a profit of $1.2 billion. This comprised a loss on the sale of the electricity generation output and a profit on the sale of the electricity retail businesses.

GenTrader transactions summary

Sale component	Sale proceeds ($m)	Net assets ($m)	Profit/(loss) ($m)
Generation	1,506.9	3,355.9	(1,849.0)
Retail	3,786.4	703.5	3,082.9
Total	5,293.3	4,059.4	1,233.9

The $1,849 million loss on the sale of the electricity generation businesses was primarily due to write-downs in the values of the power stations to reflect their sale price. The proceeds of the sale represented only 41.9% of the carrying value of the power station assets. The carrying value represented Delta Electricity's and Eraring Energy's expectation of net cash to be earned over the remaining life of the power stations.

Sale of electricity generation output

	Delta Electricity ($m)	Eraring Energy ($m)	Total ($m)
Proceeds from sale			
Generation output rights	453.8	867.1	1,320.9
Fuel stock and other items	76.0	92.4	168.4
Development sites	17.6	n/a	17.6
Total	**547.4**	**959.5**	**1,506.9**
Carrying value of assets			
Power stations	1,348.7	1,805.7	3,154.4
Fuel stocks and other items	96.8	100.7	197.5
Development sites	4.0	n/a	4.0
Total	**1,449.5**	**1,906.4**	**3,355.9**
Loss	(902.1)	(946.9)	(1,849)

The profit on the sale of the three electricity retail businesses and the Marulan development site (owned by EnergyAustralia) was $3.082 billion.

Sale of electricity retail businesses

	Energy Australia ($m)	Country Energy ($m)	Integral Energy ($m)
Sale proceeds	1,486.4	1,300.0	1,000.0
Transaction costs and adjustments	238.5	224.3	240.7
Profit on Sale	**1,247.9**	**1,075.7**	**759.3**
Total profit		3,082.9	

INQUIRY FINDINGS

Despite the prorogation of the NSW Parliament, the Legislative Council General Purpose Standing Committee No. 1 conducted an inquiry into these transactions. Since the release of the Committee's final report, the GenTrader transactions have also been reviewed by a Special Commission of Inquiry (the Tamberlin Inquiry) and the NSW Auditor-General. The Tamberlin Inquiry concluded that:

a. the governance structure adopted;
b. the process by which the assets were offered to the market; and
c. the decision to sell the assets the subject of acceptable bids were, in the circumstances of the then Opposition's position not to support the legislation, the economic climate, the expert advice available to the Government and the uncertainty over carbon pricing, reasonable and appropriate.

The key findings of the Tamberlin Inquiry are as follows:

- It is too early to say whether or not the benefits from the investment made by the State for the Cobbora coal mine warranted the cost of the investment.
- The State received value for money from the electricity transactions, with the possible exception of the Cobbora coal mine.
- The sale:
  - delivered a more competitive retail electricity market in NSW;
  - increased the potential for a more competitive wholesale electricity market;
  - encouraged increased private investment in the NSW electricity sector;
  - was not a material cause of the increase in electricity prices which retailers can now charge; and
  - in so far as it has reduced, but not removed, the Government's exposure to electricity market risk and reduced the total State sector debt, NSW is in a stronger financial position.
- It is consistent with a competitive electricity market that the retail and wholesale generation businesses be privatised.
- There is a lack of empirical evidence to support the view that privatisation of the network businesses would lead to efficiency gains over time.

INQUIRY RECOMMENDATIONS

The Legislative Council inquiry, the Tamberlin inquiry and NSW Auditor-General audit made several key recommendations to the NSW Government.

KEY RECOMMENDATIONS

Legislative Council inquiry:

- Legislation be enacted to prohibit any privatisation, leasing out or other form of disposal of a principal undertaking of a State-owned electricity company without the approval of both Houses of Parliament

Tamberlin Inquiry:

- Legislation be enacted to enable the Government to offer for sale or long term lease the Eraring, Delta West, Macquarie Generation and Delta Coastal generators
- The Government sell the development sites
- The Government sell the Cobbora mine
- The Government determines its objectives for the network businesses and in accordance with those decides on the sale or retention of all or part of the network businesses
- The State obtain expert advice as to the implementation of these recommendations

Auditor-General Financial Audit:

- The Treasurer should consider releasing the Energy Reform Strategy relating to the development and ownership of the Cobbora Coal Project for public scrutiny to ensure transparency of the energy reform process. There should be a clearly articulated business plan to demonstrate to the people of NSW the benefits from the project

CURRENT SITUATION

As of December 2011, the NSW Government retains ownership of:

- Bayswater and Liddell power stations (Macquarie Generation);
- Vales Point, Munmorah and Colongra power stations (Delta Electricity);
- High-voltage transmission network (TransGrid); and
- Local distribution network service providers (Ausgrid, Essential Energy and Endeavour Energy).

However, on November 24, the O'Farrell Government announced that it would sell the electricity generators, electricity development sites and the Cobbora coalmine. Legislation to enact the sale will be introduced in 2012. The transmission and distribution networks will be retained in public ownership.

The Auditor-General reports that the NSW Government plans to rationalise the three existing distribution businesses into a single metropolitan distributor and single regional distributor by the end of 2011-12. The aim is to save $400 million in operating costs over four years.

GAS PRICES

The natural gas supply chain is made up of the following parts:

- Gas exploration;
- Gas production and processing;
- Transmission pipelines;
- Gas storage, including underground storage;
- Distribution pipelines; and
- Wholesale and retail sales.

The Australian gas market can be broadly divided into three regions: east coast; west coast; and the Northern Territory. The east coast market, Australia's largest and most advanced market, incorporates NSW, the ACT, Queensland, Victoria, South Australia and Tasmania. The east coast market is connected by transmission pipelines, which transport gas from where it is produced to particular markets (e.g. Sydney). Distribution pipelines reticulate gas within each market.

Recent wholesale gas market reforms include establishing a Gas Bulletin Board and a Short Term Trading Market (STTM), with a hub based in Sydney. The wholesale gas market, transmission and distribution networks are regulated by the Australian Energy Regulator (AER), whereas the retail market is regulated by the NSW Independent Pricing and Regulatory Tribunal (IPART). The wholesale and retail markets are operated by the Australian Energy Market Operator (AEMO) [see Key Issues: Energy Market Reforms and Regulations].

WHOLESALE PRICES

Australian gas prices have historically been low by international standards. Gas retailers procure wholesale gas via long-term bilateral contracts with gas producers and transmission asset owners. Each retailer holds a portfolio of commercial-in-confidence gas supply contracts with varying expiry dates. With uncertainties about demand and supply creating uncertainty about future gas prices, contract prices for new contracts are projected to rise from approximately $5.50/GJ to between $6/GJ and $9.50/GJ by 2030.

Prior to the introduction of the STTM, little market data on wholesale gas prices was publicly available. The lack of market data made it difficult for IPART to estimate appropriate wholesale gas costs for regulated retail gas customers in NSW. IPART's 2010 review of regulated retail tariffs and charges for gas between 2010 and 2013 assumed certain prudent, efficient wholesale gas costs. These costs include base gas supply costs, additional deliverability costs (to service peak demand) and transmission costs.

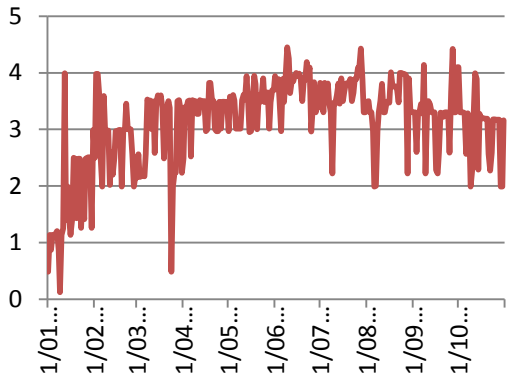
Prudent, efficient wholesale gas costs for the period 2010-11 to 2012-13 ($ per GJ, $2009/10)

	AGL	ActewAGL	Country Energy	Origin Energy
$/GJ	7.26	7.11	6.17	6.81

According to the AEMO, the STTM has improved the availability of gas market information. The STTM is a compulsory gas market that requires all participants to settle gas imbalances (the difference between gas injected into and withdrawn from the system).

In the first month of the STTM's operation, wholesale gas prices at the Sydney hub fell from just under $4.5/GJ to $2.3/GJ. By the week of October 16-22, the average daily price at the Sydney hub had risen to $2.97/GJ. At the same time, wholesale gas prices were $2.47/GJ in Victoria and $3.61/GJ in South Australia.

Sydney wholesale spot gas prices ($/GJ): 1 Jan 2011 to 31 October 2011



RETAIL PRICE CALCULATION

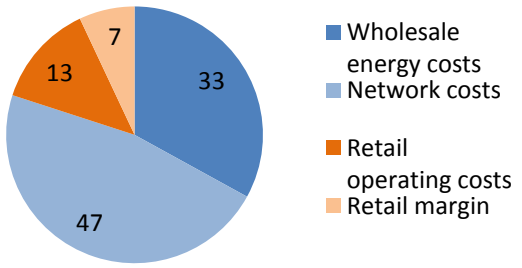
Although the NSW Government has agreed to phase out gas retail market regulation, it has retained the option of regulated retail gas tariffs at least until 2013. In 2010, IPART released its decision on regulated retail gas tariffs for the period 1 July 2010 to 30 June 2013. IPART's final decision reflects its view that a light-handed regulatory approach is the most appropriate form of regulation for regulated retail gas tariffs. Such an approach involves the use of Voluntary Transitional Pricing Arrangements (VTPA) and a Weighted Average Price Cap (WAPC). IPART has a VTPA with each Standard Retailer. Each VTPA includes a WAPC that only applies to the retail component of the regulated tariff, not the network component. IPART concluded that, since retailers have no control over the network component, it is appropriate for them to pass these costs on to customers.

IPART's final decision on gas prices reflects the efficient costs of gas supply, which were independently assessed. It also allows for retailers to pass on any potential compliance costs associated with Federal Government climate change mitigation measures.

RETAIL PRICES: BREAKDOWN

According to IPART, there are essentially two components to the small gas customer's overall bill: the retail component; and the network component. The retail component, which is regulated by IPART, is comprised of wholesale gas costs, retail operating costs and the retail margin. The network component is either regulated by the AER or unregulated.

Indicative composition of residential gas bills in NSW (%)



Retail and network contributions to the recent increase in regulated gas retail tariffs vary by retailer. In general, the retail component will increase by less than the expected increase in CPI. In the case of Origin Energy, IPART approved the restructure of Origin Energy tariffs to incorporate network cost increases from the previous period.

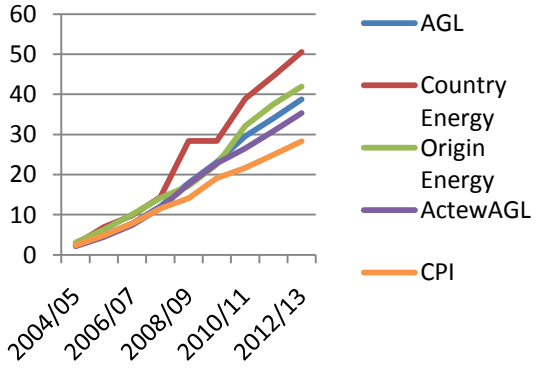
Retail and network contributions to increases in regulated gas retail tariffs: 2010/11 to 2012/13

Retailer	Retail (%)	Network (%)	Total (%)
AGL	4.2	8.6	12.7
Country Energy	3.8	13.4	17.2
Origin Energy	11.1	4.8	15.9
ActewAGL	1.4	8.8	10.3

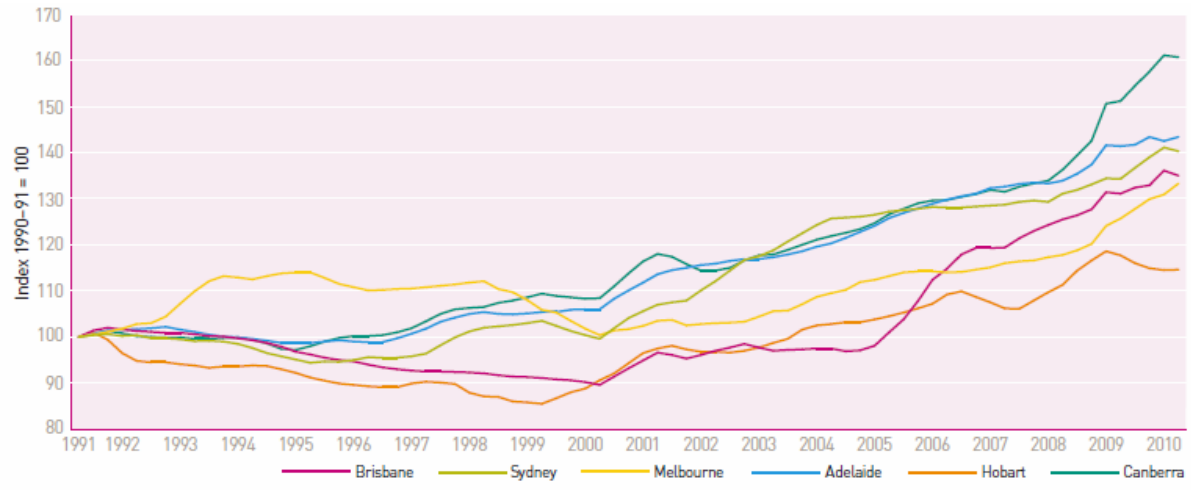
RETAIL PRICES: TRENDS

There are two types of gas customers in NSW: residential and small-scale commercial; and large-scale industry. Gas retail prices for small customers have trended upwards since 2001 when jurisdictions began phasing in retail competition. In contrast, inflation-adjusted gas prices for large-scale industry have fallen since 1991, although they are currently trending upwards. In NSW, gas retail price increases have varied between retailers. Since 2004-05, Country Energy gas prices have risen the most, while ActewAGL prices have risen the least.

Cumulative % increase in average regulated gas retail tariffs between 2004 and 2013 compared to CPI



Gas retail price index (inflation adjusted), Australian capital cities: 1991 to 2010



Recent regulated retail gas price increases also vary by region in NSW. The largest increases between 2009 and 2011 occurred in the Sydney Greater Metropolitan Region, and in the Boroowa, Goulburn, Yass & Young region.

Gas price increases (average) by area: July 2009 to July 2011

Supplier	Area	Total increase	% increase
AGL	Sydney, Newcastle, W'gong, Blue Mts	$100	13
Country Energy	Cooma & Bombala	$55	8
	Holbrook, Henty, Culcairn & Walla	$50	7
	Temora	$50	7
	Tumut & Gundagai	$60	8
	Wagga Wagga & Uranquinty	$80	12
	Tamworth	$40	5
Actew AGL	Boroowa, Goulburn, Yass & Young	$105	14
	Queanbeyan & Bundgendore	$80	12
	Shoalhaven	$40	5
Origin Energy	Albury, Moama & Jindera	$70	16
	Murray Valley Towns	$30	5

RETAIL PRICES: FORECASTS

In 2010, IPART released its gas retail price decision for the period 2010-2013. Estimated increases in annual retail gas bills all exceed the expected cumulative increase in CPI of 7.7%.

Indicative annual gas bill for residential customers: 2009-10 to 2012-13

Retailer	2009-10 ($)	2012-13 ($)	% increase
AGL	618	699	13.1
Country Energy	571	672	17.6
Origin Energy	380	462	21.4
ActewAGL	583	649	11.3

Estimated increases in annual gas bills for large-scale industry also exceed the expected cumulative increase in CPI of 7.7%.

Indicative annual gas bill for business customers: 2009/10 to 2012/13

Retailer	2009-10 ($)	2012-13 ($)	% increase
AGL	3,460	3,789	9.5
Country Energy	2,223	2,586	16.3
Origin Energy	3,048	3,389	11.2
ActewAGL	3,326	3,616	8.7

The 2010 IPART decision included agreed Voluntary Transitional Pricing Arrangements (VTPA) for each gas retailer. Proposed retailer price increases for 2011-12 complied with the VTPAs. Consequently, regulated retail gas tariffs and charges increased from 1 July 2011.

Changes in indicative annual gas bills from 1 July 2011 (%)

Retailer	Customer type	% change
AGL	Small residential (5GJ/yr)	1.1
	Typical residential (23GJ/yr)	10
	Large residential (40GJ/yr)	5.2
	Typical business (184GJ/yr)	1.9
Actew AGL	Small residential (5GJ/yr)	-9.4
	Typical residential (23GJ/yr)	9.8
	Large residential (40GJ/yr)	7.5
Country Energy	Typical residential (23GJ/yr)	4.8
	Typical business (184GJ/yr)	3
Origin Energy	Typical residential (23GJ/yr) (Albury region)	5.8

PRICE INCREASES: RETAIL COMPONENT

The retail component of gas retail prices is comprised of wholesale gas costs, retail operating costs and the retail margin.

Wholesale gas costs: NSW is unique among the mainland Australian States given it has few commercially viable reserves of natural gas. Gas is primarily sourced from South Australia, Queensland and Victoria. Key factors currently affecting wholesale gas costs include:

- increasing exploration and production costs;
- increasing export and domestic gas demand;
- increasing gas-use for electricity generation; and
- growth in coal seam gas production.

Gas production costs vary by location and according to whether or not new infrastructure is required. Currently, production costs at most east coast gas production projects range between $3/GJ and $5/GJ. However, production costs for several projects extend as high as over $9/GJ.

Gas demand in the eastern gas market is driven by electricity generation, mining, mineral processing and export demand. Excluding LNG exports, gas demand is expected to increase by 2.0 to 4.8% per annum over the next 20 years. When LNG exports are included, demand is expected to increase by 4.7% to 8.7% per annum over the next 20 years. Gas demand for electricity generation in NSW may increase by as much as 16.9% per annum over the next 20 years.

Retail operating costs: Gas retail operating costs comprise two broad categories:

- retail operating costs - which includes billing and revenue collection, call centres and corporate overheads; and
- customer acquisition costs - marketing costs.

IPART, in making its 2010 decision on regulated gas retail tariffs for 2010-11 to 2012-13, assessed changes in retail operating costs per customer. IPART approved the retailers' applications for an average 6% increase between the previous and current regulatory periods.

Retail margin: IPART concluded that it is reasonable for gas retailers to earn a retail margin because of the risks faced due to factors such as variations in demand and economic conditions. Consequently, it approved a retail margin of 7% for the current regulatory period.

PRICE INCREASES: NETWORK COMPONENT

Transmission networks: Four major gas transmission pipelines are located in NSW.

Major gas transmission pipelines in NSW

Pipeline	Location	Regulated
Moomba to Sydney	SA-NSW	Partial (light)
Central West Pipeline	NSW (Marsden to Dubbo)	Yes (light)
Central Ranges Pipeline	NSW (Dubbo to Tamworth)	Yes
Eastern Gas Pipeline	Vic-NSW	No

Construction on two additional transmission pipelines is expected to start in 2012.

Announced major gas transmission pipeline investment in NSW

Pipeline	Owner	Scale (km)	Cost ($m)
Queensland Hunter Pipeline (Wallumbilla to Newcastle)	Hunter Gas Pipeline	831	900
Lions Way Pipeline (Casino to Ipswich)	Metgasco	145	120

Upfront capital costs generally comprise 70% of total gas transmission costs, with operating costs making up the remainder.

Distribution networks: Four major gas distribution networks are located in NSW. The AER regulates each of these networks using a building block approach. The AER recently approved increased investment of 43% for Jemena Gas Networks over the current access arrangement period, compared to investment in previous periods. Operating costs are forecast to increase by 8.6% over the same period.

Gas distribution networks in NSW & the ACT

Network	Customer numbers	Opening capital base ($m)	2010-15 investment ($m)
Jemena Gas Networks	1,050,000	2,313	768
ActewAGL	112,000	278	88
Wagga Wagga	23,800	60	20
Central Ranges System	7,000	n/a	n/a
Total	1,192,800	2,651	876

Gas distribution network cost drivers include rising connection numbers, infrastructure development to maintain the capacity of ageing networks, and infrastructure to support market operation changes.

RETAIL COMPETITION

In 2010, IPART concluded that, while the competitiveness of the gas retail market had not changed significantly since 2007, it nevertheless continues to increase. There are 7 active retailer licence holders in NSW. In the NSW market, AGL is clearly the dominant player. However, it has steadily lost market share, falling from 85% in 2003-04 to 71% by 2008-09.

In 2010, IPART also found that a lack of transparent information and a lack of consistency in tariff presentation increased search costs for customers. Since then, a price comparator service has been established by IPART under the *Electricity and Gas Supply Legislation Amendment (Retail Price Disclosures and Comparisons) Act 2010*, which commenced on 1 July 2010.

CUSTOMER SATISFACTION

The Energy & Water Ombudsman NSW is the government approved dispute resolution scheme for NSW electricity and gas customers. The number of complaints received in 2010-11 fell slightly on the previous year's figures. The top three complaint topics were billing (51%), customer service (19%) and credit (19%).

Customer complaints: 2009 to 2011

	No. complaints 2009-10	No. complaints 2010-11	% change
Retailer	2722	2690	-1%
Distributor	67	84	+25%
Exempt retailer	0	1	+100%
Other	37	25	-32%
Total	2826	2800	-1%

ELECTRICITY PRICES

The electricity supply chain is comprised of the following parts:

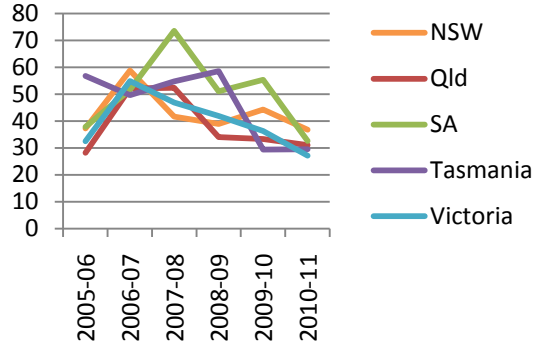
- Power generation;
- Transmission networks;
- Distribution networks;
- Wholesale markets; and
- Retail markets.

Transmission networks transport power over long distances, linking generators with load centres. Distribution networks transport electricity from points along the transmission network, and criss-cross urban and regional areas to provide electricity to customers. The National Electricity Market (NEM) operates as a wholesale market for the supply of electricity to retailers and end-users in Queensland, NSW, the ACT, Victoria, South Australia and Tasmania. More than $10 billion of electricity is traded annually in the NEM to meet the demand of more than eight million consumers. The Australian Energy Market Operator (AEMO) operates the NEM according to the National Electricity Law, Regulations and Rules [see Key Issues: Energy Market Reforms and Regulation].

WHOLESALE PRICES

The National Electricity Rules set a maximum and minimum spot price for electricity in the NEM. The maximum floor price, of $12,500 per MWh, is the maximum price at which generators can bid into the market. The Rules also set the Market Floor Price - the minimum spot price of -$1,000 per MWh. Wholesale electricity costs reached record levels in 2006-07 and 2007-08. This was due to the drought, which raised the cost of water-cooled coal-fired power stations and reduced the output of hydroelectricity power stations. In 2010-11, the average spot price in NSW fell by 16.9% to $36.74 per MWh. The highest price in 2010-11 was $12,136.17 per MWh, while the lowest price was -$147.03 per MWh.

Average electricity spot prices in the National Electricity Market ($/MWh)



RETAIL PRICE CALCULATION

Although the NSW Government has agreed to phase out electricity retail market regulation, it has retained the option of regulated retail electricity prices at least until 2013. In 2010, IPART released its final decision on regulated retail electricity prices for 2010-11 to 2012-13. According to its terms of reference, IPART was required to ensure that: prices reflect efficient costs; the NSW retail electricity market remains adequately competitive; and that electricity retailers are able to finance their operations.

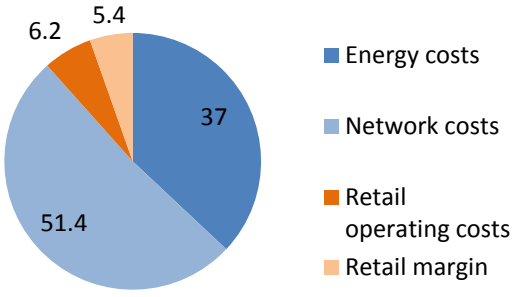
In its 2010 decision, IPART decided to continue to allow retailers to set regulated tariffs subject to a weighted average price cap (WAPC). Under a WAPC approach, IPART determines the maximum average percentage by which each retailer can increase its regulated tariffs in each year of the determination period. IPART considered this form of regulation sufficient given the level of competition in the NSW retail market, the small number of regulated retail tariffs and the capacity of the WAPC to allow retailers to rebalance and restructure their tariffs so as to achieve cost-reflexivity and promote competition.

RETAIL PRICES: BREAKDOWN

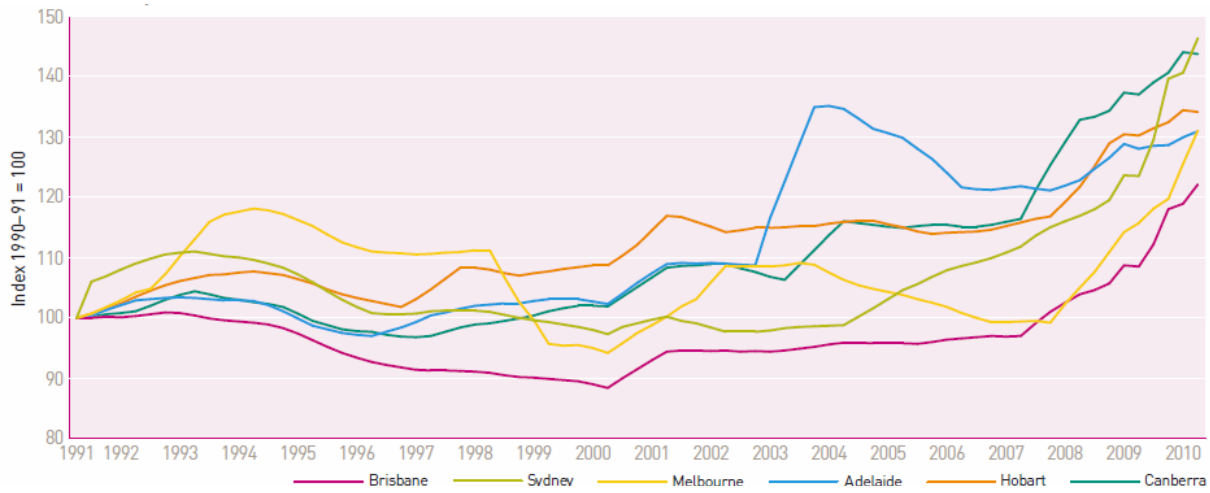
The electricity regulated retail tariff is made up of three components: energy costs; network costs; and retail costs. Retail costs include a retail cost allowance and a retail margin allowance. Each component is set at different timeframes and by different bodies:

- Energy costs: determined every 5 minutes in the National Electricity Market (IPART provides for an energy cost allowance for retailers in its regulatory decisions);
- Network costs: set every 5 years by the Australian Energy Regulator;
- Retail costs: set every 3 years by IPART.

Indicative composition of residential electricity bills in NSW in 2010-11 (%)



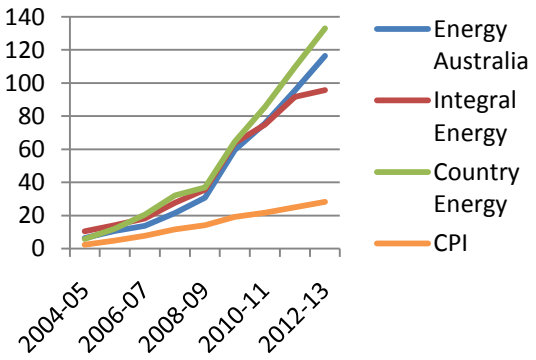
Electricity retail price index (inflation adjusted), Australian capital cities: 1991 to 2010



RETAIL PRICES: TRENDS

Electricity retail prices across the NEM have risen sharply since 2007, varying by State and retailer. For example, Country Energy regulated electricity retail tariffs increased by 85.5% between 2004-05 and 2010-11.

Cumulative % increase in average NSW regulated electricity retail tariffs between 2004 and 2013 compared to CPI



Regulated retail electricity price increases since 2009 vary by NSW region. The largest increases between 2009 and 2011 occurred in rural NSW.

Indicative electricity price increases by area: July 2009 to July 2011

Area	Increase ($) Single rate	Two rate	% increase
EnergyAustralia (Inner Sydney, Central Coast and Hunter)	430	380	24
Integral Energy (Western Sydney, the Illawarra and Blue Mts)	370	330	19
Country Energy (Most of rural & regional NSW)	620	580	25
Country Energy (Far west NSW)	570	530	25

RETAIL PRICES: FORECASTS

In 2011, IPART released its electricity retail price decision for 2011-12. Electricity prices were forecast to rise by an average of 17.3% from 1 July 2011.

Average price increases by each standard supply area: 1 July 2011

Retailer	Network component	1 July 2011 decision (%)
EnergyAustralia	9.6	17.9
Integral Energy	7.3	15.5
Country Energy	10.9	18.1

Of this increase, network costs account for 9%. Green schemes account for 6%, most of which is attributable to the Federal Government's Renewable Energy Target Scheme [see Key Issues: Renewable Energy]. Network (transmission and distribution) costs are forecast to make up 64.62% of price increases in NSW between 2009-10 and 2012-13. In the same period, green schemes are forecast to make up 17.08% of total price increases.

The contribution of each cost component to electricity price increases: 2009 to 2013

Cost component	NSW (%)	Australia (%)
Wholesale	10.90	19.07
Transmission	5.50	8.02
Distribution	59.12	41.24
Retail	7.41	13.83
Feed in tariff	6.17	3.25
Energy efficiency and demand management	2.45	3.41
Large scale Renewable Energy Target (Cth)	1.99	2.59
Small scale Renewable Energy Scheme (Cth)	6.47	8.13

The IPART decision also included an estimated price increase for 1 July 2012. Should prices rise by the estimated amount, electricity bills for residential customers will increase by up to 29.7% between 2010-11 and 2012-13.

Indicative annual electricity bill for residential customers: 2010-11 to 2012-13

Retailer	2010-11 ($)	2012-13 ($)	% increase
EnergyAustralia	1,283	1,664	29.7
Integral Energy	1,391	1,639	17.8
Country Energy	1,747	2,259	29.3

Annual business electricity bills will also increase by the same percentage by 2012-13.

Indicative annual electricity bill for business customers: 2010-11 to 2012-13

Retailer	2010-11 ($)	2012-13 ($)	% increase
EnergyAustralia	2,006	2,601	29.7
Integral Energy	1,982	2,335	17.8
Country Energy	2,917	3,772	29.3

IPART's 2011 decision on electricity prices included two recommendations for limiting future price increases:

- Limit future increases in network costs by reviewing key aspects of the regulatory framework; and
- Limit future increases in green scheme costs by only adopting the most cost-effective options and by improving the cost-effectiveness of existing schemes.

While IPART has stated that a carbon price will add to electricity prices, it did not include the effect in its 2011 decision when calculating possible 2012-13 prices. In December 2011, IPART announced that it had started its update of electricity prices from 1 July 2012, in which it will calculate the impact of a carbon price.

FORECAST CARBON PRICE IMPACT

The Federal Government carbon price will be introduced from 1 July 2012. The Federal Treasury modelled the impact of a carbon price on electricity prices with parameters including:

- An initial $23/t CO_2-e price, rising by 2.5% per year plus inflation in the fixed price period; and
- A requirement that businesses meet at least 50% of their annual liability from domestic permits and credits until 2020.

Carbon price impact: average household electricity price increases relative to a medium global action scenario (%)

	Clean Energy Future Scenario		
	2013-17	2018-22	2046-50
NSW	10	8	35
Australia	10	8	32

Average NSW household electricity prices are expected to rise by 10% due to a carbon price between 2013 and 2017, compared to a medium global action scenario (a scenario which assumes global action to stabilise greenhouse gas concentrations without an Australian carbon price).

A preliminary analysis by the NSW Treasury found that a carbon price of $23/t would cause electricity bills to rise in 2012-13 by:

- 16% for EnergyAustralia customers;
- 20% for Integral Energy customers; and
- 14% for Country Energy customers.

PRICE INCREASES: WHOLESALE COMPONENT

Electricity retailers purchase wholesale electricity through the NEM. IPART sets an energy cost allowance for retailers that also includes the following directly related costs: green scheme compliance costs; NEM fees; and the cost of energy transmission losses. The energy cost allowance is based on each retailer's forecast regulated load. The calculation takes into account energy cost drivers such as: the cost of capital; increased electricity generation investment; and increasing fuel costs. The 2012 IPART decision will also include the impact of a carbon price.

PRICE INCREASES: NETWORK COMPONENT

The AER regulates transmission and distribution networks in NSW. For a transmission network, the AER determines a revenue cap that sets the maximum revenue the network can earn during a regulatory period. For a NSW distribution network, the AER uses a WAPC which allows flexibility in setting tariffs within an overall ceiling. In both cases, the AER must take into account a network's efficient operating and maintenance expenditure, capital expenditure, asset depreciation costs and taxation liabilities, and required commercial return on capital.

Network expenditure: 2009-10 to 2013-14

Company	Asset base ($m)	Capex ($m) (% increase since last period)	Opex ($m) (% increase since last period)
Transmission			
Transgrid	4,346	2,541 (71%)	862 (23%)
Distribution			
Ausgrid	8,688	8,579 (103%)	2,837 (34%)
Endeavour Energy	3,803	3,052 (42%)	1,634 (34%)
Essential Energy	4,451	4,277 (73%)	2,211 (38%)
Grand Total	21,288	18,449	7,544

In 2009, the AER released its regulatory decisions for transmission and distribution networks in NSW for the 2009-10 to 2013-14 period. These decisions allowed for significant increases in capital (capex) and operating expenditure (opex) in comparison to the previous regulatory period. The 2009 AER decisions also allowed for significant increases in business revenue: Transgrid (29%); Ausgrid (73%); Endeavour Energy (52%); and Essential Energy (78%). Consequently, the NSW Auditor-General found that the dividends paid to the NSW Government increased significantly in 2011.

Revenue from State owned electricity network businesses: 2010 to 2011

	Distributors		Transmission	
	2010	2011	2010	2011
Dividends	440.4	3,779.4	135.1	133.9
Income tax	269.2	343.3	50.5	76.0
Total	709.6	4,122.7	185.6	209.9

According to network businesses, several factors have driven rising network costs including:

- Network expansion to provide capacity for rising peak demand;
- Enhanced reliability and security of supply regulatory requirements;
- Replacement of ageing assets;
- Higher input costs; and
- Higher borrowing costs.

Some, however, question the sharp increase in costs. For example, Ross Garnaut recently argued that:

- The allowed cost of debt for network businesses is too high;
- The merits appeal mechanism, by which network businesses can challenge the AER's regulatory decisions, is free to the business and without a realistic possibility of an adverse outcome; and
- There is a confluence of incentives that may lead to significant over investment and "gold plating" of network infrastructure.

The Australian Energy Market Commission is considering several proposals that aim to address perceived weaknesses in the regulatory framework for network businesses [see Key Issues: Energy Market Reforms and Regulation].

PRICE INCREASES: RETAIL COMPONENT

Retail cost allowance: the retail cost allowance set by IPART in 2010 has two components:

- Retail operating costs - which includes billing and revenue collection, call centres and corporate overheads; and
- Customer acquisition and retention costs.

In IPART's 2010 decision, the retail cost allowance per customer falls from $115.3 in 2009-10 to $113.7 in 2012-13.

Retail margin allowance: IPART concluded that it is reasonable for electricity retailers to earn a retail margin because of the systematic risks they face. The retail margin set by IPART is 5.4% of the retailers' EBITDA (earnings before interest, tax, depreciation and amortisation).

RETAIL COMPETITION

IPART reviewed the effectiveness of retail competition in its 2010 decision. While it found that the three Standard Retailers (EnergyAustralia, Integral Energy and Country Energy) had lost market share since 2007, it concluded that the competitiveness of the market had not changed significantly since 2007. In its 2010 decision, IPART also noted that the NSW Government's sale of its three electricity retailers would most likely lead to a more concentrated electricity retail market, thereby affecting some measures of market competitiveness.

Responding to recommendations in IPART's 2010 decision, the Keneally Government introduced the *Electricity and Gas Supply Legislation Amendment (Retail Price Disclosures and Comparisons) Act 2010* in order to strengthen retailer price disclosure licence requirements and establish a price comparator service.

CONSUMER ISSUES

The Energy & Water Ombudsman NSW provides information on the various NSW and Federal customer assistance programs. On 1 July 2011, the O'Farrell Government replaced the Energy Rebate with the Low Income Household Rebate. It also intends to implement a Family Energy Rebate from 1 July 2012.

Between 2008 and 2011, the number of complaints about electricity businesses received by the Ombudsman increased by 70%. In 2010-11, the top three complaint topics were billing (39%), credit (22%) and customer service (15%). 'Credit' complaints concerned issues such as disconnection, difficulty in payment and debt collection.

Customer complaints: 2008 to 2011

	No. complaints 2008-09	No. complaints 2010-11	% change
Retailer	7,007	11,983	71
Distributor	642	1,014	58
Exempt retailer	58	51	-12
Other	75	218	191
Total	7,782	13,266	70

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